Dear Colleague:

This document summarizes the comments provided by the peer reviewers at the U.S. Department of Energy (DOE) Biomass Program's Peer Review meeting, held on November 14-15, 2007 in Baltimore, MD and Platform Reviews conducted over the summer of 2007. The Platform Reviews provide evaluations of the Program's projects in applied research, development and demonstration. The Program Review provides evaluations of the Program's projects in analysis and an evaluation of the overall program strategic approach, balance across research areas, resource allocation and future plans.

This Report includes first a review of the presentations from the Program Review (analysis and the program element overviews) then includes project reviews from the Platform Reviews (feedstock production and logistics, biochemical conversion, thermochemical conversion, integrated biorefineries, infrastructure, and biodiesel and other). Each presentation was evaluated and scored. The weighted scores are based on a 4-point scale involving five criteria. The scores and peer review comments are included in this report. To furnish all presenters with direct feedback, all evaluations and comments are provided to each presenter; however, the authors of the individual comments remain anonymous. The principal investigator of each project is instructed to fully consider these summary evaluation comments, as appropriate, in their FY 2008 plans. Additionally, the recommendations of the reviewers have been taken into consideration by DOE Technology Development Managers in the generation of future work plans. This report includes highlights of program adjustments in response to reviewer comments.

I would like to express my sincere appreciation to the reviewers. It is they who make this report possible, and upon whose comments we rely to help make project and programmatic decisions for the new fiscal year. Thank you for participating in the 2007 Peer Review meetings.

The Biomass Program plans to conduct their next Peer Review in the spring of 2009. Details about the next review will be posted on our website at www.eere.energy.gov/biomass. We look forward to your participation.

Jacques Beaudry-Losique
Biomass Program Manager
Office of Energy Efficiency and Renewable Energy

Program Peer Review Summary Report

Introduction

The first section of this report focuses on the Peer Review Panel at the 2007 DOE Biomass Program Merit Review, held on November 15-16, 2007, at the Tremont Plaza Hotel in Baltimore, Maryland. The purpose of the program review was to evaluate the Program's performance and strategic planning as well as the contribution of the individual Platforms to Program goals, and alignment with the President's "20-in-10" plan.

The Peer Review process followed the guidelines of the Peer Review Guide developed by the Office of Energy Efficiency and Renewable Energy (EERE). The Peer Review Panel members, listed in Table 1, attended the meeting and provided comments to the Biomass Program on the Multi-Year Program Plan, Program Overview Presentation, Platform Overview Presentations, Platform Peer Review Reports and Presentations, and Analysis presentations. Peer review panel members include experts from a variety biomass related backgrounds representing academia, industry, finance environmental and the environmental communities. Additional members of the panel served as chairs of the platform reviews across the biofuels supply chain (feedstock, conversion, biorefineries, infrastructure and end use, and other). Each of the eleven panel members was screened from a conflict of interest perspective per the Peer Review Guide.

Name	Organization	Expertise/Area
Ralph Cavalieri	Washington State University	Academia
Terry Jaffoni	Clean Transportation Fuels	Ethanol industry
Irvin Barash	Vencon Management, Inc.	Finance
Daniel Sonke	Protected Harvest	Environmental
Todd Werpy	Archer Daniels Midland	Products
Lyle Stevens	John Deere (retired)	Feedstocks
Donald Johnson	Grain Processing Corporation (retired)	Biochemical Conversion
Mark Jones	Dow Chemical	Thermochemical Conversion
Bill Cruickshank	Natural Resources Canada (retired)	Biorefineries
Mike Tumbleson	University of Illinois	Biorefineries/Neutraceuticals
David Terry	Governors' Ethanol Coalition	Infrastructure and End Use
Shaine Tyson	Rocky Mountain Biodiesel	Biodiesel and Other

In addition to the program peer review panel comments this section of the Peer Review Report gives an overview of the program direction and funding as background for the comments that follow. The second section of the report provides a description of the process used for the Platform Peer Reviews and the peer review panel comments on individual projects.

Discussion of Program Direction

President Bush laid out aggressive goals for moving biofuels into the marketplace to reduce the nation's dependence on foreign sources of energy and reduce greenhouse gas emissions from the transportation sector. Specifically, the President's goals are to:

- Foster breakthrough technologies needed to make cellulosic ethanol cost competitive with corn-based ethanol by 2012[1]
- Increase the supply of alternative and renewable fuels to 35 billion gallons per year by 2017 (the 20-in-10 plan)[2]

The federal government responded to the 20-in-10 plan by increasing the membership of the Biomass Research and Development Board (Board) and the frequency of meetings. The Board is co-chaired by the DOE and Department of Agriculture (USDA) and includes senior level members from eleven federal agencies. The Board is developing a National Biofuels Action Plan that supports the 20-in-10, which is planned for release in the summer of 2008. Even though the Plan has not been released publically, the Board has already begun to organize and oversee Interagency Working Groups to begin implementation of the Plan.

Additionally, the DOE Biomass Program has laid out an aggressive strategy in research and development of biomass feedstock and conversion technologies; demonstration and deployment of large-scale, integrated biofuels production facilities; and development of biofuels infrastructure in support of the President's goals. The Program strategy is currently focused on cellulosic ethanol; however, a study will be conducted in FY2008 to evaluate the potential contribution of fuels other than ethanol toward the 20-in-10 plan and the federal role in developing those fuels. The study will inform future Program planning to add targets and goals for additional biofuels to the Biomass Program Plan.

The Program recognizes the need to continue to increase emphasis on feedstock production and logistics. More emphasis is also planned for thermochemical conversion through platform research and development and demonstration in integrated biorefineries. Distribution Infrastructure and End Use development was initiated in FY2007 in partnership with the Vehicle Technologies Program with testing of intermediate blends of ethanol (E12, E15 and E20) as a potential pathway to enable full utilization of increased ethanol production, while minimizing cost and infrastructure challenges. The testing will evaluate potential environmental, health and safety impacts of these intermediate blends. Additional Distribution Infrastructure and End Use plans will be developed in FY2008.

Program Funding

The Biomass Program budget more than doubled from FY2006 to FY2007 with an appropriation larger than the request and no congressionally directed projects within appropriated funds. As a result, FY2007 was a planning year with several active solicitations for key program areas including: commercial scale integrated biorefineries; integrated biorefineries that are 10% of commercial scale; saccharification enzymes; fermentation organisms; and synthesis gas clean up and fuel synthesis.

[1] Advanced Energy Initiative. (February 2006) The White House National Economic Council http://www.whitehouse.gov/stateoftheunion/2006/energy/energy_booklet.pdf

[2] 2007 State of the Union Address, 20-in-10: Strengthening America's Energy Security, http://www.whitehouse.gov/stateoftheunion/2007/initiatives/energy.html

Specific Program Responses to Select Reviewer Comments

Reviewer Comment		**Program Response**
Program Overview (Initial Reviewer Comments)		
Program should better define “transportation fuels”, and use the standard definitions to set R&D priorities (Need to articulate why the fuel of choice is the priority)		The Biomass Program agrees and is evaluating the potential of biofuels other than ethanol to contribute to the President’s 20-in-10 plan. Fuels that have the potential to be deployed within the next 10 years will be given priority. The Program plans to release a report on the potential of transportation biofuels other than ethanol in the fall of 2008.
Appreciate use of systems approach to decision making. Review panel encourages further use of analysis results to effect program changes and decisions. (tracking vs. managing)		The Biomass Program agrees and will seek to implement the reviewer recommendation.
Resource allocation does not seem to mirror the needs of industry • Thermochemical is underfunded • Feedstocks funding increase is applauded, but should continue to be increased		The Biomass Program agrees and will seek to implement the reviewer recommendation. The study to evaluate the potential of fuels other than ethanol to contribute to the President’s 20-in-10 plan will inform the direction of the thermochemical area and resource allocation.
Platform-level Comments		
Feedstock Logistics and Integration are instrumental pieces to the Program. Resources should be allocated accordingly.		The Biomass Program agrees and is conducting a 10-year planning process to update the biofuels strategy and evaluate resource needs across the supply chain. Feedstock logistics and integration activities will support both the conversion R&D activities and the integrated biorefineries. As such resources will be allocated appropriately.
Applaud the creation of an infrastructure and end-use platform		The Biomass Program has initiated end use activities of evaluating the impact of intermediate blends of ethanol on vehicle emissions, performance and lifetime. The Program will coordinate with other Federal agencies, specifically the Department of Transportation and the Environmental Protection Agency to inventory biofuels distribution infrastructure and end use activities and develop a cohesive federal plan.
Middle distillate replacement potential needs to be quantified and evaluated to help define priorities of “diesel replacement”		The potential opportunities and needs for middle distillates will be included as part of the study to evaluate the potential for fuels other than ethanol. This study will be completed in the fall of 2008.
Other Comments		
The reviewers encourage the Program to review and implement the Reviewer Comments noted at the Platform Reviews.		The platform reviewer comments are included in the appropriate sections of this report with Biomass Program response.
Would like to see more coordination in intra- & inter-agency relationships (i.e., USDA and DOE feedstock activities)		The Biomass R&D Board is a federal interagency Board with senior level representation from eleven agencies. Since May 2007, the Board has been meeting monthly to coordinate federal biomass activities with a focus on biofuels to support the President’s 20-in-10 plan. The Board is developing a National Biofuels Action Plan that is planned for release in the summer of 2008. Implementation is through interagency working groups across the supply chain and in cross cutting areas.

Initial Reviewer Feedback

- Applaud the program's portfolio expansion to include alternative biofuels in addition to ethanol
- Program should better define "transportation fuels", and use the standard definitions to set R&D priorities (Need to articulate why the fuel of choice is the priority)
- Appreciate use of systems approach to decision making. Review panel encourages further use of analysis results to effect program changes and decisions. (tracking vs. managing)
- Resource allocation does not seem to mirror the needs of industry
    - Thermochemical is significantly underfunded
    - Feedstocks funding increase is applauded, but should continue to be increased
- Reviewers recognize increased diversity of feedstocks in Program focus, and encourage linking between all platforms' feedstock work to maximize effort

Platform-level Comments

- Feedstock Logistics and Integration are instrumental pieces to the Program. Resources should be allocated accordingly.
- Biochemical Platform is well organized and focused correctly
- Conduct a critical review of the thermochemical conversion program – if the potential for fuel production exists – additional funding should be applied
- How will the results of program success be used in terms of setting future direction (i.e., UOP – pyrolysis, syngas conversion)
- Applaud the creation of an infrastructure and end-use platform
- Middle distillate replacement potential needs to be quantified and evaluated to help define priorities of "diesel replacement"
- Potentially include biodiesel in the end-use platform

Other Comments

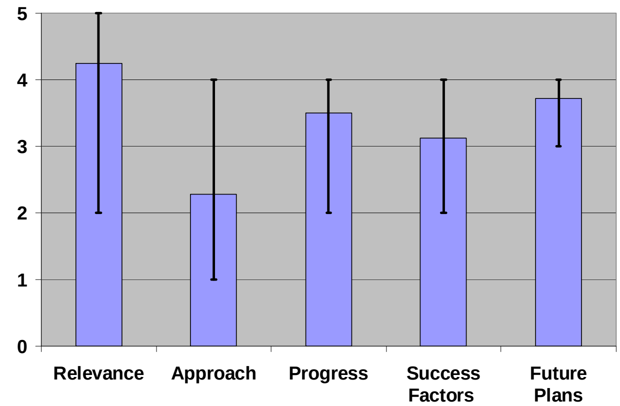
- The reviewers encourage the Program to review and implement the Reviewer Comments noted at the Platform Reviews.
- Would like to see more coordination in intra- & inter-agency relationships (i.e., USDA and DOE feedstock activities)
- The reviewers thought some of the presenters could have done a better job of relating their efforts to the program goals and conversion technologies discussion

Program Peer Review Full Comments and Scores

Program Overview

Presenters: Jacques Beaudry-Losique (Biomass Program)

Relevance	4.25	2.25	0.75
Approach	2.29	1.29	1.71
Progress	3.50	1.50	0.50
Success Factors	3.13	1.13	0.88
Future Plans	3.71	0.71	0.29
Average	**3.38**		



Question 1: Program Planning

- How many people are involved in the program? How many department heads? What is the mechanism to solicit external changes? What are reporting relationships? How is he program monitored as quarterly?
- The MYPP is of very high quality. Barriers, targets, goals et al. are appropriate, logical and considered sufficient to meet Program objectives.
- Rigorous impressive document. Clearly establishes rationale for focus on biofuels as most immediate path to achievement of program goals. Strategic goal aligns well with DOE, EERE vision, mission and strategy, with key drivers (climate change, petroleum fuel displacement) and with President's "20-in-10" and Advanced Energy initiatives. Supply chain model provides correct framework. Plan achieves an appropriate balance between focus on ethanol and other biofuels
- The document is excellent and a treasure trove of information, targets and plans.
- The program is well aligned and managed to about the 85% level. There are issues that seem to being addressed to balance the portfolio.
- This is my first interaction with the Biomass Program and I was quite impressed by the way the Program has utilized planning, analysis, systems integration, and related tools to develop and guide its MYPP. Overall, the MYPP does an excellent role at targeting its resources at appropriate and logical activities. I am also pleased at the way industry resources are utilized, such that the Program supports the development of the industry rather than competing or working against it.

Question 1b. What improvements can be made to improve the MYPP effort?

- The quality of the plan is best understood from the tasks of the individual managers and their resources for accomplishing the tasks.
- The MYPP and the Biomass Program's movement toward a more comprehensive approach to a variety of biofuels from a larger variety of feedstocks as well as its response to the 20-in-10 challenge are admirable. While the draft I reviewed still has some incomplete sections and some inconsistencies of structure, it reflects an excellent effort at strategic, programmatic planning.
- Specific Comments: The role of biodiesel/renewable diesel needs to be critically evaluated and its role in achieving Program goals better defined.
- I don't have much to say in the way of changes-I think the plan is outstanding and we need to move forward with it. Suggest more thought be given to how current petroleum

distribution system works e.g. how a single fuel and a fungible system keeps costs down and assures reliable supplies. Diversity of fuels will be problematic in the marketplace as there is no practical way to identify and preserve fuels. Performance targets are important but they may actually end up being irrelevant- $1.33/gal by 2012 and $1.20/gal by 2017 are based on EIA gasoline price projections which I think are too low---given uncertainties in commodity price relationships and policy environment, it is entirely possible that higher cost targets would work-thus lowest cost technologies should be developed and deployed as quickly as possible. Biodiesel should be given special emphasis as it is a fuel that is commercially available today, however, I don't think a separate platform should be established for Biodiesel.

- Need to get a better handle on real cost of feedstock.
- Re-examine the thermo-conversion (why is it so attractive now when it was shelved twenty or so years ago by NREL.)
- There are still projects that are carry-overs or are inserted into the program. This detracts from the overall program. As already stated, this seems to be improving.
- My major suggestion is that the Biomass Program seek a forum with high-level USDA administration to specifically pursue coordination of feedstock (and, to some extent, infrastructure) platform activities. There certainly seems to be cooperation occurring, and staff report that this has improved from previous years. However, there still seems to be a sense of the right hand not knowing what the left is doing. While DOE certainly can't force action from USDA, if I was to attend a review in future years I would like to hear that this had been attempted. A similar relationship with the EPA may also be beneficial. My suggestion in #1 is primarily out of concern that the Biomass Program not be caught behind the curve on sustainability issues. The utilization of biomass has much potential for environmental benefit; however, it also has potential for harm. The Program cannot afford to be caught unprepared on these issues, even if the production of feedstocks technically falls into the domain of USDA. I am pleased to see the Program looking into issues of water conservation. While this is a hot button issue right now, it is hardly the only sustainability issue. I am pleased to see the Program pursuing non-ethanol renewable fuels, thermochemical production pathways, and integration of production systems. These may prove to be important in the future and hopefully the Program will be responsive if and when these investigations show promise. That said, I think that Program has done a good job, for the most part, at using systems integration to prioritize its current activities.
- Consumer participation is required to achieve fuel displacement goals. The Plan should emphasize paths that are least disruptive to consumers; e.g. produce fuels that are most similar to current fuels. No pressurized gases, maximum vehicle driving range reduction of 10%.

Question 2: Resource Allocation

- It appears that the resources are inadequate. 15 staff at DOE HQ and a similar amount in Golden, although the labs contribute, requires substantial adjustment. A significant budget increase for this program is required. The capabilities of the individuals in the program are excellent.
- The total resources dedicated to this effort are insufficient to meet the challenge. While it appears that success is likely on the conversion processes, there is a huge gap in effort and resources in feedstock development, which is of immediate concern due to the long term nature of such development activities. There should also be more resources dedicated to strategic analysis activities, including life cycle assessment (LCA).

- More resources should be allocated to feedstocks, particularly with regard to logistics. Thermochemical resources should be increased if justified following a full re-evaluation of its potential to contribute to meeting Program goals.
- FY08 request of $179 million is double that received in FY05-this seems reasonable in light of Herculean effort required. Need to beef up funding for thermochemical platform and in particular for gasification, which was cut 40% in FY08 request. Don't know what FY08 funding request is for integrated biorefineries and distribution and end use platforms as well as crosscutting market transformation activities so I cannot comment. Prioritization must be given to generic pathways that have best chance of generating immediate and impactful results. Support public-private partnerships to mitigate risk, leverage expertise and funds, which improve overall chances for successful demonstration and deployment.
- A critical look at thermochemical conversion technology is needed, and if the technologies hold promise, more funding should be afforded. Also, more funding is appropriate to get at real cost of feedstocks when they are being utilized at volumes anticipated.
- Feedstocks and thermochemical seem to be underfunded. Other funding is about OK, congressionally directed not figuring into this comment.
- I would suggest an increase in the feedstock and thermochemical platforms to address some of the suggestions made by reviewers.
- The potential for the thermochemical platform to produce fuels that are more compatible with existing infrastructure than ethanol requires that it be given as serious a look as ethanol has gotten.

Question 3: Program Strategic Approach

- The new MYPP reflects the responsiveness of the program to changing national and stakeholder priorities.
- The conversion platforms and integrated biorefinery platform are responsive to stakeholder needs.
- There is no evidence that the feedstock platform is responsive to the needs of feedstock growers or providers.
- Strategy exhibits good understanding of biofuels market dynamics, competing technologies, barriers and policy issues. More focus is needed on outreach to environmental community, auto/oil stakeholders. Program must consider economics in mandated markets separately from economics in so called discretionary markets whereas in mandated markets there are no substitutes for meeting requirements of RFS, in discretionary markets, refiners can chose to blend their gasolines using more iso-octane and alkylate, thereby reducing demand for ethanol.
- Good planning, targets. The updating of strategies is being done incorporating externalities such as market changes and societal concerns.
- There is too little involvement of the oil industry and too little international involvement. It might be that neither can be addressed, but they are lacking.
- The use of systems integration tools and independent analyses certainly paints a picture of a program which is responsive to external market changes and stakeholder needs. Based on my limited knowledge of the Program's past, it appears there has been a response to new developments, but with an increasing focus on investing resources where they will have the greatest impact.
- The number of flexible fuel vehicles (FFVs) and E85 fueling stations needed to meet gasoline displacement goals is far more than the general public (stakeholders) will be willing to invest in.

Question 4: Biomass Program Portfolio R&D Balance

- (Balance over Biomass Supply Chain (i.e., Feedstock Production, Feedstock Logistics, Conversion, Integration, Deployment and End Use))
- More activities should regard infrastructure requirements and impacts.
- More effort is needed in feedstock production. The biomass projects assume a doubling of productivity. The only way to drive down the cost of purposely grown feedstock is to improve per acre and per input cost productivity. It is also necessary to improve the cost of feedstock logistics including in field and off field technology.
- The Program is considered balanced with respect to the platforms included in it i.e. no new platforms needed (save for the decision regarding the future of biodiesel). However as indicated above, there is need for rebalancing within and/or between several platforms.
- Balance over supply chain appears to be good but would like to see more emphasis on areas downstream of the biorefinery-lack of adequate and efficient distribution infrastructure will be a critical barrier to overcome ---this is an area not well understood and often overlooked-also more emphasis needed on end use.
- I thought the work breakdown structure for these areas as described in the MYPP was lacking substance.
- The program appears to be on target for the 2017 objectives. The supply chain needs more emphasis, to get at the real cost of feedstock when done on a large scale. An integrated pilot plant must be run soon on a continuous basis to uncover issues with recycle streams.
- Feedstock area seems under funded.
- The issues related to Feedstock Production are my biggest concern for the Program. I would advocate for more investment here to invest more in sustainability issues, feedstock development (not just corn and switchgrass, though these are certainly worth of attention too), and regional resources outside of the Midwest.
- I think it wise to add the infrastructure platform, as this might otherwise be a weak link in the chain.
- Inadequate funding for feedstock production. DOE's version of the supply chain really starts at logistics.

(Balance over Research Categories (i.e., Analysis, R&D, Deployment, Demonstration, Communications))

- I think more funding should be directed at analysis. Good policy and program direction is based on adequate analysis. R&D should not be decreased.
- Communications can be enhanced through partnerships.
- To this point the balance is good. However as commercial scale biorefineries near reality, there will be a need for increased outreach and communication to the public and stakeholders.
- More focus needed on communications and outreach, especially to environmental community, and the general public.
- Core R&D remains an important activity, but analysis should be done to identity policy initiatives that will support program goals.
- Good balance of tasks to reach targets.
- Overall I am very pleased with the way the Program has targeted its investments in R&D. A slightly greater look at non-ethanol processes and non-switchgrass energy crop development might be worthwhile, but overall it is impressive.

- Demonstrations need something important to demonstrate, such as a solution to the fuel mileage problem of ethanol.
- Analysis requires a lot of ground truth to be sure models reflect reality. Not sure I see adequate stakeholder input to analyses.

Question 5: Proposed Future Research

- As noted above, feedstock development (across all potentially significant production and collection sources) must be increased. Genetic improvements come slowly, so efforts that will be successful in 10 to 20 years have to be supported now and for the duration. Implicit in feedstock quantity and diversity is the need to develop the collection and related logistical systems.
- There is an urgent need to enhance the funding in thermochemical conversion as it can be useful for the 20-in-10 plans through its ability to convert heterogeneous biomass (already collected woody materials and MSW in particular) into useful imported petroleum replacement fuels and chemicals.
- As identified in the reviewer report-out, it appears that thermochemical conversion is under-represented and should be critically evaluated for an increase in resources. Thermochemical conversion can provide several alternative transportation fuels or blend stock not available via biochemical conversion.
- The feedstock platform requires an increase in resources. This is considered to be the most critical requirement for the Program. No reliable supply of feedstock to any biorefinery equals no biofuels and bioproducts, no matter how great the conversion technology.
- Higher priority should be given to 1) gasification 2) environmental impacts of biofuels 3) energy balance well to wheels definitive analysis 4) food vs fuel economic analysis 5) LCA carbon footprint of biofuels 6) pipeline R&D, 7) policy research and in particular how biofuels can tie in to Climate Change cap and trade program 8) market research (if needed) to demonstrate value of branding program like “Energy Star” 9) research on ethanol corrosivity, permeability, volatility, biodiesel NOx emissions 10) feedstock logistics R&D.
- As mentioned above, more emphasis on feedstock cost is needed and perhaps specific availability. This may be achieved with the 10% of commercial scale and commercial biorefinery demonstration programs, but they are down the road a spell and the data are needed now. It was also mentioned above that an integrated continuous pilot run is needed soon for a reasonable length of time to uncover the many recycle issues that are bound to appear.
- The program generally holds together well, meeting the stated goals. It is generally well managed and funded. It is an important program and DOE funding broadly probably does not reflect this importance. As already stated, within the Program, feedstocks and thermochemical seem anemic.
- My comments related to exploration of non-ethanol processes and a wider array of energy crops stem mainly from a desire to see the Program remain nimble to take advantages of developments which may come from any sector. Overall, I think the Program has done a good job at targeting its R&D resources to technical barriers in cellulosic ethanol production and furthering the expansion of ethanol use. However, if our goal is to maximize the production of renewable fuels there may be other avenues of opportunity which could assist, especially regionally.
- Dedicated energy crop production needs fundamental research, not demonstrations.

Additional Comments

Strengths

- This program, as document in the new MYPP, demonstrates a comprehensive understanding of the nature of the challenge it is confronting. Given adequate resources and allowed to follow its MYPP, with the adjustments noted above, it likely will lead to successful achievement of the 20-in-10 and subsequent biomass program goals.
- The quality of the personnel managing and implementing the Program. The strategic integration and analysis components of the program. The efforts to seek stakeholder input.
- Program strategy focused on generating near term results. Program achieves right balance of core R&D and demonstration/deployment. Direct investment in new technologies. Good collaboration with other agencies, state/local groups, key stakeholders. More targeted approach than in previous years-focus on cellulosic ethanol. Government providing markets i.e. reverse auction is terrific idea. Enhanced communication activities (but more is needed here)
- Strengths include good project management, good communication across platforms, excellent industry academia and national laboratory partnerships and a strong cohesive plan driving the program.
- The program generally holds together well, meeting the stated goals. It is generally well managed and funded.
- The use of systems integration to target limited resources is a real strength for the Program. I hope that the staff can weather politics and use this tool appropriately. Funding seems to be largely adequate for the Program

Weaknesses

- As discussed, the program appears to be severely underfunded.
- The Program is understaffed. The biodiesel component is weak (but not beyond redemption)
- Not enough people resources at the program management level (only 15 people). More target outreach needed to general public i.e. radio/TV. Lack of standardized definitions. Must be close collaboration with USDA especially in feedstock area. More sense of urgency in feedstocks logistics R&D. Downstream R&D needed (see above). More funding for thermochemical. Too much redundancy in review process. Avoid reinventing the wheel…there is huge quantity of information already out there on Biofuels.
- A concern is that the national labs will have difficulty recruiting and maintaining the technical staff at this critical time to maintain the momentum seen in the program. Competition for bio-engineers and scientists is only going to get more intense.
- There are clearly still pockets that aren't really addressing the overall program goals. These need to be pruned and replaced with additive programs.
- Sustainability should be made more visible. Human resources, as reported in response to a question, sounded less than adequate for the number of projects being managed. A clear strategy for dealing with codes and standards was not apparent to me during the review.

Recommendations for Additions/Deletions to Project Scope

- Consider having a platform/activity to consider various entities that could be appropriate and bear some of the budget requirements of the program to meet the President's objectives. This could involve a government/private sector entity, funded principally by private sector development financing.

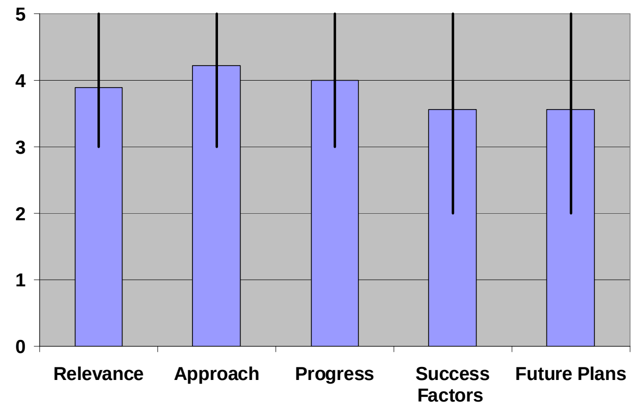
- Some of the communications methodologies used in the Technology Revitalization Program (TRP) of about 15 years ago should be considered. In this Defense Advanced Research Projects Agency Program, there were stakeholder meetings in many cities for communications and input. Such meetings usually had many hundreds of attendees. To gain public acceptance and expand media awareness, such programs would be worthy of consideration.
- The Program should estimate what the requirements will be for suitably trained /engineering technical staff to operate the number of biorefineries that will be in production if Program goals are achieved. There may be a requirement for post-secondary technical colleges and university engineering/science programs to adjust their curriculums to meet the aforementioned requirements.
- Given size and complexity of the task at hand, I strongly recommend greater oversight role for Biomass R&D Board. This will be especially important to ensure effective collaboration across agencies. Platform strategic and performance goals must align with program goals but must also be in sync with what is going on in other platforms. Biochemical platform FY08 funding request is 4X that of request for the feedstock platform-why such a difference? Crosscutting market transformation needs to be its own platform—a lot of work is needed in this area and stand alone platform will give it focus in particular more policy research needs to be done as mandates, incentives account for nearly all biofuels growth to this point---in addition, growth in international biofuels trade is raising many complex trade policy issues.
- This is a strong program, well run, and achieving positive results. The targets are crucial to the well being of the United States.
- I would encourage the communications and outreach staff to utilize new media (e-mail newsletters, web, podcasts, etc.) to achieve wide distribution and even to increase penetration into the old media. I am glad to see an effort to penetrate key conferences and workshops as well. One last note about the review process. I would encourage a bit more up front explanation of the process, perhaps even one-on-one during the initial contact with each reviewer. I would also encourage the Program to assemble the Steering Committee earlier in the process, and even utilize them to assist with the platform review process. This would likely result in the reviewers having a better understanding of the Program when they walk into the MYPP review later.
- The MYPP describes the feedstock production component of the Feedstock Platform as “selecting feedstocks and resolving production issues”. The Feedstock Platform review had only one production presentation, an earmark project of switchgrass establishment. The MYPP describes a grower payment of $13 per ton in 2012. In high yielding corn (200 bu. per ac.) it may be possible to remove 3 tons per acre and still meet erosion control goals. However the $13 must buy replacement Potassium and Phosphorus nutrients at a cost of perhaps $6 (current prices may be higher), leaving a net of perhaps $20 per acre. That is the price of 5 bushels of corn, which may be the amount of yield reduction due to the loss of soil carbon. We don’t know the value of soil carbon, but farmers know it has value. The MYPP predicts a price of $26 per ton in 2017, but only if the industry grows, which it will not do if farmers aren’t willing to sell for $13 in 2012. USDA doesn’t seem to be doing this research, either, but it needs to be done. I think this is a modern version of “For want of a nail (soil carbon management) a kingdom (cellulosic biofuels) was lost”.
- The MYPP includes an enzyme cost target of 33 cents per gallon of ethanol in 2009 and 10 cents in 2012. Is there any support for that figure?

Platform Overviews (from the Program Peer Review)

Feedstock Platform

Presenters: John Ferrell (Biomass Program) & Lyle Stevens (Formerly of John Deere), Review Chair

Relevance	3.89	0.89	1.11
Approach	4.22	1.22	0.78
Progress	4.00	1.00	1.00
Success Factors	3.56	1.56	1.44
Future Plans	3.56	1.56	1.44
Average	**3.84**		



Question 1: Platform Approach

- In general, the approach is moving the R&D effort forward. I believe it is too little effort and one that does not recognize the location specificity of feedstocks and the challenge of developing new genetics that will improve the amount, characteristics, and cost structure of new feedstocks.
- Well directed projects, focused targets across a somewhat narrow arena. Projects appear to be diverse, but localized to particular area, no apparent overarching tie among them. Especially with new crops, i.e. switchgrass, unless a broad large acreage is harvested, we won't know the real cost.
- Seems like all angles are being investigated and direction of platform is valid.
- My assessment from the presentation and materials is the feedstock platform is just getting up and running. Some broad assessments have been done of the potential supply, but much work remains to be done on logistics and more detailed analyses.
- In the realm of platform organization, I continue to desire to see more high-level coordination with USDA. From the comments I heard, I recognize cooperation but not overarching coordination. I would recommend that an effort be made to seek an audience with the new Agriculture Secretary as soon as he is confirmed.
- This platform is well planned and managed. It uses good engineering and science to attack the objectives spelled out.
- Feedstock logistics and logistics technology from the farm to the delivery point is key to the Program's success. Funding level of 5% of total Biomass Program budget is too low unless one major project is selected and tightly defined. The Biomass Program has too many feedstocks and regions for the money, and the benefit of this diversification is questionable other than political support.
- The platform concept—harvest, collection, storage, preprocessing, transport, queuing, and handling is well defined and can create scenarios (if integrated together as scenarios or pathways) that can help the program identify what the current cost of existing systems are, what the barriers are or what the cost hurdles are that need to be reduced, where money should be invested, what R&D targets should be, what the value of the investment should achieve, and whether or not one or more pathways/scenarios are needed to be successful in the first facility, the second facility, etc. The Program's organization has diversified from ORNL to include INL, which is good, but still needs a Midwest partner to succeed.

- Unfortunately, no clear allocation of funding between residues and energy crops, or between each technology stage (harvesting, storage, preprocessing, queuing, handling); and no justification for these allocations.
- The division between production, logistics and system integration is well balanced. The attention to sustainability is key. More work on preprocessing should be done.

Question 2: Platform Goals (in relation to the Program)

- The platform is engaged in important aspects of the program's goals and the recent effort to engage in regional feedstock development is a very positive platform enhancement.
- Good support for overall program. Need this information to move program forward. A lot of diversity, innovation not apparent in presentation. Addressing sustainability issues, Potassium and Phosphorus replacement, Carbon issue in doubt. Need better handle on real availability at what price.
- As explained, the platform is identifying and addressing issues.
- My impression was that the platform goals are generally in line with the Program's goals. I appreciated the references to "not betting on one winner." I think it would be prudent to continue investing in research on multiple feedstock crops and forest residues, as sustainability and geographic issues will likely result in regionally appropriate feedstocks.
- Feedstock logistics are crucial to the success of the Biomass Program.
- Integration with USDA agriculture and forestry services appeared weak, which is the biomass program's responsibility to ensure better coordination. DOE should focus on one major project that can be succeed, such as a fully integrated design for corn stover to ethanol at some achievable scale and target date that can meet DOE's cost and performance goals. Targeted focus, such as the "man on the moon" focus is more likely to succeed than to "put a little money into three or four feedstocks and three or four regions for political reasons." These diversified investments should be employed only after the main project (stover to ethanol) is fully funded. Without this one major stover to ethanol integrated system, the biomass program's feedstock activity is not fully integrated with their biochemical conversion activity. Without a single objective or focus, it will be very difficult to get USDA to coordinate with the biomass program.
- The platform goals are considered to fully support the Programs goals.

Question 3: Platform Goals (in relation to industry)

- The overall goal and the specific performance goals in the MYPP are clear. I believe the performance goals are too narrowly focused and ignore the enormous challenge of conducting cropping systems research, pest mitigation research, etc. The partnership with USDA is critical. However I did not find any acknowledgement that the platform must cooperate closely with each state's agricultural experiment station system. Connection with Extension was made in the report by the peer review team, but the critical connection with the land grant university agricultural experiment station system was not mentioned. It is the scientists in the agricultural experiment stations that conduct the genetics, breeding, cropping systems, and economics studies that are needed.
- Goals are realistic for the way things are now, but need some "out of the box" thinking is needed on moving the biomass around.
- I felt that the presentations and reports could have been clearer about the specific objectives of the platform. My impression was that there is much activity to be done. I think some strong coordination with USDA (not just cooperation or "friendly competition") needs to help give firm delegation of activities.

- Of the two goals—production and logistics—the majority of the focus of the program is on logistics, and presumably the production focus is integrated with the USDA, although this is not clearly articulated nor are any USDA integration activities identified or connections shown with DOE program goals. There needs to be more detailed USDA integration. The goals are a good start, since the program is moving from practically zero to $10 million, but as a result, the goals appear to be generic and do not demonstrate strategic focus or priorities yet, even though there was a "discussion on priorities", there wasn't any prioritization presented.
- The cost reduction goals for dry herbaceous materials appear to stagnate, which tends to imply that the program should focus on the wet herbaceous materials that show significant cost reductions with R&D. As an aside, INL does not appear to be well informed about current cost for stover harvesting, transport and storage. It would also tend to imply that INL is not up to date on material degradation based on previous NREL work. Program needs a feedstock production interface, technologies that may modify or improve any of the logistical steps. Program needs a conversion interface to the biochemical platform, which is focused on stover and switchgrass. Including this interface will help focus the entire feedstock program.
- Sufficient detail was not provided to discern the realism or logic of each goal. Any focus on woody biomass should be prioritized on the fraction of resources the program invests in the thermochemical platform.
- The program lacks realistic risk reduction strategies. The program will need to develop a good database of variability to support equipment manufacturers. What is the scale of the first plant? Scale will have a significant impact on technology.
- There was a high level attempt to quantify the value of each goal, but an aborted attempt to transfer those estimates into strategic priorities. There wasn't an attempt to focus on which step of the process chain (from harvest to handling) is the key barrier? Is it storage, densification? Not all steps can be equally important all the time. Some good technology focus was provided, but how these are crucial to the entire effort not clear. Too much focus on modeling and not enough ground truth data development and identification of key barriers and technologies necessary to overcome.
- Work to date has been largely done by universities and/or government laboratories. More industry involvement should be sought.

Question 4: Focus and Balance of the Platform R&D

- The necessity to conduct the work that is the focus of the feedstock platform is unquestionable. However, the need to invest in improved genetics and to understand the role of energy crops in sustainable production in the diversity of production areas is under-emphasized.
- Focused on meeting feedstock goals, will need continued scrutiny to get good handle on actual costs at refinery.
- I would like to see more specific activities in the realm of exploring sustainability issues (soil carbon, nitrogen leaching and phosphorus runoff, pest and disease issues, etc.). Alternatively, I would like to know what Program/platform activities are being done to support EPA USDA in this sector.
- Too much focus on political expediency, such as multiple regions and multiple feedstocks and not enough focus on making the first facility successful, where ever that may be. Within the various steps (harvesting, storage, preprocessing, handling, etc.) there are numerous gaps that should be addressed as an integrated scenario with well-justified investments into each. Do the future developers really have a lack of data? Which regions are developers focusing in? Which feedstocks are the developer's

focused on? Focus on lifecycle pathways and environmental impacts is good, but should be prioritized to the regions and feedstocks that the developers are interested in. Building an inventory by crop/residue and region should start with where the priority is.
- The platform would benefit from more work on preprocessing and storage logistics.

Question 5: Platform Progress
- The peer review team for this platform noted that there is a sound plan and progress is being made. It is my perspective that substantially more effort (i.e., funding) will be necessary to achieve the biomass feedstock goals.
- This platform is expanding to meet the needs of the integrated refineries. It must keep doing more, because of the importance of feedstock cost. We do need more innovation in harvesting and transporting these bulky materials.
- My impression is that the platform is gearing up its activities, but needs some focus which may not be able to come until some technological advances are made. I am not sure that this platform is ready to meet the targets of the Program.
- Need Midwest partnership, perhaps USDA Peoria Laboratory. Need more integration on corn stover. Need to have a better vision of what is a real priority and what will become a priority in the future once the first plant gets off the ground. One year of funding does not give a track record for the program, but the program is too diffuse and needs a better focus on what the developers are going to focus on. Bring in the developers. INL needs to diversity its area of interests. Good start on one year but now is a key time to refocus.
- It's not clear if the platform is on course to meet the feedstock cost targets for 2012 and 2017.

Additional Comments

Strengths
- Strong teams working on gathering this important information.
- As explained, the parts of the platform are working together well and are logically derived.
- The program is making progress on complex issues. The realization that a diversity of feedstocks is needed to fulfill program goals is positive. This will be important in regions outside the Midwest.
- Good organization using good science. Work at INL on storage and queuing as well as harvest and collection appears to be on target.
- The platform has identified the key areas necessary to achieve program goals.

Weaknesses
- Not enough switch grass has been collected to get a handle on real cost. The fertilizer the biomass removed does not appear to be factored into the cost of the biomass. Current phosphate, nitrogen and potassium costs are significant.
- It screams for DOE and USDA involvement that don't appear to be happening sufficiently.
- I appreciate the Program's (and platform's) growing consideration of sustainability issues. I think that many of the issues which may emerge have readily available answers, but the Program and Department need to be prepared to respond when questions are raised. An example is the realm of nitrogen and phosphorus contamination of water. In the short term, there are concerns about the expansion of corn production for biofuels. However, there are long-established production practices and agronomic research which can be implemented in production to mitigate these concerns (if

implemented). Also, a sustainable harvesting technique to protect soil carbon levels may assist (but will not completely mitigate) this effort. Additionally, a long-term shift to perennial crops may involve dramatically lower nitrogen and phosphorus needs, depending on the crop species selected and the production practices which emerge. Some research on these emerging species is needed, but likely would not take much effort.
- Scaling up to handle corn stover will create new challenges. Need to lay out a plan now.
- Critical concern for separation of biomass components must be reviewed with appropriate scientists and engineers. Perhaps this area is for early treatment studies; however, some separation may be accomplished in the field
- Lack of industry partnership/involvement. Lack of clarity as to how DOE and USDA activities are complimentary/synergistic.

R&D Portfolio Gaps
- I agree with the gaps assessment which was identified.
- The gaps identified by the review team are OK, but they do not go far enough. The yield productivity anticipated by the Billion Ton Study requires sustained funding of genetics and breeding programs across most production areas. Likewise, there is an urgent need for longer term sustainable production research.
- The real cost of biomass has not been convincingly determined.
- As noted above, I agree with the need for sustainability attention. The need for life cycle analyses likewise is an important area for attention. Increasingly, the science of environmental analysis is focused on this methodology, as are international corporate social reporting standards. I don’t have the resources/information to analyze the recommendation to resolve different cost targets; however, it was reported that this effort has already progressed. Similarly, I don’t feel prepared to comment on the econometric recommendation. The comment that the platform should conduct statistical analysis on yield trials is worthy of attention from the Program. Yield variability is a fact of life and is well document for grain crops. It will surely be an issue in future feedstocks.
- If giant biorefineries are needed in order to obtain low operating costs, logistics is crucial. That critical weakness in the Program justifies research to identify conversion technologies that can operate at acceptable cost at smaller scale (thermochemical processing is one option). Pyrolysis oil is much more energy-dense than wheat straw. A number of feedstocks were identified (MSW, forest residues) were identified that are quite different from wheat straw, and will have quite different handling, storage, and pretreatment needs and will broaden the research challenges even more than corn stover will.
- A critical area of interest for accomplishing the overall goals with respect to conversion of cellulose (and perhaps hemicellulose at a later date) is procurement of feedstocks. Considerable discussion has occurred about source of material as well as delivering functional, microorganism free fiber. However, minimal data are available for ascertaining realistic economic numbers with respect to possible tons to be delivered during the next five years. Also, conflicting information has been presented with respect to cost/ton delivered. A specific area of need is for appropriate interagency personnel involvement for convincing growers (farmers) to select change with little enticement for:
    - Sale of present planting, tilling and harvesting equipment and purchase of needed equipment; however, necessary modifications to possible equipment have not been achieved.
    - Ability to collect straw, stover, corncobs etc without contact with the soil (which will result in hydration as well as bacterial and fungal contamination).

- Storage sites and equipment.
- Equipment to transport chips, straw, stover etc, which often is ¼ the density of cereal grains and debarked trees.

- A major need is to identify opportunity costs of fiber production. Tons/acre often do not encompass duration from planting to harvesting, altering soil quality, need for nutrient replacement or productivity of land utilized. Duress to plants grown without pesticide protection, adequate nutrients and concern of harvesting time is paramount; this may result in plant chemical production and/or cohabitation with fungi to produce appropriate chemical compounds to repel predators.
- Cooperation with machinery manufacturers should proceed early in the overall game plan, rather than after arbitrary decisions on source materials have been made. Subsequent to elucidating enhanced value of current products or value of to be identified fractionated products, contact can be initiated with possible agricultural and forest producers. Questions about drying of material in the field or forest need to be identified and answered. Harvesting dates and methods will be site specific, e.g., dry air in KS is a bit different than wet air in SD; also, ability to harvest without deleterious effects on soil quality must be delineated.

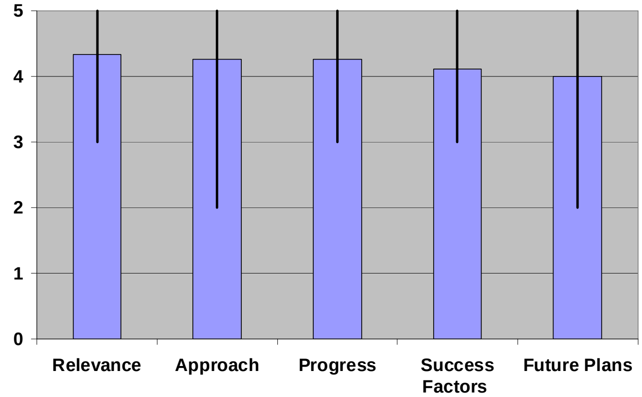
Additional Recommendations, Comments and Observations

- I would have appreciated hearing about the Regional Biomass efforts in conjunction with this platform. I understand that this is a new endeavor, but the presentation on Thursday afternoon about the NW regional study seemed to indicate that there are opportunities in this realm.

Biochemical Conversion Platform

Presenters: Amy Miranda (Biomass Program) & Don Johnson (Formerly with GP), Review Chair

Relevance	4.33	1.33	0.67
Approach	4.25	2.25	0.75
Progress	4.25	1.25	0.75
Success Factors	4.11	1.11	0.89
Future Plans	4.00	2.00	1.00
Average	**4.19**		



Question 1: Platform Approach

- Clearly moving in the right direction
- This platform has the weight of history behind it and therefore was the best "packaged" of all the platforms presented. It appears to have adequate funding, a good sense of mission and corresponding activities (fundamental and applied science, enzymes and organisms, etc.).
- R&D portfolio and funding distribution well presented. Benefits of biochemical platform accomplishments are excellent, and demonstrate value of R&D investments (page 12 of Miranda's presentation). The milestones and R&D portfolio was clear and well presented.
- Overall, the platform approach is well set up to reach the proposed goals. Consideration should be given to decreasing the emphasis on C5 conversion to ethanol and redirecting those resources to production of other bioproducts from C5 sugars.

Question 2: Platform Goals (in relation to the Program)

- Completely consistent.
- This platform seems to have a clear understanding of the Program's role in relation to the biochemical industry and research needs. As is true for the whole program, the platform should remain able respond to emerging technologies and feedstocks while being focused on current needs.
- Clearly the platform is core of the liquid fuels program. However, there is a tendency for the program to focus on the high liquid yield potential of the program, no matter how far out into the future it may be and no matter how complex it will be and how difficult it may be to duplicate these highly complex facilities; compared to a lower yield, and more simplistic approach that could produce liquid fuels in the near term through gasification.
- For the most part, the platform goals support the Program's goals.

Question 3: Platform Goals (in relation to industry)

- The only suggestion I have after reviewing MYPP 3.2.1.2 is that the goals for energy crop pathway should include other, high volume energy crops, such as poplar, and not just switchgrass.
- Good goals and good involvement of Government labs and universities.
- This platform was presented in a logical and clear manner and it appears that the goals are very appropriate to the Program's role in relation to the industry.

- There is still a perception that the complexity of the entire biochemical system will be very difficult to achieve, much less multiply facilities successfully. Need more industry involvement throughout the biochemical system, primarily to prepare the industry to provide various approaches to success without reinventing the wheel once these technologies are presented as a first facility.
- No major changes to the goals are needed and if achieved will meet the needs of industry.

Question 4: Focus and Balance of the Platform R&D

- Good balance
- The platform research seems to be balanced very well. A small amount of research into feedstocks other than corn stover, poplar and switchgrass may be valuable. As indicated in both presentations, knowledge of plant science is needed to address differences in plant chemistry at different harvest dates, regions, etc. Storage may additionally impact results dramatically and should be considered as research continues.
- WBS needs to show interaction of partners, solicitations, outside of core program. The budget associated with the fermentation/saccharification area does not reflect the potential benefit of investment in that technology. Related to this comment, the integration investment may be premature to some degree, allowing the program to move some funding from that area to fermentation.
- I disagree with the reviewers who wanted to include more feedstocks, such as wood. It would dilute near term success. Once near term success has been achieved, future industry partners will assist with the harder to integrate feedstocks such as wood.
- The focus of the platform is excellent.

Question 5: Platform Progress

- As documented in the peer review, many of the projects are performing quite well. There are some that are lagging or even virtually irrelevant.
- Program is varied and complete.
- Funding to attract quality staff and/or utilize private industry partnerships will be needed. I'm not qualified to analyze the progress on enzymatic pathways and genomics; however, I appreciate their importance and am pleased to see a focus on these research needs.
- Needed to put more effort into getting more presentations into the program review: only 17 out of 27 attended.
- I support the recommendation that the program build an integrated processing structure as soon as possible. It is not clear that the pilot plant at NREL is suitable for this effort without substantial remodeling and reworking. It may be cheaper to abandon the NREL pilot plant and build a pilot plant somewhere else in partnership with a major construction and engineering company and a funding partner. Perhaps building more than one pilot plant will accelerate commercial development and allow for more variations and novel cost improvements. NREL and Midwest Research Institute will need to make licensing agreements clear, easy, and quick to accommodate.
- Publication of unique testing and evaluation standards would be highly beneficial for creating an industrial structure for success. The program should continue identifying and retaining high quality partnerships, particularly as the R&D moves from bench scale to pilot and pre-commercialization stages. Creating these partnerships may allow for more access to personnel and engineers that the program has difficulty retaining.
- Elimination of disruptive NREL management (occurred in FY2007) may also reduce turn over.

- The platform is progressing well and the degree of process integration is commendable.

Additional Comments

Strengths

- This platform is noted for its strong progress and focus on critically important topics. The quality of much of the science and engineering is internationally recognized for its excellence.
- Integration and singularity of focus are good. The program really seems to be abiding by guiding principals.
- I appreciate this platform's understanding of its role as a government program and how it has utilized its resource to focus on technical barriers. This platform appears to be well funded. Utilization of university consortium taps a wider intellectual resource base. I am pleased to note increased interaction with USDA. I hope that a coordination relationship can be developed as well. I would recommend an early request for an audience with the new Secretary of Agriculture (once confirmed).
- Good liaison with industry. Work on process integration. Correct focus on work required to meet platform and Program goals.

Weaknesses

- Several programs were mentioned in a negative light, indicating that better management could be warranted.
- Focusing on switchgrass and hybrid poplar is a logical development, but a small amount of research of other feedstock species may be valuable. For example, woody biomass was mentioned by the platform review.
- No major weaknesses; however, decreased emphasis on C5 fermentation to ethanol should be considered.

R&D Portfolio Gaps

- Review was of summer proceedings. It was needed to close the loop of what will be done with the assessments and if comments are taken seriously.
- I find the list of critical gaps (challenges and barriers) discussed in MYPP 3.2.1.3 to be fairly comprehensive, if not daunting.
- The platform review recommended use of pilot runs as soon as is practical. This seems to be a theme of the week and therefore deserves attention.
- No significant gaps were identified.

Additional Recommendations, Comments and Observations

- I agree with the peer review team's recommendations, in general. However, while I agree that woody biomass be included in the platform's goals, such work must be limited to those feedstocks that are in sufficient abundance and logistic availability to justify their incorporation into this platform. I suspect that the thermochemical platform can more readily handle a temporally varying mix of heterogeneous woody materials.
- I have to express some disappointment that we have to revisit the enzyme development process. We have been given misleading information about the cost of enzymes in the past, and I have no reason to be any more confident in the future. The enzyme cost goals shown in the MYPP seem to be drawn from thin air.
- Pretreatment and enzymatic hydrolysis program at NREL is focused to the overall objectives. A project which encompasses both esoteric and applied research aspects; therefore, finding should be of benefit to the industry while utilizing background

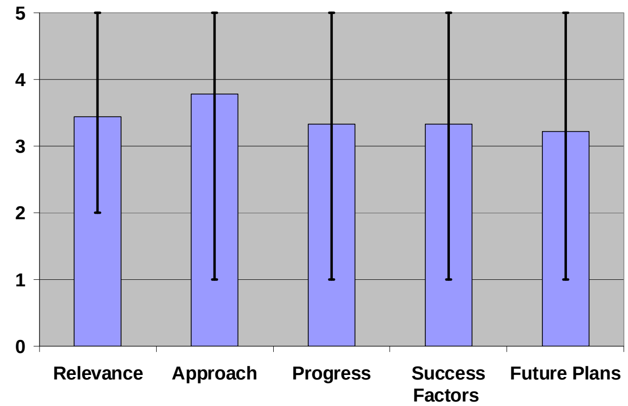
information. As scientists and engineers within the NREL program continue to relate with those individuals with knowledge about needed outcomes, this program will flourish.

- Biochemical Process Integration Task has been designed to provide samples and relevant findings to other NREL programs as well as extramural researchers. Perhaps a bit more coordination with feedstock needs would be helpful. A critical portion of this program will be to provide state of the art instrumentation as well as data generated from the analytical objectives.
- As work continues towards converting cellulose to ethanol, the fundamental drivers in this project will be critical to future investigations. Well designed studies to assess relevance of providing clean cellulose from samples containing hemicellulose and/or lignin will be imperative to advancing cellulose conversion science. Continued extra and intra-agency discussions and joint projects will be relevant to future success.
- A higher sense of urgency on planning and operation.
- Ongoing evaluation of the value of CAFI work to achieving platform goals. The work is very academic and several of the pretreatment processes CAFI is studying are unlikely to ever be implemented at commercial scale.

Thermochemical Conversion Platform Overview

Presenters: Paul Grabowski (Biomass Program) & Mark Jones (Dow Chemical), Review Chair

Relevance	3.44	1.44	1.56
Approach	3.78	2.78	1.22
Progress	3.33	2.33	1.67
Success Factors	3.33	2.33	1.67
Future Plans	3.22	2.22	1.78
Average	**3.42**		



Question 1: Platform Approach

- The immediate focus on only agricultural residues and energy crops as feedstocks as documented in the MYPP is too narrow. Robust processes, able to handle a wider variety of materials will solve many problems associated with seasonal availability of feedstock and limitations in amounts of certain types of feedstocks. Connecting with other DOE groups working on gasification of coal makes sense.
- As presented the projects are doing an excellent job of supporting platform goals and are on track and meeting goals. The results are so encouraging that the reasons for shelving this approach twenty or so years ago must be revisited.
- This platform has much potential. I can understand the political and budgetary reasons for the focus on agricultural residues and energy crops, but there is a logical role for government to play in utilization of wastes and forestry residues in this platform. Likewise, the historical focus on gasification is not enough. I am pleased to hear of a new focus on pyrolysis. This should be funded well. Fischer-Tropes processes appear to require more investigation as well.
- The thermochemical platform has the potential to produce a wide variety of end products that are compatible with existing infrastructure. It deserves greater funding.
- The MYPP comment on page 3-45 “The Program, therefore, has prioritized gasification R&D in its near term efforts” is overblown, and would be more accurate to say that program has recognized the value of modest funding to the program commiserate (or perhaps not) to is near term benefits. Similarly any claims that pyrolysis R&D may be increased in the future is premature until a clear and unbiased evaluation of the cost and benefits and fuel supply impact is fully evaluated. Any pyrolysis fuels used as refinery feedstocks should include petroleum industry partnerships to achieve these goals. Rather than continue in a point-by-point debate, the thermochemical portion of the MYPP document is not fully integrated in terms of near term impacts, barriers, costs, supply impacts, and, byproduct market saturation risks compared with other program areas such as biochemical. The relative merits of each program area should be clearly defined and not shown as a debate between each program area. As a program area with new funding, the biomass program should show what the benefits would achieve, the costs, the risks, and the impact to fuel supply compared with other strategies.
- Since many of the “10% pilot scale projects” were thermochemical, the maturity of the thermochemical technology is much advanced and the rational for investing in this area is in doubt unless clearly defined and always associated with a commercial partner. As

like the biodiesel and corn ethanol industry, the program should not invest in program areas that are commercial.
- The platform approach supports achievement of its goals.

Question 2: Platform Goals (in relation to the Program)

- This is a very important platform area that is critical to achieving program goals. It is good to see that it has received renewed emphasis.
- The estimated capital costs and plant gate price are where we want to be. So why aren't we doing it. What is missing?
- The platform goals do support the Program's goals, but need to be expanded.
- Feedstocks and feedstock interface targets should include water/moisture reduction and biochemical lignin quality assessment as a priority, and a focus on feedstocks residues and crops as a secondary priority unless the thermochemical area can show that value to the public that is equal to the value of the biochemical area.
- The lack of focus on the co-product produced from the biochemical area shows that this program area is not supporting the other program areas, but competing for existing feedstocks.
- Barrier Tt-B should be a priority over Tt-A.
- Feedstock selection processes are too broad and display a lack of prioritization. The cost performance goals and dates are the same as the biochemical areas cost goals and performance data, which is unusual as these two technologies are different and may have different cost starting points and different milestone achievement dates.
- Grabowski's modeled ethanol price on slide 9 (see also slide 13) in his presentation conflicts with his slide on slide 5. The Biomass Program should clarify current ethanol costs and performance dates for each technology area (biochemical and thermochemical). They should not be the same unless serendipity occurs.
- Funding all feedstocks and all fuel pathways denotes a lack of strategic planning and prioritization. Only one or two of these will offer the best options. This type of approach denotes the lack of prior analysis and independent review of technologies.
- Production of mixed alcohols will require a high degree of biofuels distribution area investment in ASTM fuel standards, fuel registration, and demonstration with fuel infrastructure partners; not shown in program. Ditto with pyrolysis fuels, product is clearly not ASTM quality diesel fuel and does not meet EPA's fuel registration of diesel fuel.
- The platform's goals are well aligned with those of the Program. The milestones selected are relevant and the dates for their achievement are reasonable.

Question 3: Platform Goals (in relation to industry)

- The goals as outlined in the MYPP 3.2.2.2 are nearly comprehensive and are good, as far as they go. However, it strikes me as odd that there are challenges noted but no goal for woody biomass and MSW. This seems to ignore the opportunities to use these abundant feedstocks for which logistical challenges are solved or nearly solved, but which will require some research and development to achieve commercial viability.
- The goals are reasonable and logical, and if met can be easily implemented into existing petroleum processing facilities. It will take capital to implement, as will all, and could require less capital than biological processes. Need to verify at larger scale, and let industry run with it (verified).
- The platform review was well done and pointed out some clear needs for this platform. I support the recommendations of the reviewers, which were specific and logical.

- There is little analysis, less strategic planning, poorly defined goals, and given all that, the results cannot be clear, realistic or logical. Projects such as Tt-G for alcohol synthesis with better selectivity and better yields should be a priority. The pyrolysis investment should equal the impact of a homogenous fuel infrastructure opportunity (e.g., very little opportunity, similar to Oxygen Diesel). The value of pyrolysis over gasification should be questioned and the answer should be clearly articulated. Given the pre-commercialization nature of thermochemical technologies; how much of the R&D should be bench scale, how much should be pilot scale, and how much should the R&D be partnered with private industry? Task Tt-H has low value to the program, e.g., small market impact to gasoline displacement, high barriers to fuel distribution commercialization, etc.
- The goals will definitely meet the needs of industry i.e. clean syngas and new catalysts for mixed alcohol production.
- Recognition of increased profile for pyrolysis is good.

Question 4: Focus and Balance of the Platform R&D

- Program is narrowly focused and has enough projects to be comprehensive and balanced within the scope.
- An increased emphasis on pyrolysis and Fischer-Tropes should be made. The infrastructure benefits could lead to a more rapid achievement of 20-in-10.
- If the Tt-A project is poorly defined, redefine the name of the project to reflect the goals.
- Balance and focus is good and appropriate to achieving the goal of producing a range of biofuels from a broad range of biomass feedstocks.

Question 5: Platform Progress

- As noted in the peer review report, there is good progress in a number of the platform's projects and there are some projects that have little connection with the platform and have not contributed to achievement of its goals.
- The information presented showed that the platform is progressing well and meeting important targets. I am still concerned with what has changed in the last twenty years to make this now feasible and better than the biochemical route.
- I am pleased to see that the platform is making some course corrections in recognition of emerging technologies because this is such a diverse collection of processes; it was difficult to assess platform progress in the brief time frame of this review.
- The Gasification of Biorefinery Residues was ranked midway between all the projects reviewed; and either that was because the reviewers don't think that is a priority or that the presentation was poor, is unclear from the comments. At a minimum, the relevance should have been higher.
- There are few projects in task Tt-G in the reviewer's lists, where R&D invested in this category (higher yields, higher alcohol selectivity) would provide major benefits to the program.
- The platform is making satisfactory progress.

Additional Comments

Strengths

- The program is based on an excellent understanding of the issues.
- Good partnering with UOP who has experience in both petroleum processing and biochemical processing. Good university, industry and national lab cooperation. Using technology that for the most part has long experience.

- This platform has potential in addressing multiple issues – biorefinery integration, integration with existing fuel infrastructure, utilization of multiple feedstocks, etc. In the gasification focus of the platform, there seems to have been an appropriate focus on bottlenecks (catalysts/tar removal).
- Innovative dryer designs would benefit a wide range of technologies if successful, including the biochemical projects.
- Decision to increase focus on pyrolysis. Focus on producing a range of biofuels, several of which would be attractive to the existing petroleum industry.

Weaknesses

- The weakness is in the goals as articulated in the MYPP, which seem to not be in agreement with the MYPP's statements about the opportunities and challenges with a wider variety of feedstocks. This platform is the primary platform to address their use.
- Concern about what has changed that makes this attractive now, and worth reopening.
- As previously noted in the platform review, the platform should widen its scope to reach its potential in achieving the President's goals.
- Subsequent to many years of funding projects to produce syngas, perhaps work should be oriented to separation of producer gas components. A review of current data should be accomplished to delineate relevance of simple and/or multiple technology procedures.
- Numerous projects were not focused; a shotgun approach often was evident. Economic assessments could have been made with current available information.
- It is not clear that DOE has been under funding gasification and pyrolysis R&D once the DOD and DOE coal R&D activities and the commercial R&D investments are considered. The Program clearly needs to integrate these technologies into their Biochemical conversion platform but a more rigorous effort is needed to define what needs to be done for the Program and program goals, not necessarily to benefit the industry at large. I want to reiterate one of the reviewer's comments as I support these strongly.
    - Techno-economic modeling is needed to help determine the priority direction for platform funding.
    - The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach.
    - The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE (coal) and DOD R&D.
- Duplication of effort regarding cellulosic biomass gasification and coal gasification as they pertain to the use of the syngas produced.

R&D Portfolio Gaps

- There wasn't a separate slide for gas, but this matter was embraced in comments and recommendations. The most important gap is to increase funding. Other gaps cited are acceptable to this reviewer.
- The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.
- I agree with the platform review's analysis of the existing gaps.
- The potential of this platform is so great it deserves additional funding to determine whether the remaining challenges can be resolved. This may be the same state of affairs

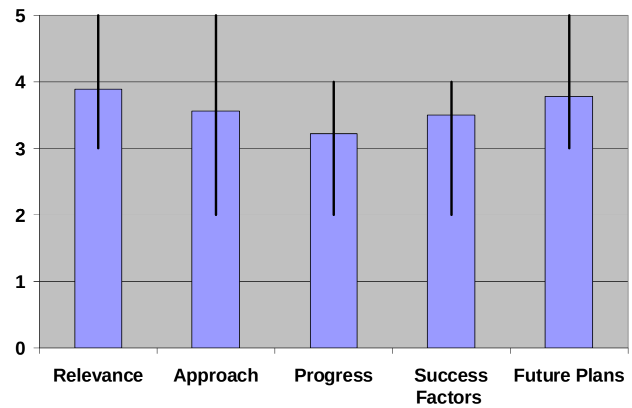
that existed when the platform was downsized some years ago, but the world has moved forward since that time.
- Project outlines need to be developed to focus on particular, relevant objectives. Perhaps because of considerable past work, the researchers did not feel the need to define specific items, rather to continue with general approaches which can be projected well with enthusiastic show persons. In particular studies, there appeared to be little awareness of DOE goals.
- Available dollars may have been spent on state of the art equipment; however, there is a lack of researchers capable of utilizing the equipment as well as interpreting the data.
- There is a need to have projects present coherent approaches to posed questions.
- No additional gaps to those identified in the platform review report.

Additional Recommendations, Comments and Observations
- Excellent presentation. The appropriate amount of details was covered in a short presentation.
- Look for opportunities to share research and development with some of the Fossil Energy programs.
- The platform review was nicely presented.
- It would be beneficial (but probably very difficult), for the thermochemical conversion program to establish criteria for validating the claims of the plethora of companies purporting to have viable, operating gasifiers.

Integrated Biorefinery Platform

Presenters: Larry Russo, Biomass Program & Dr. William Cruickshank (formerly of National Resources Canada) and Dr. Michael Tumbleson (University of Illinois, Co-Review Chairs

Relevance	3.89	0.89	1.11
Approach	3.56	1.56	1.44
Progress	3.22	1.22	0.78
Success Factors	3.50	1.50	0.50
Future Plans	3.78	0.78	1.22
Average	**3.59**		



Question 1: Platform Approach

- The integrated biorefinery platform's approach is largely sound, yet its effectiveness is clearly dependent on the performance of the feedstock, biochemical conversion, and thermochemical conversion platforms. The generalized approach documented in the MYPP 3.3.4 is logical.
- Seems like a potpourri of projects to develop high valued products concurrently with ethanol that can enable economic production of fuel alcohol.
- Seems like to be taking the whole view.
- The platform seems to have a good focus within the program. The current focus on building the commercial scale and pilot scale plants is appropriate.
- This platform supports a wide range of projects, some of which (wet mill/dry grind improvements) are in the "commercialized" category.
- Too many work breakdown structure (WBS) elements. Need to focus on the things that the Program is investing in. May simplify WBS to include feedstocks (a-z), conversion technologies (a-z), byproduct production with linkages to feedstocks and/or technologies,
- Project definition (techno-economic analysis, LCA, Food vs Fuel, environmental, waste minimization, etc.). Technology verification and integration (including solicitations, 2nd plants, process integration, risk minimization, etc.).
- Since the Program is trying to get TECHNOLOGIES into commercial use in order to achieve some 20% gasoline displacement goal, why are the milestones not technology based? At least we could see if a technology is successful or not, and it's a lot more difficult to say that a feedstock is successful (see Milestones for this discussion).
- Need to focus on program priorities: why oil processing, forest resources, waste processing, etc.? OK as part of WBS as defined above, but begs the question of priorities if broken out separately.
- No milestone deadline targets. No info on solicitations, so not clear as to how well defined or the value of the partnerships to date.
- How much co-product benefits are enough?
- Platform area is new and under various definitional changes, but so far, we don't see much substance, although substance is possible and desirable.
- The platform organization and milestones facilitate reaching its goals as well as those of the Program.

- The R&D portfolio is constrained to some degree by the availability of relevant industrial partners and/or their willingness to partner in projects.

Question 2: Platform Goals (in relation to the Program)

- The general platform goal (MYPP 3.3.1) clearly is supportive of the overall Program goals. I have some concern about one of the two pathways selected for initial performance goals inasmuch as collection and transport of agricultural residue is still under development whereas collection and transportation of forest materials (not slash) and MSW is already commercially available. Somewhat in mitigation of this point is its recognition as a barrier in the MYPP.
- As reported, some projects do not support program goals, but most of them do. Could have better tie in or linkage among projects to see they function together to meet platform goals, which would support program goals.
- The platform seems to have focused well on the technical and market barriers.
- The goals are critical but poorly defined at this time. Some good progress has been achieved such as solicitations and analyses. Some good partnerships have been developed. But all in all, the platform is still too nebulous to be as useful as it could be. The goals of the platform need to be better defined via a better defined WBS.
- The goals may also be improved by created a list of partnerships that would provide specific benefits to the Program and then design around that (using solicitations). The scattergun approach is no different than the earmark approach. While the solicitations for the pilot plants and the 10% facilities are crucial, the solicitations should be more targeted to define Program benefits.
- Technology transfer products need to be improved, especially the publications of patents, standardized leasing agreement, or at least the identification of trade secret processes. The benefits would be quantified via technical improvements (yields, etc.) and costs.
- More thought should be invested in personnel training programs. Where are all the complex biochemical experts going to come from?
- Consider a solicitation that invests in multiple biochemical pilot plants rather than reinvest in the NREL pilot plant.
- No change to platform goals is considered necessary.

Question 3: Platform Goals (in relation to industry)

- If successful, they will clearly achieve the goal of achieving commercially acceptable performance. Achieving the cost goals likely will be dependent on optimization of plant designs and creation of maximum value from all mass and energy flows. Such optimization may take longer than the 2017 time horizon.
- Goals for projects are clear and realistic, but how they tie together to meet platform goals is not clear. Platform does pull different platform performers together.
- Issues raised by separation of C5 and C6 sugars give impression that there are issues around clarification of goals.
- The goals are clear, but broad. In this case, the activities chosen to support the goals will be more important to success than the goals themselves.
- Need more quantifiable goals and milestone dates.
- Need better targeted solicitations, for example a challenge/solicitation to densify dry corn stover in wrapped cubes for flat beds (may also include stacking height demonstrations). Or demonstration of using ethanol plant gases (such as CO2 gases) for drying and stabilizing dried materials. Etc. Identify the integration needs and focus them as solicitations. Try waste minimization, biochemical inhibitors.

- Present industry partnerships are contributing well to the platform's goal and meet industry needs.

Question 4: Focus and Balance of the Platform R&D

- Looking at the specific projects that were included in the materials, it does not appear that they all meet the needs of this platform's goals.
- Not clear whether platform R&D is focused and balanced, seems more like a collection of projects which don't fit elsewhere.
- Comments indicate lack of concern for the animals and final land disposal of the solids.
- By necessity, the platform has its fingers in a lot of pies. It appears the platform reviewers felt that some of the projects were not useful to promote the overall Program goals. This may include earmark projects. However, the 10% scale plants appear to be a beneficial focus as the platform moves forward.
- The Techno economic portion of the platform is excellent and investment in this task area should continue. This should provide better focus on where portions of integration are weak and need to have more focused solicitations. Specifically the market barriers are very poorly defined and not clearly needed as a platform barrier with the exception of Im-D.
- Focus on deployment is commendable. Water issues need to be a focus area. Need to focus on cross-cutting technologies.

Question 5: Platform Progress

- The platform peer review report that was presented indicated that the platform is moving in a commendable way toward emphasis on deployment. It also stated that integration with feedstock platform is exceptionally important, and I agree with this statement. I also agree with the recommendation to focus on water management and cross-cutting technologies – particularly those that can handle heterogeneous and time-varying feedstock supplies.
- The review is essential to keep program on track and mission oriented. Progress is made in the individual projects and with the scope as explained at this review; it will mitigate the issues with the 632 and 10% projects.
- While Congress appears to have put a hiccup in the platform's methodology, I am pleased that the platform is simultaneously moving forward on the 10% scale plant development and has a stepwise plan of implementation.
- The platform is on track but still in its infant stage of development and planning. It will be critical to bring this platform up to speed as soon as possible. The solicitations have generated a lot of interest but it isn't clear yet if the responders are high quality or will provide value, since none of that information has been presented yet.
- The analysis and strategic planning component of the platform must be used not only for tracking but also for effectively managing the platform's progress.

Additional Comments

Strengths

- Projects are well managed to meet specific goals.
- Liked the discussion of the options.
- The platform seems to have done a good job of assessing the barriers which are appropriate for the Program to address. The program is well funded. The development of commercial scale plants may be premature for technical reasons, but may also help identify new areas of research needed to remove impediments for future plants. The

recognition that 10% scale plants are more desirable is to be commended. I applaud the program's utilization of "investment banker" philosophy and risk analysis in the 932 process. Risk mitigation is necessary for success. I am happy to see the platform planning to look at utilization of new feedstocks and conversion technologies in the months and years ahead.

- Good industry partnerships. Good synergy with the biochemical conversion platform.

Weaknesses

- There are many gaps in the program.
- Needs to have better explanation of how they fit together in this platform.
- Clarity of purpose, and option development were expressed as concerns.
- No work on utilization of perennial crops, forest residues and post consumer waste. Insufficient focus on full life cycle analysis specifically, full life cycle GHG emissions and energy balance.

R&D Portfolio Gaps

- There are many gaps in the program, as cited by the presentation. These include little or no work on logistics of feedstock supply; issues around water supply and management; no work on utilization of perennial crops, forest residues or post consumer waste; lack of full life cycle energy balance and GHG emissions; and insufficient focus on unit process integration.
- The report noted little or no work on logistics of feedstock supply. While I agree that this is a paramount need for the overall program, I don't think it is a gap in this specific platform. I agree with the other four gaps noted by the peer review for this platform.
- Gaps were well pointed out.
- I agree with the comment that water supply issues need attention.
- There are opportunities in biorefinery integration to tell a good public relations story.
- I agree that perennial crops/forest residues could use more attention, especially regionally. Likewise wastes such as cobs are logical opportunities for attention.
- Full life cycle analyses are increasingly important in the investment and marketing world. In my experience, they are emerging as a real environmental and corporate investor focus.
- Agree with gaps identified in the platform review presentation.

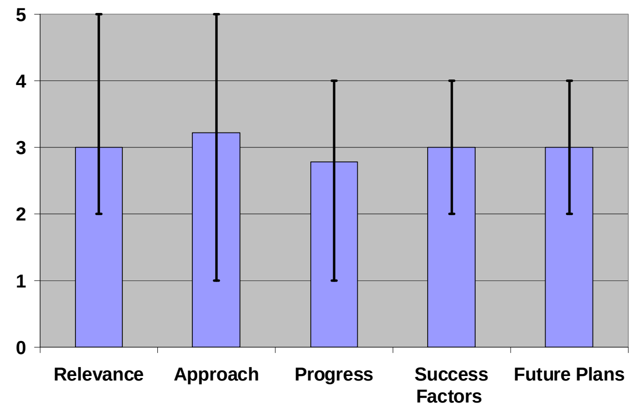
Additional Recommendations, Comments and Observations

- The reviewer recommendation to publish more and encourage information sharing is understandable, but I question whether or not it is practical. Where possible, the use of public funds to develop resources that can be shared is to be encouraged, but the leveraging of private resources is so helpful it would not be wise to restrict it.
- This platform is ideally situated, by virtue of its being at the interface with commercial implementation, to provide feedback to the feedstock, thermochemical and biochemical platforms as to what R&D adjustments, refocusing, etc. is required in those platforms in order to assure commercially viable biorefinery processes.

Infrastructure Platform

Presenters: Joan Glickman (Biomass Program) & David Terry (State Line Energy for Governor's Ethanol coalition), Review Chair

Relevance	3.00	1.00	2.00
Approach	3.22	2.22	1.78
Progress	2.78	1.78	1.22
Success Factors	3.00	1.00	1.00
Future Plans	3.00	1.00	1.00
Average	**3.00**		



Question 1: Platform Approach

- The issues of product distribution infrastructure and product standards are important and their recognition as a platform component is a positive development.
- A very important component of the biomass program. Once we double the amount alcohol in the pool, we will need to know how to move it around.
- This was a workshop review, not a platform peer review.
- It is wise for the Program to add this platform to address the final link in the chain.
- The platform approach could support the Program goals, except that the platform as described does not have enough content to achieve anything. The platform as presented does not contain any substance, no key milestones or date, no focus or strategic value, no priorities.
- Clearly this platform needs to differentiate its self from the Freedom Car and create a focus that has value. For example, shooting for an E22 world, realistic or not, would be a goal.
- The conception of existing and future Infrastructure does not accommodate new facility locations, or incentives to get new facilities to build in the right places. That would minimize rail, pipeline, etc.
- Focus on new fuels creates a huge chicken and egg issue. If you are going to add new fuels, then why not mixed alcohols with better fuel economy and lower conversional costs? At least there is a rational here. Furthermore, how will you prioritize the fuel choices? Where are the following platform activities necessary to support a new fuel: fuel registration, demonstration, ASTM standards, fuel quality optimization activities, engine design, material compatibility, etc. Where are the partnerships to achieve all that? How will you justify some new fuels (based on volume and cost) versus other new fuels with limited niche markets, limited volumes, limited cost benefits, etc?
- Who really cares about lawnmowers, trimmers, etc? How much volume for how much investment will be needed for these? Tractors are NOT small engines. They are larger than all transportation fuel vehicles except semi-tractor trailers. Alcohols have not been good fits for large engines, what will you do differently?
- Isn't there enough private investment in automotive alcohol engine research? You will need to focus on a large blend such as E22.
- Your list of potential partners is good, but how the partnerships will be managed and directed is nebulous.

- There are adequate federal incentives for ethanol blending infrastructure.
- Given that some issues regarding infrastructure fall outside DOE's mandate, the platform approach is considered satisfactory.
- Since this is a new platform, it is expected future reviews will indicate refinements to its approach.

Question 2: Platform Goals (in relation to the Program)

- Based on the slide presentation, which updated the MYPP, this platform's goals are fully supportive of the program goals.
- Not a platform, but certainly supports the program.
- The goal at this point seems to be simply exploring what is the national infrastructure status, and what are the early-identifiable bottlenecks. From what I saw, the emerging concerns seem to be appropriately identified.
- No, the platform goals don't seem to support Biomass Program goal of 20-in-10 or any other related vision except for the vague decision to do something in the ethanol and biodiesel arena.
- To generate a volume equal to 20 Billion or 20% of gasoline industry, you are not going to play around with lawnmowers.
- The key areas are storage infrastructure and investment and pipeline incentives—no one has given the pipelines any incentive to move ethanol. The rest (material compatibility, standards, etc.) will be partially driven by industry if they decide to get invested.
- The platform's goals support the Program goals.

Question 3: Platform Goals (in relation to industry)

- As noted in the presentation, the platform is evolving rapidly. It is important that the goals address the range of biofuels and develop the platform's goals in consultation with the appropriate industrial partners.
- No goals, but a number of recommendations came out of project, and more outreach planned to get input on this important area.
- These goals will have the benefit of making a lot of people feel good about the biofuels program. The history of slow acceptance of E10 by uninformed car owners (still a problem) shows the benefit of public education.
- There are good Geographic Information System programs already available for liquid fuel transportation and storage. In addition to research on stress corrosion cracking, pipeline and storage infrastructure research to move ethanol will require research on pumps, seals, cleanout operations, safety, environmental impact analysis, risk analysis, etc.
- The goals of the platform are realistic, but the platform will need to expend a major effort on consultation/communication with other agencies, industry groups, standards, organization etc. in order to achieve them.

Question 4: Focus and Balance of the Platform R&D

- Need to focus on infrastructure to get good data on how we distribute the large amount of biofuels planned.
- The platform R&D portfolio could perhaps focus on some larger issues (small engines are very important in emissions for certain regions, but maybe this is EPA's responsibility?). I trust that R&D will mature as the program matures.

- All over the map, needs some real focus with solid value. They may be on the right track with some issues but unable to prioritize and identify where the value is for some of the things they want to include.
- The platform is as well balanced as can be expected given that it's new and subject to influence by many stakeholders.

Question 5: Platform Progress

- The workshop was an excellent first step.
- Good progress (held workshop) and plans to generate much more information.
- Since this platform is new, there is no progress to report.
- Just getting started.
- Poorly, who ever is supporting this area, they should bring focus groups specific to fuel storage firm and pipelines and even rails for unit train operations, and see exactly what the barriers are and how important each barrier is and what to do about it and who to do it.
- Too early to assess how well the platform is progressing. Progress of the platform may well be limited by factors beyond its control and/or mandate.

Additional Comments

Strengths

- Outreaching to end users and addressing issues on fuel ethanol.
- The platform is to be commended for its early effort to coordinate with other agencies, industry, and organizations to determine the needs and the work being done by others. Outreach to the public is wise. Partnering with private industry will likely allow greater penetration into media markets than government efforts alone. I am glad to see the door being left open for efforts for other renewable fuels, though I agree that, for now, a priority focus on ethanol and biodiesel is appropriate.
- Outline of work to be accomplished was provided. Need for intra and interagency cooperative efforts were described.
- The platform's initiative to engage all relevant stakeholders right from its beginning is a key strength.

Weaknesses

- Distribution and storage of the feedstocks will likely be a serious issue and should have some attention from this platform and/or close communication with the feedstock platform.
- The weakness of this progress is that its ability to achieve its goals may be limited or prevented by the actions of organizations beyond its influence.

R&D Portfolio Gaps

- Gaps were not identified, but this reviewer is in agreement with the programs objectives, of:
  - Identify challenges, barriers, and opportunities that need to be addressed in order to promote the increased use and distribution of biofuels, and,
  - Gain industry (i.e., producers, petroleum wholesalers and retailers, pipeline operators, rail, etc) insight into how the Biomass Program can best focus its infrastructure efforts.
- It appears that this program is its early stages. This reviewer believes it should be accelerated and that investor considerations and interests being part of the program. As

important as any of the other presentations, this should be considered to be a major externality towards meeting the overall program goals. This reviewer emphatically agrees with the conclusion that an infrastructure plan be prepared.

- I don’t believe gaps were presented to the reviewers.
- Efforts to achieve goals were not apparent.
- The weakness of this progress is that its ability to achieve its goals may be limited or prevented by the actions of organizations beyond its influence.

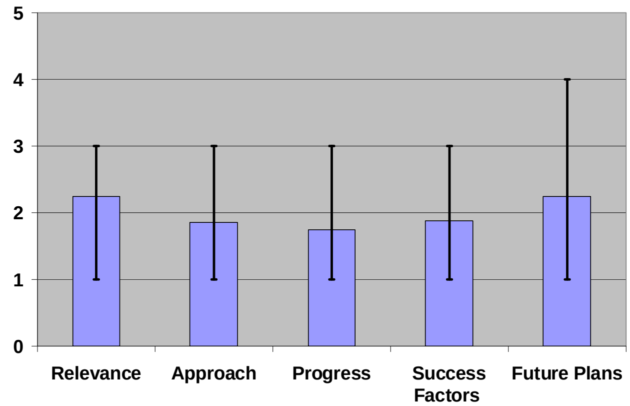
Additional Recommendations, Comments and Observations

- Focusing on transporting fuel, may learn useful information about moving around biomass.
- Explore partnership with the state of CA on your emissions work for possible synergy with their San Joaquin Air Quality District needs.
- Infrastructure issues can deter the growth of biofuels consumption, so workshops like this can help. Their outcomes need to be communicated more broadly, however.
- This reviewer was unable to glean the relevancy of the direction presented.
- Will there be joint presentations and deliverables provided to the public, staffers on the hill, DOE administrators and industrial organizations?

Biodiesel and Other Technologies

Presenters: Mark Decot (Biomass Program) & Shaine Tyson (Rocky Mountain Biodiesel), Review Chair

Relevance	2.25	1.25	0.75
Approach	1.86	0.86	1.14
Progress	1.75	0.75	1.25
Success Factors	1.88	0.88	1.13
Future Plans	2.25	1.25	1.75
Average	**2.00**		



Question 1: Platform Approach

- Difficult to answer – there is no biodiesel platform. The interest across the nation in this subject makes it seem appropriate to have some effort directed to improve the base of knowledge concerning oilseed feedstocks, conversion processes including co-products, and distribution issues.
- Not a platform, group of congressional mandated projects. Lack of structure at the review. Broad diversity of projects, mostly related to biodiesel. $1.00/gal subsidy brought scads of people to the table.
- Discord and discontinuity stressed.
- There are no platform approaches or organization to review. I am glad that the Program has put these under review, and hope that the feedback the “platform” reviewers provided will be utilized.
- Many of these projects support local interests, but not national program goals. Platform managers have little ability to refocus project goals or require good quality research.
- This platform’s approach is very scattered and serves as a prime example of how earmarks negatively impact achievement of the Biomass Program objectives.

Question 2: Platform Goals (in relation to the Program)

- There are no platform goals, so the response to this question should be N/A
- Not a platform, but supports the overall program.
- Unclear
- No platform goals to review. Some of these projects should be moved into the new Infrastructure platforms so that they can be judged in light of the goals of that platform.
- No. If the Program decides that biodiesel is worthy of platform status, it should make the effort to define realistic goals etc.

Question 3: Platform Goals (in relation to industry)

- There are no industry reviewers in this program. It appears that this program is a technical activities program.
- There are no stated goals.
- Goals not clearly articulated, but assumed to replace gasoline. No articulation of goals or how much diesel could be replaced.
- Congressionally directed seem to be a problem.
- No goals.

- What goals??

Question 4: Focus and Balance of the Platform R&D

- Since the projects are primarily not directed by the DOE staff, there does not appear to be any planned balance in the set of projects.
- Good assessment by review committee, tried to get answers. Have good handle on how to bring the program together.
- Clearly some disconnects in focus.
- Obviously, the research is not focused or balanced, though I thank the reviewers for highlighting those projects which had some usefulness for achieving Program goals.
- What focus?

Question 5: Platform Progress

- Future assessment should be better detailed.
- Some projects appear to have some value to addressing imported petroleum replacement.
- Needs organization, review committee gave helpful suggestions, recommendations, but no indication that input would be incorporated.
- No platform for which to track progress.
- Fifteen different projects going in fifteen different directions will not contribute to progress towards goals.

Additional Comments

Strengths

- This is not a platform, rather a collection of mandated projects. It was a good review of the projects with many good suggestions/recommendations.
- The reviewers performed a valuable service in analyzing these “orphan” projects. Leveraging with private funding is to be commended. Pipeline testing projects may have use to the new infrastructure platform.

Weaknesses

- As the presentation indicates, a biodiesel platform does not exist. Much more work is needed on this activity.
- Didn’t appear likely that many of the recommendations would be followed.
- There is no platform. Some of the projects could be moved into existing platforms for better review. However, I don’t fault the Program for conducting the review in the manner they did.
- No focus.

R&D Portfolio Gaps

- Gaps are not indicated.
- The reviewers’ comment that a biodiesel/renewable diesel platform is needed is interesting. I don’t think that a separate program is appropriate, but should rather be integrated into existing platforms. However, we did not see much attention to biodiesel this week. As clean diesel engines have certain advantages over gasoline engines for improved fuel use, there is a need to give this some attention (at least a cost analysis). I would suggest that the Program follow up on the suggestion that the Program attempt to bring PIs from these types of projects together early and educate them on the Program goals and useful tools for project success.

- Overall, the projects presented were not focused on DOE Office of the Biomass Programs. Project timelines did not appear to be a major area of concern. As some of the projects were earmarked with a lack of coordination with more stable research programs, accomplishments were minimal. Inadequate data on cost benefits from utilizing biodiesel. Prior to demonstration projects, dollars should be spent on basic aspects of bioconversion and sourcing. Studies on engine performance and responses to regulatory requirements must be conducted. Relevant relationships with biorefineries were not apparent. Project innovations must be listed and acknowledged. Economic analyses are needed to ascertain relevancy to utilization of current and proposed materials.
- Too many to comment on.

Additional Recommendations, Comments and Observations

- Much work is required in this activity.
- The need for middle distillates is known. It seems that a biodiesel or middle distillate platform is needed.
- Biodiesel ought to be relegated to niche applications, such as mandated usage in recreational vehicles and boating where it is affordable. Biodiesel costs are prohibitive in view of other renewables. It has value to replace petro-diesel in ecologically sensitive areas.
- I agree with the ideas presented for managing earmarked projects. They can't hurt, and a few PIs might actually cooperate.
- The Program should consider abandoning support for biodiesel (fatty acid esters) and instead focus on renewable diesel as supported by a strengthened thermochemical conversion platform. If the decision is to retain oil based biodiesel, the focus should be on new (as in economically viable) feedstocks.

Platform Peer Review Summary Reports

Process Overview

Introduction

The Technology Platform Peer Reviews for the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Biomass Program were conducted over a three month period prior to the November 2007 Biomass Program Peer Review. The summary report of each meeting provided in the following sections includes a summary of comments from the Review Panel, scores and feedback on individual projects and PI responses to the reviewer comments. The primary intent of the peer reviews was to provide information that assists the Program Manager and staff in their efforts to improve program performance. Other important potential outcomes of the reviews include: improving program management, demonstrating public accountability, providing an honest independent review of the projects and program, and transparently communicating the value of the programs to the larger public.

The objectives of this meeting were to demonstrate the R&D projects':

- Relevance to platform objectives
- Progress against planned milestones and likelihood of commercial success
- Relationship to mission and goals and contribution to 20-in-10 targets
- Strategic mix of industry, academic, laboratory involvement in the research
- Appropriateness of industry-government cost share
- Recommendations (i.e. go/no-go decisions, redirection, etc)

The work evaluated at these reviews support achievement of DOE goals and the results of the reviews are used by the Program as inputs for future funding decisions. In addition to the initial reviewer comments, the report anonymously discloses the full comments, scores for each of the criteria rated, and the average project score in the body of this report.

Feedstocks	August 21 - 23, 2007	Washington, DC	12	• Feedstock Supply & Sustainability • Feedstock Logistics Core R&D • Feedstock Systems Integration
Biochemical Conversion	August 7 - 9, 2007	Golden, CO	17	• Biochemical Platform Support • Feedstock-Biochemical Conversion Interface • Biochemical Processing Core R&D • Biochemical Process Integration Core R&D • Fundamental New Concepts • Chemicals and Products
Thermochemical Conversion	July 10 - 11, 2007	Golden, CO	18	• Thermochemical Platform Support • Gasification/Black Liquor Gasification • Clean-up and Conditioning • Fuel Synthesis • Pyrolysis
Integrated Biorefineries	August 13 - 15, 2007	Golden, CO	14	• Analysis and Strategic Planning • Corn Wet/Dry Mill Improvements • Oil Mills Improvement • Agricultural Residue Processing • Other Refinery-Related Projects
Biodiesel and Other Technologies	August 15 - 16, 2007	Golden, CO	18	• Biodiesel and Fuels Demonstration • Combined Heat and Power • Associated Products • Anaerobic Digestion • Communications, Outreach, & Partnerships • Other Technologies
Infrastructure	October 30, 2007	Washington, DC	0	

Technology Platform Reviewers (*Review Chairs)

Feedstocks	Lyle Stephens*	Lead Reviewer; John Deere (retired)
	Beth Calabotta	Monsanto
	Peter Flynn	University of Alberta
	Tom Miles	T.R. Miles Technical Consultants
	Phil Rasmussen	Utah State University
Biochemical Conversion	Bonnie Hames	Ceres
	Don Johnson*	Retired from GPC
	Dale A. Monceaux	AdvanceBio LLC
	Sharon Shoemaker	Univeristy of California, Davis
Thermochemical Conversion	Jim Frederick	Georgia Institute of Technology
	Lisa Myers	Conoco Phillips
	Mark Jones*	Dow Chemical
	Robert Brown	Iowa State University
	Ron Breault	National Energy Technology Laboratory
	Steve Kelley	North Carolina State University
Integrated Biorefineries	William Cruickshank*	Natural Resources Canada (retired), Consultant
	Carol Babb	R.W. Beck
	Dr. Michael Tumbleson*	University of Illinois
	Jason Denner	Point 380
Biodiesel and Other Technologies	Dr. Shaine Tyson*	Rocky Mountain Biodiesel
	Rodney Boyd	McMinnville Electric Systems
	Dr. Joe Bozell	University of Tennessee
	Rick Handley	Coalition of Northeastern Governors (CONEG)
	Dr. David Sjoding	Washington State University
	Dr. Philip Shepherd	National Renewable Energy Laboratory
	Dr. Matt Smith	USDA – Agricultural Research Service
	Dr. Mark Zappi	University of Louisiana at Lafayette
Infrastructure	David Terry*	Governors’ Ethanol Coalition

Review Design and Process

The following outline was provided to the Principal Investigators (PIs) to help them present their project information in a format that addresses the review objectives. Additionally, project background summaries were submitted by the PIs in a similar outline before the meeting.

1) Project Overview
   a) Timeline
   b) Barriers
   c) Budget
      i) Total project funding
      ii) Funding received in FY06 and FY07, Future funding, if applicable
   d) Partners
   e) Stage of Development
2) Goals and Objectives
   a) Project objective(s)
   b) Relevance to the Biomass Program
3) Approach
   a) Overall technical approach
   b) Unique aspects of approach
4) Technical Accomplishments/Progress/Results
   a) Describe most important technical accomplishments achieved and their significance
   b) Describe the significance of the accomplishments by relating the results to the appropriate DOE targets and milestones from the MYPP
   c) Benchmark progress to previously reported results (if applicable)
   d) Benchmarks results against technical targets (if applicable)
5) Accomplishments/Progress/Results
   a) What was done leading to technical accomplishments
   b) Data and results
6) Success Factors and Showstoppers
   a) Top 2-3 potential showstoppers to achieve successful project results
   b) Window of opportunity to develop the technology
7) Future Work
   a) Plan of work through to the end of the project
   b) Highlight upcoming key milestones
   c) Remaining issues
8) Summarize key points for reviewers and audience to take away

Evaluation Criteria

Platform Review Summaries

U.S. Department of Energy
Office of the Biomass Program
Feedstock Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Feedstock Platform Portfolio Peer Review held on August 21st through 23rd in Washington D.C.

The work evaluated in this document supports DOE, and the results of the review are major inputs used by the Department in making future funding decisions.

The projects were presented to the reviewers organized by the type of Feedstock R&D activity they supported (i.e. supply and sustainability; logistics; and systems integration). The platform review agenda is included in Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four-point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The name of the reviewer who provided the individual comments will remain anonymous.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Sam Tagore
Technology Manager – Feedstocks R&D
DOE/EERE, Office of the Biomass Program

Feedstock Supply System Design Report	4.00	4.00	4.00	3.67	3.25	3.78
Feedstock Logistics - Storage & Queuing	4.00	3.33	3.50	3.50	3.75	3.62
University of TN Switchgrass Demonstration Project	3.75	3.67	3.75	3.67	3.25	3.62
Feedstock Logistics - Harvest & Collection	3.75	3.75	3.75	3.25	3.50	3.60
Feedstock Logistics - Preprocessing	3.75	3.75	3.50	3.50	3.50	3.60
Biomass Resource Supply Analysis	3.75	3.75	3.50	3.33	3.33	3.53
GIS-Based Biomass Resource Sustainability	4.00	3.75	3.25	3.00	3.50	3.50
Feedstock Logistics - Handling & Transport	3.50	3.75	3.25	3.25	3.25	3.40
Alternative Fuel Source Study	3.00	3.33	3.67	3.67	3.33	3.40
Regional Biomass Energy Feedstock Partnerships	3.50	3.50	3.00	3.50	3.00	3.30
Supply System Logistics	3.00	2.67	2.67	2.67	2.67	2.73
MSU Sustainable Energy Center	2.75	2.25	2.50	2.25	2.50	2.45

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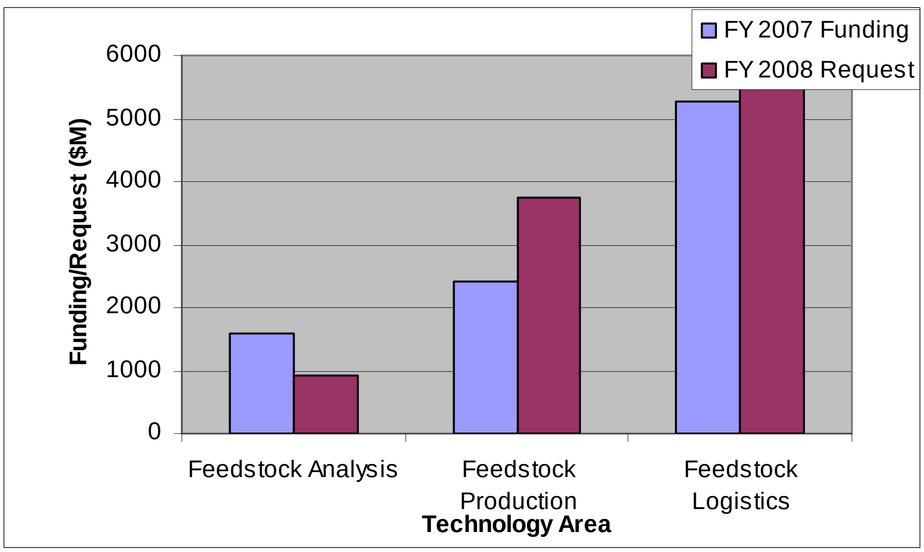
Platform Direction

In FY2008, the Feedstock Platform will continue work through the Regional Feedstock Partnerships and/or by leveraging OBP biorefinery demonstration projects to conduct large crop demonstration trials in order to collect more realistic feedstock production data, ultimately leading to more informed decision-making regarding specific energy feedstocks on which to focus programmatic efforts. By the end of FY2008, the platform will have also completed the first phase of the GIS-based resource assessment tool, which will also better inform platform and programmatic decision-making. Finally, in FY2008, the platform will release a solicitation for industrial-scale feedstock logistics projects, which will help lower feedstock costs.

Platform Funding (in $M)



Specific Responses to Select Comments

• Well directed and well focused. Strong teams working on gathering this important information. • As explained, the parts of the platform are working together well and are logically derived. • The program is making progress on complex issues. The realization that a diversity of feedstocks is needed to fulfill program goals is positive. This will be important in regions outside the Midwest. • Good organization using good science. Work at INL on storage and queuing as well as harvest and collection appears to be on target.		The TM appreciates the reviewer's comments regarding the overall strength of the Feedstock Platform in terms of being well directed, organized, and focused. The TM further acknowledges the good work at INL. Further, the TM recognizes the challenges that lie ahead, particularly outside of the Midwest.

Work at INL on storage and queuing as well as harvest and collection appears to be on target.		Same comment for INL as above.
• Not enough switch grass has been collected to get a handle on real cost. The fertilizer the biomass removed does not appear to be factored into the cost of the biomass. Current phosphate, nitrogen and potassium costs are significant. • The real cost of biomass has not been convincingly determined. • Scaling up to handle corn stover will create new challenges. Need to lay out a plan now.		Only under the Charitan Valley project was switchgrass collected in sufficient quantities to provide meaningful costs. Fertilizer costs are figured into feedstock production estimates, but are not included under the feedstock logistics element. The TM agrees that corn stover represents some new challenges. It is planned that corn stover logistic costs and operations will be developed in conjunction with appropriate 932 or 10% validation integrated biorefinery projects, and their industrial partners.
• I appreciate the Program's (and platforms) growing consideration of sustainability issues. I think that many of the issues which may emerge have readily available answers, but the Program and Department need to be prepared to respond when questions are raised. An example is the realm of nitrogen and phosphorus contamination of water. In the short realm, there are concerns about the expansion of corn production for biofuels. However, there are long-established production practices and agronomic research which can be implemented in production to mitigate these concerns (if implemented). Also, a sustainable harvesting technique to protect soil carbon levels may assist (but will not completely mitigate) this effort. Additionally, a long-term shift to perennial crops may involve dramatically lower nitrogen and phosphorus needs, depending on the crop species selected and the production practices which emerge. Some research on these emerging species is needed, but likely would not take much effort. • The gaps identified by the review team are OK, but they do not go far enough. The yield productivity anticipated by the Billion Ton Study requires sustained funding of genetics and breeding programs across most production areas. Likewise, there is an urgent need for longer term sustainable production research.		The TM appreciates the reviewers' comments pertaining to sustainability issues. Under the feedstock umbrella, sustainability practices will be developed and supported. As the reviewers suggest, some long-established practices should be implemented to mitigate concerns. Under the regional feedstock partnership effort (launched in 2007-2008), the Program will foster the development and adoption of more advanced sustainable agronomic and silvicultural practices. While the platform supports perennial energy crops, in part because of their intrinsic sustainable root profile, the program will encourage the sustainable production of feedstocks among all of the different feedstock pathways. The DOE feedstock platform acknowledges that it will probably not have the fiscal resources for sustained funding of breeding and genetics across most production areas, but believes that USDA, land grants, and private companies will engage in this area to help meet the Billion Ton vision.
Critical concern for separation of biomass components must be reviewed with appropriate scientists and engineers. Perhaps this area is for early treatment studies; however, some separation may be accomplished in the field.		This concern calls for synergy between the feedstock platform and conversion platforms, as well as integrated biorefineries. The feedstock platform will pursue this avenue.
• Lack of industry partnership/involvement. Lack of clarity as to how DOE and DOA activities are complimentary/synergistic. • It screams for DOE and USDA involvement that don't appear to be happening sufficiently		FY 2008 is the first year that the Feedstock Platform will have sufficient funds to procure funds for industrial partnerships. The Biomass R&D Board has established a feedstock interagency working group between USDA and DOE (and other agencies) to enhance interagency coordination.

The need for life cycle analyses likewise is an important area for attention. Increasingly, the science of environmental analysis is focused on this methodology, as are international corporate social reporting standards. I don't have the resources/information to analyze the recommendation to resolve different cost targets; however, it was reported that this effort has already progressed. Similarly, I don't feel prepared to comment on the econometric recommendation. The comment that the platform should conduct statistic analysis on yield trials is worthy of attention from the Program. Yield variability is a fact of life and is well document for grain crops.		Life cycle analyses are now required as part of the implementation of the recently signed Energy Independence and Security Act of 2007. The comment of statistical validity of crop trials is well taken; and an individual with a strong statistical base will help design the crop trials that will be planted during the 2008 growing season. The "Uniform-Format Feedstock Supply System Design for Lignocellulosic Biomass" (November 2007) by INL provides a better basis for developing cost targets.
If giant biorefineries are needed in order to obtain low operating costs, logistics is crucial. That critical weakness in the Program justifies research to identify conversion technologies that can operate at acceptable cost at smaller scale (thermochemical processing is one option). Pyrolysis oil is much more energy-dense than wheat straw. A number of feedstocks were identified (MSW, forest residues) were identified that are quite different from wheat straw, and will have quite different handling, storage, and pretreatment needs. They will broaden the research challenges even more than corn stover will.		There are many potential alternative biorefineries at different scales. The 932 and 10% validation solicitations should provide different scenarios with a broad range of feedstocks. Where possible, the feedstock platform will interact with these industrial partners to develop acceptable feedstock logistics.
A critical area of interest for accomplishing the overall goals with respect to conversion of cellulose (and perhaps hemicellulose at a later date) is procurement of feedstocks. Considerable discussion has occurred about source of material as well as delivering functional, microorganism free fiber. However, minimal data are available for ascertaining realistic economic numbers with respect to possible tons to be delivered during the next five years. Also, conflicting information has been presented with respect to cost/ton delivered. A specific area of need is for appropriate interagency personnel involvement for convincing growers (farmers) to select change with little enticement for: • Sale of present planting, tilling and harvesting equipment and purchase of needed equipment; however, necessary modifications to possible equipment have not been achieved. • Ability to collect straw, stover, corncobs etc without contact with the soil (which will result in hydration as well as bacterial and fungal contamination • Storage sites and equipment • Equipment to transport chips, straw, stover etc, which often is ¼ the density of cereal grains and debarked trees.		The TM agrees with the reviewers that appropriate interagency personnel are needed to interact with the growers. The regional feedstock partnership will develop extension opportunities to help address this need. The feedstock platform will also explore various feedstock scale-up projects that already receive State and private financing for leverage opportunities to help convince growers. In addition, it is anticipated that the upcoming Farm Bill may provide enticements for growing energy crops.

A major need is to identify opportunity costs of fiber production. Tons/acre often do not encompass duration from planting to harvesting, altering soil quality, need for nutrient replacement or productivity of land utilized. Duress to plants grown without pesticide protection, adequate nutrients and concern of harvesting time is paramount; this may result in plant chemical production and/or cohabitation with fungi to produce appropriate chemical compounds to repel predators. Cooperation with machinery manufacturers should proceed early in the overall game plan, rather than after arbitrary decisions on source materials have been made. Subsequent to elucidating enhanced value of current products or value of to be identified fractionated products, contact can be initiated with possible agricultural and forest producers. Questions about drying of material in the field or forest need to be identified and answered. Harvesting dates and methods will be site specific, e.g., dry air in KS is a bit different than wet air in SD; also, ability to harvest without deleterious effects on soil quality must be delineated		The reviewer comments point to a need for a greater understanding of plant requirements during its life cycle, the importance of machinery manufacturers to improve the source materials and appropriate fractionation of the products, the importance of drying in the field and forest, and the potential to cause deleterious effects on the soil through the harvesting cycle. These are all important considerations for the feedstock platform.
I would have appreciated hearing about the Regional Biomass efforts in conjunction with this platform. I understand that this is a new endeavor, but the presentation on Thursday afternoon about the NW regional study seemed to indicate that there are opportunities in this realm.		Sorry the Regional Biomass efforts were not better explained in the full program review, but this is a relatively new effort and will be much more fully covered in the next peer review meeting.

Program Review Comments

Strengths

- Well directed and well focused. Strong teams working on gathering this important information.
- As explained, the parts of the platform are working together well and are logically derived.
- The program is making progress on complex issues. The realization that a diversity of feedstocks is needed to fulfill program goals is positive. This will be important in regions outside the Midwest.
- Good organization using good science. Work at INL on storage and queuing as well as harvest and collection appears to be on target.
- Work at INL on storage and queuing as well as harvest and collection appears to be on target.
- The platform has identified the key areas necessary to achieve program goals.

Weaknesses

- Not enough switch grass has been collected to get a handle on real cost. The fertilizer the biomass removed does not appear to be factored into the cost of the biomass. Current phosphate, nitrogen and potassium costs are significant.
- It screams for DOE and USDA involvement that don't appear to be happening sufficiently.
- I appreciate the Program's (and platforms) growing consideration of sustainability issues. I think that many of the issues which may emerge have readily available answers, but the Program and Department need to be prepared to respond when questions are raised. An example is the realm of nitrogen and phosphorus contamination of water. In the short realm, there are concerns about the expansion of corn production for biofuels. However, there are long-established production practices and agronomic research which can be implemented in production to mitigate these concerns (if implemented). Also, a sustainable harvesting technique to protect soil carbon levels may assist (but will not completely mitigate) this effort. Additionally, a long-term shift to perennial crops may involve dramatically lower nitrogen and phosphorus needs, depending on the crop species selected and the production practices which emerge. Some research on these emerging species is needed, but likely would not take much effort.
- Scaling up to handle corn stover will create new challenges. Need to lay out a plan now.
- Critical concern for separation of biomass components must be reviewed with appropriate scientists and engineers. Perhaps this area is for early treatment studies; however, some separation may be accomplished in the field
- Lack of industry partnership/involvement. Lack of clarity as to how DOE and DOA activities are complimentary/synergistic.

R&D Portfolio Gaps

- I agree with the gaps assessment which was identified.
- The gaps identified by the review team are OK, but they do not go far enough. The yield productivity anticipated by the Billion Ton Study requires sustained funding of genetics and breeding programs across most production areas. Likewise, there is an urgent need for longer term sustainable production research.
- The real cost of biomass has not been convincingly determined.
- As noted above, I agree with the need for sustainability attention. The need for life cycle analyses likewise is an important area for attention. Increasingly, the science of environmental analysis is focused on this methodology, as are international corporate social

reporting standards. I don't have the resources/information to analyze the recommendation to resolve different cost targets; however, it was reported that this effort has already progressed. Similarly, I don't feel prepared to comment on the econometric recommendation. The comment that the platform should conduct statistic analysis on yield trials is worthy of attention from the Program. Yield variability is a fact of life and is well document for grain crops. It will surely be an issue in future feedstocks.

- If giant biorefineries are needed in order to obtain low operating costs, logistics is crucial. That critical weakness in the Program justifies research to identify conversion technologies that can operate at acceptable cost at smaller scale (thermochemical processing is one option). Pyrolysis oil is much more energy-dense than wheat straw. A number of feedstocks were identified (MSW, forest residues) were identified that are quite different from wheat straw, and will have quite different handling, storage, and pretreatment needs. They will broaden the research challenges even more than corn stover will.
- A critical area of interest for accomplishing the overall goals with respect to conversion of cellulose (and perhaps hemicellulose at a later date) is procurement of feedstocks. Considerable discussion has occurred about source of material as well as delivering functional, microorganism free fiber. However, minimal data are available for ascertaining realistic economic numbers with respect to possible tons to be delivered during the next five years. Also, conflicting information has been presented with respect to cost/ton delivered. A specific area of need is for appropriate interagency personnel involvement for convincing growers (farmers) to select change with little enticement for:
  - Sale of present planting, tilling and harvesting equipment and purchase of needed equipment; however, necessary modifications to possible equipment have not been achieved.
  - Ability to collect straw, stover, corncobs etc without contact with the soil (which will result in hydration as well as bacterial and fungal contamination
  - Storage sites and equipment
  - Equipment to transport chips, straw, stover etc, which often is ¼ the density of cereal grains and debarked trees.
- A major need is to identify opportunity costs of fiber production. Tons/acre often do not encompass duration from planting to harvesting, altering soil quality, need for nutrient replacement or productivity of land utilized. Duress to plants grown without pesticide protection, adequate nutrients and concern of harvesting time is paramount; this may result in plant chemical production and/or cohabitation with fungi to produce appropriate chemical compounds to repel predators. Cooperation with machinery manufacturers should proceed early in the overall game plan, rather than after arbitrary decisions on source materials have been made. Subsequent to elucidating enhanced value of current products or value of to be identified fractionated products, contact can be initiated with possible agricultural and forest producers. Questions about drying of material in the field or forest need to be identified and answered. Harvesting dates and methods will be site specific, e.g., dry air in KS is a bit different than wet air in SD; also, ability to harvest without deleterious effects on soil quality must be delineated.

Additional Recommendations, Comments and Observations

- I would have appreciated hearing about the Regional Biomass efforts in conjunction with this platform. I understand that this is a new endeavor, but the presentation on Thursday afternoon about the NW regional study seemed to indicate that there are opportunities in this realm.

Specific Responses to Select Comments

The Feedstock Platform has developed a sound plan to address the Administration's current goals.		The TM, on behalf of the Feedstock Platform, greatly appreciates the reviewer comment.
• Coordination between multiple agencies/stakeholders is improving. Cooperation with Extension is identified as a need to be addressed and can be strengthened by consistent funding. • Progress is being made across a variety of complex issues. The tools being developed by platform R&D have the potential to be widely applicable to existing and future industry. • There is a need for enhanced coordination with USDA, the Sun Grant Initiative, etc. on breeding timelines.		The TM appreciates all of these comments from the reviewers. The TM is also cognizant that there is an enhanced need for coordination among DOE, USDA, the Sun Grant Initiative, etc. on breeding timelines as well as other crop development activities.
• The means to address issues of sustainability (such as soil carbon) have begun to be identified, but not yet to the full extent necessary. • Life cycle analysis in the feedstock platform is encouraged. • There is an ongoing need to understand competing food, feed, and fuel interactions while maintaining global economic and environmental sustainability. • The largest portfolio gap is in looking at opportunity costs of increasing the use of agricultural products for fuel and the impact on soil quality and productivity, as well as pest and disease pressure, by shifting agricultural practices.		The Feedstock Platform agrees with regard to the increasing importance of sustainability, life cycle analysis, and macro economic issues such as the food versus fuel. The Billion Ton vision was produced with the consideration that biofuels would be produced in a sustainable way and not have a major negative impact on food markets. However, there may always be some tradeoffs. Public policy will sort these out to some degree and it is important for the program to scientifically-based information to help address these important issues.
The diversity of the feedstock pathways that have been funded is positive.		The program appreciates this comment. Portfolio management has been a challenge.

• There is a need to resolve cost targets and estimates between the design report (as reported by Richard Hess) and the IBSAL model (as reported by Shahab Sokhansanj). • Many of the cost models used by the Platform have econometric implications, and therefore need to reflect market implications and include an estimate of accuracy.		Reported cost discrepancies between IBSAL and the Uniform Format Design (UFD) are the result of differences in assumed cost and performance parameters (e.g., machine lifetime, annual hours, travel speed, field efficiency, etc.). IBSAL uses standard ASABE/ANSI costing methodology and data as the source for these cost and performance parameters, whereas the UFD analysis used the best available data including field/lab data, manufacturer/dealer estimates, operator estimates, and ASABE/ANSI methods and data. To resolve these differences, the costing methodology will be updated to include the use of nonstandard (i.e., “best available) data for assessing unique feedstock designs. This provides a common method for insuring that all modeling efforts are using the same cost estimating methods regardless of the data source, and that the UFD, as well as other innovative supply system designs, will interface seamlessly with the IBSAL computational engine.
The Platform needs to accumulate and conduct statistical analysis of yield trials		The Program agrees and has insisted that someone with statistical expertise be added to the energy crop team.

General Platform Comments

- The Feedstock Platform has developed a sound plan to address the Administration’s current goals.
- Progress is being made across a variety of complex issues. The tools being developed by platform R&D have the potential to be widely applicable to existing and future industry.
- Coordination between multiple agencies/stakeholders is improving. Cooperation with Extension is identified as a need to be addressed and can be strengthened by consistent funding.
- The means to address issues of sustainability (such as soil carbon) have begun to be identified, but not yet to the full extent necessary.
- Life cycle analysis in the feedstock platform is encouraged.
- The diversity of the feedstock pathways that have been funded is positive.
- There is a need to resolve cost targets and estimates between the design report (as reported by Richard Hess) and the IBSAL model (as reported by Shahab Sokhansanj).
- Many of the cost models used by the Platform have econometric implications, and therefore need to reflect market implications and include an estimate of accuracy.
- The Platform needs to accumulate and conduct statistical analysis of yield trials.

General Comments (applicable to all presentations)

- Overall it is apparent that the stage gate review methodology is still being learned by Program collaborators.

General Comments (on multi-agency issues)

- There is an ongoing need to understand competing food, feed, and fuel interactions while maintaining global economic and environmental sustainability.
- The largest portfolio gap is in looking at opportunity costs of increasing the use of agricultural products for fuel and the impact on soil quality and productivity, as well as pest and disease pressure, by shifting agricultural practices.
- There is a need for enhanced coordination with USDA, the Sun Grant Initiative, etc. on breeding timelines.

Initial Reviewer Feedback – Comment Summaries

Feedstock Supply & Sustainability Projects

Project Title: Biomass Resource Supply & Sustainability Analysis
Project Investigator: Bob Perlack, Oak Ridge National Laboratory and Tris West, Oak Ridge National Laboratory

Strengths
- This project is critical to future feedstock efforts.
- There is depth of thought around linkages and a commitment to good data.
- The tool is flexible and able to integrate data from multiple sources.
- There is a strong link between this project and other programs (i.e. IBSAL, ORIBAS, POLYSYS).
- Project performers have a good understanding of the data available and computational requirements.
- This is a good communication tool as well as an analysis tool.

Weaknesses
- Project performers need to verify the benefits of using 30m resolution.
- The year to year variability of the data being used could become an issue.
- The tool is not yet open source.
- Project performers need to increase attention to soil erosion data set.
- The Platform needs to ensure quality control of the model through continued funding.
- This project will require several years of data to reduce the uncertainty of estimates being used.

Comments
- The tool should be designed to capture year to year (or seasonal) variability.
- Soil carbon and denitrification data should be added to the project.
- There needs to be confirmation that there are enough local people to supply data to the project.
- Potential production vs. farmer acceptance is a concern.

Project Title: Regional Biomass Energy Feedstock Partnerships
Principal Investigator: Jim Doolittle, SDSU (with Terry Nipp, National Sun Grant and Kevin Kephart, SDSU)

Strengths
- The project brings local involvement and ground-truthing into the portfolio.
- Land Grant universities have a high amount of credibility, are an unbiased source of information for farmers, and have a proven record of introducing new technologies.

Weaknesses
- Sun Grant universities may not be as equipped to address forest residue issues as other organizations.

- The Sun Grant initiative is broader than the Feedstock Platform's and may at time conflict. However, there are also many synergies and alignment of objectives.

Comments

- Progress within the Sun Grants has been slow, potentially due to lack of consistent funding.
- Project performers need to ensure communication between all Sun Grant centers and/or other portfolio initiatives.
- There needs to be continuous monitoring of the link between local Extension and Land Grants.

Project Title: Mississippi State University Sustainable Energy Center
Principal Investigator: Michael Collins, MSU

Strengths

- An initial screening trial of potential feedstocks has been completed.

Weaknesses

- Geographic coverage is narrow; the results are not applicable to a larger region and are in some cases below economic size.
- Longer term studies are needed to address the sustainability of double-cropping oil seeds.
- Project results would be improved if research design considered factors relevant to the use of biomass in subsequent processes.
- The research design, as reported, lacked measurable outcomes.
- Increased communication with other Feedstock Platform elements is needed.
- A more rigorous agronomic design would improve the quality of project results.

Comments

- The project would benefit from an independent review from ORNL/INL experts to ensure the funded work has broad applicability (possibly should be incorporated with the RFP).

Project Title: Switchgrass Demonstration Project
Principal Investigator: Burt English, University of Tennessee

Strengths

- The project incorporates a good agronomic design.
- The project will be able to affect change at the grassroots level.
- The project uses a rational approach to introducing an entirely new crop to the region.
- This is a high-risk project that has gotten good results.

Weaknesses

- The selection of pyrolysis as a downstream processing area of research is questionable.
- The addition of a chemical processing expertise would benefit the project.

Comments

- Some of the lessons learned on this project should be shared with other Sun Grant regions.

Project Title: Alternative Fuel Source Study
Principal Investigator: Ralph Zee, Auburn University

Strengths
- The project includes a cooperative and committed industrial partner.
- A wide variety of alternative fuels are tested (though this may not address the Platform focus).
- Project performers recognize the need for a bench-scale burn simulator.
- Quantification of the limits of fuel substitution has been addressed (phosphorus and chlorine).

Weaknesses
- Generic economic data and/or project drivers/context would have been useful.
- Some of the feedstocks used may not be available for free beyond this project.
- More explanation of the significance of emission results would be helpful.

Comments
- Project performers have infectious enthusiasm.

Feedstock Logistics Core R&D Projects

Project Title: Harvest and Collection
Principal Investigator: Kevin Kenney, Idaho National Laboratory

Strengths
- Good fundamental study.
- Detailed, high-quality engineering and cost analysis associated with the project.

Weaknesses
- Project needs more inclusion of existing technologies for densification.

Comments
- Should assess the nutrient impact of fractionation, including denitrification.
- Further development of the single pass approach to fractionation is needed.

PI Response
- Reviewer Item: "Need more inclusion of existing technologies for densification"
    - Response: There are indeed many existing technologies and processes for densifying biomass, primarily for the feed industry. The results of a literature review were briefly discussed in the presentation, but since the technology to densify crop residues within the engineering limits posed by a harvesting machine does not exist today, the presentation focused more on the deficiencies of current technologies rather than the opportunities to learn from existing technologies. Successful development of densification process suitable for integration with single-pass harvest

technology will certainly require inclusion of existing technologies, and as we progress with this task considerable attention and effort will be devoted to this issue.

- Reviewer Item: “Nutrient impact of fractionation including denitrification”
  - Response: The nutrient impact of fractionation is a major focus of a current stover removal project involving the INL, Iowa State University and the National Soil Tilth Lab. A paper discussing this issue has been published per the following reference:
  - Hoskinson RL, Karlen DL, Birrell SJ, Radtke CW, and Wilhelm WW. Engineering, nutrient removal, and feedstock conversion evaluations of four corn stover harvest scenarios. Biomass and Bioenergy 2007;31:126-136.
  - This publication represents data and findings from the first year of the project, and the project is currently approaching the third harvest season of the study.

- Reviewer Item: “Further development of single pass approach to fractionation needed”
  - Response: Since the single-pass fractionation material presented focused on small grain crop residues, I assume this comment is referring to the single pass fractionation of corn stover. Single-pass fractionation of corn stover would certainly require a different approach than that presented for small grain residues, since unlike cereal residues, not all of the corn stover passes through the harvester during grain harvest. This issue is being addressed on two separate fronts. First, the INL is involved with a stover removal project involving Stuart Birrell at Iowa State University and Doug Karlen at the National Soil Tilth Laboratory. This project is evaluating different stover harvest scenarios, and evaluating the impacts on machine performance as well as agronomic impacts. Secondly, plans for another project to evaluate yield potential, moisture and complete stover mass balance for material other than grain (MOG) collection with typical grain combine configurations is being planned, and these plans were presented in one of the slides titles “Path Forward.” This project will establish baseline data that will help drive the engineering systems for single pass approach to corn stover harvest, including fractionation based on either compositional differences or moisture differences of the stover fractions.

Project Title: Preprocessing

Principal Investigator: Chris Wright, Idaho National Laboratory

Strengths

- Good framework for investigation.
- Detailed, high-quality engineering and cost analysis associated with the project.

Weaknesses

- There is a need for further investigation of existing engineering aspects of grinding technologies.
- The project performers should investigate shear shredding as a grinding option.

Comments

- Grinding is a size preparation step that may be specific to bioconversion. For thermochemical conversion, other methods of densification and size modification may be appropriate.

PI Response

- Reviewer Item: "Need further investigation of existing engineering aspects of grinding technologies"
    - Response: This is a very relevant comment based on the general maturity of the grinding industry. As the INL preprocessing task moves forward, particularly in conjunction with grinding industry partners, a more focused effort to identify current grinding technologies that may impact the size reduction and densification of a wide variety of biomass feedstocks will occur. This effort will primarily rely on the expertise of INL partners and other research organizations, which have tested preprocessing equipment, because of their intimate knowledge of grinding processes. The preprocessing task will document these technologies and their implementation into a grinding system as part of the FY08 preprocessing hardware development and fundamental bulk biomass characterization subtasks.

- Reviewer Item: "Should investigate shear shredding as a grinding option."
    - Response: This identified weakness is very perceptive on the part of the reviewers, since INL/ORNL researchers and their industrial partners have identified shear forces as key parameters in the development of herbaceous biomass grinder designs. The INL full-scale grinding test plan (delivered as an E-level milestone in May 2007) identifies research scope that will evaluate shear grinding designs as they apply to current industrial machines. As the INL preprocessing task continues in FY08 with different industrial partners, the scope of the work will include using grinding designs that incorporate significant shear force characteristics.

- Reviewer Item 1, investigation of existing grinding technologies, and Reviewer Item 2, investigation of shear shredding options, will be two of the basic guidelines for FY08 and FY09 biomass feedstock preprocessing validation and prototype development scope.

Project Title: Storage and Queuing
Principal Investigator: Corey Radtke, Idaho National Laboratory

Strengths
- Project considers qualities that are not normally considered in this type of analysis (i.e. fundamental biochemistry and biophysics; water activity for example).
- Detailed, high-quality engineering and cost analysis associated with the project.

Weaknesses
- There is a need to identify the health risks associated with storage activities.
- There is a need for better definition of the current state of dry storage.

Comments
- The "revolution not evolution" approach is interesting.

Project Title: Handling and Transport
Principal Investigator: Judy Partin, Idaho National Laboratory

Strengths
- Impressive instrumentation.
- Project assesses state of the art science.

- Important characterization of data is not readily available.

Weaknesses

- Would like to have heard abrasiveness data in the presentation.
- Characterization should be developed with equipment manufacturers.
- Problems need to be defined more clearly (i.e. designing trucks for unloading).

Comments

- The most suitable application may be in the hoppers and loading/unloading aspects of transportation.
- Rheological data for biomass slurries is lacking and needed in processing, and could be supplied by this project.

PI Response

- Reviewer Item: “would like to have heard abrasiveness data”
    - Response: The PI does recognize the need for this type of data and has included it in recent status reports as a parameter of significant interest in the design of pipeline conveying systems. Since the design and testing of these advanced systems is not scheduled to begin until FY-08, this work has not yet been initiated. We have, as part of our fundamental rheology task, looked into various types of wear testers. In particular, we have looked at some rotational shear testing systems that could be used to evaluate abrasion. We are also familiar with the wear tester used by Jenike and Johanson, Inc. Again, as with our other property characterization techniques, we are looking at adapting these measurement systems so that they can be used over a range of compaction pressures, particle sizes, and size distributions. In light of the reviewer comments, we will expedite completing the design and fabrication of our measurement system so we can initiate this data collection.

- Reviewer Item: “should develop characterization with equipment manufacturers”
    - Response: The PI agrees that collaborating with industry is very important to the success of the project and should be pursued at every opportunity. Prior to initiating the rheological experiments, the project personnel had multiple interactions with Mike Belingheri of Johanson Innovations, Inc. and Lee Dudley and Kristin O’Quest of Diamondback Technology, Inc. These interactions included the exchange of sample materials for testing and helped shape the testing protocols and approaches used in our work. In particular, in view of their independent test results, we decided to not purchase a commercial hang-up indicizer, but rather build our own system adapting concepts used in the commercial device and reported in the literature.

      The project work which supports aspects of harvesting and collection, preprocessing, and storage is leveraged by a number of industrial partnerships that are associated with these efforts. In particular, a consulting contract with Diamondback Technology is providing specific input to the harvesting and collection task and feedback on the use, and limitations, of rheological property attributes for the design of various handling and conveying systems. And, while we do not yet have formal relationships, we have interacted with a number of equipment consultants and vendors in the areas of material compaction and pumping to collect valuable data and insight for use in the design and evaluation of advanced systems.

- Reviewer Item: "Need to define problems more clearly (i.e. designing trucks for unloading)"
    - Response: The PI admits that in presenting the overview emphasizing the rheological property testing some of the project scope described in the work plan may not have been conveyed to the reviewers very effectively. The initial focus of the work is to obtain physical and rheological property data that will allow us to understand how these properties impact the capacity, efficiency, and in some cases, the quality of the various feedstock assembly operations, including loading and unloading trucks. This data will then be used to help us develop material formats and modify assembly processes to optimize these operations.

      For example, in the case of transporting materials via truck, we know the material bulk density we need to achieve the maximum load limits for different handling scenarios. We also know from our testing the pressure required to produce that bulk density for a particular biomass material and screen size. Consequently, one of our project tasks is looking at the efficiency, capacity, and cost of compacting auger and tamping systems that could compress feedstock materials of a particular grind fraction to the desired density as part of the truck loading operation. In addition, we have measured the material consolidation strength as a function of particle size and compaction force, and from this data we can determine the properties of the feeder systems used in the operation. In some cases, we know the hang-up potential due to material strength will require us to use live-bottom, or other active, means of unloading the material from the truck once it is compacted. Any losses in handling efficiency, or added equipment cost, will be assessed and used to determine if the compaction of feedstocks using these types of techniques has the potential to reduce the cost of truck transportation systems.

      We envision that as we continue to collect property data as function of the various assembly operations, and investigate scenarios for manipulating those properties to increase handling capacities and efficiencies, we will be able to define the material properties, or format, that will lead to both optimizing the feedstock assembly operation and standardizing the feedstock commodity delivered to the plant.

Feedstock Systems Integration Projects

Project Title: Development of Engineering Data for Feedstock Supply Operations/Supply System Logistics

Principal Investigator: Shahab Sokhansanj, Oak Ridge National Laboratory

Strengths

- Good attack on a challenging problem.
- Integration of INL work.
- Useful tool for normalizing and sharing information.

Weaknesses

- Complexity of the model may end up masking potential inaccuracies.

Comments

- Model validation and verification are essential to the project and should be a focus in later presentations.
- Linking the model with GIS could be challenging.
- The model needs to include a range of accuracy or error bars.

<u>Project Title: Feedstock Supply System Design Report</u>
Principal Investigator: Richard Hess, Idaho National Laboratory

Strengths
- Depth & breadth of the analysis provided.
- Organization & clarity of the project are positive.
- Some cost targets have been met (i.e. Idaho straw).

Weaknesses
- There is a need more flexibility of separating biomass for thermo- or biochemical conversion.
- There is a need to tap further into existing outside expertise.

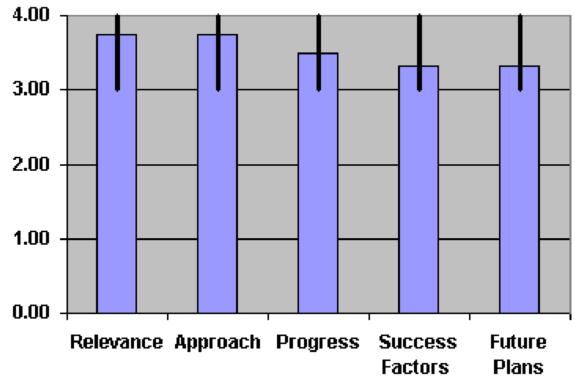
Comments
- The portion of DDGs considered cellulosic should be clarified.
- It is difficult to evaluate multi-year project when only one year of project milestones is presented (timeline would be helpful).
- Wet storage may be the mostly costly logistics element & therefore may require additional resources – other parts of the program should work to assist this portion (i.e. selection strategy, address downstream costs, depot concept).

Feedstock Supply & Sustainability Projects

Project Title: Biomass Resource Supply Analysis

Principal Investigator: Bob Perlack, Oak Ridge National Laboratory

Relevance	3.75	0.75	0.25
Approach	3.75	0.75	0.25
Progress	3.50	0.50	0.50
Success Factors	3.33	0.33	0.67
Future Plans	3.33	0.33	0.67
Average	**3.53**		



Question 1: Relevance to Overall Objectives

- This project is critical to all future biomass program projects.
- GIS Analyses are CRITICAL, as distances=dollars, and are critical for overall sustainability (long-term). This is a positive aspect of the modeling.
- This project covers some projects that are clearly needed area of analysis.
- Sustainability has not been addressed, as yet. This cannot be added as an afterthought. You've got to build it in from the beginning.
- Good approach and pretesting.
- Good tool for managing resource data and issues.
- This is highly useful work, in that knowing the feedstock
- Potential is key to forecasting bioenergy success.

Question 2: Approach to Performing the R&D

- Well thought out, but a big job. Is 30 meter scale really needed? Even if the data are free, there is a cost to utilize such a vastly larger amount of information.
- Using NASS data has problems. I have hit this myself. Yet, it is critical.
- Resource availability and costs of production are crucial elements to model. This seemed to be a real strength of the program.
- The County level scale is not a bad way to go.
- The amount of data and use of the database presented shows thorough pretesting has been done.
- The real challenge is getting and verifying low level data from the field. 30 m may be too ambitious.
- Nutrient replacement cost work should be expanded to look at how much of the nitrogen in the stover/straw actually gets into next year's crop, vs. being lost in denitrification. This will vary by region. A model was developed, I think by Michigan State, to model denitrification. Bruce Dale would be one contact regarding this model.
- Store multiyear data so stochastic modeling can eventually be related to actual historical data.
- I assume that the model can be expanded to include specific properties for biomass, e.g. alkali content of straw.

Question 3: Technical Accomplishments and Progress

- The conclusion of 1.3 billion tons of resources is a bit optimistic. I am not against biofeedstock use and development. However, I am concerned that there was not more attention.
- The assumption of 25-50% yield increases is a bit optimistic vs. declining fertilizer availability due to energy (natural gas) constraints. 99% of all nitrogenous fertilizers come from natural gas. We've seen what even a "little" blip (Katrina) can do to that supply. You have to have the fossil fuels to even approach the yield estimates given here. HAS A CALORIE IN VS. CALORIE OUT ANALYSIS BEEN DONE?
- I am less able to judge the assumptions of forest lands. However, Western forest resources (slow growth forests) are much more constrained that Southern forests (fast growth forests). Hence, I am disagreeing in the rather optimistic.
- I agree that tillage practices may affect the residue availability. I was glad to see that you addressed that.
- Good developing effort.
- Very high level of database development.
- Problem will be to maintain focus on feedstock objectives and continual verification of results.
- Quantifying sustainability issues will be the major contribution of this work.
- This and the billion ton study are good working platform for discussion at the state and local level.
- The level of detail in the model today is impressive, as is the ability to manipulate the model and test cases with it.

Question 4: Success Factors and Showstoppers

- I appreciated your note regarding private vs. public lands. This is a critical factor in the Western forests. Obviously, there are more constraints there. Is someone representing these, primarily public forests, on your team?
- I really think a GIS modeling approach has REAL potential!!
- I applaud your efforts there.
- Don't you need some significant ECONOMIST input? It may be there, but I missed it.
- Budget may be the biggest limitation.
- Can the data show risk of ability to harvest the resources identified?
- Grower cost data is always a challenge and will be for this project.
- Can the data show the shifts in production e.g. CRP to corn acres?
- Linking the model to work in siting and also in logistics (IBSAL) is a positive factor, as well as its ability to model future scenarios (POLYSIS).
- Knowing the collection density (tons per total square miles in the collection area) is key for forestry data. The key problem with forest harvest residues is that they are highly scattered in any given year due to long rotation times.

Question 5: Proposed Future Research Approach and Relevance

- Can the move to 30m scale be justified? Do the benefits justify the costs? I assume you have answered this, but it wasn't made really clear.
- The presentation reflects good planning. Obviously a number of issues have already been confronted and addressed.
- It's not clear what state-level tools and personnel are available to provide the information for this effort.
- Apparently good integration or links with other models.

Additional Comments

Strengths

- I really feel that the GIS approach is a great idea. The existing elements of arcGIS, etc. to analyze the effects of transportation and distances needs to be tapped.
- I agree that modeling efforts are the ONLY way to do the projects. I applaud your use of remotely-sensed NDVI (greenness index) data. Yet, there are some assumptions that must be admitted.
- The multiplicative model of yield is a good approach.
- I, very much, appreciated the reference to Agronomy Journal, January 2007 (Graham, et al.) which showed depth of research into the CONSEQUENCES of the use of corn stover.
- Appropriate tool for a "moving target."
- Good integration to other tools.
- A flexible tool that embeds known data and allows simulation and modeling of future scenarios. This is good work.

Weaknesses

- The Billion Ton follow-on study looks like a huge undertaking, increasing both the fineness of resolution and the breadth of topics covered. The results will be important, but it will require a large amount of resources to meet the goals you have set.
- Opportunity costs (alternative, competing uses and net returns) must be considered in the resource supply models. Things are changing rapidly in the agricultural commodity pricing area, due to existing effects from biofuel production. This is a difficult area to model. I have empathy for you!!
- Show trends ad historical data. Can Stanford Research Institute biomass inventory (nationwide county level) from the 1970s be used for comparison?
- Need to organize data acquisition from local level.
- Need to further develop sustainability criteria.
- None that are not already acknowledged as part of the research program.

Technology Transfer/Collaborations

- Define explicit rules for sustainability with NRCS, Extension etc.
- Add risk analysis to harvestable resources (timber, residues).
- Extremely high: answers the question "what's out there?"

Recommendations for Additions/Deletions to Project Scope

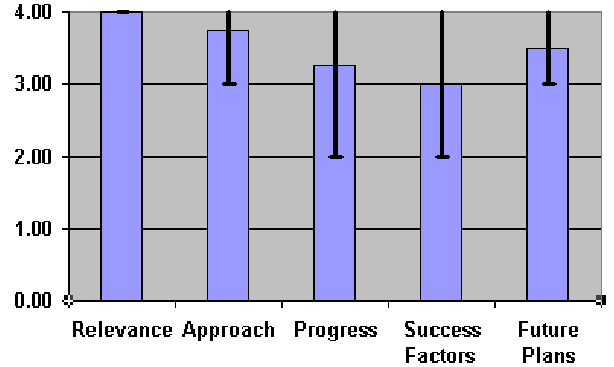
- Somehow, we need to build some links to existing USDA-CSREES Sustainable Ag. Efforts. Yah, I am biased, but I think there are some synergies there that could add real credibility to your efforts in this area. I am not against biofuels, in fact I'm very much "for" them – but I think the overall "system" (on-site effects, off-site effects, and longer term effects) must be considered. Surely there must be a way that we can work together on this, beyond simply the USDA-ARS efforts.
- Need to account for year to year environmental changes.
- Reassess yield projections. These have been most criticized area of billion ton study.
- Is urbanization and land use accounted for? This is a major impact on farm and forest (4% per year?)
- As noted above, two items that I think should be added over time are a geographically specific model of denitrification (and soil carbon impact, if possible), and the storage of

multiyear data so that it can be ultimately recovered and perhaps used for stochastic modeling.

Project Title: GIS-Based Biomass Resource Sustainability

Principal Investigators: Tris West, Oak Ridge National Laboratory

Relevance	4.00	0.00	0.00
Approach	3.75	0.75	0.25
Progress	3.25	1.25	0.75
Success Factors	3.00	1.00	1.00
Future Plans	3.50	0.50	0.50
Average	**3.50**		



Question 1: Relevance to Overall Objectives

- If all this can be accomplished, it will increase the certainty with which investments in bio-based industries are made.
- There is no question that these data are needed.
- Clearly focused on goal of refining information.
- Highly relevant to all subsequent work: it answers the question "what resources do we have to work with". It will only stay relevant if it is rigorously updated. Storing the history in a recoverable manner, i.e. letting a model user see the actual history of yields and crops for a given area, will add to the relevance of the model.

Question 2: Approach to Performing the R&D

- SURGO/STATSGO efforts are laudable. NASS-CDL link is also laudable. However, the references of "hope that regional partnerships will help" shows that much of these links have not been made, as yet.
- Feedstocks at 30m resolution is going away (LANDSAT is going away) – what are your options??
- NLCD vs. NASS-CDL is a difficult data "mesh" to achieve. What are your plans for this? THIS IS DATA INTENSIVE. Wow! Do you have the capabilities? I have worked with NASS on their CDL…you have a big tiger by the tail here!
- CO2 emissions from POLYSYS? Hmmm….
- Barriers clearly identified and alternate systems have been identified or tested to resolve data issues.
- Recognition of, and attempts to address conflicts between data sets is a good component of the planned research.

Question 3: Technical Accomplishments and Progress

- Plan of attack has been developed.
- It seems that more was given as "will do" than any "have done."
- I am not convinced that CO2 sequestration vs. feedstock production has been addressed adequately.
- There are HUGE assumptions in both EPIC and SWAT.
- This is obviously an overview study at the START GATE -- with many things that still need to be filled in.
- Good base established for further development. Main advantage is ability to following changing data quality and changing results.
- This is a work in progress; progress to date is excellent, specifically the ability of the model to interact with other systems such as IBSAL, stochastic modeling.

Question 4: Success Factors and Showstoppers

- Can the Regional Partnerships do all the work expected of them?
- This seemed to have all the right buzzwords and models…but the findings seem to be rather limited and narrow at this point.
- Models have provided for development of technical and business related factors with coefficients.
- Business data apparently has placeholders.
- Competing uses of resource not clearly identified. Water identified as an area for development.
- The key success factor is the quality of the data and its updating.

Question 5: Proposed Future Research Approach and Relevance

- Sustainability issues and the stability of supply over time need to be included. The late frost in Tennessee wasn't expected, but brings supply stability into question, for example.
- Certainly most of this still REMAINS to be done. The GIS computational needs will be ominous.
- I agree much of the data is still becoming available.
- Well developed plan for highly complex project.
- Decisions will have to be made to focus analyses and use of data.
- Outstanding.

Additional Comments

Strengths

- WELL aware of the current models and buzzwords.
- This fellow is extremely bright and his breadth of knowledge is impressive.
- I am concerned about the depth of the approach and real research, as displayed here.
- Flexible tool. Apparently good talent and equipment to realize objectives.
- Ability to integrate different data sources greatest strength.
- This is a very versatile model, and the key strength of the research is the determination of the research team to improve the usefulness of the model. The team is looking at conflicts in data from different sources, and at extending the usefulness of the model. One example of this is linking it to DOE work on carbon sequestration and linking it to water quality. This is a very valuable research program, in my opinion.

Weaknesses

- Not a darn thing done, except a word in last slide, regarding sustainability….but it seemed, primarily lip service.
- Where is a link to the USDA-ARS Wind Erosion Lab at Manhattan, KS? You say that it is difficult to get at for a national level. I am not convinced that you are looking deep enough.
- Problem of getting and validating local data. Factors are site specific.
- Budget? For 30 m resolution at local level? State level tools and personnel may be a problem.
- Can risk analysis be added to feedstock availability (e.g. farmer willingness to provide feedstock, agency ability to make wood resource available, etc.)?
- How can this tool be made useable by Sun Grant and energy people at local level? What interfaces are planned?
- How will data be accessed or integrated into general economic modeling?

- I am aware of no weaknesses that have not been identified by the research team.

Technology Transfer/Collaborations

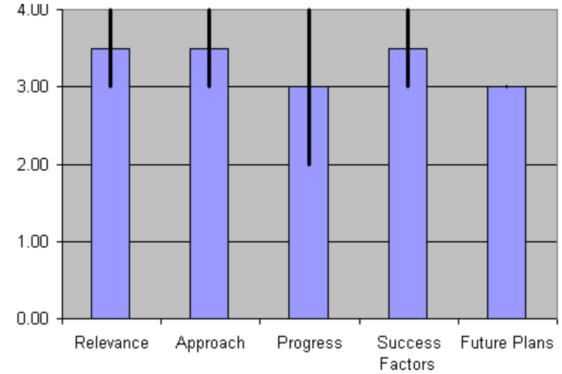
- Seemed to have a good links with NASS – which is an outstanding source.
- Clear list of data and interface needs. Major problem may be ability of local information sources to handle and enter data. Do local entities have the budget and personnel to accomplish this? How much support is needed from regional program budget?
- This model is critical for all subsequent analysis of biomass energy projects.

Recommendations for Additions/Deletions to Project Scope

- You have to have been links with the opportunity costs of carbon sequestration and both on-site and off-site effects (such as soil erosion). The on-site effects (such as groundwater pollution) seemed to be addressed much better than any other off-site effects.
- Series of local validations will be very useful.

Project Title: Regional Biomass Energy Feedstock Partnerships
Project Investigator: Jim Doolittle, SDSU; Kevin Kephart, SDSU; Terry Nipp, SGI

Relevance	3.50	0.50	0.50
Approach	3.50	0.50	0.50
Progress	3.00	1.00	1.00
Success Factors	3.50	0.50	0.50
Future Plans	3.00	0.00	0.00
Average	**3.30**		



Question 1: Relevance to Overall Objectives

- Regional Partnerships will provide local “ground truth” on all aspects of local biomass production.
- Good overall approach identifying local sources of data.
- Feeding data up to a national data base / GIS system is very relevant; this activity should not be devolved into five regional data bases.
- The bioweb activity is a national activity; it can be done by the structure outlined, but in a year or two it is worth checking whether this method of implementation is effective.
- The cited goals in Kevin’s part of the presentation are disturbing: agricultural diversity and rural economic development as interpreted by 50 land grand universities through five regional associations is not relevant if the objective is bioenergy.
- Certainly, this is relevant.
- Key partnerships with Land-grants are critical for many for the accomplishment of important objectives.
- The Land-grant partnership has elements in each COUNTY -- MAKE THIS A PRIORITY…don’t let it die at the Ag. Exp. Station level! This should be an integrated effort between extension and Ag. Exp. Stations. I don’t see reference to this. Utilize the key clientele that Extension can bring to the table.

Question 2: Approach to Performing the R&D

- Uniform procedures will enhance the value of the test results. The list of agronomic factors covers a lot of important issues.
- Regional focus for local issue.
- Local partners identified.
- GI Compatible goals. Market oriented, coordinating role.
- Builds on Land grant capabilities.
- Need to incorporate former USDOE regional partners that are now supported by the states. There is a wealth of information that the Sun Grant link needs to take advantage of. Where are the reports? You have a new team that needs to understand what has been done since 1979.
- Sun grant folks are mostly agriculturists and need an education in Energy as demonstrated in the western region meeting after the review.
- Is there room for universities other than land grant universities to make a contribution?
- Using universities to be educational outreach is a good idea: there is a need for better knowledge about bioenergy, and there is a need to challenge standard but erroneous assumptions.

- The merit of a bioweb run by a regionally oriented entity isn't clear; hence check if it is effective.
- I am a true cheerleader for the COMPLETE Land-grant mission. Hence, I'd like to see more extension and farmer/rancher involvement at the grass-roots level. Too often, the Ag. Exp. Stations neglect the grass-roots level. To date, what I have seen in the Sun Grants has been limited to the "academic elite," who, understandably aren't really elite.
- Have you considered ways to involve farmers/ranchers on key Sun Grant advisory councils? Of course, a key is to ensure that these farmers/ranchers are truly involved and not merely names listed on a proposal or report.

Question 3: Technical Accomplishments and Progress

- Regional meetings could have been accomplished sooner. Goals are well-formed and deal with important issues.
- Regional workshops have limitations. The Regional workshop at SD was more productive than at Portland. The latter was asking groups to come up with a wish list for grant money.
- Bioweb should include interactive forums moderated by local experts in soils, crops and energy.
- Need to identify existing local expertise in all institutions not just Land Grants.
- Should develop functional teams in regions of technical people.
- It is too early to rate this higher than fair, as only two regional meetings have been held. A key question in my mind is whether this structure will provide true help and efficiency or a cumbersome layer of bureaucracy; let's hope for the former.
- The grass roots elements (farmers/ranchers/county agents/etc.) are a key to getting reliable data and "ground truth" in into the proposed GIS Atlas. Pretty pictures are nice, but REAL ground truth is ESSENTIAL.
- The climatic data that is available at Land-grants is also a big "PLUS" for the Sun Grant partnership. How are you going to integrate this across the regions? Many states are very protective of these data.
- Some of the details in your tables RUSLE2 vs. RUSLE showed "attention to detail" in your efforts. Some investigators would have overlooked this.

Question 4: Success Factors and Showstoppers

- Are there sufficient incentives to induce participation by qualified scientists at these institutions? Promotion and tenure policies and committees really influence research plans.
- Problems clearly identified.
- Big diversity in needs and understanding between forest resources and agricultural resources. This program could provide a valuable link between energy, agricultural extension and NRCS.
- Resource issues are very site specific especially in mountain forest and dry land agricultural areas.
- Bioweb could be a useful tool but needs to be managed (that's from 12 years of running bioenergy discussions a websites).
- My sense is that this is in the early stage, so the ability to assess whether "showstoppers" are identified and resolved isn't clear. Coordinating cross state research will be daunting.
- Certainly, a success factor is the Land-grant system.
- The POWER is in the SYSTEM. However, it is "easier said than done" to integrate the total system into your program.
- It is so very easy to have farmers/ranchers involved in only a "token" way. How are you going to ensure (and measure for OMB) the real impacts on the farms/ranches?

- I'm not sure how the alternative crops (oilseeds, such as camolina, etc.) fit with the cellulosic model of this program. I understood, from the review instructions that "cellulosic" was the model here.

Question 5: Proposed Future Research Approach and Relevance

- The plans presented here address the issues that seem most pertinent to the supply issue.
- Well-organized programs, good organization.
- Good balance of budget.
- Main problem is integrating interests and organizations. There is a lot of good information and activity out there but it needs to be managed. The regional biomass program (1980-2002?) was an outreach program. Sun Grant looks like a research program.
- This is an early stage project but there are plans in place for future activity.
- This seemed a little "fuzzy" at this point. Perhaps, it is due to the late arrival of the funds?

Additional Comments

Strengths

- Local involvement.
- Building on existing infrastructure good concept.
- Regional level of information.
- Built in educational components.
- Local field trials experience will be essential.
- Communication with stakeholder good focus.
- Enthusiastic use of 50 universities, including their outreach educational capabilities.
- The "strength is in the SYSTEM" (Land-grant system)…Therefore, this program has many, many built-in advantages. There is no way to overstate this. It is a powerful feature to enable outreach to the grass roots sector.

Weaknesses

- Delay in implementation. It has been 12 months since the second regional meeting.
- Balancing efforts of other crops.
- Problem identified quality of information – recognized.
- Keeping economic relevance.
- The only way the GIS data base contribution will be effective is if it is very capably integrated into ORNL's national work.
- However, that same strength (of the Land-grant system), is often overlooked or underutilized by the "academic elitists" of those same Universities. Don't let this happen!! Make sure that Extension [especially the County adult educators (a.k.a. County Agents)] are involved at the get go. How many, for example, are coming to the regional workshops? I've yet to see any county educators who even knew about Sun Grant, much less know of the regional workshops. Nonetheless, some will find it on their own (via Google) via BioWeb. However, I have used BioWeb and VERY LITTLE IS THERE. A search for Camolina brings up ZERO. Why aren't you using eXtension's community of practice as an option? This is cheap, easy and effective – but not used.
- There is an assumption here that Coop. Extension is "connected" to Sun Grant. IT HASN'T HAPPENED!!!

Technology Transfer/Collaborations

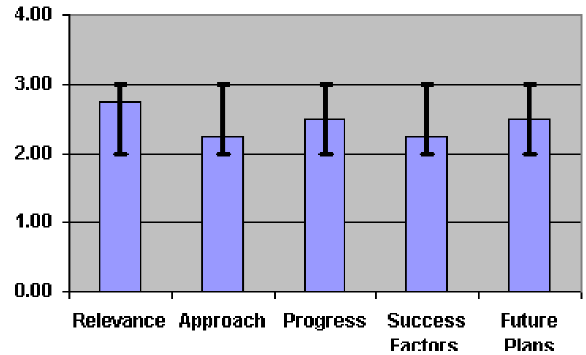
- Full interaction with existing programs like regional biomass program (now funded individually be states.) Organized and disseminate information from prior programs.
- If successful, the degree of collaboration will be high.
- Somehow, we need to build some links to existing USDA-CSREES-SARE Sustainable Ag. Efforts. Yah, I am biased, but I think there are some synergies there that could add real credibility to your efforts in this area. I am not against biofuels, in fact I'm very much "for" them – but I think the overall "system" (on-site effects, off-site effects, and longer term effects) must be considered. Surely there must be a way that we can work together on this, beyond simply the USDA-CSREES-AES and USDA-ARS efforts.

Recommendations for Additions/Deletions to Project Scope

- Add local expert forums to Bioweb.
- Assess in one to three years whether the bioweb is better run through this entity vs. a separate national contract issued by the Department of Energy.
- How do you really get "force" interstate research when you can't even get interdisciplinary work? Terry is a terrific person – and an effective lobbyist. However, I worry that he cannot see the forest for the trees here. If you are letting the Sun Grants be lead by the Agricultural Experiment Stations, you have not really involved Extension. They have a whole different set of leaders, ECOP for Extension vs. ESCOP for Ag. Exp. Stations. At many institutions, they don't even talk to each other. Ask Mike Harrington (WAAESD), Extension Dirs. in the West cut him totally out of their loop (a mistake, I admit – but they did).

Project Title: Mississippi State University Sustainable Energy Center
Principal Investigator: Michael Collins, Mississippi State University

Relevance	2.75	0.75	0.25
Approach	2.25	0.25	0.75
Progress	2.50	0.50	0.50
Success Factors	2.25	0.25	0.75
Future Plans	2.50	0.50	0.50
Average	**2.45**		



Question 1: Relevance to Overall Objectives

- Certainly relevant in several areas.
- Field plots across soil types are a strength. Most PI's in this area ignore the critical element of the plethora of soil types.
- I just have to admit that I like the emphases that come to mind in the name: Sustainable Energy Research Center.
- Local screening study good exercise developed local data.
- This is a first step project that identifies opportunities for further work.
- The highly focused small area analysis limits the applicability of the work, which is compounded by what appears to be limited research design. For example analysis of pine residue usage should extend past the state boundary, and the work on switchgrass does not appear to systematically study establishment issues such as seeding rate, nutrient supply and weed control.

Question 2: Approach to Performing the R&D

- This seems to be totally focused on Mississippi vs. a regional or national approach. Wouldn't there be economies of scale if it were not simply a state-based approach?
- Are three years of data sufficient for a perennial crop?
- Extremely broad coverage makes success very uncertain.
- Market orientation?
- Not as thorough a market and application study as the Tennessee work.
- Need to integrate with other activities in the state.
- This is really just a scoping study.
- I have some reservations about the concepts embedded in the approach to this research. Two examples: thinking that energy crops would be used for forage or energy at the whim of the producer (what does the bioenergy plant do for feedstock if much of the normal supply goes to forage). Second example: limiting transportation distance for forest thinnings from pine to 50 miles: is there enough wood within this diameter to make ethanol at a meaningful scale? Is wood envisioned as being converted to ethanol in the same plant as other biomass? My sense is that the research focuses on all biomass in one state but with a low level of focus on ultimate processing. Switchgrass trials would benefit from a systematic agronomic design.

Question 3: Technical Accomplishments and Progress

- Measurable outputs seemed to be looking in this project.
- Just getting started. Estimates of woody biomass availability and production costs estimates for lignocellulosics are useful if they are reliable. Data on the performance of

so many new crops are not very reliable, since there are no established management practices for many of these crops.
- Discussion in 06.
- Example of what can be done by regional approach.
- Field trials.
- 300k t rice straw.
- Management recommendations for producers.
- Good oilseed results.
- Economics screening results good for Switchgrass and miscanthus shows potential.
- There is some interesting data of a very site specific nature generated from this study, but there is no evident agronomic design, which limits the usefulness of the data. There is the comment about the difficulty of establishing switchgrass, but as noted above no data was presented on seeding rate, weed treatment. The linkage of the results from this study to other work isn't clear. As well, I am not aware that concepts of scale of end usage have entered into the research design or analysis of results.

Question 4: Success Factors and Showstoppers
- Poultry litter biofeedstocks research appears to be the only work in this area. Although, I should have looked in the other big poultry area (DelMarVa peninsula).
- Uncertainty of funding hasn't been overcome.
- Good local demonstration of suitability.
- Identify comparison of Switchgrass with cotton.
- Good data to feed into regional program.
- As noted above, I am concerned that some business factors have not been adequately identified, especially the scale of usage of bioenergy crops. The ultimate goal of a bioenergy program isn't biomass; it is the conversion of biomass to useful energy.

Question 5: Proposed Future Research Approach and Relevance
- There seemed to be limited thought given to this – perhaps, because this funding is ending?
- Too many tasks to do them well.
- Project complete.
- Good plans, future funding?
- 3 year data collection.
- Low cost SWG potential with risks identified.
- To what extent were agronomic issues systematically investigated; to what extent will they be if extended?

Additional Comments

Strengths
- This project has some links to the farm level.
- The integration of economists into the project seemed to be implemented at the very first…but it was unclear.
- Addresses risk of grower familiar with new crops.
- Can fold into regional efforts.
- Identification of multiple uses (e.g. range Switchgrass field).
- Detailed data at a local level. Thoughtful observations re the difficulty of establishing a perennial crop.

Weaknesses

- This seemed to be a final report, rather than a “get up and go” interim report.
- Could be best with multi year program.
- 3 year data insufficient for perennial crop.
- Need additional funding.
- Insufficient thought about the ultimate use of biomass, including scale; based on the presentation, limited systematic exploration of agronomic factors.

Technology Transfer/Collaborations

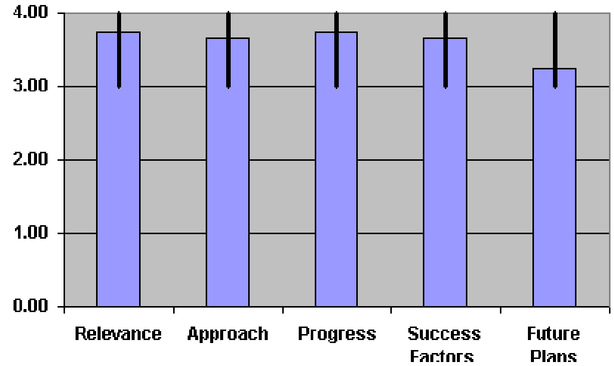
- Co-funding with plant breeders.
- Data is very locally focused.

Recommendations for Additions/Deletions to Project Scope

- Align with regional program.
- Address scale of biomass, e.g. is there enough thinnings from pine to make ethanol in a real plant? Systematize the exploration of agronomic variables.

<u>Project Title: Switchgrass Demonstration Project</u>
<u>Principal Investigator:</u> Burton English, University of Tennessee

Relevance	3.75	0.75	0.25
Approach	3.67	0.67	0.33
Progress	3.75	0.75	0.25
Success Factors	3.67	0.67	0.33
Future Plans	3.25	0.25	0.75
Average	**3.62**		



Question 1: Relevance to Overall Objectives

- The three questions are pertinent to the future of a biomass industry. Identifying the needed inducements will be important to encourage private industry to invest.
- Certainly this is relevant, based on the President's State of the Union. However, part of what makes this VERY relevant was that this was one of the few that clearly showed a farmer/rancher link from the beginning. Clearly, this immediately brings it to a low "publishable research" level – but, it always gives it credibility with the folks who MUST BE CONVINCED TO GROW THE FEEDSTOCKS. I basically dislike "earmarks" – but this one may give everyone some MEASURABLE IMPACTS which are difficult to identify and measure.
- Testing and developing basic variety tests data.
- The rating of this project is based on the agronomic component only. I consider the upgrading component to be very weak, but I accept that the results weren't presented to this session. The feedstock component includes and interesting agronomic study of the factors affecting switchgrass establishment and productivity. I have concerns about pyrolysis: light off oil for a coal fired power plant doesn't seem to be a large enough end use to be relevant to a national bioenergy program, and pyrolysis product is bad stuff (acidic, toxic, prone to polymerization, and inefficient unless the char is used). If DOE has interests in pyrolysis then consider discussing a program at the German Federal research entity, Forschung Zentrum in Karlsruhe, Germany. Their processing concept recovers the char, vastly improving the overall process efficiency.

Question 2: Approach to Performing the R&D

- Good plan to identify missing information on switchgrass culture and go get it.
- Objectives gleaned from the presentation:
  - Alamo is assumed to be the standard variety.
  - Estimate RN farmers' willingness to plant an energy crop.
  - Also looked at bio-oil from switchgrass
  - Wanted low-input
  - This is an earmark…
- Enough funding to keep research for 5 years & farmers for 4.
- 4 farmers participating.
- Tyler is both soil scientist & general agriculturalist.
- BID PROGRAM TEST IS A GOOD IDEA…
- Field trials with applications.
- Good awareness of needs of early adopters.

- Good approach re agronomic component; the systematic exploration of weed control in response to an unexpected result (weeds not being out competed by switchgrass) is well done.
- In future I suggest clarifying that pyrolysis results are presented elsewhere so that reviewers don't think it should be included in their evaluation.

Question 3: Technical Accomplishments and Progress

- Information on stand establishment, labeled weed control, combustion properties.
- Yes, I realize that this research is VERY applied vs. much of the sophisticated engineering that has been shown in the review. However, this is one that can yield some real "OMB-mandated" results:
  - # of acres impacted
  - # of farmers who have changed attitudes/actions
  - # of growers who will PRODUCE measurable amounts of biofeedstocks
  - # of weed control agents tested and eliminated or labels could be acquired.
- You just have to give them credit for this.
- This is "no brainer stuff" – BUT, IT MUST BE DONE BEFORE THE FEEDSTOCKS WILL BE AVAILABLE.
- Field trials.
- Management practices – weed control needed- not learned from other sites.
- Tested transportation.
- Bio-oil at BECON.
- Gadsen tests.
- Before frost and after frost tests.
- Recognize equipment needs.
- Identification of the agronomic issues regarding switchgrass is a valuable contribution, e.g. seeding rate, weed control, nutrient response.

Question 4: Success Factors and Showstoppers

- No unidentified risks, but the identified ones are bad enough.
- Clearly, the strengths of this project are the link to the grass (no pun intended) roots level.
- 29% who will, 45% need info, 25% will not follows EXACTLY the Don Dillman (Rural Sociologist, WSU) model for adoption of technology (ANY) by farmers/ranchers.
- Example of "early adopter" farmer who contacted extension having zero weeds, vs. the "early adopter" who did not, should be documented and measured.
- Field trials.
- Management practices – weed control needed- not learned from other sites.
- Tested transportation.
- Bio-oil at BECON.
- Gadsen tests.
- Before frost and after frost tests.
- Recognize equipment needs.
- As noted above, the agronomic component seems well founded, the processing component is not.

Question 5: Proposed Future Research Approach and Relevance

- Yield measurements are crucial to this project and to all other switchgrass projects.

- As much as I love the grass roots approach of this project, I didn't see the rationale for further applied research.
- Putting in 5 million gallon ethanol plant need 8,000 acres.
- Carryover to 2009 good.
- Finding funding from variety of sources.
- The agronomic work is likely to succeed and lead to a very valuable contribution.

Additional Comments

Strengths
- Local involvement with some real people.
- Clearly, the strengths of this project are the link to the grass (no pun intended) roots level. You are NOT going to get growers to grow the feedstocks (in any significant "billion ton" way) unless SOME HOW, SOME WAY, you find funds to fund THIS TYPE of outreach to farmers/ranchers. Yet, the only way this received funding was through an earmark. A sad commentary on the Land-Grant system…
- Both field and experiment station data.
- Good data developing and interactions.
- Good systematic agronomic work.

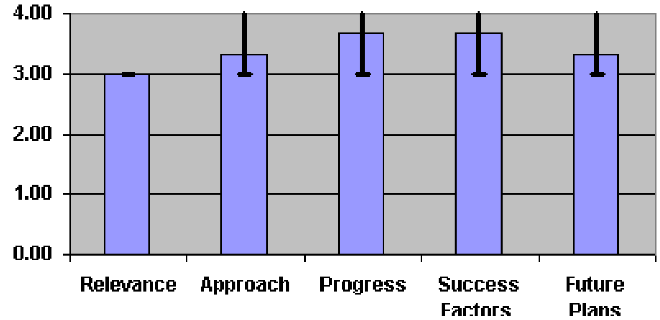
Weaknesses
- Can you justify the estimated yields? This is the most critical piece of information in the whole program.
- This is not flashy or publishable…just needed…
- Need market assurance to grow SWG from state.
- Seed production critical issue.
- Equipment needs identified.
- The choice of pyrolysis isn't clearly explained or justified; it is almost as if "we had to do something with the biomass, so we chose pyrolysis.

Technology Transfer/Collaborations
- Survey and bids.
- Discovered role of Extension for seed planting at right depth and weed control.
- Farm Field Day.
- Let farmers resolve harvesting problems on their own good solution.
- The switchgrass work will, I think, make a significant contribution.

Recommendations for Additions/Deletions to Project Scope
- Find a way to fund this type of applied research and outreach in the "system."
- You need to get a rural sociologist involved to look at "if" growers will shift and "when" (see Dr. Don Dillman's "early adopter" research).
- Continue support for this project. It has generated good information in area where switchgrass is an unfamiliar crop.
- Include a survey of other work in the area of pyrolysis.

<u>Project Title:</u> <u>Alternative Fuel Source Study</u>
<u>Principal Investigator:</u> Ralph Zee, Auburn University

Relevance	3.00	0.00	0.00
Approach	3.33	0.33	0.67
Progress	3.67	0.67	0.33
Success Factors	3.67	0.67	0.33
Future Plans	3.33	0.33	0.67
Average	**3.40**		



Question 1: Relevance to Overall Objectives

- Seems to be less relevant due to lack of direct “agricultural link.” However, I started to see the link later on.
- Lafarge is largest cement maker in the world.
- Lafarge is using switchgrass, wood waste, broiler litter, scrap—tires, recycled plastics instead of coal. They can burn these low quality fuels because of very high temperatures. Interesting that this is one of the ONLY users who can use landfill wastes, etc. because of high temperature kilns.
- Some fuels are relevant.
- Does not demonstrate advanced technologies for fuels but it does demonstrate feedstock issues for handling and feeding while using an existing market.
- OBP should find a good way to integrate these congressionally directed programs in the overall program plan to show relevance. It demonstrates delivery system and co-production.
- Cement manufacture is a wonderful outlet for biomass, reducing carbon emissions.
- The gasification component is of high relevance to other projects.
- The results of this research will have a high relevance to cement manufacturers around the world.
- Cement production was identified as a high energy consuming industry, so this is relevant to overall energy consumption, but not to liquid fuel replacement goals.

Question 2: Approach to Performing the R&D

- VERY WELL DESIGNED STUDY…(or, very well EXPLAINED).
- They are going into a lab study AFTERWARD, which is sort of backward – but totally understandable in this situation.
- Goal is replacing 50% of coal with waste, which Europe has done already.
- Poultry litter is at least 40-50% energy content of coal.
- A VERY detailed and intense sampling procedure was observed.
- A VERY GOOD “systems approach dealing with on-site and off-site (pollution, safety, health) effects…”
- Biomass handling not germane to large scale production but appropriate to specific application. Pilot testing at full scale is useful.
- The research design is thoughtful and rigorous.
- The presentation of data for concrete properties should include error bars (standard deviation of testing) so that one can judge whether the variance between runs is significant.
- The work seems very well thought out and executed.
- Well planned.

Question 3: Technical Accomplishments and Progress

- I was very impressed with the sampling procedures and experimental design. The detail of the presentation was immense.
- I am not sure that I am convinced that hydrocarbon emissions are zero…but I am not competent to judge!
- Testing – broiler litter and plastic.
- Good industrial testing.
- Good screening trial.
- I don't believe the model or simulator will have as much general value as proposed but it should be developed and tested.
- Test burns are half completed: this is a major accomplishment.
- Work seems well underway.
- The industrial partner is particularly well committed.
- This project has contributed to two goals: saving energy and cleaning up the environment. I hope LaFarge and its industry will implement this to the maximum extent possible. Burn simulator is a very useful idea.

Question 4: Success Factors and Showstoppers

- It seems to me that you have discovered an industry that can use complex and hazardous (high hydrocarbon) wastes, without a problem. Any residuals go into the cement – but are probably "bound" in the environment – so it is a smaller consequence. FASCINATING! The Phosphorous pollution problems are solved, because: who cares about high-P cement!
- What a great way to use poultry waste!
- Established some burn rates.
- Successful burn rates.
- Simple feed system.
- No showstoppers evident; success factor is the commitment of the industrial partner.
- You identified a number of potential showstoppers, including some social issues, and got the information needed to address them.

Question 5: Proposed Future Research Approach and Relevance

- Interesting…but funding may be difficult to obtain…
- Gasification technologies – thee are well known. This could be a minor part of effort. (Look at California energy commission PIER program projects by GEEER for kiln scale gasification).
- Burn simulator – to be developed.
- The decision to include a burn simulator is a good addition. The decision about gasification by oxygen vs. air needs to be critically based on an economic and technical analysis; oxygen separation is expensive and the merit, if burning the resulting gas, isn't clear.
- Completed project, but provides useful information for others to use in future applications.

Additional Comments

Strengths

- Again, it seems to me that you have discovered an industry that can use complex and hazardous (high hydrocarbon) wastes, without a problem. Any residuals go into the cement – but are probably "bound" in the environment – so it is a smaller consequence. FASCINATING! The Phosphorous pollution problems are reduced.

- What a great way to use poultry waste!
- Test burns and emission results good.
- Variety of fuels tested well.
- Good research design and an outstanding industrial partner.

Weaknesses

- High Phosphorus cement can be a problem.
- Need economics in results.
- Not evident that cement chemistry has been included in proportions of fuels co-fired. Alkali in cement is critical and should be highlighted or tested as the potential limiting factor in alternative fuel such as Poultry Litter.
- Large scale storage and handling should be addressed.
- None evident.

Technology Transfer/Collaborations

- Coordinate with RAM – Rubber Manufacturers Association – which handles tire co-firing for assessment of general application of this model to other kilns around the US.
- Cement is an “everywhere” industry, so the results of this work will have a very high relevance to that industry. The gasification work will be of interest beyond the cement industry.

Recommendations for Additions/Deletions to Project Scope

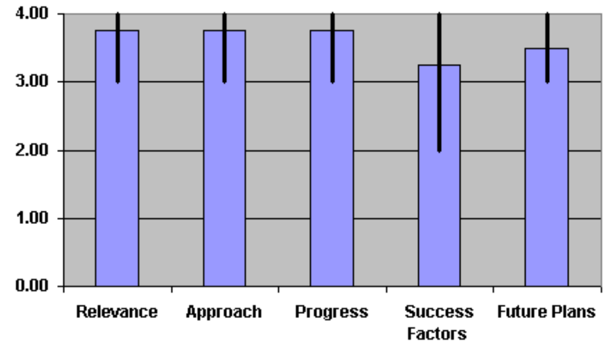
- I am unsure as to whether I am qualified to address this. However, the project is fascinating!
- Continue this work and find ways to bridge work to goals off feedstocks program. This represents a potential “front end” to providing energy or feedstock for conversion.
- The analysis to support the selection of a gasification process should be included in the project report.

Feedstock Logistics Core R&D Projects

<u>Project Title: Harvest & Collection</u>

<u>Principal Investigator:</u> Kevin Kenney, Idaho National Laboratory

Relevance	3.75	0.75	0.25
Approach	3.75	0.75	0.25
Progress	3.75	0.75	0.25
Success Factors	3.25	1.25	0.75
Future Plans	3.50	0.50	0.50
Average	**3.60**		



Question 1: Relevance to Overall Objectives

- Key issues have been identified.
- Well-organized approach with clearly specified target toward large scale harvesting of feedstocks for conversion.
- Given that all biomass processing plants will need material transport, the high quality of this work will ensure its relevance.
- “Only link to sustainability” according to presenter.
- This is another essential link – so it is assumed to be critical to the systems analysis.

Question 2: Approach to Performing the R&D

- Good fundamental study, similar to the process used to develop the cuber many years ago. Good plan to gain fundamental understanding.
- Account for significant factors.
- Better integration with engineering and accomplishments of existing industry needed.
- Thoughtful analysis of the work of others, e.g. cob and chaff harvesters. Very good fluid dynamic modeling.
- I have a bias against pelletizing that reflects my understanding of its relatively high cost. I don’t want to impose any bias on this work, so I simply caution that the program should not commit to pelletizing without a thorough analysis of other options and an analysis of the cost of pelletizing. The program has recognition of costs and a focus on it, i.e. a good approach.
- The analysis of fractionation is of very high quality.
- The key need is a better understanding of how much biomass needs to be left on the field for sustainability. Part of this needs to be consideration of denitrification, including whether fractions denitrify at the same rate.
- The depth and breadth of the analyses seemed well-planned and comprehensive….well done!

Question 3: Technical Accomplishments and Progress

- Good application of the CFD research.
- First steps given the state of the program. Project should continue to maintain cost and energy efficiency criteria in harvesting technologies.
- Excellent results to date. For example, the work on fractionation has excellent results of major impact.
- The presenter seemed to understand the complexities of the total system, as well as the various harvester systems.

- Obviously, you have some real constraints here, including horsepower, etc. However, the presenter was not afraid to admit the problems and then go on to identify a probable solution.
- I like the first principles approach -- to identify the bulk properties that are critical – then, to go from there to develop analytical techniques.
- Interesting “reverse engineering” approach.
- The use of Johanson indices is applauded!!! I had not heard of them – however, I found them on the web and the description is a vindication of your approach and knowledge of the subject!!!

Question 4: Success Factors and Showstoppers

- A critical issue is maintaining harvest capacity of current crop harvesting systems. Producer participation will hinge on not reducing current capacity.
- GMO,MC, pellet
- Depends on single pass system which has had many problems in the past 30 years. Single pass depends on identifying and quantifying enhanced value of fractionated products. Good approach but needs to be developed further.
- Need better definition of what a “pioneer Plus” system with existing technology can do. It is not accurately characterized.
- Too much emphasis on ¼ minus particle size and densification. This needs to be thoroughly reviewed by those of us in industry who have years of experience working on this. Cost and energy are critical showstoppers unless added value can be clearly identified.
- Potential of single pass to produce higher value co-products should also be identified.
- The key success factor is the high quality of both research design and execution. I see no showstoppers to the research and engineering, although the targets themselves are daunting.
- “To take what we should take and leave what we should leave” is an exemplary mantra. KEEP THIS! YOU ARE ON-TARGET!

Question 5: Proposed Future Research Approach and Relevance

- Baseline data will be invaluable. Needs to include corn harvest in central Corn Belt where field drying may be slower than in Kansas and Nebraska.
- Field test – good idea but not large enough. Need 25,000 bales per feedstock with different technologies used for baling (hydraulic vs. mechanical balers).
- Realign work plan to spend more time on aspects with good potential such as single pass and fractionation.
- Excellent plans to proceed.
- Looking at socio-economic factors is essential.
- Your Sustainability Index flowchart is terrific. Keep at it. This is, admittedly, VERY difficult. However, I APPLAUD YOUR EFFORTS. “Hang in there,” as this will take both time and money. However, THIS IS ESSENTIAL TO THE SUCCESS OF THE OVERALL EFFORT.

Additional Comments

Strengths

- Systems approach is good. Good basic information gathered as first step.
- Excellent engineering and cost analysis and a broad ranging focus.
- The depth of breadth of the PROPOSED analyses (this project is just getting under way) is startling. However, the discussion by the presenter showed an unusually broad knowledge of the subject. This is a winner! Keep this effort going!

Weaknesses

- Densification characterization is very weak. There is more to science and technology that realized. Major changes have been made to the engineering and process of densification in the last 10 years. Many field trial shave been made for using densification as an intermediate product.
- Pioneer systems are not adequately characterized. Actual densities and capabilities are higher 14 lb/ft3 and reliability. Apply to harvesters and balers. Specific energy consumption 50 kWh/ton.
- Relate fractionation to specifications from platforms. Some platforms (thermochemical) do not need ¼ minus from the field.
- Need to move further in understanding and experience from existing industry. There are hundreds of mechanical and agricultural engineers who could contribute to this topic in both private and public organizations. Need to engage existing industry more.
- None evident.
- The emphasis on a “sustainability index” could be superficial. I’d like to reserved judgment until another year.

Technology Transfer/Collaborations

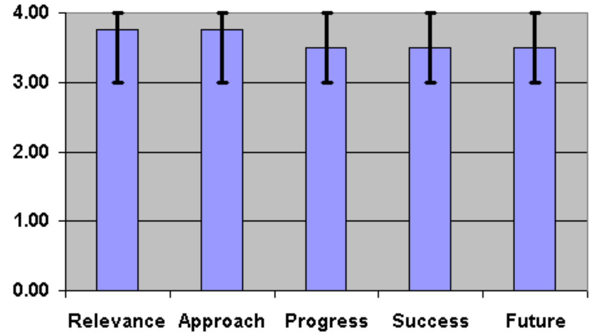
- This will be high because of the high quality of the work and its impact on all residue biomass projects.
- Industry collaboration is ABSOLUTELY ESSENTIAL to this projects success. However, to this point…it seems fairly low.

Recommendations for Additions/Deletions to Project Scope

- Get together with existing engineering and industrial experience.
- Feedstock needs to be reliable and of good quality. Feedstock quality starts at harvest with harvest decisions made by harvester. Develop systems that take need for decisions away from harvester/baler etc.
- Ensure that denitrification is included at some point in analyzing nutrient and sustainability issues: this will affect the grower payment.

Project Title: Preprocessing
Principal Investigator: Chris Wright, Idaho National Laboratory

Relevance	3.75	0.75	0.25
Approach	3.75	0.75	0.25
Progress	3.50	0.50	0.50
Success Factors	3.50	0.50	0.50
Future Plans	3.50	0.50	0.50
Average	**3.60**		



Question 1: Relevance to Overall Objectives

- Seems tightly tied to dry straw process. Need to make it as broadly applicable as possible. Is there a possible collaborator like Diamond Z somewhere in the corn belt?
- Well-prepared and focused project plan.
- The high quality of the work and the fact that cellulosic ethanol plants will require processed biomass ensures the relevance of this work. Note that if combustion or gasification applications become of interest in the future the size requirements for biomass will be different. Given the current focus on ethanol, the work is well designed.
- Admittedly, preprocessing is another essential element in the “system” of feedstock and conversion processes.

Question 2: Approach to Performing the R&D

- Good that you are working with Al Womack. The $6 per ton goal needs to have a good definition of what is being done in the process (input size, output size, etc.) or you may not be making valid comparisons.
- Good overall organization. Thoughtful consideration of problems and aspects of preprocessing. This step should identify critical costs and alternatives of preprocessing.
- Good broad thinking. One caution I have is to recognize that storage may occur more than once in a chain, e.g. a farmer, might store bales on farm and take them to a depot at a flexible time; the depot might then process it and store the biomass in a different form. The general concept that packaging and then undoing to repackage is uneconomic is a good observation, but one needs to be careful not to over apply this.

Question 3: Technical Accomplishments and Progress

- Grinding and compression studies have added to a better understanding of these processes. The test plan will expand this to other materials.
- Overall aspects of problem have been identified and some preliminary work has been done. Much more work should be done on alternative methods of sizing, densification and fractionation.
- Very good results to date based on good thorough research.
- Excellent analysis in terms of both depth and breadth.
- The detail in looking at particle size, etc. is excellent.

Question 4: Success Factors and Showstoppers

- Cost targets, both in money and energy, are important.
- Good basics to move forward. Need better integration with existing industry. Too dependent on mobile tub grinder as processing unit. Need to consider that preprocessing will probably be in stationary setting connected to storage.

- Results to date are outstanding and are the basis of future work.
- No showstoppers are evident in the research, although the targets themselves are daunting.
- Again, this is not “showy” stuff – but the analyses are essential to the success of the overall program.
- Looking at density, particle size, etc. – as related to compression and etc. – are key factors.
- The radiography studies were intriguing.
- The varietal difference data from the laser ultrasonic analyses are extremely interesting.

Question 5: Proposed Future Research Approach and Relevance

- Good plan.
- Not clear what resources will be used to move forward or how project will integrate and benefit from experience in wood and fiber technology, grinder manufacturers and engineering, etc. Need clear definition of the range of specifications of conversion platforms.
- Plans for future research are appropriate and build on past work.
- It appears that the radiography, spectroscopy (UV), laser, and other particle analyses are proposed, rather than complete. The explanation is a little fuzzy. I am assuming this is because this research is proposed rather than done.

Additional Comments

Strengths

- Good approach.
- Good basic background work.
- Excellent engineering and cost analysis supporting a broad approach to a key problem.
- The 3 analytical techniques may not be all inclusive – but they are intriguing and logical extensions of the technology.

Weaknesses

- Need further development of grinding. Include shear shredding (SSI) as a process. Consider and contact existing grinder manufacturers. Send them materials and pay for them to grind to your specifications. (E.g. Chariton valley Biomass Project). Many engineering decisions used in grinder design have not been considered in this study.
- Too much reliance on ”deployable uniform feedstock”. Feedstock for our fuel and fiber industries takes on many characteristics and specifications. Objective should be the most economic and energy efficient form on just a uniform form.
- Design and testing of mobile or field equipment has many challenges that are not identified in these studies.

Technology Transfer/Collaborations

- The high quality of the work and the fact that all lignocellulosic ethanol plants will require pretreated material insure that this work will be used by many.

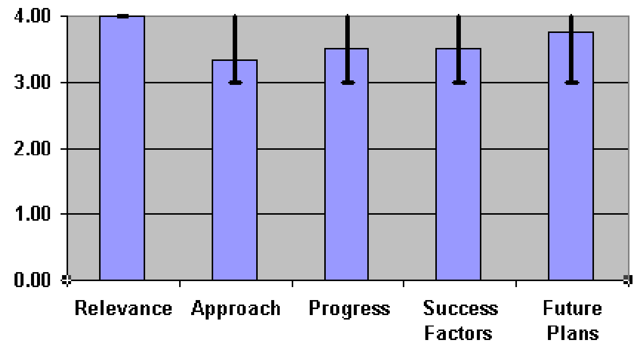
Recommendations for Additions/Deletions to Project Scope

- Improve grinder engineering.
- Better definition of feed and final product qualities.
- Contact and better integration with existing industry in grinding, densification and field equipment.

- Why hasn’t the modular big bale system used successfully for more than 1 million tons of straw per year in Europe (and panned for Chariton Valley) not been included in preprocessing or handling options?
- I see no need for changes to the research scope.

Project Title: Storage & Queuing
Principal Investigator: Corey Radtke, Idaho National Laboratory

Relevance	4.00	0.00	0.00
Approach	3.33	0.33	0.67
Progress	3.50	0.50	0.50
Success Factors	3.50	0.50	0.50
Future Plans	3.75	0.75	0.25
Average	**3.62**		



Question 1: Relevance to Overall Objectives

- There is no question that this is an essential element of designing a sustainable system.
- Given that almost all biomass is seasonal, work on storage is highly relevant to virtually all biomass processors. The very high quality of the work ensures its usefulness and relevance.
- Critical part of process. Clearly focused.
- Storage is an integral part of the overall system. The possibility of preprocessing biomass in storage may offset some storage costs.

Question 2: Approach to Performing the R&D

- “Needs revolution not evolution” is an interesting comment regarding this area of analysis.
- These analyses seemed in-depth, as well.
- Very good systematic analysis. The recognition of where a revolution rather than evolution is required is a good contribution. Investigation of cost is systematic. In general this is a very well designed project.
- Good integration of broad knowledge in moisture etc. Main challenges appear to be clearly identified.
- Wet storage is clearly a challenge.
- Creative. I’m sure the list of possibilities is very large. Keep other possibilities open.

Question 3: Technical Accomplishments and Progress

- The depth and breadth of the analyses were impressive.
- Excellent results to date. An example of this is the systematic analysis of the current cost of drying.
- Good outline of options.
- Storage and water activity.
- Equipment bids basis.
- Good concepts and principles.
- Can ethanol generated in storage be recovered by the processes currently considered? If not, does ethanol act as a sufficiently good preservative to justify the loss of soluble sugars?

Question 4: Success Factors and Showstoppers

- This isn’t a flashy topic, but the analyses seemed to be “spot on.”
- There are no show stoppers as regards the project. The success factor is the rigorous and thoughtful approach.
- Good progress
- Need to extend storage characterization across regions and conditions.

- Cost will be main showstopper.
- An industrial plant needs reliable quality.
- To what degree can drying/preprocessing be integrated with storage to add value to fractionated product?
- This wasn't clearly called out.

Question 5: Proposed Future Research Approach and Relevance

- The recommended areas of future research seemed logical.
- However, I could have used some more detail. Three bullets seems a bit low to me.
- This is a work in progress, and plans for future research are appropriate.
- Very impressive approach. It is clear that it is in early stages of development.
- Identified a number of potential issues to look at.

Additional Comments

Strengths

- The depth and breadth of research was very impressive.
- Solid analyses.
- I appreciated seeing the publications at the end. This shows a serious commitment.
- Solid high quality technical and cost analysis in a well focused program.
- Good basic approach and information.
- Good identification of potential value added in storage as preprocessing (ethanol). There should be other values that can be obtained.
- Good focus on water soluble carbohydrates.

Weaknesses

- This was a robust, in-depth study. I did not see any specific weaknesses.
- Not quite as stimulating as other presentations.
- No weaknesses are evident.
- Density is a delusion. Densification can be more costly (energy and labor) than benefits. Identify practical density ranges and potential target ranges.
- Need to identify role of leaf fraction in degradation of products during storage. Leaves have highest inorganic and nutrient content and most fragile structure. Should leaves of stover etc. be separated, processed and stored separately?
- How is storage different for thermochemical platform? Still needs to be dry and consistent.
- How do storage methods compare for allowing processor to manage inventory feedstocks of different quality? Bales can be handled in dense blocks of 3 tons or more at rates of 120 tph with a squeeze. How do you shift inventory with ground material?

Technology Transfer/Collaborations

- This area was unclear.
- The high quality and comprehensive nature of this project ensures its usefulness to others.

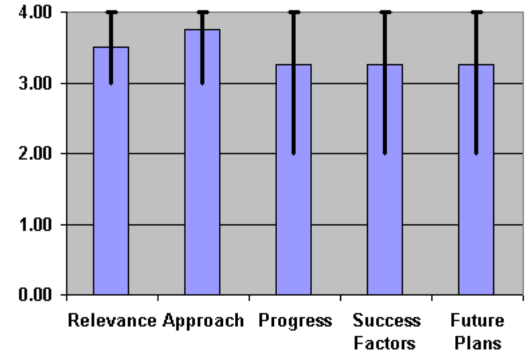
Recommendations for Additions/Deletions to Project Scope

- The scope of the research is appropriate as designed and no additions or deletions are evident to me.
- Add/identify specific health impacts of moisture in storage and processing. We found some people have strong allergies or reaction to bacteria. This is well known in composting science.

- Define characteristics of stored material that are important to specific platforms – sugars, solubility, degradation, dry matter. What other preprocessing steps can be integrated with storage?
- Identify protocol for storage testing for wet or dry feedstocks.
- Provide interactive information for comment and co-development by industry.
- What process plant effluents (CO_2) can be used to offset storage risks (fire, explosion) from ground material?

Project Title: Handling & Transport
Principal Investigator: Judy Partin, Idaho National Laboratory

Relevance	3.50	0.50	0.50
Approach	3.75	0.75	0.25
Progress	3.25	1.25	0.75
Success Factors	3.25	1.25	0.75
Future Plans	3.25	1.25	0.75
Average	**3.40**		



Question 1: Relevance to Overall Objectives

- Good problem statement. Fibrous materials are a major challenge.
- Again, there is no argument that this is a significant area in the critical path analysis of the harvesting to reactor continuum.
- Good preliminary testing of basic properties of materials.
- Because all biomass will be transported, the relevance of this work is high, which is aided by the rigor with which the project is designed and executed.

Question 2: Approach to Performing the R&D

- Good plan to obtain fundamental data needed to design handling systems. I don't expect the Johansen property measurements to provide all the information needed. They did not do much work on fibrous materials. You will need to develop your own measurements, and test apparatus size will be important.
- Use of Johansen indices and Instron are true "state of the art" measurements. You clearly did your homework.
- It's not clear where this research is headed. It appears to be pretty academic. Results need to be compared with real world experience in bin flow and hopper flow and densification.
- One outstanding element of this project is the use of the formalism of Johanson in analyzing flow properties in bins. One consequence of this is the recognition of the interaction of particle size and material flowability.
- Analysis of the rheological properties of biomass slurries will require expertise in characterizing viscosity; the object is a characterization of viscosity as a function of shear rate.

Question 3: Technical Accomplishments and Progress

- Initial tests are a good start, but this is a big project. Some data from the development of silage handling equipment might be available in the literature, particularly at the USDA Dairy Forage Research Center in Madison, WI.
- Capsule method is intriguing. Clearly, you have thought of most of the options.
- I was very impressed, again, with the breadth and depth of knowledge of the presenter…the science was dead-on as well.
- Fills basic data need.
- Results to date from the characterization of switchgrass and wheat straw are excellent.

Question 4: Success Factors and Showstoppers

- Our current approach to handling difficult materials is to increase the size of the handling machinery. That approach is too expensive. The industry will need to work smarter, not larger, to solve this one. Some experience is already available, like the Chariton Valley boiler fuel handling system, and many others, and should be brought to bear on this problem.
- Clearly, the deep extent of the testing is going to smooth many bumps in the road ahead.
- Good characterization. Needs to align with industry experience in handling these materials. They don't flow. How will INL contribution help to break the bottleneck to prevent know problems with fibers? Speculations presented about flow not convincing.
- Cost needs to be added to the analysis of pneumatic conveying, the sooner the better. Given the quality of analysis in this study, in both engineering and cost analysis, the prospects of success are high. I see no show stoppers.

Question 5: Proposed Future Research Approach and Relevance

- Good plan for future work. Need to work with companies with conveying experience.
- I was very impressed with the detailed list of work to be done.
- This was one of the best projects in totally describing what has been done vs. what is yet to be done.
- Need better definition of outcomes of this research. What is it leading to? Best possible expected outcome is improved bin hopped design for loading and unloading material. How does it compare with existing systems? Not convinced that there ahs been good communication with existing suppliers and designers of storage and handling systems.
- Good plans for research that builds on past work.

Additional Comments

Strengths

- Use of STANDARD processes and tests (INSTRON, JOHANSON INDICES, etc.) shows a clear understand of the science and engineering limits of flow theory.
- Fills basic information on properties.
- Very high quality of engineering and cost analysis in a broad search of the issues.

Weaknesses

- None identified.
- What risks does this effort address?
- Question what bottleneck breaking potential of extensive testing.
- Need to relate properties to morphology of materials. This will explain results found in lab tests.
- Results likely to be overly academic.
- Need to relate lab tests to full scale operation. There are many examples in industry.
- None evident; early cost analysis of pneumatic conveying may identify length limitations.

Technology Transfer/Collaborations

- Work will be useful to most projects.

Recommendations for Additions/Deletions to Project Scope

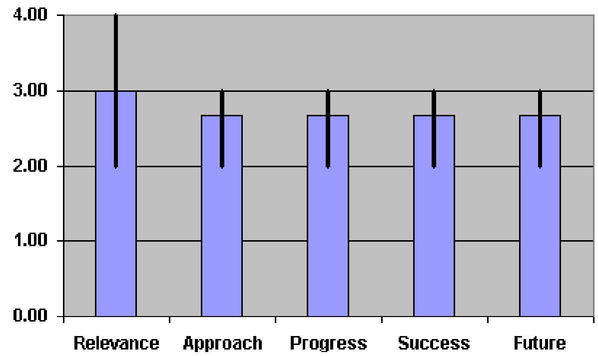
- Need more interaction with industry and to better define pioneer situation of existing industry.

Feedstock Systems Integration Projects

Project Title: Supply Systems Logistics

Principal Investigator: Shahab Sokansanj, Oak Ridge National Laboratory

Relevance	3.00	1.00	1.00
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.67	0.67	0.33
Future Plans	2.67	0.67	0.33
Average	**2.73**		



Question 1: Relevance to Overall Objectives

- I have a difficult time seeing a direct positive project link for IBSAL.
- Engineering tool.
- Good presentation of engineering tool and potential uses. This relevance of the tool is the ability to model processes.
- If this work succeeds it will have a high relevance in that it can predict many factors important to biomass. Its relevance will depend critically on the accuracy of the overall model.
- Provides the opportunity to optimize logistics systems using existing equipment, as well as concepts that do not yet exist.

Question 2: Approach to Performing the R&D.

- Integrating biomass supply into corn-ethanol production? Why? Isn't the most efficient method going to be cellulosic?
- Takes into account variability in feedstocks and processes. Continuous model validation will be important.
- A good feature of this work is the recognition of the multiple options in moving biomass from field to plant, for example on farm storage, depot storage or direct transport to the plant for storage.
- Good combination of modeling supported by experimentation to supply missing data. List of risks shows good thinking. Good level of cooperation with other researchers. Expansion beyond local collection point is good. Linkage to ASPEN is under way.

Question 3: Technical Accomplishments and Progress

- Certainly, models can be an excellent way to analyze a system. However, they are much better to show what elements are the most critical and do sensitivity analyses for each variable. IBSAL may or may not be a realistic simulation scheme. We would need to see more, or have some independent scientific validation.
- Model exploration and verification.
- Basic components identified.
- What showstoppers or opportunities has IBSAL identified for high production feedstock.
- Preliminary results quantify case for biomass.
- Model use in existing plants.
- This project has led to the quantification of a number of elements of the biomass chain.
- Good work in building the model and getting the data needed to use it. Need to find or generate data to replace any assumptions that had to be made.

Question 4: Success Factors and Showstoppers

- None seen.
- Validation?
- Optimization results.
- Success at quantifying risks?
- Biggest success factor is ability to identify showstoppers in processes.
- Demonstration of shear shredding is good. That is used in our export forage industry.
- The results of any complex model need to be verified on an ongoing basis against actual data. I think that it is important in the future for reports on IBSAL to discuss ongoing verification efforts. This is a key success factor that appears to be well recognized by the principal investigator.
- Models need to be continuously validated, due to changes in crop properties from plant breeding and in agricultural practices due to increasing farm size and machine productivity.

Question 5: Proposed Future Research Approach and Relevance

- The use of IBSAL with GIS is problematic, at best.
- Focus of this particular task?? Integrated process modeling?
- Who is using model and interfacing validation etc. Can it be distributed to use it for its advantage?
- Continuous verification?
- This is a work that is underway; future planned work builds on past results.
- Future extension to the fuel distribution system will make this into a huge model. Need to balance the benefit of this extension against the cost. Should work with equipment manufacturers to validate the performance of existing machines and to encourage their participation in future model development and application.

Additional Comments

Strengths

- I did appreciate the extensive list of refereed publications.
- System approach.
- Flexible model.
- Integration of fuel distribution.
- Quantification of any process step forces a deeper understanding of that step, hence this kind of research increases insight into unit operations.
- The overall model will be very useful if verified and validated.

Weaknesses

- “To date, it has been modeler to modeler…” The next step is taking it further. THIS IS A MISTAKE. Others should have been involved, up front. Complex models need intense criticism and verification. INDEPENDENT VERIFICATION HAS NOT BEEN DONE, YET. Whoa! This is a weakness. I am not convinced that IBSAL is a robust model. (Admittedly, I would need more data than was given here.).
- Need industry interaction for densification work. There is more science and engineering in existing industry than is reflected in presentation.
- The potential weakness is that the model will mislead unless accurate. It is too early to tell.

Technology Transfer/Collaborations

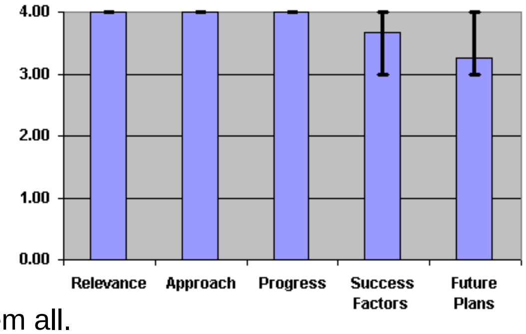
- A good job has been done in collecting other information. However, the independent verification is late, at best.
- Continuous verification.
- The model will have high use when completed: it is ASPEN for biomass.

Recommendations for Additions/Deletions to Project Scope

- Better definition of specifically who can use the model.
- Continuous verification? Dept of Defense. Validation and Verification.
- Be more explicit in future presentations on efforts to verify and validate.

Project Title: Feedstock Supply System Design Report
Principal Investigator: Richard Hess, Idaho National Laboratory

Relevance	4.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	4.00	0.00	0.00
Success Factors	3.67	0.67	0.33
Future Plans	3.25	0.25	0.75
Average	**3.78**		



Question 1: Relevance to Overall Objectives
- Critical to the overall program, since it feeds them all.
- Without question, the logistics are an essential element of a successful system…end of story!
- Very well focused overall approach.
- The vision of a commodity industry supplying feedstock is highly relevant to the emergence of a viable processing industry. The high quality of this work makes it highly relevant.

Question 2: Approach to Performing the R&D.
- Well thought out, but do we know enough about processes to say that all reactor throats look alike? A uniform feedstock specification may not be optimum for all processes.
- Design and data gathering appear to be relevant and "real." These are not 'fudged" data – but real life examples.
- OBVIOUSLY, Richard is an effective team leader, as everyone in his group gave the very highest rated presentations. This speaks very well to both Richard's leadership and to the capabilities of his team.
- Defined goal- two tier wet dry bulk.
- Preprocessing – good attack.
- Emphasis on "uniform format feedstock" maybe big limitation. Should allow more flexible identification of forms of feedstock.
- Systematic and well grounded in both engineering and cost analysis.

Question 3: Technical Accomplishments and Progress
- Very thoughtful analysis of system alternatives.
- "Pioneer design" is obvious realistic.
- A VERY comprehensive approach. I appreciate it when someone says: "We are counting all the costs – we are not "cheating the system" by charging zero labor for the owner, etc.
- Detail of approach, down to dust control and regulations, is amazingly thorough. Fire code, etc. could shut down an operation. THIS DETAIL OF ANALYSIS WAS VERY, VERY impressive!
- Someone really did their homework here! For example, as you push processing upstream, your efficiencies go down. You also go from electrical to diesel.
- Good preliminary investigation and successful approach.
- Should include measures of specific energy efficiency and specific conversion platform needs and specifications. Note they are different for bio and thermo conversion.
- The noteworthy components, as mentioned above, are the engineering coupled with cost analysis.

Question 4: Success Factors and Showstoppers

- Uniform concept may be in conflict with some unique requirements of some processes.
- Again, the detail of analysis was very impressive. Understandably, moving water is expensive. Any way to remove it at the source keeps the costs low. The detail here is impressive, as well.
- Analysis that shows the key is a “commodity-driven” system is an extremely critical finding.
- Recognition of factors.
- Organization of variables, challenges etc. good identification of challenges.
- The progress to date is impressive, and no showstoppers are evident.

Question 5: Proposed Future Research Approach and Relevance

- I couldn’t really zero-in on what is left to do. Is it all done?
- In general very good. Caution use of uniform format feedstock as goal and expectations for it. Spend more time defining specifications of platforms and comparing with actual use of materials with similar specifications in industry. Not just 932 projects.
- Future objectives and plans to realize them are sound.

Additional Comments

Strengths

- Again, the detail of analysis was very impressive.
- This was absolutely amazing in that it looked, not only at costs and efficiencies, but “permitting,” as well.
- OBVIOUSLY, Richard is a very effective TEAM LEADER, as EVERYONE in his group presented the very highest rated presentations. This speaks very well to both Richard’s leadership and to the capabilities of his team.
- Good overall approach.
- Good definition of 425/ton as target on cost curve.
- Solid technical and cost analysis to achieve a vision of a commodity feedstock.

Weaknesses

- Need better definition of range of forms feedstocks can be accepted by conversion platforms. The ¼ inch “flowable” feedstock sounds like a researchers dream not a practical process engineers plan.
- Need more complete industry review to guide project.
- Define use of DGS as feedstock.
- Should emphasize or use measure of reliability of delivery as measure of process suitability. There will be tradeoffs to get reliability. These will cost money.
- Need to consider site specific aspects or localization effects.
- Need to recognize and define limits of grain analogy.
- Wood seems to be largely ignored in this approach.
- Need to better define role of potential commercial organization s in process. Harvesters and balers don’t have funds for capital required.
- How do you ensure feedstock quality? That’s the biggest issue in 40 million tons of forage harvesting and much more in wood fiber harvesting.
- Where is sustainability? How does overall processing system help sustainability? Identify what nutrients or other elements are lost or could be returned at stages in the system.
- None evident to me.

Technology Transfer/Collaborations

- I think it would be well to see more of the linkages. I feel that they were there, or the detailed data could not be developed, yet I didn't see it.
- The high quality of this work and the broad vision guiding the work will make it highly relevant to most/all future users of biomass.

Recommendations for Additions/Deletions to Project Scope

- Advanced pioneer processing to challenge existing suppliers.
- Building organization infrastructure through existing products and projects. This effort should be educating the engineers who will build the next generation feedstocks systems.
- Price targets are good for driving progress, but at some point need to be treated with caution: a highly efficient processing plant will be able to use more expensive feedstock. In Finland efficient users of woody biomass can outbid inefficient plants, which translate to being willing to transport biomass over a longer distance.
- Recognize that if two or three "commodity" biomass systems emerge, this may reflect economic reality. The oil industry has gravitated to two or more "commodity" crude oils: heavy crudes vs. standard crudes; this isn't a failure for the oil industry; it is an outcome that maximizes efficient processing.

APPENDIX A

Agenda

Day One – Tuesday, August 21, 2007

7:00	Wine & Cheese Reception	*All participants*

Day Two – Wednesday, August 22, 2007

8:00	Welcome & Program Overview	*John Ferrell, OBP*
9:00	Feedstock Platform Future Directions (MYPP)	*Cindy Riley, NREL*
10:00	Q&A	*Introduction Presenters*
10:45	Area Overview	*Kevin Craig, Golden Field Office, Session Moderator*
12:15	GIS-based Biomass Resource Sustainability Analysis - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Tris West, ORNL*
2:00	Regional Biomass Energy Feedstock Partnerships - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Terry Nipp, National Sun Grant Initiative &* *Kevin Kephart, South Dakota State* *Jim Doolittle, South Dakota State*
3:45	Break	
5:30	End of Day Wrap-up & Adjourn	*John Ferrell, OBP*

Day Three – Thursday, August 23, 2007

8:00	Welcome & Day One Overview	*John Ferrell, OBP*
8:15	Area Overview	*Kevin Craig, Golden Field Office, Session Moderator*
10:20	Preprocessing - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Chris Wright, INL*
11:15	Development of Engineering Data for Feedstock Supply Operations - 20 mins presentation - 10 mins Q&A/Reviewer Reflection	*Shahab Sokansanj, ORNL*
12:30	Lunch	
2:15	Area Overview	*Kevin Craig, Golden Field Office, Session Moderator*
3:20	Design Report - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Richard Hess, INL*
5:00	Review Committee Summary Report	*Lyle Stephens, Lead Reviewer*

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Sam Tagore

Please copy Laura Neal (Laura.Neal@ee.doe.gov)

You have been invited to serve as a Reviewer for the DOE Biochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	**No**
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in	_____	_____

a research activity in program/project area.

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Sam Tagore (202-586-9210) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

______________________________ ______________________
Signature Date

____
Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session: [2] [3] [4] **Reviewer Name**: ____________________

Title of Project: ____________________

Presenter Name: ____________________

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ____________________

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan or the missions and objectives of USDA Programs, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach** to performing the R&D.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE or USDA goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

U.S. Department of Energy
Office of the Biomass Program
Biochemical and Products Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Biochemical and Products Platform Review held on August 7-9, 2007 in Denver, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the biochemical and products area they were investigating (i.e. preprocessing and storage, processing and process integration). The platform review agenda is attached to this report in Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for response. Any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Amy Miranda
Biochemical Platform Technology Manager
DOE/EERE, Office of the Biomass Program

Pretreatment and Enzymatic Hydrolysis	4.00	3.67	3.67	3.67	4.00	3.80
Biochemical Process Integration Task	4.00	3.50	3.50	4.00	4.00	3.80
Targeted Conversion Research	4.00	3.67	3.67	3.33	4.00	3.73
Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis	3.00	4.00	4.00	3.50	4.00	3.70
Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products	3.67	4.00	3.33	3.33	3.50	3.57
Biochemical Platform Analysis	3.67	3.67	3.33	3.33	3.67	3.53
Integrated Biorefinery - Separations/Separative Bioreactor - Continuous Bioconversion and Separations in Single Step	3.00	3.67	3.67	3.00	4.00	3.47
Advanced Catalyst Development for Polyols Production	3.33	3.67	3.67	3.67	3.00	3.47
Fungal Genomics	3.33	3.67	3.33	2.67	3.67	3.33
Development of Sustainable Bio-Based Products and Bioenergy in Cooperation with Midwest Consortium for Sustainable Bio-Based Products and Energy	3.00	3.50	3.00	3.00	4.00	3.30
Lab Validation for Organism Development Solicitation Recipients	3.67	3.00	3.33	2.67	3.00	3.13
Succinc Acid as a Byproduct in Corn-Based Ethanol Biorefineries	3.00	3.50	3.00	3.00	3.00	3.10
Preprocessing and Storage Systems Development/Qualification	3.67	2.67	3.00	2.33	2.67	2.87
Energy Corn Consortium	3.00	3.00	2.67	2.33	3.00	2.80
Development of Applied Membrane Technology for Processing Ethanol from Biomass	3.00	2.67	2.67	2.67	3.00	2.80
Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol	2.00	2.00	2.33	1.67	1.67	1.93
Iowa State University Biomass Energy Conversion Project	1.50	2.00	1.00	1.50	2.00	1.60

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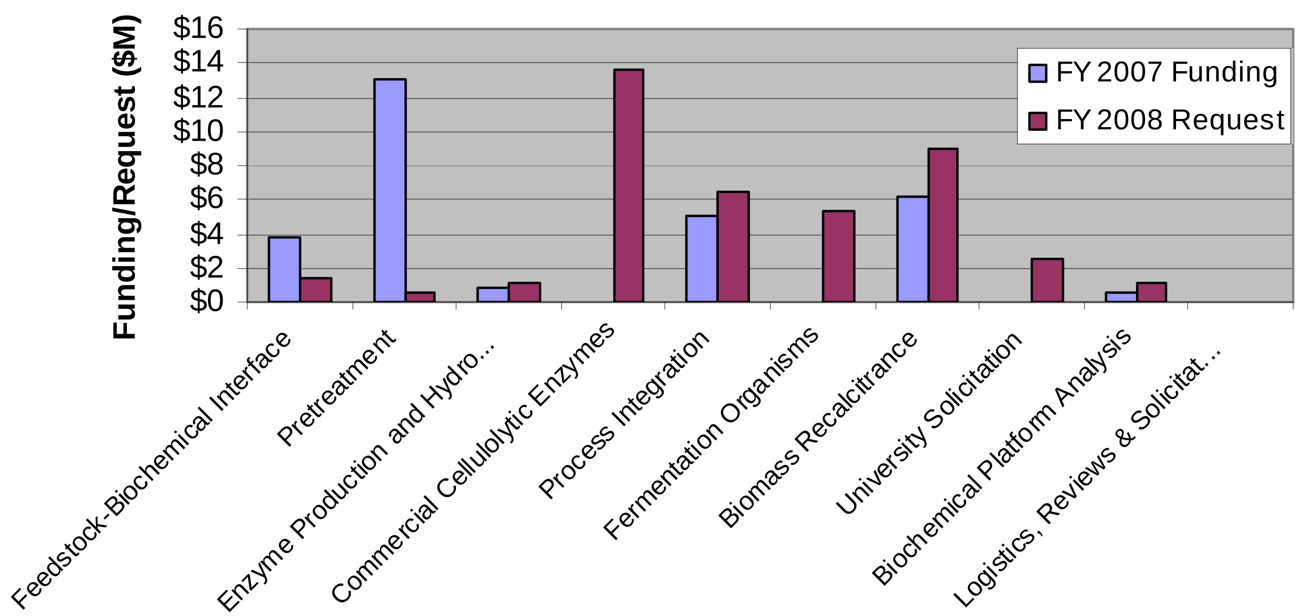
Platform Direction

In 2008, the Biochemical Platform will continue to work with a diverse group of partners including the National Laboratories, academia and industry to achieve the progress necessary to support the Program 2012 goal. The Biochemical Platform is focusing R&D on tasks related to enzyme development and fermentation processes as well as process integration in order to reduce sugar costs. In FY2008, solicitations on fermentation organisms (ethanologens) and commercial enzyme systems will be awarded. This research is focused on ethanol as the end-product but these economically viable technologies will act as the springboard to the next generation technologies which will produce ethanol, other alternative biofuels and products from a wide range of cellulosic feedstocks.

Additionally, the Biochemical Platform is expanding its focus to consider research on a wider potential alternative feedstocks and biofuels. An additional solicitation will be released in FY2008 to increase university participation in the Biochemical Platform.

Platform Funding (in $M)[1]



[1] Please note that FY 2007 Pretreatment funding included forward funding for FY 2008 activities.

Specific Responses to Select Comments

While I agree that woody biomass be included in the platform's goals, such work must be limited to those feedstocks that are in sufficient abundance and logistic availability to justify their incorporation into this platform. I suspect that the thermochemical platform can more readily handle a temporally varying mix of heterogeneous woody materials.		The Biomass Program is utilizing a strategically balance portfolio of feedstocks, evaluating the promise and risk associate with various feedstocks and investing appropriately by platform. The Biochemical Platform is looking to extend its focus to additional feedstocks but plans to continue work on agricultural residues.
I have to express some disappointment that we have to revisit the enzyme development process. We have been given misleading information about the cost of enzymes in the past, and I have no reason to be any more confident in the future. The enzyme cost goals shown in the MYPP seem to be drawn from thin air.		While the Program recognizes that there is no market for the enzymes developed within our portfolio and that costs of these enzyme cocktails will be higher than our projected costs, the advances in the enzyme characteristics were sufficient to encourage ongoing research in this area and further improvements are needed to reduce enzyme production cost even further. The cost goals in the MYPP were developing using modeled data from the 2002 enzyme advancements on pure sugar streams, current work is focused on meeting that target with a more realistic hydrolyzate stream.
Focusing on switchgrass and hybrid poplar is a logical development, but a small amount of research of other feedstock species may be valuable. For example, woody biomass was mentioned by the platform review.		The Biomass Program is utilizing a strategically balance portfolio of feedstocks, evaluating the promise and risk associate with various feedstocks and investing appropriately by platform. The Biochemical Platform is looking to extend its focus to additional feedstocks but plans to continue work on agricultural residues.

Program Review Comments

Strengths

- This platform is noted for its strong progress and focus on critically important topics. The quality of much of the science and engineering is internationally recognized for its excellence.
- Integration and singularity of focus are good. The program really seems to be abiding by guiding principals.
- I appreciate this platform's understanding of its role as a government program and how it has utilized its resource to focus on technical barriers. This platform appears to be well funded. Utilization of university consortium taps a wider intellectual resource base. I am pleased to note increased interaction with USDA. I hope that a coordination relationship can be developed as well. I would recommend an early request for an audience with the new Ag Secretary (once confirmed).
- Good liaison with industry. Work on process integration. Correct focus on work required to meet platform and Program goals.

Weaknesses

- Several programs were mentioned in a negative light, indicating that better management could be warranted.

- Focusing on switchgrass and hybrid poplar is a logical development, but a small amount of research of other feedstock species may be valuable. For example, woody biomass was mentioned by the platform review.
- No major weaknesses; however, decreased emphasis on C5 fermentation to ethanol should be considered.

R&D Portfolio Gaps

- Review was of summer proceedings. It was needed to close he loop of what will be done with the assessments and if comments are taken seriously.
- I find the list of critical gaps (challenges and barriers) discussed in MYPP 3.2.1.3 to be fairly comprehensive, if not daunting.
- The platform review recommended use of pilot runs as soon as is practical. This seems to be a theme of the week and therefore deserves attention.
- No significant gaps were identified.

Additional Recommendations, Comments and Observations

- I agree with the peer review team's recommendations, in general. However, while I agree that woody biomass be included in the platform's goals, such work must be limited to those feedstocks that are in sufficient abundance and logistic availability to justify their incorporation into this platform. I suspect that the thermochemical platform can more readily handle a temporally varying mix of heterogeneous woody materials.
- I have to express some disappointment that we have to revisit the enzyme development process. We have been given misleading information about the cost of enzymes in the past, and I have no reason to be any more confident in the future. The enzyme cost goals shown in the MYPP seem to be drawn from thin air.
- A) Pretreatment and enzymatic hydrolysis program at NREL is focused to the overall objectives. A project which encompasses both esoteric and applied research aspects; therefore, finding should be of benefit to the industry while utilizing background information. As scientists and engineers within the NREL program continue to relate with those individuals with knowledge about needed outcomes, this program will flourish. B) Biochemical Process Integration Task has been designed to provide samples and relevant findings to other NREL programs as well as extramural researchers. Perhaps a bit more coordination with feedstock needs would be helpful. A critical portion of this program will be to provide state of the art instrumentation as well as data generated from the analytical objectives. C) As work continues towards converting cellulose to ethanol, the fundamental drivers in this project will be critical to future investigations. Well designed studies to assess relevance of providing clean cellulose from samples containing hemicellulose and/or lignin will be imperative to advancing cellulose conversion science. Continued extra and intra-agency discussions and joint projects will be relevant to future success.
- A higher sense of urgency on planning and operation. Ongoing evaluation of the value of CAFI work to achieving platform goals. The work is very academic and several of the pretreatment processes CAFI is studying are unlikely to ever be implemented at commercial scale.

Platform Review Feedback

Specific Responses to Select Comments

Project work would benefit from requirement that results be put into public domain		We agree. The platform will continue to publish any non-proprietary advancement and work with the project performers to facilitate communication of progress.
The Biomass Program should educate the public about its full range of technologies		The Program is in the process of updating the Program website and reinvigorating our communications plan, which will hopefully increase public awareness of the Program's focus. Additionally, the Program is expanding out outreach activities to organizations at the state, local and international level.
The economic goals and targets (example: the feedstock economic value added or subtracted to the economic goals of the biochemical platform) for the two platforms should be the same.		The Program Platforms work closely to ensure that all targets consistent and are appropriately documented and disseminated. The differences in feedstock economic value are related to the feedstock needs for both biochemical and thermochemical conversion processes.
Strengthening the interface between the platforms integrates the goals overall.		We agree. Thank you for your comment.
Biochemical platform is exclusively tied to a subset of feedstocks and isn't tied to others or all. For example, the forest products industry isn't addressed within this platform. Attention is focused on corn stover and moving toward switchgrass and completely negates any focus on woody feedstocks. There is value in looking at woody feedstocks within this platform.		Biomass Program is utilizing a strategically balance portfolio of feedstocks, evaluating the promise and risk associate with various feedstocks and investing appropriately by platform. The Biochemical Platform is looking to extend its focus to additional feedstocks but plans to continue work on agricultural residues.

General Platform Comments

- For future reviews, if you want the public to be invited, but you need the technical information, then ask all attendees to sign confidentiality forms so that technical data can be given. If not, consider a closed session so that detailed technical information can be presented allowing full utilization of evaluation by the Reviewers.
- Evaluation form contains reference to USDA goals. This is confusing to the Reviewers and it's not clear why it's on the form.
- Feedstocks present important economic factors relevant to this platform as well and the interface between the two platforms is very important. The projects in both platforms should take this into consideration – feedstock projects should include economic impacts to biochem and vice versa. Consistency in the values assigned is important.
- The economic goals and targets (example: the feedstock economic value added or subtracted to the economic goals of the biochemical platform) for the two platforms should be the same. What is encompassed in that value should be better defined as well (delivered, processed, handling, etc.). Although it's noted that the feedstock value is approached from the same economic viewpoint for both biochem platform and thermochem platform, the feedstock 'value' is different. Processing, handling, etc. can be

significantly different for biochem vs. thermochem. Set value is based on corn stover – however, this is not necessarily applicable to other feedstocks. Definition of this value is very important and can address the concerns noted. Consider looking at other industries to see how they allocate a 'value' to issues like this.

- Strengthening the interface between the platforms integrates the goals overall.
- Biochemical platform is exclusively tied to a subset of feedstocks and isn't tied to others or all. For example, the forest products industry isn't addressed within this platform. Attention is focused on corn stover and moving toward switchgrass and completely negates any focus on woody feedstocks. There is value in looking at woody feedstocks within this platform.
- The platform should align with the growth, sensitivities and issues associated with the major corn to ethanol industry, the petroleum industry and the interactions thereof.

General Comments (applicable to all presentations)

- Overall the presenters did a good job of answering review panel questions and sticking to the presentation template provided.
- Presentations needed to provide more detailed quantitative information on their goals and achievements.
- Better Performance Metrics are needed
- In many of the presentations, the titles to the presentations don't necessarily represent what they are going to discuss. It would be so much more useful to the Reviewers if the content supported the title and vice versa. The titles can lead to expectations by the Reviewers that don't necessarily get met within the actual presentation.

Initial Reviewer Project Feedback – Comment Summaries

Biochemical Platform Support

Project Title: Biochemical Platform Analysis
Project Investigator: Andy Aden, National Renewable Energy Laboratory

Strengths
- This is the benchmark of the expertise in the industry
- The work is the "guidepost" for the Platform R&D
    - o Identifies barriers and identifies future work and tasks
- Dynamic essential tool that evaluates the state of technology
- Includes limited private advancements, excellent starting place for a model that can be customized for each individual case.
- Continue to communicate a snapshot of "where you are" towards the goals

Weaknesses
- Some of the existing and future technology advancements do not fit well in the model
- Need to develop additional complexity based on new variables
- Difficult to maintain the high quality effort with the expected turnover in industry today.

Comments
- Recognized (as it was stated) that the work should be continually evaluated for the assumptions going into the model
- Tendency for the public to misinterpretation of the goals in pilot/bench scale test will be applicable (or seen) in a full-scale plant
- Continue to incorporate environmental, socio-political factors into the model
- Continue to link with other DOE and industry working groups

PI Response
- Model is a tool – we do plan/strive to capture the future state of the art technologies

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Feedstock Interface

Project Title: Feedstock Interface
Principal Investigator: Corey Radtke, Idaho National Laboratory

Strengths
- Feedstock (type, composition and quality) and infrastructure development is vital to this industry
- Feedstock interface effort is needed to bring feedstock supplier issues into this platform
- Effort on harvesting technique vs. quality (composition, treatment, yield, etc) of feedstock is extremely valuable

Weaknesses

- This is a new project, that would benefit from more interaction with other projects in the platform
- This task should be integrated with an overall picture at the impact to the farmer (cost/acre), the environmental effort and overall availability

Comments
- The role of a cross platform integration task could be better defined.

PI Response
- The team is working with the feedstock analysis group and integrated across all of the laboratories. Some of that funding is going into sustainability efforts too.
- There is also extended interaction with USDA as well.

Biochemical Processing Core R&D

Project Title: Pretreatment and Enzymatic Hydrolysis
Principal Investigator: Rick Elander, National Renewable Energy Laboratory

Strengths
- Outstanding degree of integration with other platform projects and outside industry groups
- Good job of incorporating all the latest ideas and technologies
- Achieved goals with a high degree of relevance to industry needs
- Long-term vision - on track to achieve 2017 goals
- Been able to utilize sophisticated tools to improve understanding of the chemical processes

Weaknesses
- Lacks ability to disseminate results for use of advanced enzymes and studies
- Lack of transparency in team process

Comments
- Urge continued pressure to be able to communicate results of latest technological /enzymatic advances
- Recognize the tremendous range of activities addressed by this task

PI Response
- Stakeholders have shown interest in how well advanced enzymes operate under more rigorous conditions
- Review Team: Recognizes that and would like to see that happens

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Project Title: Novel Enzyme Products
Principal Investigator: Larry Allen, Lucigen

Strengths
- Made progress towards very specific technical goals
- Fundamental research preformed well

Weaknesses

- Not clear how success in this project would impact ethanol cost/production
- Lack of understanding of the processing area
- Technical issues with enzyme selection

Comments

- Soy isolates have not been competitive industrially and industry has been unwilling partner or showing interest.
- "Solution looking for a problem"

PI Response

- That work has been done – interest from different industry and capital groups
- Several alcohol companies are interested in the work, ethanol
- In response to the question on enzymes – we didn't use cellulose for the testing, we used MEC for the exo substrate and AZCl-He – Cellulose (Megazyme Corporation) for the endo acting cellulases

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Project Title: Energy Corn Consortium

Principal Investigator: Michael Blaylock, Edenspace

Strengths

- Excellent group of partners
- Showing good progress
- Good strategic plan (concept to commercial application)
- Good understanding of the significant barriers

Weaknesses

- There may be a mismatch between the enzyme and the process (what value will the enzyme have after processing)
- Project would be strengthened by targeting the timing of enzyme expression during plant development to carryout plant cell wall deconstruction
- Didn't present clear technical plan to address all the barriers identified

Comments

- More attention to the technical aspects of the screening with appropriate substrates (e.g. CBH is not active on CMC)
- Incorporating cellulases in cell wall plants ***may be*** extremely valuable

PI Response

- There are a lot of barriers that we have people working on (both within and outside of the funded effort)

Project Title: Lab Validation for Ethanologens

Principal Investigator: Kent Evans, National Renewable Energy Laboratory

Strengths

- Good oversight and credible strain validation provided by DOE

- Developing a needed benchmarking method that compares and verifies ethanologens for simultaneous conversion of C5/C6 sugars (includes stresses and inhibitors)
- Strong QA/QC plan, to incorporate lessons learned as the project matures
- Evaluation is thorough, through cap investment and operating/production costs
- Open to future developments/organisms – Not a constrained task

Weaknesses
- Inclusion on scalability testing would help assess the commercial viability of an organism
- There were no clear guidelines from DOE concerning the disclosure of results
- Validation screen method may not particularly simulate realistic proportions of sugars in hydrolyzate stream or operating conditions in a commercial facility (inclusion of acetic acid may also bias results)
- Significant challenges in comparing results in customized conditions and substrates.

Comments
- Second validation time period is too long. Twelve to fifteen months would be sufficient.
- Should be required to publish standard protocols
- Very appropriate use of national lab expertise
- Not enough attention to cost estimating for use in commercial process

PI Response
- No response given.

<u>Project Title: Development of Applied Membrane Technology for Processing Ethanol from Biomass</u>
Principal Investigator: Don Stookey, Compact Membrane Systems

Strengths
- Development of novel membranes to address important industry requirement for FGE (i.e., elimination of water)
- Two candidates identified with excellent characteristics (laboratory testing)
- Extensive experience with membranes, albeit not in fuel ethanol

Weaknesses
- Only lab scale so far, need flux and durability with industrial feeds
    - Realistic process streams should be incorporated, as early as possible
- May not be appreciating the complexity of the process stream
- Realistic process streams should be incorporated, as early as possible
- Incremental value to the Biomass Program

Comments
- Work plans may overlap with other projects, clarify who is paying for what work
- There are similar technologies that are commercially available today

PI Response
- CMS plans to have membrane devices in field streams during the 1st Q ’08 in collaboration with an industry player.
- CARB certification and ramp-up of our VOC product line will lead to early commercialization of a Fuel Ethanol dehydration product.

Process Integration

Project Title: Process Integration
Principal Investigator: Dan Schell, National Renewable Energy Laboratory

Strengths
- Vital importance to achieving program goals
- Works well with other platform projects to validate data from processes that are optimized in isolation
- Good interface with larger community providing feedstocks and process intermediates
- Have done very good and timely job of disseminating latest analytical methods
- Planned expansion of pilot facilities is important

Weaknesses
- Have not run a process from start to finish for any length of time
- Pilot plant and system are not flexible
- Unclear transition of activities from this project into feedstock interface
- No clear work plan presented to evaluate impact of feedstock improvements and feedstock variability

Comments
- NIR method of raw material may be a problem. Could expand efforts to make NIR method available to and validated by the community.
- More detailed information on ammonia conditioning system would have been good.

PI Response
- No response given.

Fundamentals and New Concepts

Project Title: Targeted Conversion
Principal Investigator: Mike Himmel, National Renewable Energy Laboratory

Strengths
- Strong credible fundamental program with excellent collaborations
- Established a program that is internationally recognized and therefore experts are coming to DOE as a point of contact
- Novel work that ensures new discoveries are incorporated into projects, essential for achieving long term Program goals.
- This project is developing a novel capability to explore the fundamentals of plant chemistry

Weaknesses
- Encourage to continue the fundamental work to the point that it can be handed off to the applied projects

- Focus needs to be expanded to include feedstock variability

Comments

- Impressive team that furthers understanding of underlying principles of enzyme structure function towards achieving cost effective enzyme for use in commercial applications
- Impressive animation and graphics as communication vehicles

PI Response

- We are aware of the challenge to increase integration
- The trouble is where (or what point) to take the fundamental work – how far do you push?
- Genencor package does in fact include an enzyme developed by NREL
- LOTS of interaction within the NREL groups

Project Title: Engineering Thermotolerant Biocatalysts

Principal Investigator: K.T. Shanmugam, University of Florida

Strengths

- Solid fundamental approach with promising results
- Great team, commercialization partners in place
- Successful results will optimize process integration (aligns temperatures for saccharification and fermentation steps)

Weaknesses

- Dilute ethanol solution

Comments

- Worthy of the no-cost extension
- There may be outstanding issues with public acceptance (or perception) of use of a GMO

PI Response

- No response given.

Project Title: Fungal Genomics

Principal Investigator: Scott Baker, PNNL

Strengths

- Great focus on tool kit development
- Fundamental research with a keen awareness of the final application and potential for advancement with new organisms
- Addressing important area of study (fungal morphology as it relates to productivity)
- Impressive group of partners

Weaknesses

- Too early in the R&D project to evaluate the role of filamentous fungi as ethanologens

- The fermentation strategy maybe have some serious showstoppers that we are not yet aware
    - Fungal may need aeration, which is a challenge because it can produce acetic acid bacteria – so competitive issues

Comments

- Would like to see project screen for organisms with both ethnologic and enzyme relevant activities incorporated
- Project team needs to do conceptual engineering early on (what is this organism going to need), in light of the unique metabolic requirements

PI Response

- PNNL has restructured the program and plans to do the conceptual engineering
- Aeration has been discussed within the team and we plan to determine the need for aeration in the coming months

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Chemicals and Products

Project Title: Separation/Separative Bioreactor

Principal Investigator: Seth Snyder, ANL

Strengths

- Strong committed partners
- Excellent leverage of National Laboratory strengths
- Excellent attention to process economics
- Challenging goals, to which the outcomes look promising
- Novel and relevant to chemical products with potential application in another areas
- 12 weeks of continued operation in pilot is significant

Weaknesses

- Data was not presented on relevant testing processes
- Scale-up information presented was anecdotal
- If this is going to make a large impact on the industry, then what are they going to do with the material? Do they have a market for this? Market potential was clearly presented.
- The raw material used for the pilot runs is not well defined.

Comments

- Technology has strong potential for wide application to other areas

PI Response

- No response given

Project Title: Advanced Catalyst Development for Polyols Production
Principal Investigator: John Holladay, PNNL

Strengths
- Strong collaboration with catalyst leader UOP, with extensive petroleum and wet milling processing experience
- Working with realistic bioenergy feedstocks
- Commercialization potential is high due to IP and industrial partners
- Excellent internal communication exchange and well-managed work plan

Weaknesses
- Vulnerability around carbon support

Comments
- Integrity and stability of feedstock needs to be evaluated

PI Response
- No response given.

Project Title: Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis
Principal Investigator: Rodney Williamson, Iowa Corn Promotion Board

Strengths
- Met goals and projects succeeded
- Generating valuable IP with licensing strategy in place
- Selected partners with needs in mind

Weaknesses
- Tied to corn price and production
- Economics are not proven or modeled

Comments
- Interesting slate of new polymers and materials considered
- Strong team and a lot of upside opportunity for future applications

PI Response
- No response given.

Project Title: Succinic Acid as a Byproduct in Corn-Based Ethanol Biorefineries
Principal Investigator: Susanne Kleff, Michigan Biotechnology Institute

Strengths
- On track with plan with a commercialization partner in place
- Generating potentially valuable IP with potential licensing in place
- Have demonstrated C5/C6 utilization and conversion

Weaknesses
- No end user on board yet
- Not economic for large scale use
    - o $0.50/lb your target, or would it need to be even lower

Comments
- Significant additional work required for isolation of new strain

PI Response
- Have some end use testers lined up, but cannot disclose the company names
- $0.50 is based on suggestions from our initial "early adapters"

<u>Project Title: Development of Sustainable Bio-Based Products and Bioenergy</u>
Principal Investigator: Mike Ladisch, Purdue University

Strengths
- Strong analytical foundation within the consortium
- Valuable exploration of different enzyme systems
- Public dissemination of results
- Strong industrial ties

Weaknesses
- Unknown feed value of eDDGS
- Not exploring DDG diversity

Comments
- Results of economic modeling not shown
- DDGS – The corn leaving the market might actually lower the available grain – which would have impact on cost of DDG

PI Response
- We do have economic modeling results in a version of the presentation (was distributed for reviewer consideration)
- Projecting DDG supply/demand is a big issue that we acknowledge and are pursuing
- The team has looked into some DDG diversity and plans to have more results by the end of project in March 08.

<u>Project Title: Biomass Energy Conversion Project</u>
Principal Investigator: Norman K. Olson, Iowa State University

Strengths
- Interesting preliminary approach based on lab scale evidence
- Team appears to be adequate
- Process may interface well with ensiled biomass

Weaknesses
- Team does not appear to understand challenges and complexity of the objective

- Shot-gun approach may be too scattered
- No pre-assessment of economic potential

Comments

- This project is at a very early stage of R&D and it is too early to evaluate
- Similar approaches being investigated by others, this effort may be duplicative

PI Response

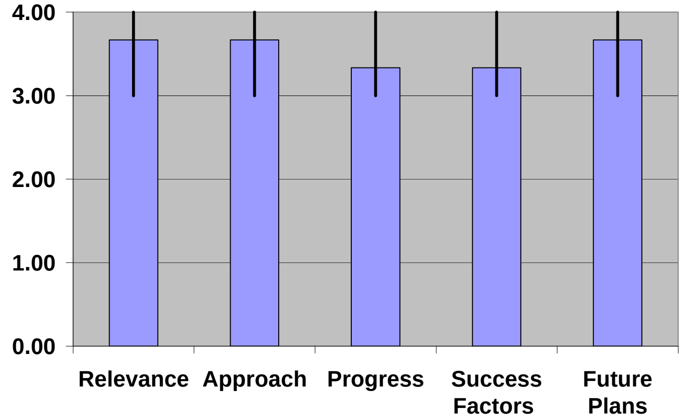
- It is tricky, and we think there is a good shot to move forward and will serve us well in moving forward.

Full Reviewer Comments and Scores

Biochemical Platform Support

Project Title: Biochemical Platform Analysis
Principal Investigator: Andy Aden, National Renewable Energy Laboratory

Relevance	3.67	0.67	0.33
Approach	3.67	0.67	0.33
Progress	3.33	0.33	0.67
Success Factors	3.33	0.33	0.67
Future Plans	3.67	0.67	0.33
Average	**3.53**		



Question 1: Relevance to Overall Objectives.

- This project is critical for assessing progress and identifying major hurdles, prioritizing project work and integrating results across all project areas.
- This is the "mission control center" for internal and external R&D projects, tracking, synthesizing and incorporating results.
- Good overview of the ongoing biochemical platform technical program. Highly relevant but needs to be focused in light of what private sector researchers or doing as well.
- Excellent, high standard interface with all aspects of new industry benchmark expertise. One place to go for excellent data on many aspects of biomass conversion.
- Essential tool when facing so much change in so many aspects of this industry.

Question 2: Approach to Performing the R&D.

- This project focuses the work of the mission, identifies barriers and is the critical component to prioritize the tasks.
- Good approach but be careful with cost estimates of this level. Need some detailed estimating on large scale unit operations just to calibrate the factored cost estimates to real world numbers.
- Outstanding work being done in support of a diverse set of new technologies
- Feedstock effects should be evaluated at a higher level.

Question 3: Technical Accomplishments and Progress

- This is the tool to do all of the above! Progress on the overall program depends upon progress by task units. This task tracks it and insures priorities are updated.
- Obviously on track with DOE and USDA goals.
- This project is recognized world-wide as the place to go for techno-economic data in biomass conversion.

Question 4: Success Factors and Showstoppers

- Does the identifying, may not emphasize regulatory issues as well as it could.
- The effort is closely aligned with and dependant upon numerous other programs.
- Identifying key technical an business barriers for many

- Projects within the biochemical platform. Work should now extend to waste-water discharge and emissions on the downstream end and to identifying key issues / opportunities on the feedstock end.

Question 5: Proposed Future Research Approach and Relevance.

- This is the tool which signals when other tasks or the overall project can proceed to the next stage, though it may not have all the components (financial, social, and political) that may impact next stage.
- Good future plan.
- DOE should fund this project adequately to allow NREL to attract and retain quality process engineers knowing that employee turnover is likely to be high over the next 5-10 years.
- Would like to see additional complexity added to the design case to evaluate the potential impacts of feedstock variability for processes using short rotation woody crops, agricultural residues and dedicated energy crops.

Additional Comments

Strengths

- Necessary, critical to program.
- The Charrette study is especially useful in attacking barriers
- Good to keep R&D focused on capital and production cost as compared to grain and oil. May want to include the Brazilian benchmark as well since it is the low cost global producer.
- Excellent, high standard interface with all aspects of new industry benchmark expertise. One place to go for excellent data on many aspects of biomass conversion.
- Essential tool when facing so much change in so many aspects of this industry.

Weaknesses

- Hard to find any weakness.
- Pro activity not apparent in presentation. Needs to anticipate hurdles as barriers are deal with by task units.
- Need some private participation from industrial partners/ engineering groups.
- May not get critical feedback from industry due to concerns with proprietary technology protection. Be careful with using the RMI charrette type programs. They can be useful but some ideas can be very distracting if not properly filtered.
- Capital cost comparison with corn plants can be dangerous since these numbers of highly variable and may not include the full project scope. Also, recent escalation in steel pricing results in high maintenance effort to keep cost information current.
- There is a lot of work ahead. Is this project adequately staffed and funded to attract and retain the expertise required to maintain the high DOE/NREL standards?
- Model needs additional complexity in some areas e.g. assessing the potential impact of feedstock choices and feedstock variability.

Technology Transfer/Collaborations

- Part of the input is from external sources as relevant.
- Outstanding web-based information
- Essential support for 10% scale up projects.

Recommendations for Additions/Deletions to Project Scope

- Can socio-political issues be incorporated into such a model?
- May want to provide a high level view of the potential impact of implementing technologies not included in the model. Such as, other hemicellulose hydrolysis options, other cellulose hydrolysis and fermentation strategies. This may allow commercial technology developers to better assess the economics of their research. Benchmark against other technologies options, including some EU groups.
- Make sure that this project has adequate resources for required scope changes as industry requests quality data on new and complex processes not addressed in the design case.

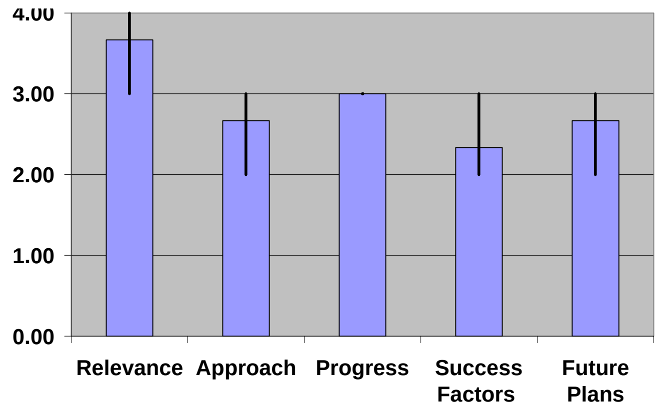
PI Response to Reviewer Comments

No comments were provided by the PI

Feedstock-Biochemical Conversion Interface

Project Title: Preprocessing and Storage Systems Development/Qualification
Principal Investigator: Corey Radtke, Idaho National Laboratory

Relevance	3.67	0.67	0.33
Approach	2.67	0.67	0.33
Progress	3.00	0.00	0.00
Success Factors	2.33	0.33	0.67
Future Plans	2.67	0.67	0.33
Average	**2.87**		



Question 1: Relevance to Overall Objectives.

- Important information which may have a profound effect on our view of biomass availability
- Valuable information for private sector researchers.
- Highly relevant interface with feedstock platform. This connection must be made for successful biorefineries. Working in isolation without communication is never good.

Question 2: Approach to Performing the R&D.

- Strongly interrelated with the ability to pretreat biomass, and will certainly affect the economics of pretreatment-raw material cost.
- They don't indicate partnering or counseling with John Deere or other equipment manufacturer, but they should draw them in early to so that results can be used to design collection.
- The work is mostly qualitative. The research is well planned providing solid information of future commercial value.
- The project plan looks too much like a feedstock project within the biochemical platform. This project should focus on integration activities, e.g. ensuring that the biochemical projects are working with the best feedstocks produced by the feedstock platform, ensuring that the feedstock platform projects have access to the latest analytical methods, continuing the feedstock variability studies and providing data and samples to the biochemical platform for assessment of the impact of variability on downstream biochemical processes

Question 3: Technical Accomplishments and Progress

- Significant progress made since project inception. Need more progress and even more rapidly to incorporate into model.
- The results of this effort will be measured by performance improvements in others research areas.
- New project, but the stover cut height study was very valuable and interesting. Samples now need to be provided and processed by the BC platform

Question 4: Success Factors and Showstoppers

- Should include equipment manufacturer in program early.

- Likely need more ag economic content. Feedback from farming community could contain showstoppers.
- New project. There is a lot of work to do here in identifying integration barriers and addressing them in a clear workplan

Question 5: Proposed Future Research Approach and Relevance.

- They have a good plan, and progress has been made, but they need to integrate their findings with equipment development and environmental (and regional availability) studies.
- Need more specifics on future data.
- Workplan needs to focus more on integration tasks. It should not be the feedstock research in the BC platform.

Additional Comments

Strengths

- Good plan well integrated with pretreatment area.
- Uncovering new critical issues, may profoundly change thinking on harvesting, storing and transporting residue.
- Cooperative effort among labs
- Information on harvest techniques and plant morphology versus processing ease and yield is very good information
- Need more of this type of data on other feedstocks
- Well aware of feedstock platform and issues for feedstock suppliers
- Interesting and valuable results reported

Weaknesses

- Need to include equipment manufacturer early
- Need to compress time table for this critical issue
- Need more input on the farmer perspective. Should include overall crop economics in the case of cereal grain/straw and corn/ stover applications. i.e., what is the impact on the farmer's gross and net income per acre? The SE US needs to be included.
- New project. Integration with biochemical platform could improve. The role of this project should be better defined.
- Project activities should align more closely with program goals and more specifically address barriers.

Technology Transfer/Collaborations

- Close coordination with pretreatment and availability studies indicated, which is good. This is extremely important to program.
- Needs more ASDA and regional state AG participation.
- Could improve – the role of this project as an integration tasks should be better defined.

Recommendations for Additions/Deletions to Project Scope

- Recommend that they ramp-up the program and condense the timetable. These data are too important to the program stretch out the program as indicated.
- Expand harvest techniques & plant morphology vs. processing ease and yield is very good information. More focus should be placed on this but with consideration of other treatment techniques.

- This project should compliment, not replicate work being done in the feedstock platform. Workplan should focus on ensuring that the latest information, materials and techno-economics are available to both platforms.

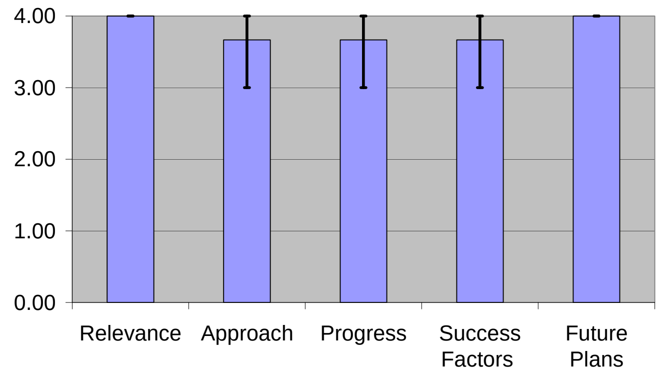
PI Response to Reviewer Comments

No comments were provided by the PI

Biochemical Processing Core R&D

<u>Project Title: Pretreatment and Enzymatic Hydrolysis</u>
<u>Principal Investigator</u>: Rick Elander, National Renewable Energy Laboratory

Relevance	4.00	0.00	0.00
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.67	0.67	0.33
Future Plans	4.00	0.00	0.00
Average	**3.80**		



Question 1: Relevance to Overall Objectives.

- Project is core to the overall program
- Extremely valuable work especially the analytical side.
- This project deserves the highest rating. It is right on track in its research portfolio. It is serving industry needs with an outstanding combination of fundamental and applied tasks. Impressive list of partnerships
- The project is clearly aligned with both short and long-term program goals and is ahead of the game in its preparation for long term goals and the future needs of this industry. Already working to meet 2017 goals.
- Also outstanding is the degree to which this project is integrated with other aspects of the Biomass Program.
- CAFI support was downplayed, but deserves much credit. The coordinating efforts provided to CAFI by this project are essential for its success.

Question 2: Approach to Performing the R&D.

- Good job of identifying barriers. One barrier not stated is inability to disclose certain data from enzyme companies
- May need to look into possibility of scaling down pilot and commercial unit operations to bench scale. In some areas the correlation between batch and continuous process may be problematic.
- Excellent focus on integration with other platform tasks.
  - Using the unique tolls available at NREL
  - Using BSC facility tools to guide research
  - Using analytical pyrolysis tools as a screening tool and to investigate the chemistry of recalcitrance
- This task is clearly up to date and flexible. The newest ideas and techniques are incorporated into the research plans.
  - Screening with advanced enzymes
  - Screening with cellulases and hemicellulases.
  - High solids pretreatment
  - Low severity pretreatment
  - High solids saccharification /rheology

Question 3: Technical Accomplishments and Progress

- Very good progress toward DOE goals, and good communication of results, except as noted above.
- Good yardsticks for determining progress.
- Impressive accomplishments covering many, diverse aspects of pretreatment in the Biorefinery.
- Multiclave screening at low solids loading to screen for feedstock variability.
- High solids pretreatment optimization.
- High solids saccharification work planned.
- Testing advanced enzyme systems.
- Excellent integration at all levels.
- Positioning project well for feed forward and feed backwards integration.
- Working closely with fundamental science projects to ID structure of oligomers and to verify nature of recalcitrance.

Question 4: Success Factors and Showstoppers

- Need more interface with structural and fermentation researchers.
- On track to meet goals. Providing innovative solutions. Addressing industry needs.

Question 5: Proposed Future Research Approach and Relevance.

- Progress is good and they have made it transparent, except for position of enzyme suppliers, which may be beyond their control
- Ambitious but comprehensive plan to meet short and long-range goals.

Additional Comments

Strengths

- Good plan, critical component of overall program
- Good interaction with other projects and external developments
- Barriers well identified and targets to overcome are spelled out.
- Sound research on fundamental problems.
- Outstanding degree of integration with other aspects of the platform
- Incorporating all of the newest ideas and technologies.
    - High solids PT and saccharification
    - Advanced enzymes
- Keeping relevant and aware of industry needs.
- Interacting well with community as evidenced by numerous partnerships and subcontracts. Providing essential support to the CAFI efforts.
- Clear vision and long-term plan for meeting industry needs.
- Well aligned with program, both short-term and long-term program goals
- Excellent balance of fundamental research and applied science.
- Leveraging unique capabilities at NREL, many types of PT reactors, BSCL and MBMS

Weaknesses

- Would like to see their timetable compressed more sense of urgency.
- An effort needs to be made to develop bench scale systems that better mimic larger scale continuous commercial processes.

- Need some work on non-acid hydrolysis pretreatment strategies to keep alternate options open.

- Extremely diverse set of tasks and activities. May need additional resources

Technology Transfer/Collaborations

- Must cut across all boundaries to be successful, they appear to be striving to do that.
- Could use more private sector participation.
- Keeping relevant and aware of industry needs.
- Interacting well with community as evidenced by numerous partnerships and subcontracts.
- Providing essential support to the CAFI efforts.

Recommendations for Additions/Deletions to Project Scope

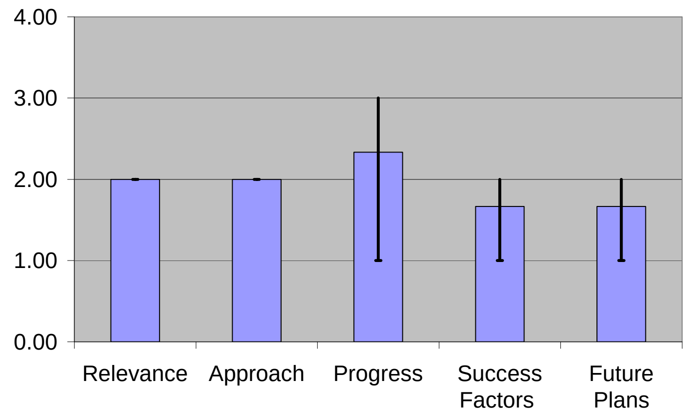
- There seems to be too broad a subject for presentation to reviewers. The section needs to be broken into multiple sections with more detail.

PI Response to Reviewer Comments

No comments were provided by the PI

<u>Project Title: Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol</u>
<u>Principal Investigator:</u> Larry Allen, Lucigen Corporation

Relevance	2.00	0.00	0.00
Approach	2.00	0.00	0.00
Progress	2.33	1.33	0.67
Success Factors	1.67	0.67	0.33
Future Plans	1.67	0.67	0.33
Average	**1.93**		



Question 1: Relevance to Overall Objectives.
- This is generous rating. Perhaps developing enzymes to hydrolyze stachyose has a place in the program , but it appears to aimed at producing a soy isolate, and by the way, a small amount of ethanol
- Have not done a thorough job of assessing market potential or private sector interest. More details on the economic claims need to be provided.
- Not clear how this work could have a significant impact on
- Renewable fuels production.
- No commercial partners

Question 2: Approach to Performing the R&D.
- Should be funded by NSF as it is fundamental research with no clear relevance.
- Minimal data beyond genetic engineering was provided. Too early in the development effort to determine.
- Technical weaknesses in enzyme selection, e.g. Why focus on xylanases when hemicellulose is galactan?

Question 3: Technical Accomplishments and Progress
- They have accomplished their first steps. Haven't shown how this can be relevant to program however, the reviewer was not qualified to judge the significant of the enzyme development effort but it appears that this is an isolated organism/ enzyme in search of a process instead of the opposite more conventional strategy.
- No data on economics.
- Compositional information on the feedstock (soybean meal) seems to be poorly understood.
- Progressing with workplan

Question 4: Success Factors and Showstoppers
- Too early to comment
- Very limited reference to success factors and showstoppers
- No plan presented to connect this project to liquid fuels production. Technical barriers not clearly defined.

Question 5: Proposed Future Research Approach and Relevance.

- They seem to have done some good research, but need to show relevance, more than the vague assertions so far
- There doesn't appear to be a strong plan towards future process/ technology development and commercialization.
- Workplan should be revised to connect this project to liquid fuels production. Technical barriers to this goal should be clearly defined and addressed.

Additional Comments

Strengths
- Good team to perform the genetic engineering planned.
- Isolation of new, potential valuable enzymes.
- Progress being made toward specific technical goals.

Weaknesses
- A conceptually engineered process estimating cost of process and overall economics within identified assumptions would guide this project to determine whether it is worthwhile.
- An industrial partner who has some interest would be helpful. (Presenter later, in later conversation indicated that they did have such interest, but is only anecdotal.)
- A more critical look at "what if successful" with an industrial partner would be very helpful (with a definition of "success.")
- Soy isolates have been around for a long time, and the small amount of alcohol produced in conjunction is interesting but not very exciting.
- There appears to be a poor understanding of the soy industry and potential impact of this concept. Significant work will be needed on pretreatment strategies, etc.
- Very long shot of commercial success.
- Not clear how success can be measured in terms of ethanol production
- Technical weaknesses in enzyme selections
- Could improve on understanding of the role of this project in OBP goals.

Technology Transfer/Collaborations
- Minimal beyond the molecular biology. Should have had a soy processor on board.

Recommendations for Additions/Deletions to Project Scope
- Recommend that project funding be very closely controlled and that other activities be limited until enzymology has been thoroughly demonstrated.
- Start working with a more relevant slate of enzymes.

PI Response to Reviewer Comments

A major problem with the reviews appears to be the mistaken assumption that this project is on the Commercialization, rather than the Exploratory & Development Research track. The presentation and documents supplied to the reviewers explained that the work was to determine the feasibility of converting soy carbohydrates into a feedstock for producing ethanol and, if feasible, developing an enzyme product capable of this conversion. There are currently no commercial industrial enzyme products for converting soy carbohydrate to fermentable sugars, so it is not just a matter of optimizing current products to determine the economic viability. Soy contains no starch or xylose based hemicellulose, making all current industrial enzyme products useless for the conversion. The galactose-based polymers of soy will require the discovery, cloning and expression of new enzymes to convert the soy carbohydrate to fermentable sugars.

Once the enzymes are in hand, fermentation of sugars to ethanol will be performed and the compositional quality of the residual protein will be determined.

Responses in order of the Weakness given on the previous page:

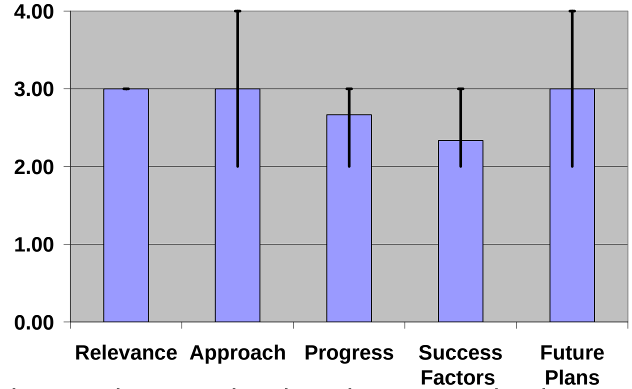
- An economic analysis was performed using the base case of a dry mill ethanol plant, no pretreatment of the soybean meal, 5% to 7% final ethanol, and $0.25 to $0.30/lb of soy protein. This resulted in ethanol production costs of <$1.00/gallon. Depending on the quality of the soy protein produced, values of and $0.65 to $1.00/lb of soy protein can be obtained; this would effectively make the production cost of the ethanol <$0.50/gallon. These costs make ethanol from soy the lowest cost source of bioethanol.
- Confidential discussions are continuing with two major soy crushers; both are extremely interested in the technology if feasibility is demonstrated. Because of the confidential nature of the discussion, we were not then, and still are not, at liberty to comment further.
- The reviewers appear to have little understanding of the soy industry. The processes for preparation of soy isolates are both capital and energy intensive processes resulting in products that sell for >$1.00/lb. An outline of the research and goals of the project were presented at The First Soy Protein Technical Advisory Panel of the United Soybean Board on Feb, 12, 2007 to major soy crushers, soy isolate producers, and isolate users. The talk was well received, and all attendees felt the work was very exciting and, if successful, this work would have a major influence on the future of the soy protein business. This presentation resulted in initiation of discussions with one of our two potential industrial partners.
- The lack of lignin and altered hemicellulose structure in the soybean meal suggest that traditional pretreatment, a major cost center for most cellulosic ethanol processes, would be unnecessary and useless. Preliminary results with thermostable cellulase confirm that pretreatment may be unnecessary.
- C5-6, with support from the state of Wisconsin commissioned a study on the current and potential markets for high protein soy isolates by Dr. R. Fortenberry, a noted agricultural economist at the U. of Wisconsin; the study was underway at the time of the presentation. Dr. R. Fortenberry has completed the study and identified a number of current and potential large markets for the highly concentrated soy isolates produced as a byproduct of ethanol production.
- Based on discussions with venture capital and angel investors, soy crushers and biodiesel producers, the soy conversion to ethanol has a much stronger shot at commercial success than most cellulosic processes due to the predictable cost and availability of feedstock and the strong byproduct value for the protein, both lacking in proposed cellulosic processes.
- Ethanol fermentations will be conducted using enzyme-treated and untreated soybean meal to determine the fermentability of carbohydrates. The goal of this work is to develop a mixture of enzymes capable of converting >80% of the soy carbohydrate into sugars fermentable by yeast.
- The reviewers appear to have not been paying attention. The presentation clearly stated that the xylanase cloning was done to validate the host-vector system for the cloning and expression of the enzymes, a milestone agreed to by the DOE. Never was it stated that the cloned and expressed xylanase was for use in soy hydrolysis. Enzymes to degrade soy carbohydrates are not commercially available, and must be individually discovered, identified, cloned and expressed. The presentation showed clear progress in identification and capture of thermostable bacterial cellulases, beta-glucosidases, and alpha-galactosidases, all enzymes absolutely required for soy hydrolysis.

- This work clearly falls within the goals of the OBP. In 2000, 2.5 billion bushels of soybeans were produced in the U.S., of which 1.6 billion were crushed for oil. This 1.6 billion bushels of crushed soybeans yielded 70.4 billion lb of soybean meal, containing approximately 30 billion lb of carbohydrate. Currently, soybean meal is sold as a protein source for animal feed; the carbohydrate portion of the meal has no commercial value. Assuming 90% efficiency in conversion to alcohol, the soluble and insoluble carbohydrates could yield as much as 2 billion gallons of additional ethanol. Besides creating a new source of bioethanol, the enzymes discovered here will have significant value in improving the economics of conversion of cellulosic biomass to ethanol.

<u>Project Title: Energy Corn Consortium</u>

<u>Principal Investigator:</u> Michael Blaylock, Edenspace Systems Corporation

Relevance	3.00	0.00	0.00
Approach	3.00	1.00	1.00
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	3.00	1.00	1.00
Average	**2.80**		



Question 1: Relevance to Overall Objectives.

- Interesting approach, in early stage of research. May be more barriers than recognized. Results may be important to overall program, but in different way than planned!
- Concept could be making a strong contribution to the biofuels effort.
- Potential improvement to biomass conversion processes, but not essential to their success
- Good partnerships in place.

Question 2: Approach to Performing the R&D.

- Good experienced folks working on project and the program is well designed to address issues.
- Have a good strategy for developing and testing the technology.
- Some technical questions about the screening of enzymes with relevant substrates.
- It is important that this project address the timing of enzyme production in the plant lifecycle.
- These enzymes must survive senescence as well as pretreatment.
- Assumptions are being made that viable , low severity pretreatment technologies will be developed

Question 3: Technical Accomplishments and Progress

- Project has an impressive milestone chart with time tables.
- Good progress was reported
- This will be difficult to accomplish until significant progress has been made.
- Progress shown in tobacco

Question 4: Success Factors and Showstoppers

- They appear to have a good handle on issues and how to deal with them
- No technical show stoppers were provided.
- Assumptions are being made that viable , low severity pretreatment technologies will be developed
- Other significant regulatory barriers lie ahead without clear plans presented to address them.

Question 5: Proposed Future Research Approach and Relevance.

- Aggressive timetable and good work plan
- Workplan should show clear plan to address known barriers

Additional Comments

Strengths

- Novel approach, may have ramifications on Himmel's project even if not successful
- Fits well with overall program approach.
- Good solid team which includes commercialization experience
- Raised venture capital for the approach
- Sound research plan.
- Understands significance and challenges of this work.
- Excellent group of partners

Weaknesses

- May have more issues to deal with than they let on.
- Need to develop protocols for measuring the benefits of the technology.
- Significant barriers to overcome
- Not clear how all barriers will be approached.

Technology Transfer/Collaborations

- If they are successful, the results may be more significant than just having enzymes in the raw material. It may verify of augment Himmel’s theory on cellulose recalcitrance by imbedding enzyme in cell wall regions which are difficult to reach with external cellulases
- Could use stronger partners. Current group has limited biomass experience.
- Impressive group of partners in place

Recommendations for Additions/Deletions to Project Scope

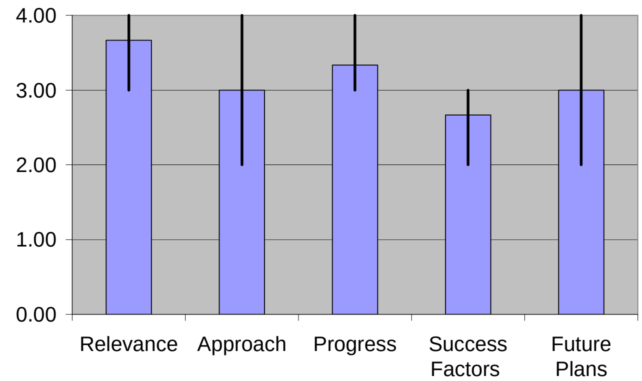
- Mike Himmel should work closely with them to have early access to cellular material with embedded enzyme
- Need to look at application into faster growing plants to test the impact of imbedded enzymes.

PI Response to Reviewer Comments

No comments were provided by the PI

Project Title: Lab Validation for Organism Development Solicitation Recipients
Principal Investigator: Kent Evans, National Renewable Energy Laboratory

Relevance	3.67	0.67	0.33
Approach	3.00	1.00	1.00
Progress	3.33	0.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**3.13**		



Question 1: Relevance to Overall Objectives.
- This could be the singularly most important project in the platform program for the present stage of development. A robust ethanologen could spell the success or failure of the upcoming demo plants.
- Good applicability. Will help with the development and benchmarking of new and existing organisms.
- Impartial comparison of available strains is clearly useful information, needed to guide feedstock selection in pilot scale facilities and beyond.
- Appropriate use of National lab expertise

Question 2: Approach to Performing the R&D.
- The validation and oversight, which is the focus of this program, is critical.
- Sound approach. More attention needs to be placed on costing. Budget seems too low for a though job on later phases of the task.
- Well thought out QA/QC plan with flexibility for as-needed improvements
- Project should be required to publish standard protocols
- The concept of an over-site / validation projects is new and may offer many lessons-learned for efforts of this type in the future.
- Adequate access to process engineering to guide these complex evaluations.

Question 3: Technical Accomplishments and Progress
- Doesn't fit this evaluation. Team is overseeing the development of organisms, mostly by industrial entities.
- Accomplishments are out of program manager's control, except to ensure that contractors are doing what they said they'd do.
- n\a program just starting. Good planning effort.
- Slow start, but acceptable early progress. Good plan

Question 4: Success Factors and Showstoppers
- Overcoming big technical hurdle.
- Researchers have to deliver
- Presented success factors not realistic. This program will not confirm commercial readiness of this industry or significantly reduce risk.
- Significant challenges lie ahead in comparing results in their chosen conditions with their substrates. This may be a highly controversial effort.

Question 5: Proposed Future Research Approach and Relevance.

- Program is ready to go
- Limited contingency planning.
- Good initial plan, but flexibility will be essential to incorporate
- Lessons learned and offer fair and equivalent comparisons

Additional Comments

Strengths

- On sight validations well thought out.
- Oversight plan good, retains good control over purse strings.
- Good standardization of review.
- Needed effort.
- Strong QA/QC plan for objective analysis of all strains, with flexibility to include lessons-learned.
- Access to process engineering task, essential for economic evaluations
- Willingness to take "poison pill"
- Relevant and needed by industry to guide process selections.
- Strong QA/QC plan with flexibility to include lessons learned.
- Goes all of the way through to evaluate impact on capital and investment impacts

Weaknesses

- Robustness criteria may be somewhat lacking, but four of the five recipients are industrial entities that have experience with commercializing such processes and should know what they need.
- 18-22 months to second validation is too long. Recommend 12-15 months
- More focus on the costing strategy. There is a sound strategy for benchmarking the organism but not the capital or operating cost efforts.
- No clear guidelines from DOE concerning disclosure of results
- Significant challenges in comparing results in their chosen conditions with their substrates.

Technology Transfer/Collaborations

- Goes without saying, ethanologens are critical to program.
- Information like that which will be generated in these projects is needed to guide feedstock selection in pilot scale facilities and beyond.
- Standard methods for strain evaluation should be published a kept available for the inclusion of new strains and organisms.

Recommendations for Additions/Deletions to Project Scope

- Spend more time on costing effort to ensure that cost comparisons are valid.
- Public disclosure of methods used for evaluation. Publication through ASTM as industry standard.

PI Response to Reviewer Comments

1. Robustness criteria may be somewhat lacking, but four of the five recipients are industrial entities that have experience with commercializing such processes and should know what they need.

Response: It is true that we are unable to broaden the robustness beyond the inhibitory compounds generally identified in pretreated biomass. Robustness could certainly expand to areas of scale-up, process variations, substrate variations, etc... DOE established this funding opportunity to address the development of ethanologens that meet the basic characteristics.

1. High yield and full sugar utilization with minimal byproduct formation
2. High final ethanol titer
3. High overall volumetric productivity
4. Tolerance to inhibitors present in hydrolyzates
5. Low cost fermentation process

This solicitation was directed to groups that have organisms under development and are near pilot demonstration (Topic 2) or groups that have identified organisms that could meet the above criteria with further development (Topic 1). Topic 2 projects require the organism to be tested in actual biomass developed by the Recipient's process, while Topic 1 projects are not required to ferment hydrolysate but need to demonstrate that the organism can tolerate inhibitory compounds generally found in pretreated biomass. We determined that acetic acid is one compound that is found in many types of pretreatment processes and severity conditions. The inclusion of furans and phenolics are less defined due to the variability of the chosen feedstock and the individual processes to create a fermentable sugar stream.

The topic 2 projects will need to demonstrate the robustness of their organism in fermentations of specified biomass as it applies to the specific process proposed by the contractor. This process will need to be commercially relevant confirmed by the validation of supporting process economic data.

2. 18 – 22 months to second validation is too long. Recommend 12 – 15 months.

Response: DOE/GO established a 6 – 8 month go/no go decision in the validation plan that does not require a site visit but it does require each project to set performance targets by which DOE will determine whether the research is following the established schedules and objectives. Since the performance targets are based solely on fermentation improvements, we felt it was necessary to provide adequate time to perform genetic research which can be a time intensive process (gene identification, construction, transformation, selecting isolates, testing expression, etc.). Twelve months did not seem adequate to allow the projects to select an isolate and perform preliminary testing in fermentations prior to conducting the pre-Stage Gate validation and successfully meeting the proposed target performance. Additionally, each project is required to establish and follow very specific milestones throughout the project and each milestone has performance metrics that are as quantifiable and specific as possible. The progress against the milestones is reported on each quarter by the PI, so any issues with validation should be flagged early by the PI allowing for mid-course corrections.

3. More focus on costing strategy. There is a sound strategy for benchmarking the organism but not the capital or operating cost efforts.

Response: "Perhaps it did not come across as clearly as desired, but there is a sound strategy for benchmarking both the organism and the process economics, ensuring consistency between the two. From the very start, DOE made it clear that these organisms were to be commercially viable, which meant demonstrating positive economics. A very important part of each proposal was filling out all benchmarking data, both for the organism (Table A) as well as the economics for the process that would use the organism (Table C). Capital and operating costs are broken out into significant detail as part of this table.

The primary purpose for engineers on the Validation Team during each benchmarking auditing visit is to understand a clear basis for where those economics come from. If they were derived from the Aden, et. al 2002 report, awardees are required to describe in detail how their process differs from the Aden, et. al. process. If their process is a large departure from Aden, et. al. or is a much different process, awardees are required to show material and energy balance data that provides the basis for their costs. A second key part of the economics strategy and auditing visit is to understand exactly how the strain improvements over the 36 month period translate into economic improvements. If there are discrepancies, NREL engineers will catch these during the auditing process.

4. No clear guidelines from DOE concerning disclosure of results.

Response: We fully agree that there was no specific language in the FOA that required the groups to provide information for public dissemination. Due to the commercialization requirements and IP and confidentiality related issues, DOE chose not to require disclosure information in addition to those already in place. The applicants are required to prepare a final technical report that contains meaningful, but non-proprietary information. DOE will on a case-by-case basis, continue to make determinations regarding requiring additional disclosure of results. An example of additional disclosure requirements in a recent Funding Opportunity Announcements may be found in the FOA entitled “Development of Saccharifying Enzymes for Commercial Use” which was announced in August 2007. The document includes the following section;

Dissemination of Research Results on Model Systems

Following selection and at the first audit, each successful and awarded applicant will be required to evaluate their enzyme system on a benchmark lignocellulosic feedstock prepared by NREL. Standard conditions will be established in an audit and validation plan that will be made available to any selected applicant prior to finalizing the award. The evaluation will be done either at the applicant’s site by personnel from NREL or at NREL. The determination of site will be made during negotiation of award. The data from these specific evaluations will be reproduced without attribution of applicant in an NREL Technical Report that will be available to the public.

No reference to enzyme type, source, or system description will be published, but comparative data regarding the performance of the enzyme or enzyme systems on the benchmark feedstock will be documented in the Technical Report.

5. Significant challenges in comparing results in their chosen conditions with their substrates.

Response: For Topic 2 projects, the researcher is required to perform the benchmark fermentation using the pretreated feedstock described in their process design. The benchmark is conducted at the beginning of the project to show the deficiencies of the organism by low fermentation yields, inability to utilize all sugars, or the need to dilute the feedstock to overcome inhibition by substrate toxicity or ethanol titer. The proposed research objectives should relate to the demonstrated fermentation deficiency and improvements to the organism should be reflected in the performance targets stated at the pre-Stage Gate and Final validation audit. In the event that the substrate or fermentation conditions change over the course of this project, the researchers will be required to conduct the modified benchmark with the starting organism and the improved strain to verify that the performance targets are achieved solely on the improvements to the strain.

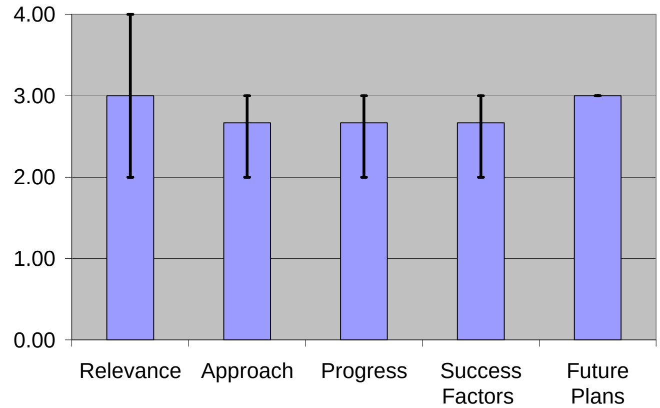
Specific strain improvements will also be validated by performing the series of pure sugar fermentations described in the validation plan throughout the project; #1 – 5 sugar fermentation to show sugar utilization capability, #2 – 5 sugar fermentation with acetic acid to show tolerance to known inhibitors, and #3 – elevated fermentable sugar with acetic acid to show ethanol titer in the presence of inhibitors.

The final performance target in the benchmark fermentation must be met to achieve the economic targets that are described in detail for the entire process. The process economics will be validated along with the technical performance of each group throughout the project. All cost improvements must be related to the improvement of the organism and not through other unit operations such as the inclusion of a detoxification process.

Project Title: Development of Applied Membrane Technology for Processing Ethanol from Biomass

Principal Investigator: Don Stookey, Compact Membrane Systems

Relevance	3.00	1.00	1.00
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.67	0.67	0.33
Future Plans	3.00	0.00	0.00
Average	**2.80**		



Question 1: Relevance to Overall Objectives.

- Aims at lowering the investment and operating cost of FGE dewatering
- Not specifically related to biomass. Only incremental benefits to the overall program, if any, if successful.
- De-watering technologies will be needed for the production of FGE.

Question 2: Approach to Performing the R&D.

- The technical barrier addressed is not that much of a hurdle.
- They are applying their technology from a different application to FGE dewatering, which, if successful, can lower the operating cost and investment of this process step. It does not appear to be a significant improvement over present technology, but may have some interesting ramifications in other areas within the program
- This appears to be a product development effort as opposed to an R&D program.
- Actual process samples may present a significant challenge
- Weak understanding of biomass conversion process and challenges to process separations.
- This is not a simple water/ethanol separation. No clear plan was presented to incorporate other process stream components into tests and screens.
- Workplan may overlap with those of other projects. Care should be taken to avoid duplication of efforts.

Question 3: Technical Accomplishments and Progress

- This is more of an applications development project, and they appear to be on track
- Don't see how this relates to biochemical platform.
- Performance indicators are really the competition.
- Early progress good. Potential candidates identified with relevant characteristics.

Question 4: Success Factors and Showstoppers

- Appear to be ready to proceed with a commercial product
- Have to overcome current technology providers already offering commercial membrane dehydration systems (Mistui White Fox).
- Actual process streams will be very different from simple ethanol/ water mixtures. Realistic substrates should be incorporated in screening at earliest possible point.

Question 5: Proposed Future Research Approach and Relevance.

- Appear ready to test at large scale, though it isn't clear where.
- Savings may not be enough to interest industry
- Plans for commercialization appear to be reasonably well understood.
- Waiting for data on 25 different materials that they have identified for further testing.

Additional Comments

Strengths
- Two candidates identified with excellent characteristics in laboratory tests.
- Manufacturing arrangements have been put in place for large scale production.
- Company has had extensive experience, though not in fuel ethanol
- Candidate materials show excellent permeation at low water levels, necessary for dewatering FGE.
- May have broader applications than just FGE
- The fluorinated polymers offer superior operating life vs. other membrane systems.
- Necessary technology for production of FGE
- Partnership in place to provide realistic substrates for testing.

Weaknesses
- Only lab scale so far, need flux stability, durability with real materials.
- Operating cost savings are not that significant, though dewatering investment savings may be if full scale testing confirms lab results.
- "Significant" energy savings not substantiated in presentation, should be able to equate to $/gal savings
- Sounds like they are solving a problem that may not exist. Does not appear to have a strong understanding of the current ethanol dehydration industry.
- Weak understanding of biomass conversion process and challenges to process separations.
- This is not a simple water/ethanol separation. No clear plan to incorporate other process stream components into tests and screens.

Technology Transfer/Collaborations
- Could have positive impact in production, but need field confirmation
- Needs help from people in the ethanol industry. Membrane dehydration is currently being marketed.

Recommendations for Additions/Deletions to Project Scope
- Needs to get more detailed information on competing technologies. The current net cost of operating a mol sieve is less than $0.02 per gallon. So, claims of saving $0.01 appear to be excessive.
- The title of the presentation is highly misleading.
- Keep workplan clearly defined as distinct from projects funded from other sources.

PI Response to Reviewer Comments
Regards Q.1
The membrane technology being developed is expected to be universally applicable to drying of biochemicals, not only biochemical FGE.

Regards Q.2

CMS has chemically and thermally resistant membrane polymers. The challenge is availability of equally chemically and thermally resistant porous supports on which our membranes can be applied.
CMS' emphasis in this project has been on the most difficult final purification of FGE. Our work on other solvent and chemical services suggests this to be the most severe and that minor moieties identified are less aggressive than the FGE itself.
Azeotrope breaking is a major energy consideration in FGE and is likely to be so in other chemicals as well. The objective of CMS' R&D efforts is a long-life membrane device for azeotrope drying of Fuel Grade Ethanol (FGE) that operates in continuous processing fashion.

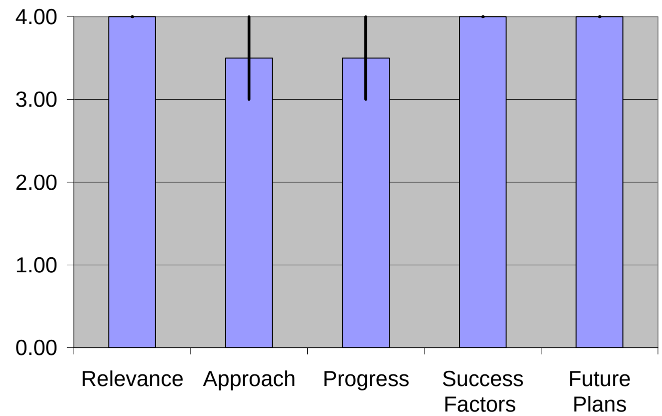
Regards Q.4
Indeed, many membranes have been tried for dehydration of FGE since as early as 1980; unfortunately most have failed in the harsh environment. Others are now in development and testing suggesting this is indeed a barrier and not a fait accompli.
CMS membranes have been certified and are commercial in other applications.
Our FGE dehydration product developments are in parallel and complimentary with current efforts on other products and applications.

Regards Q.5
Two engineering firm collaborators confirm interest in the projected 75% reduction in capital cost and $2 million operating cost savings at the 100 mgy scale for our FGE dehydration system.

Other Comments
Indeed, CMS intends to conduct laboratory tests with materials sampled from and representative of commercial processes. The high temperature test rig currently being developed will be portable and suited for easy field installation to also allow processing of various commercial process streams.
It is expected that biomass sourced FGE whether from enzyme catalyzed fermentation or from gasification routes, like corn sourced FGE, will also be processed from an azeotrope.
Preliminary results evidence the CMS high flux membrane and associated technology can be more cost-effective than current cycling molecular sieve practice and other lower permeance membrane devices.

Project Title: Biochemical Process Integration Task
Principal Investigator: Dan Schell, National Renewable Energy Laboratory

Relevance	4.00	0.00	0.00
Approach	3.50	0.50	0.50
Progress	3.50	0.50	0.50
Success Factors	4.00	0.00	0.00
Future Plans	4.00	0.00	0.00
Average	**3.80**		



Question 1: Relevance to Overall Objectives.

- Absolutely critical to program
- This is a highly relevant project generating data and samples that are needed by many areas of the biomass conversion industry
- Working well with other platform projects to validate data and compatibility of processes that are optimized in isolation.

Question 2: Approach to Performing the R&D.

- Project focuses other programs on hurdles to process, and integrates new developments into the process. This reviewer believes that the integrated process should be run, albeit at a small scale, from start to distilled beer, as soon as practically permissible, to detect other unforeseen cats and dogs that may emerge from the process. Closing a mass balance around a unit operation or coupled unit operations is good, but not enough.
- Workplan should be redone to more clearly define the transition of some activities to the feedstock interface project.
- The feedstock variability studies within this project should remain but should focus accessing on the economics impact of feedstock variability.
- Lab-based Stover rapid analysis tools should be made available to the feedstock platform.
- Analytical method development should now include aspects of education and outreach to the greater biomass conversion community.
- Some research choices may need to be re-evaluated in light of increased budgets. , e.g. limited fermentation testing, no long runs in the pilot plant.

Question 3: Technical Accomplishments and Progress

- Good job of uncovering and addressing issues.
- Great interface with national community – valuable resource
- Excellent job of making newest analytical methods available via website and training
- Great job of focusing in on essential tasks in times of lean budget.
- Expansion/update of pilot facilities needed and well deserved.

Question 4: Success Factors and Showstoppers

- This project can be considered the "traffic cop" of the biomass platform program
- Demonstrated, clear understanding of work that needs to be done.

Question 5: Proposed Future Research Approach and Relevance.

- Project is at the mercy of other projects, but appears to be proactively managed.
- Future research plan may need to be revised to include capabilities of new facilities, greater interactions with the feedstock platform, and interactions with the new DOE-funded pilot facilities.

Additional Comments

Strengths

- Developed some on line measuring techniques for specific raw materials
- Good job of addressing mass balance issues.
- On target and meeting goals.
- Good coordination and collaboration with other groups, internal and external.
- Proactive in planning
- Relevant and needed by industry
- Working well with other platform projects to validate data a compatibility of processes that are optimized in isolation.
- Great interface with national community – valuable resource
- Excellent job of making newest analytical methods available
- Expansion/update of pilot facilities needed and deserved.

Weaknesses

- Have not run an integrated process, from start to finish, for any length of time. It is arguable whether it should be run with key issues not resolved.
- Need more "sense of urgency" in planning and operation.
- Unclear transition of activities and projects to feedstock interface.
- No clear workplan presented to evaluate impact of feedstock improvements / variability

Technology Transfer/Collaborations

- They do a good job of this.

Recommendations for Additions/Deletions to Project Scope

- None

PI Response to Reviewer Comments

- Integrated process demonstration is important, but any unforeseen problems are currently being overshadowed by the larger performance issues in pretreatment, cellulose hydrolysis and ethanol fermentation. We intend to continue efforts to demonstrate integrated performance at the bench scale to be better positioned for FY09 or later year demonstration efforts using current and the new pilot facilities as soon as possible.
- There are some limitations with the current pilot plant that will be solved by the new facility expansion. The enhanced facility will be better able to flexibility meet varied operating and processing needs with a wider range of equipment.

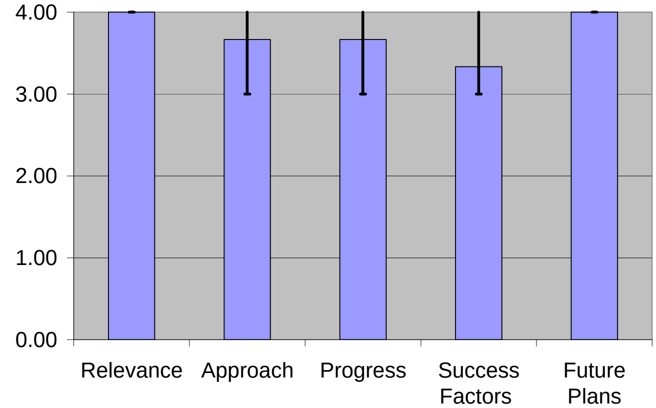
- We have begun efforts in FY08 to transition new feedstock method development activities to the Feedstock Interface Task, which should be completed by the beginning of FY09.
- This year we are finishing efforts to evaluate corn stover variability on process performance. We will start working in collaboration with the Feedstock Interface Task to identify likely feedstocks in which variability and/or improvements are possible and formalize plans in FY09.

Fundamentals and New Concepts

<u>Project Title: Targeted Conversion Research</u>

<u>Principal Investigator</u>: Mike Himmel, National Renewable Energy Laboratory

Relevance	4.00	0.00	0.00
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.73**		



Question 1: Relevance to Overall Objectives.

- Though scale-up can commence well before Mike gets all of his answers, this work will be the heart and soul of traversing the learning curve and troubleshooting for years into the future.
- As was pointed out by other reviewers, this group has gained international recognition, and thus draws experts from world wide.
- This brings ideas into the program in an immeasurable way, as well as attracting good people to the program.
- This work is critical to the timely development of fiber degradation technologies.
- This project is developing an array of fundamental research tools that may provide insight into many aspects of plant chemistry as they relate to biomass conversion
- Impressive list of partners and collaborators.

Question 2: Approach to Performing the R&D.

- Focused on the recalcitrance of cellulose to enzymatic hydrolysis
- The group has developed a very systematic approach to understanding the underlying physical and chemical issues impacting lignocellulosic conversion.
- Fundamental investigations should be continued until they can be handed off to applied projects. I would like to see some examples of a barrier being removed through a better understanding of the fundamental science; I didn’t see this in the material presented.
- I would like to see these tools applied to understanding the role of feedstock variability in downstream processing. It is not clear that more than one sample of corn stover was used.

Question 3: Technical Accomplishments and Progress

- The group has made measurable progress in developing the foundation upon which further research will be conducted
- Fundamental work in progress to support many aspects of biomass degradation

Question 4: Success Factors and Showstoppers

- The project is unraveling the mystery of cellulose recalcitrance
- The key technical parameters are well understood. The issue appears to be that success will not the either / or but in degrees. It may prove difficult for the research group to determine when they have reached the technical limits of their efforts.

- The project has identified many potential causes of recalcitrance but has not yet proven the clear connection in a manner that can be addressed in a practical way by biomass conversion processes.

Question 5: Proposed Future Research Approach and Relevance.

- Without the knowledge being developed as it is, no one would commercialize a lignocellulosic SSF process!
- Plan seems to include more interaction with other parts of the platform to test fundamental theories

Additional Comments

Strengths

- Strong, internationally acclaimed program.
- Tremendous progress in understanding recalcitrance to cellulose hydrolysis.
- Excellent communication of fundamental knowledge to the layman.
- Sound approach in a critical research area.
- Developing excellent novel capability for exploring the fundamental science of plant chemistry
- Impressive set of partners
- Some interaction with other platform projects
- Impressive animations and graphics – great communication tools.

Weaknesses

- The interface between this fundamental research and applications development resulting from it within the program is not clear.
- The effort is, imbedded in the weak acid, enzymatic hydrolysis platform.
- Should continue fundamental work to improve our understanding of plant chemistry.
- Should work with closely with feedstock interface as well as pretreatment and saccharification tasks to apply fundamental tools to applied research in overcoming recalcitrance. Stay with the fundamental science until theories can be tested.

Technology Transfer/Collaborations

- A high degree on a worldwide basis and it attracts expert knowledge and interest which is not quantifiable.
- This is one of the better applications of collaborative research.

Recommendations for Additions/Deletions to Project Scope

- The effort should be expanded to include preliminary work on other sugar platform technology options.
- Incorporate feedstock variability by working with feedstock interface task and the feedstock platform.

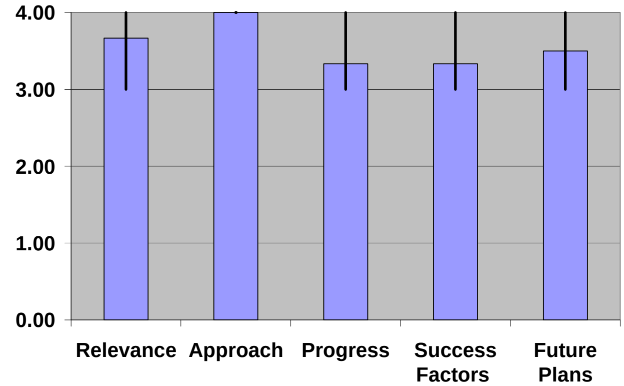
PI Response to Reviewer Comments

No comments were provided by the PI

<u>Project Title: Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products</u>

<u>Principal Investigator:</u> – K.T. Shanmugam, University of Florida, IFAS

Relevance	3.67	0.67	0.33
Approach	4.00	0.00	0.00
Progress	3.33	0.33	0.67
Success Factors	3.33	0.33	0.67
Future Plans	3.50	0.50	0.50
Average	**3.57**		



Question 1: Relevance to Overall Objectives.

- A thermo-tolerant organism for alcoholysis, to align with upstream and downstream process conditions will be a significant development, and contribution to the program.
- Highly relevant to the sugar platform development effort.
- Highly relevant project. Organisms will be needed that can convert both C5 and C6 sugars.
- Clear pathway to commercialization
- Partners in place.

Question 2: Approach to Performing the R&D.

- Thermo tolerance, though not critical to program, can be a significant process advance, reducing operating, energy and investment cost.
- Sound approach
- Testing on realistic substrates. Approach working and showing great progress.

Question 3: Technical Accomplishments and Progress

- Difficult technical issues have been successfully addressed and good progress made. Still a long way to go toward ethanol goal
- Proof of high temperature SSF concept has been accomplished
- Impressive results shown in SSCF mode

Question 4: Success Factors and Showstoppers

- Team has a handle on what is needed.
- Clear plan to commercialization. Partners in place. Optimistic about what can be accomplished in remaining period of performance.

Question 5: Proposed Future Research Approach and Relevance.

- Team are pros in this arena embarked on a tough technical problem
- Remaining barriers clearly defined.

Additional Comments

Strengths

- Good plan and good expertise employed
- Experienced experts in this particular area

- Tough technical issues dealt with successfully
- Sound plan for staged approach to development of high temperature SSF.
- Relevant work – great progress
- Commercialization partners in place.

Weaknesses

- Success with plan will still need to deal with low ethanol concentration in fermentation broth.
- There doesn't appear to be significant supporting research to draw upon.

Technology Transfer/Collaborations

- Limited collaboration.
- Significant progress in this area since last review.

Recommendations for Additions/Deletions to Project Scope

- None

PI Response to Reviewer Comments

- As the Reviewers pointed out, the ethanol concentration in the fermentation broth with these thermotolerant biocatalysts may not exceed 4.5%, the limit of ethanol resistance of these bacteria. We believe further improvement for ethanol tolerance can be achieved, as demonstrated with the ethanologenic *E. coli.*
- "There doesn't appear to be significant supporting research to draw upon." We concur with this comment and this is due to a lack of interest in this group of thermophilic facultative bacteria in the general scientific community. Unfortunately, we have no control over this. Our own research would benefit with additional investigators who are also actively working towards developing gene transfer and mutagenesis protocols for this group of interesting bacteria.

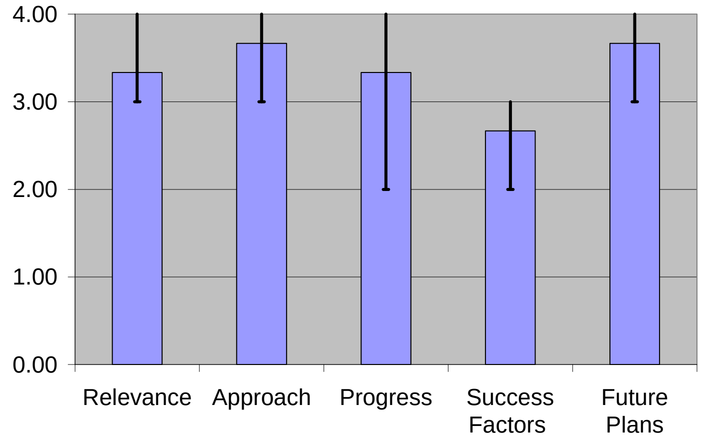
Technology Transfer/Collaborations

- Verenium corp. is interested in these biocatalysts but is waiting for the development of ethanologenic derivatives. Bioenergy International has licensed the bacteria as potential biocatalysts for L(+)-lactic acid production at higher temperatures that could minimize contamination during fermentation.

Project Title: Fungal Genomics

Principal Investigator: Scott Baker, Pacific Northwest National Laboratory

Relevance	3.33	0.33	0.67
Approach	3.67	0.67	0.33
Progress	3.33	1.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	3.67	0.67	0.33
Average	**3.33**		



Question 1: Relevance to Overall Objectives.

- No question, this can be breakthrough technology if successful
- Relevant to the sugar platform effort
- Investigation of organisms that have potential for significant impact on the industry. Relevance demonstrated by the impressive group of partners.

Question 2: Approach to Performing the R&D.

- Impressive approach to the task. From an industrial viewpoint, this is how we like to see basic research approached. Expect new intellectual property and novel useful results.
- Sound approach in developing a better understanding of fungal genomics.
- This fundamental project is focusing on the development of genomic tools, which could be applied in biomass conversion processes.
- Work plans keep an applied focus and awareness of needs of biomass conversion processes.

Question 3: Technical Accomplishments and Progress

- Covered a lot of technological ground in a relatively short time
- Progress shown. Very early in development effort. May be behind other research efforts. Possibly too late for first or second generation projects.
- Great web-based communication tools.
- Great progress shown in the identification of organisms and understanding morphology control

Question 4: Success Factors and Showstoppers

- May be overlooking some important aspects yet to be uncovered, but a good team is available to assist.
- Clearly identified. Showstopper may be understated.
- Early in the project. Too early to gauge potential impact on biofuels production

Question 5: Proposed Future Research Approach and Relevance.

- Still in early stage of technical development, but the team of collaborators is impressive.
- Keep up the great work.

Additional Comments

Strengths

- Refreshing new look by enthusiastic team
- Fungal organisms inherently more robust
- Well constructed program with excellent collaborations
- Not hindered by "NIH" syndrome!
- Good long term plan for development. Strong team.
- Excellent group of partners
- Great focus on toolkit development
- Continues fundamental research to applied work hand-off

Weaknesses

- Needs conceptual engineering guidance at onset to help guide the program
- May be overlooking ethanol oxidation problems in aerobic reactor, and should address early.
- This project appears to be on a very long term schedule. Likely minimal return on effort for 5 0 10 years. Show stoppers identified but they need to be brought into the R&D program.
- Too early in the R&D project to evaluate the role of filamentous fungus in ethanol production

Technology Transfer/Collaborations

- PI has constructed a strong team of collaborators/cooperators which bodes well for success.
- Good partnering effort. Strong team approach.
- Impressive group of industrial partners

Recommendations for Additions/Deletions to Project Scope

- Issues related to ethanol production in highly aerobic systems needs to be evaluated early on. This could be a major show stopper that needs more attention.
- I would like them to add screens for organisms with both ethanologen and enzymatic activity

PI Response to Reviewer Comments

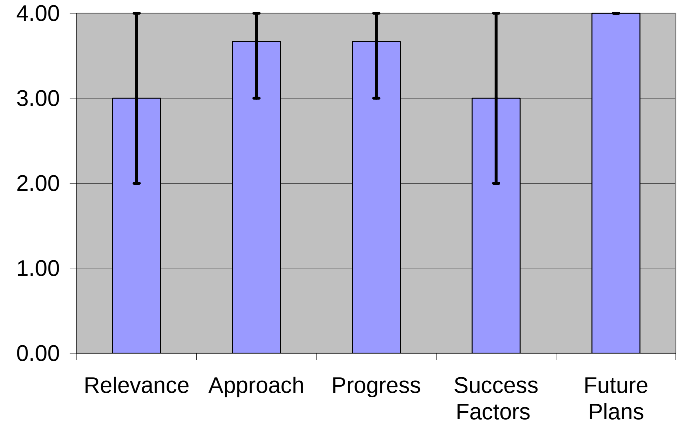
No comments were provided by the PI

Chemicals and Products

Project Title: Integrated Biorefinery – Separations/Separative Bioreactor - Continuous Bioconversion and Separations in a Single Step

Principal Investigator: Seth Snyder, Argonne National Laboratory

Relevance	3.00	1.00	1.00
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.00	1.00	1.00
Future Plans	4.00	0.00	0.00
Average	**3.47**		



Question 1: Relevance to Overall Objectives.

- The customer here is not ADM, their collaborator, but rather the end use, yet unidentified. Separation technology is important to the overall program, but not critical. An indication of market support would have been helpful
- Highly relevant to Biorefinery goals.
- This and related technologies could find application in other aspects of the Biorefinery.
- Impressive list of partners

Question 2: Approach to Performing the R&D.

- Interesting development, Novel technology developed which can have more far reaching applications.
- Effective use of underlying technologies initially developed for other industries.
- Setting and meeting high performance goals for themselves.
- Systematic plan to address all major barriers
- Good leverage of National Lab facilities and expertise.

Question 3: Technical Accomplishments and Progress

- Taking presentation at face value, the technology is ready to move into commercialization. Which begs the question of continued DOE support!
- Seven week demonstration with ADM is a significant accomplishment
- I would have like to see more data from the pilot scale work.

Question 4: Success Factors and Showstoppers

- Would award higher score if data on raw material and results were more than anecdotal.
- Working with relevant partners to make apply these techniques to bioprocess streams.

Question 5: Proposed Future Research Approach and Relevance.

- If ADM wants to commercialize, what is there to say?
- Keeping a good economic focus in technical research.

Additional Comments

Strengths

- Strong partnership
- Novel solution to technical problem
- May have much broader application
- Claimed to have 12 week continuous pilot operation problem free
- If ADM commercializes the process, it is a success
- The R&D effort appears to be near commercial.
- Excellent group of partners
- Impressive background research and attention to process economics
- Setting and meeting high performance goals for themselves.
- Good leverage of technical strength of national lab.

Weaknesses

- Pilot results claimed were anecdotal, not validated with data.
- Though the R & D effort indicates a broad based approach for applying separative bioreactors, it appears that the focus has been limited to a specific partners needs.
- Not enough data presented from ADM partnership

Technology Transfer/Collaborations

- This technology, if commercialized, could have application in other areas of DOE interest
- Good commercialization strategy. Limited partnering.
- Partners in place and actively participating in research.

Recommendations for Additions/Deletions to Project Scope

- If commercialized as claimed to be imminent, write as success and delete project.
- Though not part of the project at hand, the concept could have applications in biomass based ethanol platform.

PI Response to Reviewer Comments

Question 1:

- As mentioned in the discussion but not detailed in the submitted materials, Argonne's CRADA provides options terms to ADM to commercialize specific targets of interest. Argonne has retains the rights to pursue targets outside of the scope of the ADM CRADA. Argonne has evaluated the several models to move the technology towards a commercialization stage including licensing the technology to separate end users, forming a partnership with a technology provider, or seeking direct investment and forming a spin-off company. Discussions with potential commercial partners are protected by non-disclosure agreements. Argonne has two other CRADA's supported by DOE-Fossil Energy to use variations of the technology to desalinate water and to capture CO2 from flue gas.
- Argonne realizes that the technology could be used for multiple chemical products and also to improve efficiency in biorefinery processes. Argonne does not currently have funding to address other aspects of the biorefinery. Argonne is very interested in identifying the core value of the technology to OBP's mission and the Integrated Biorefinery.

Question 2:

- Argonne agrees with the reviewer's comments.

Question 3:

- Argonne believes that the reviewer's comments are premature. Argonne is scheduled to commission the pilot scale work in Q1 FY2008. Data from the pilot work is not expected to be available until Q2 or Q3 from FY2008. These results will be CRADA-protected and not available for public release.
- Before the technology is ready for commercialization, the pilot scale runs must be completed to gain a better understanding of the process economics. After the process economics are refined, the technology will still require standardization of the resin wafer fabrication technology. Argonne only has the capabilities to fabricate resin wafers one or two at a time. This is not a commercial process. Second the process performance must be validated at biorefinery conditions (biomass sugars, strain replacement, etc.) not laboratory / pilot conditions. Argonne's process models indicate that commercialization is still a few years away and will take additional investment.

Question 4:

- The performance results are CRADA-protected and cannot be publically released. Argonne believes that ADM is a relevant partner and has the technical and business resources to commercialize the technology in their field of use. Argonne has interactions with potential technology providers. Argonne is approached regularly regarding the results of the project. Argonne cannot reveal CRADA-protected information and refers potential end users to public releases of information. Argonne evaluates other opportunities to pursue the uses of the technology with relevant partners when it is separate from the scope of the active CRADA.

Question 5:

- Argonne agrees with the reviewer's comments.

Weaknesses

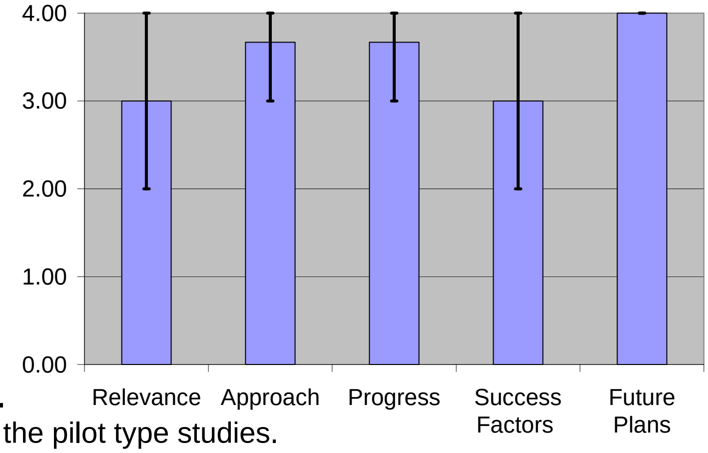
- Argonne agrees with the reviewers.

Recommendations for Additions/Deletions to Project Scope

- Argonne does not claim that commercialization is imminent. Argonne believes that the shows enough progress to continue down that pathway and warrants continued OBP investment. Before the technology is ready for commercialization, the pilot scale runs must be completed to gain a better understanding of the process economics. After the process economics are refined, the technology will still require standardization of the resin wafer fabrication technology. Argonne only has the capabilities to fabricate resin wafers one or two at a time. This is not a commercial process. Second the process performance must be validated at biorefinery conditions (biomass sugars, strain replacement, etc.) not laboratory / pilot conditions. Argonne's process models indicate that commercialization is still a few years away and will take additional investment.
- Argonne agrees that the technology cold have application in the biomass ethanol platform including multiple chemical products and also improve efficiency in the biochemical ethanol pathways. That work is beyond the scope of the current funding and project. Argonne is very interested in identifying the core value of the technology to OBP's mission and the Integrated Biorefinery.

Project Title: Advanced Catalyst Development for Polyols Production
Principal Investigator: John Holladay, Pacific Northwest National Laboratory

Relevance	3.33	0.33	0.67
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**3.47**		



Question 1: Relevance to Overall Objectives.

- Commercial type feed has been used in the pilot type studies.
- Cost performance looks attractive. Actual volume potential depends upon market acceptance and other socio-economic factors.
- Highly relevant application in the biomass to chemicals arena
- Working closely with an important partner in the petroleum industry.

Question 2: Approach to Performing the R&D.

- Good job of identifying hurdles and addressing issues. Process has excellent potential for further development into large scale uses. Good team assembled and industrial partner is heavy hitter in area.
- Very good approach. Strong focus on economics and market early in the development effort.
- Strong partnership with UOP teams.
  - Working with realistic bioenergy feedstocks
  - Clear and ambitious workplan.
- Role of each partner is clearly defined
- Performance targets being met.
- Good focus on techno-economics as ultimate metric

Question 3: Technical Accomplishments and Progress

- A long road to success, but looks like the corner has been turned. The evaluations and communication between team members' has been excellent. Now it is up to commercial partners to move the project forward into large scale usage arena
- Impressive developments in the area of catalyst development.
- Major accomplishments considering the time and money spent
- Strong partnership with UOP teams.
  - Working with realistic bioenergy feedstocks
- Performance targets being met.
- Generating valuable intellectual property

Question 4: Success Factors and Showstoppers

- Good plan, carried out to successful conclusion.
- Feedstock cost will ultimately limit the commercialization effort. This will be a challenge but with petroleum prices increases it should improve the potential for commercial success.

- Only vulnerability seen was around the yet unidentified significance of the carbon support. Plan in place for UOP to fund fundamental research focused on understanding the important characteristics of the carbon supports.

Question 5: Proposed Future Research Approach and Relevance.

- Hand off to industrial partner imminent, depends upon how well market accepts. Expect some hurdles to emerge, but the team is impressive
- Could have provided more details on work plan.
- Strong workplan for both PNNL and UOP partner

Additional Comments

Strengths

- Excellent team, very good commercial partner in UOP that has broad petrochem and wet milling experience.
- Program on target, goals met, practical targets achieved
- Impressive accomplishments in light of the time and money expended. It appears that this work has drawn upon other UOP work on Green Diesel production.
- Strong partnership with UOP teams.
  - Working with realistic bioenergy feedstocks
  - Clear and ambitious workplan.
- Role of each partner is clearly defined
- Performance targets being met.
- Bringing important industrial partner from petroleum industry into biofuels.
- Good focus on techno-economics as ultimate goal
- Generating valuable IP
- Excellent future potential

Weaknesses

- No end user apparent in presentation, UOP is a process licensing company.
- Economics. Needs to be able to deliver glycerol at a lower price. Though the available volumes are significant other technologies/markets are under development and there will likely be significant competition for the feedstock.
- Vulnerability around required carbon support. UOP to fund fundamental science as cost share.

Technology Transfer/Collaborations

- Very limited partnering. Needs to bring in glycerol supplier. Sources include biodiesel and ethanol producers.

Recommendations for Additions/Deletions to Project Scope

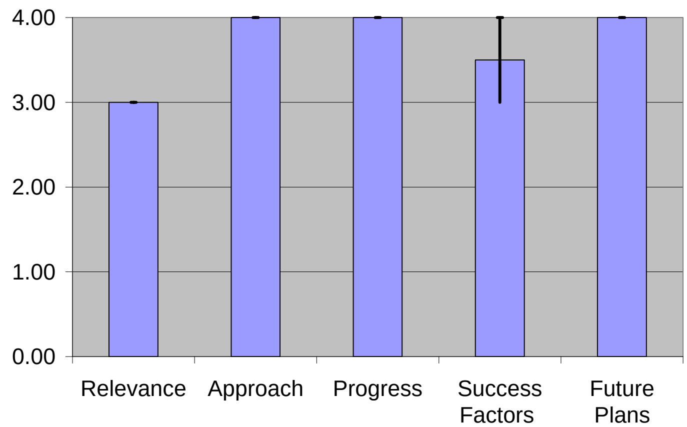
- May want to look at alternate feedstocks or sources. Also, need to look at how substrate quality impacts catalyst activity and life.

PI Response to Reviewer Comments

No comments were provided by the PI

<u>Project Title: Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis</u>
<u>Principal Investigator:</u> Rodney Williamson, Iowa Corn Promotion Board

Relevance	3.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	4.00	0.00	0.00
Success Factors	3.50	0.50	0.50
Future Plans	4.00	0.00	0.00
Average	**3.70**		



Question 1: Relevance to Overall Objectives.
- After the commodity chem. Feedstock area
- Great example of a successful project. This work has introduced an important slate of new bio-based materials.
- Valuable IP generated.

Question 2: Approach to Performing the R&D.
- Project was successful, what else is there to say
- Good example of bringing in best partners, wherever they are

Question 3: Technical Accomplishments and Progress
- Met the goals of the project. It is now in the hands of the market place.
- Great example of a successful project. This work has introduced an important slate of new bio-based materials.
- Valuable IP generated.

Question 4: Success Factors and Showstoppers
- Good example for DOE on a successful project.
- Some barriers remain, but excellent progress made in this project

Question 5: Proposed Future Research Approach and Relevance.
- It is going commercial. Success is out of the control of a government agency.
- Glad to see that USDA will continue to fund this work.

Additional Comments

Strengths
- Well defined program
- Good team working together
- Cross agency correlation, a model for future programs
- Focused on particular product
- Ongoing successful project
- Impressive slate of partners

- Generating valuable IP licensing strategy in place
- Clear relevance for integration into biorefineries

Weaknesses
- May not be large volume expected by DOE, (but can be)
- Uses corn starch, not cellulosic biomass (though could in the future)
- Claiming potential for integration in lignocellulosic Biorefinery, but no work planned for proof of concept.

Technology Transfer/Collaborations
- This should be a model for government labs and industry collaboration on a project
- Great example of how this should work.

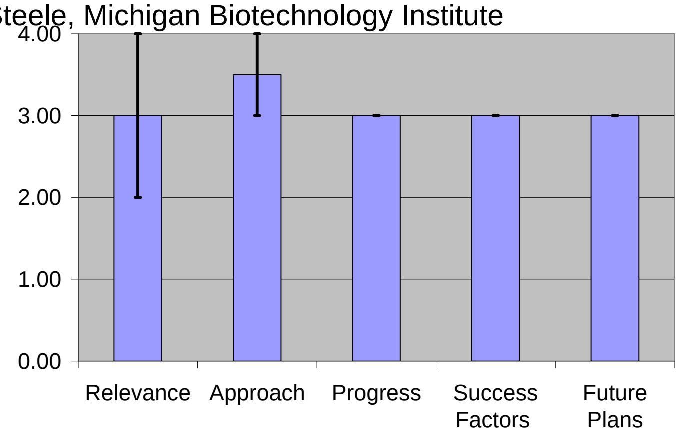
Recommendations for Additions/Deletions to Project Scope
- None

PI Response to Reviewer Comments
No comments were provided by the PI

Project Title: Succinic Acid as a Byproduct in Corn-Based Ethanol Biorefineries

Principal Investigator: Susanne Kleff and Bernie Steele, Michigan Biotechnology Institute

Relevance	3.00	1.00	1.00
Approach	3.50	0.50	0.50
Progress	3.00	0.00	0.00
Success Factors	3.00	0.00	0.00
Future Plans	3.00	0.00	0.00
Average	**3.10**		



Question 1: Relevance to Overall Objectives.

- Tough call on a good project. However, there is no indication that an end user who can set specs and economic targets is in place. It is laudable that a process licensee is on board, but making the product and selling the product are two distinct areas, both of which are critical to advancing to the next stage
- Clearly addresses the need for organisms that can ferment both C5 and C6 sugars.

Question 2: Approach to Performing the R&D.

- An outstanding job of well managed research and development. Hurdles were identified, objectives set and in general were met. Good team and good interaction demonstrated.
- Clear workplan for strain development
- Aware of economic impacts and challenges.
- Not clear what the plans are for working on the new strain with so little time left in this project.

Question 3: Technical Accomplishments and Progress

- Even though this is a very good project with excellent progress toward goals, the absence of specific economic/quality targets will hinder movement to stage 3. It is close to ready for pilot scale development, but needs market oriented inputs ($/lb at specification) to move forward. Poet may have a potential customer collaborating on the project, but it was not indicated in the presentation.
- Demonstrated ability to ferment both C5 and C6 Sugars. Significant cost reductions shown in overcoming expensive nutrient requirements of A. succinogensis.
- Generating valuable IP, partners in place to commercialize.

Question 4: Success Factors and Showstoppers

- From a process viewpoint, this could be outstanding, but from a market viewpoint, need minimum titer (is 74 G/L enough?) and other cost factors for acceptance in the market place that need to be addressed. There could be an economic showstopper of which they are unaware.
- Not quite there yet with economics of fermentation with this organism, but significant progress shown.
- Production partner identified, but end user not yet clear.
- Larger market may need to develop for Succinic acid for this approach to be economically viable.

Question 5: Proposed Future Research Approach and Relevance.

- Project has a lot of merit, but needs to address commercial aspect issues.
- Work left to be completed is clearly defined, but project period of performance nearly ended.

Additional Comments

Strengths

- Well managed project. Very good progress on goals.
- Excellent team interaction and industrial collaboration
- Raw starch fermentation impressive step
- Purity and yield data impressive.
- Uses continuous process economic updates to identify barriers.
- Commercialization partners in place for production. Hints of partner that could use succinic acid on commercial scale.
- They have developed an organism with demonstrated C6/C6 conversion, No Sterilization required
  - Identification of new isolate system with additional potential
  - Generating potentially valuable IP, licensing agreement in place.

Weaknesses

- Economic target for commercial success lacking
- Purity and yield data though impressive not clear on targets for success, or who establishes targets.
- Significant additional work required for isolation of new strain.

Technology Transfer/Collaborations

- They have a licensee (POET) which is good, but no indication of an end user who will actually buy/use the process output.

Recommendations for Additions/Deletions to Project Scope

- Need to clearly demonstrate that a commercial partner is in the wings who will take product if their commercial targets are met. Otherwise it is merely a good solution looking for a problem.

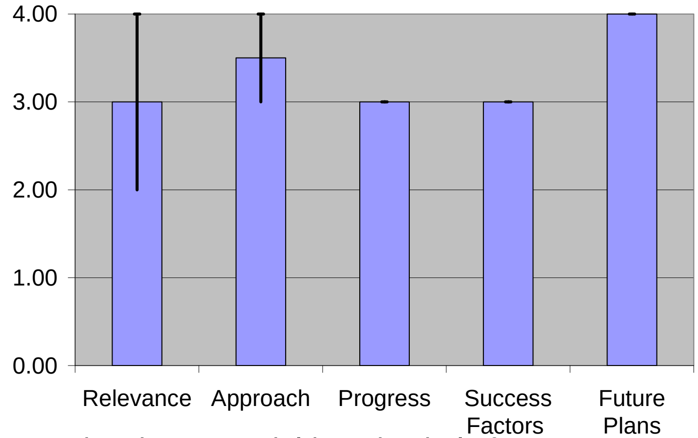
PI Response to Reviewer Comments

- End-users have been identified and contacted by MBI and the technology licensee, Poet. We are in active discussion with several chemical companies. Samples of fermentation derived succinic acid are currently being produced for end-user tests.
- The specifically targeted market segment cannot be disclosed due to the very competitive nature of the industry and affects the production price target that needs to be reached. The economic viability and market scale is dictated by the individual end-user's application.

Project Title: Development of Sustainable Bio-Based Products and Bioenergy in Cooperation with the Midwest Consortium for Sustainable Bio-Based Products and Energy

Principal Investigator: Mike Ladisch, Purdue University

Relevance	3.00	1.00	1.00
Approach	3.50	0.50	0.50
Progress	3.00	0.00	0.00
Success Factors	3.00	0.00	0.00
Future Plans	4.00	0.00	0.00
Average	**3.30**		



Question 1: Relevance to Overall Objectives.

- Could improve overall efficiency of dry mill operation, increase yield per bushel of corn and reduce the quantity of DDGS nation-wide. The customers are the existing dry mill ethanol plants. Some important issues need to be resolved, such as value and acceptability of the resultant higher protein “DDGS” (Purdue is well equipped to do that), fermentation of the xylans and nature (processability) of the treated “DDGS.”
- Impressive group of partners.
- Clear connections to relevant industry groups

Question 2: Approach to Performing the R&D.

- Well planned and coordinated. The research was well done and credible and used results from the CAFI program among others. Addressing the resulting liquid value and processability would add to the report
- Contributing to industry standards for DDGS. This is important for the future.
- Several aspects of this work were particularly interesting and relevant.
- Exploration of different enzyme systems.
- Exploring different products.
- Plans to publish research.

Question 3: Technical Accomplishments and Progress

- Results conform with expectations (objectives).
- It is nice to see the emphasis on standardizing analytical work across the labs. This took considerable effort but it elevates the quality of science in this project to publishable levels.
- The results of this work will contribute significantly to industry standards for DDGS

Question 4: Success Factors and Showstoppers

- Some issues not well addressed
- Unknown value of enhanced feed value after hydrolysis. Due to changes in amino acids during pretreatment is a significant concern.
- Extra value given to project by feed evaluations (above and beyond scope)

Question 5: Proposed Future Research Approach and Relevance.

- Although the project is somewhat narrow in focus, the work was well managed and executed. The project is ready to go to the next step, a slipstream in a commercial plant.
- There seems to be a clear understanding of the goals, limitations and work that remains.

Additional Comments

Strengths

- Well planned, executed and managed.
- Excellent collaboration among complimentary groups.
- Clear goals and clear accomplishments.
- Credible results ready to take to the next step
- Impressive group of partners
- Contributing to industry standards for DDGS
- Excellent scientific plan and cross-lab standardization of analytical methods
- Plans to publish research.

Weaknesses

- Value of resultant “modified DDGS” not adequately addressed.
- Processability issue of modified product not addressed, this could be a serious issue, or it could be marketed as a liquid feed or other options should be more fully addressed.
- May not be economically attractive enough to be adopted, as pointed out by the PI, due to market dynamics.
- Possible showstoppers around protein / feed value degradation

Technology Transfer/Collaborations

- A strongpoint of the project is the interaction, collaboration and cooperation between diverse groups. The data generated will be helpful to groups beyond the targeted “customers.”
- The degree to which the project interacts, interfaces, or coordinates with other institutions and projects, provides additional benefits to the Program.
- Partners in place who are asking for research in this area. A team has been established for deployment.

Recommendations for Additions/Deletions to Project Scope

- They really need to address the nutritional value and marketability of the material.

PI Response to Reviewer Comments

The following are further responses to the comments, suggestions, and critiques of the Stage Gate Review Panel. The responses address both verbal comments, comments communicated via a written document based on the Stage Gate Review of August 7-9, 2007. The following extended responses identified weaknesses.

1. **Unknown feed value of eDDGS.**

The feed value of the enhanced DDGS is being determined by a combination of industrially-accepted feed assays which is being carried out by an industrial laboratory, as well as determination of amino acid profiles. This has been carried out, and further validated since the August 7 meeting. The amino acid profiles show that pretreatment reduces the amount of lysine, but at the same time increases the amount of protein. As a consequence, the value of the feed, based on the amino acid profile of a larger fraction of protein, is approximately the same on a weight basis as the incoming DDGS, prior to pretreatment. Therefore, DDGS which enters the process, which may be valued at $105/dry ton, would be equivalent in value to enhanced DDGS that leaves the process, even though the protein content in the enhanced DDGS is almost double of the DDGS that enters the process. The lysine content in the current process (which is not optimized) is chemically modified during pretreatment and/or enzyme hydrolysis. Amino acid profiles, coupled with laboratory feed energy and digestibility analyses provide a preliminary measure, although the final value of the product would be established by actual field use and testing in animals. This is outside of the scope of the current project. Generation of large quantities of enhanced DDGS for these purposes will require the development of a test bed associated in an industrial corn-to-ethanol facility so that large quantities of material may be generated for animal testing. This option is being pursued, although it is outside of the scope of the current project.

2. **Not exploring DDG diversity.**

As explained during the Stage Gate Review, and as a follow-up in response to comments and clarifications associated with this report, the diversity of DDGS is indeed being examined. Reinforced by the comments of the Stage Gate Review Panel, our group has already obtained samples from 4 geographically-diverse dry grind facilities. These samples of DDGS, wet cake, and stillage will be used in order to obtain a complete work-up of composition and baseline enzyme digestibility (for untreated materials). These analyses will be carried out, in order to obtain variability of the feedstock, as well as changes in processing characteristics (if these are found to be an issue). Based on the initial results, one of the materials will be selected as being representative of a dry grind wet cake or DDGS material from a dry grind facility. This selected material will, in turn, be used to carry out a complete work-up consisting of pretreatment (both AFEX and liquid hot water), followed by enzyme hydrolysis and fermentation. This work will be carried out as part of the current project, and is expected to be completed by March and June, 2008.

3. **Results of economic modeling not shown (during presentation).**

The economic modeling has been developed in three papers, and is much more involved than could be presented in 20 minutes. Nonetheless, the summary slides during the presentation gave an overview of the ranges of costs associated with additional processing equipment required to convert DDGS to additional ethanol and value-added products. The economic modeling indicates that based on a liquid hot water pretreatment system, the net present value is approximately 32% if an alcohol price of $1.80/gallon is assumed, and a process for the pretreatment, hydrolysis, and fermentation of DDGS components is added on to an existing corn-to-ethanol plant. The economics are attractive and deserve further examination. The economic models also show that enhanced conversion of DDGS to ethanol may extend the operating range of a grain-to-ethanol plant, by enabling the plant to operate at break-even if ethanol prices decrease below $1.80/gallon. A life cycle analysis that accompanies the economic analysis shows that winter cover crops are desirable. A cover crop would decrease the amount of fertilizer that is used, as well as decrease emissions of nitrous oxide, which themselves are greenhouse gases.

4. **DDGS – The corn leaving the market might actually lower the available grain – which would have impact on cost of DDG.**

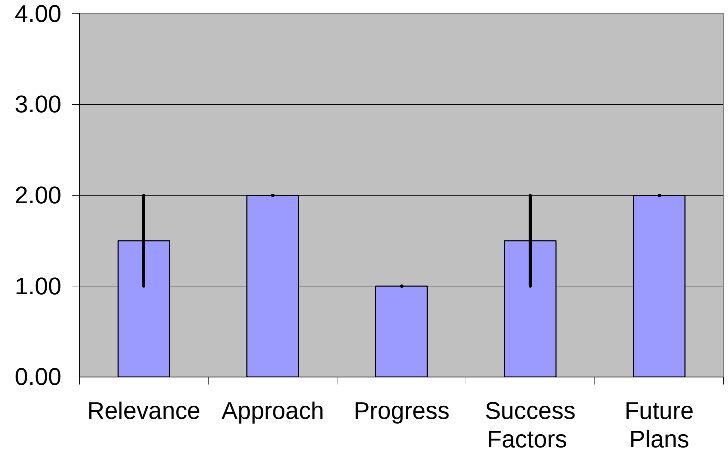
The price of corn is tied to the price of DDG, and the two price curves are parallel, with DDG having a slightly higher price per ton than that associated with corn. The price of DDG (which makes up approximately 25-30% of a bushel of corn), is included in the economic analysis and modeling. The sensitivity of the economics to DDG prices is being examined, although the quantities of DDG generated, and the geographic locations at which DDG is likely to accumulate will probably exceed the number of animals that could be fed at these same locations.

Consequently, the utility of converting DDG to ethanol is important. These analyses are still on-going, and will accompany the data that examines the impact of variability on economics of converting wet cake and DDGS to ethanol using cellulose conversion technology.

These comments give additional background for the PI responses offered during the Stage Gate Review. Economic modeling results were distributed in a detailed report given to the Stage Gate Reviewers in August. Projection of supply/demand issues and additional economics, are currently being undertaken as part of the wrap-up of this project.

<u>Project Title: Iowa State University Biomass Energy Conversion Project</u>
<u>Principal Investigator:</u> Norman K. Olson, Iowa State University

Relevance	1.50	0.50	0.50
Approach	2.00	0.00	0.00
Progress	1.00	0.00	0.00
Success Factors	1.50	0.50	0.50
Future Plans	2.00	0.00	0.00
Average	**1.60**		



Question 1: Relevance to Overall Objectives.

- The project does support the goals and objectives of the DOE biomass program. However, the information which could make the project attractive (hydrolysis yields, etc.) was anecdotal, with no actual data presented. It is an embryonic "try it and see what happens" approach.
- This project has good potential impact for products, but success is not essential for meeting the DOE 2030 goals.
- Past projects in this area have failed to meet economic targets

Question 2: Approach to Performing the R&D.

- A claim of hydrolysis of cellulose to sugars was made, but no data presented, nor was a clear targeted plan presented. What was hydrolyzed, xylans? Glucans? Both? Reviewer recognizes that equipment availability severely hinders progress, but all that was presented was a primer on super critical fluids, with no clear plan of what was sought nor any data on why the PI thought it would offer a new approach.
- Process economics need to be incorporated into this project to a greater extent.
- Successful conversion of ensiled corn could provide unique value to this process.
- No commercial partner identified

Question 3: Technical Accomplishments and Progress

- Embryonic with no results yet reported.
- Equipment delays had significantly delayed the start of this project, but some capability exists for testing at small scale.
- Only anecdotal results presented.

Question 4: Success Factors and Showstoppers

- Project has not gotten off the ground yet, nor was a clear plan on how to do it presented.
- This project may be significantly underestimating the complexity of biomass and its impact on the ability to meet their goals.
- Clean feedstock may be difficult to find.
- Affordable size reduction options may be difficult to find

Question 5: Proposed Future Research Approach and Relevance.

- This is a generous rating, because some aspects of the project are intriguing. If some data were presented to show why the investigators felt that the process has merit (i.e. Hydrolysis without added catalysts) it would have added credibility. There are too many unknowns at this point to give the overall project a high mark in any area.
- Before their equipment arrives, they can be doing extensive background research to learn from decades of research in this area. They should also select specific model biomass feedstock for evaluation.

Additional Comments

Strengths

- Interesting idea, may have some unique value to program
- ISU has good expertise to draw upon, although such collaborators were not mentioned.
- Simple process - potential for very interesting economics if successful in overcoming techno-economic barriers
- May interface well with ensiled biomass offering valuable feedstock options

Weaknesses

- No feasibility data presented, only anecdotal.
- No coherent plan presented.
- No clear approach or targets presented.
- Significant delays waiting for equipment. It is difficult to evaluate this project without any results presented.
- Biomass feed must be pumpable. Required dilutions may limit product concentrations
- The required size reduction may be a techno-economic showstopper.

Technology Transfer/Collaborations

- Interaction with U. of Iowa alluded to, but role not clarified.
- No commercial partners identified

Recommendations for Additions/Deletions to Project Scope

- PI should present a clearly specified approach and show his preliminary data on why the project has merit. The project may have important consequences to the biomass program, but the presentation was unconvincing and left that up to the imagination of the reviewers.
- Add more emphasis on process economics.

PI Response to Reviewer Comments

IOWA ENERGY CENTER

2521 UNIVERSITY BOULEVARD, SUITE 124
AMES, IOWA 50010-8229
iec@energy.iastate.edu

PHONE: 515-294-8819
FAX: 515-294-9912
www.energy.iastate.edu

Ms. Amy R. Miranda
Biochemical Platform Technology Manager
US Department of Energy
Office of Energy Efficiency and Renewable Energy
Office of Biomass Programs, EE-2E
1000 Independence Avenue, SW
Washington, DC 20585

Dear Ms. Miranda:

Thank you for the opportunity to comment on the Summary of Results for the Review Panel of the Biochemical and Products Platform held on August 7-9, 2007.

The Energy Center concurs with many of the reviewers' comments and correspondingly low score for the Iowa State University project, "Supercritical Fluids Processing of Biomass to Chemicals and Fuels", DE-FG36-06GO86014. We had not participated in a review under your program before and, obviously, did not anticipate the precise nature of the material you wished to see presented. Moreover, we assumed that information in the quarterly reports that we have been submitting would have been supplied to the reviewers in advance, thus providing some of the data they apparently sought. By the questions asked and the comments made, this appears to have been a poor assumption on our part.

If there is a future review, we strongly encourage that more explicit guidance on your expectations should be provided. Additionally, we encourage you to provide more advance notice of the review. In this instance, the short notice prevented us from being able to schedule participation by the two primary researchers involved in our project. Had they been present, many of the reviewers' concerns could have been addressed directly and with, we believe, a far different outcome.

We do have a few additional comments that we would like to provide for your consideration. For simplicity, we have organized our comments within the categories used in the evaluation: relevance, approach, progress, success factors, and future plans.

Relevance

The highest rated project at the review focuses on enzymatic hydrolysis. One significant aspect of Iowa State University's work focuses on water hydrolysis of cellulose and has shown promising results (conversions to sugar with yields of approximately 65% without the use of catalysts), yet the ISU project received a considerably lower ranking. It leads us to question whether the reviewers truly understand the work in progress.

The ISU project has also shown, with the limited equipment available, the use of supercritical fluids for direct conversion of sugars to glycol with an 80% yield using no catalyst, production of biodiesel using no catalyst, and conversion of sugars to isosorbide. Although the project has not made progress as rapidly as we had hoped, the work still remains relevant.

Approach

Early in the project, the guidance obtained from DOE was to focus on discovery of the principles underlying supercritical processes as they apply to transformation of biomass to chemicals. We were specifically discouraged from pursuing the creation of particular end products or examining in detail the economics of producing those products commercially. It is somewhat surprising, then, to have the reviewers push for more economic analysis and even question the lack of a commercial partner for research at this early stage.

This apparent contradiction aside, a venture capitalist is now funding some work – outside the scope of this project – related to cellulose hydrolysis.

Progress

The project has been seriously delayed by the inability to quickly procure and receive required equipment. Some early delays occurred due to miscommunication between the Iowa Energy Center and ISU's Purchasing Department. This led to a bid package for the supercritical reactor to which potential equipment fabricators were unable to respond. Subsequent re-bidding was successful. However, the fabricator experienced difficulty obtaining the special alloys, in the needed stock sizes, for machining the reactor components. Further delays occurred due to shortages of valves and other components as a result of the petroleum industry's efforts to rebuild infrastructure following the Katrina hurricane.

The reactor system has subsequently been delivered to Iowa State University and is being installed and commissioned. We anticipate beginning the experimentation phase of the project soon and will be working diligently to produce experimental results relevant to DOE's biomass program.

Success Factors

While the project has been severely hampered by difficulties in obtaining advanced equipment, it has none-the-less shown promise with the less-versatile equipment at hand. We believe that there has been sufficient preliminary success to illustrate the relevance of the work and the merit of pursuing it further.

Future Plans

A suggestion was made by the reviewers to conduct extensive background review of prior research in the area of supercritical fluids. The Energy Center and its partners conducted this literature search prior to commencing this project. It is a standard part of our operating procedures. It must be noted, however, that much of the prior work with supercritical fluids is not directly related to the current scope of work. Prior work on the use of supercritical fluids for hazardous waste destruction, solvent extractions, and creation of hydrogen from biomass have helped to inform the current project, but are not direct antecedents to the reactions being explored within this project.

Thank you again for the opportunity to comment. We look forward to engaging with you in future project reviews.

Sincerely,

Norman K. Olson, PE
Principal Investigator

APPENDIX A

Agenda

Day 1 – August 7th

9:00 – 9:10	Process Overview	*Valri Lightner, Office of the Biomass Program*

10:50 – 11:00 Break

11:20 – 12:10	➢ Preprocessing and Storage Systems Development/Qualification	*Corey Radtke, Idaho National Laboratory*

12:10 – 1:10 Lunch

2:20 – 2:30 Break

2:30 – 3:20	➢ Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol	*Larry Allen, Lucigen Corporation*

Day 2 – August 8th

9:00 – 9:50	➢ Lab Validation for Organism Development Solicitation Recipients	*Kent Evans, National Renewable Energy Laboratory*

9:50 – 10:00 Break

10:00 – 10:50	➢ Development of Applied Membrane Technology for Processing Ethanol from Biomass	*Don Stookey, Compact Membrane Systems*

11:20 – 12:10	➢ Biochemical Process Integration Task	*Dan Schell, National Renewable Energy Laboratory*

12:10 – 1:15 Lunch

1:35 – 2:25	➢ Targeted Conversion Research	*Mike Himmel, National Renewable Energy Laboratory*
2:25 – 3:15	➢ Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products	*K.T. Shanmugam, University of Florida, IFAS*

3:15 – 3:30 Break

3:30 – 4:20	➢ Fungal Genomics	*Scott Baker, Pacific Northwest National Laboratory*

4:40 – 5:30	➢ Integrated Biorefinery-Separations/Separative Bioreactor- Continuous bioconversion & separations in single step	*Seth Snyder, Argonne National Laboratory*

Day 3 – August 9th

9:00 – 9:50	➢ Advanced Catalyst Development for Polyols Production	*John Holladay, Pacific Northwest National Laboratory*
9:50 – 10:40	➢ Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis	*Rodney Williamson, Iowa Corn Promotion Board*

10:40 – 10:55 Break

10:55 – 11:45	➢ Succinic Acid as a Byproduct in Corn-Based Ethanol Biorefineries	*Bernie Steele, Michigan Biotechnology Institute*
11:45 – 12:35	➢ Development of Sustainable Bio-based Products and Bioenergy in Cooperation with the Midwest Consortium for Sustainable Bio-based Products and Energy	*Mike Ladisch, Purdue University*

12:35 – 1:35 Lunch

1:35 – 2:25	➢ Iowa State Univ. Biomass Energy Conversion Project (IA)	*Norman K. Olson, Iowa State University*

2:25 – 3:00 Break

4:00	Adjourn

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Amy Miranda
Please copy Leslie Pezzullo (lpezzullo@bcs-hq.com)

You have been invited to serve as a Reviewer for the DOE Biochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	No
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Biochemical Platform Analysis	
Preprocessing and Storage Systems Development/Qualification	
Pretreatment and Enzymatic Hydrolysis	
Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol	
Energy Corn Consortium	
Lab Validation for Organism Development Solicitation Recipients	
Development of Applied Membrane Technology for Processing Ethanol from Biomass	
Biochemical Process Integration Task	
Targeted Conversion Research	
Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products	
Fungal Genomics	
Integrated Biorefinery – Separations/Separative Bioreactor – Continuous Bioconversion and Separations in Single Step	
Advanced Catalyst Development for Polyols Production	
Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis	
Succinc Acid as a Byproduct in Corn-Based Ethanol Biorefineries	
Development of Sustainable Bio-Based Products and Bioenergy in Cooperation with the Midwest Consortium for Sustainable Bio-Based Products and Energy	
Iowa State University Biomass Energy Conversion Project	

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Amy Miranda (202-586-6471) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

________________________________ _______________________

Signature Date

____

Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session: 2 3 4 **Reviewer Name**: ______________________________

Title of Project: ______________________________

Presenter Name: ______________________________

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ______________________________

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach** to performing the R&D.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

U.S. Department of Energy
Office of the Biomass Program
Thermochemical Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Biomass Program Peer Review for the Thermochemical Platform, held on July 9th and 10th in Golden, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the thermochemical area they were investigating (i.e. analysis, gasification, cleanup, fuel synthesis or pyrolysis). The platform review agenda is attached to this report as Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for comment, and any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Paul Grabowski
Thermochemical Platform Technology Manager
DOE/EERE, Office of the Biomass Program

Pyrolysis Oil to Gasoline	4.00	3.67	3.33	3.33	3.00	3.47
Syngas Platform Analysis/Thermochemical Platform Analysis	4.00	3.33	3.67	3.33	2.50	3.37
Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer Project	3.33	3.00	3.00	3.33	4.00	3.33
Thermochemical Conversion of Corn Stover	3.67	3.00	3.00	3.00	3.33	3.20
Integrated Catalyst Testing	3.33	3.33	3.33	2.33	2.33	2.93
Engineering New Catalysts for In-Process Elimination of Tars	3.67	3.33	2.33	2.67	2.67	2.93
Pyrolysis Oil R&D	3.33	2.67	3.00	2.67	3.00	2.93
Catalyst Fundamentals (Integration and sub tasks)	3.67	3.00	2.67	2.00	2.50	2.77
Syngas Quality for Mixed Alcohols	3.33	2.67	2.67	2.33	2.50	2.70
Gasification of Biorefinery Residues (lignin/modeling and optimization)	3.00	2.67	2.67	2.33	2.67	2.67
Biomass Gas Cleanup Using a Therminator	3.33	2.67	2.67	2.33	2.00	2.60
Biomass Derived Syngas Utilization for Fuels and Chemicals	3.33	2.67	2.33	2.67	1.50	2.50
Applications of Thermo-Depolymerization Technology	2.50	2.00	1.50	2.00	1.50	1.90
Small Scale Biomass System (Biomax)	3.00	1.00	2.00	1.50	1.50	1.80
Developing Thermal Conversion Options for Biorefinery Residues	2.00	2.00	1.33	1.67	2.00	1.80
Mississippi State University Sustainable Energy Center (MS)	2.33	2.00	2.00	1.33	1.33	1.80
Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant	2.33	2.00	1.67	1.33	1.33	1.73
Mississippi State University Sustainable Energy Center (MS)	2.00	1.67	1.67	1.33	1.33	1.60

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Program Peer Review Platform Results

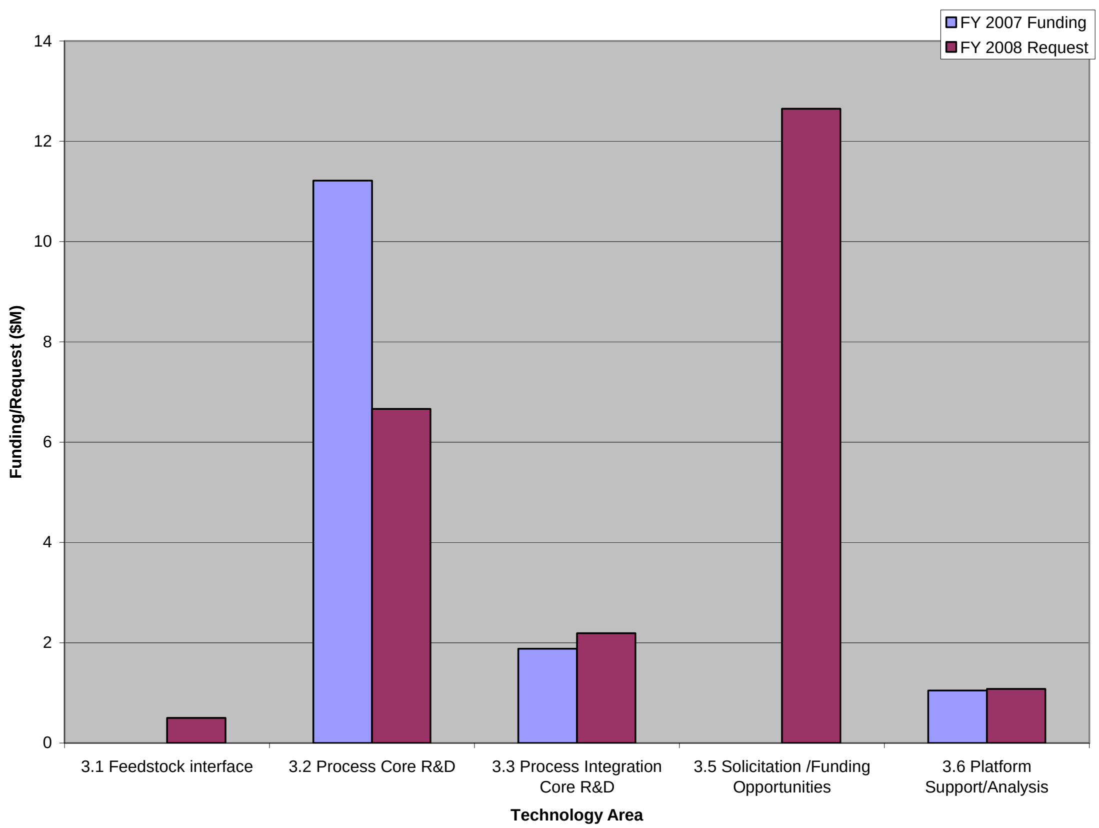
Platform Direction

In 2007 and 2008, the TC platform made a concerted effort to expand its R&D activities to include a wide range of available feedstock (agricultural residues to wood), a wide range of processing options (gasification and various liquefaction options), and a wide range of fuels synthesis technologies (alcohol, gasoline, diesel, jet). Two solicitations (one in 2007 and 2008) are key in developing projects for this expanded R&D effort. Beginning in 2008 these initial efforts have received additional funding. Additionally, the platform expanded an effort in feedstock analysis and logistics. These activities address multiple strengths and weakness.

The Thermochemical Conversion Platform is facilitating technology that can process multiple feedstocks, including those less suitable for biochemical conversion technologies and can produce a wide range of fuels.

In 2007 the platform completed design reports for both gasification to alcohol fuel and 2008 a design report for pyrolysis to a refinery feed for gasoline/diesel production.

Platform Funding (in $M):



Specific Responses to Select Comments

Good partnering with UOP who has experience in both petroleum processing and biochemical processing. Good university, industry and national lab cooperation. Using technology that for the most part has long experience.		We agree, thank you
This platform has such potential in addressing multiple issues – biorefinery integration, integration with existing fuel infrastructure, utilization of multiple feedstocks, etc. In the gasification focus of the platform, there seems to have been an appropriate focus on bottlenecks (catalysts/tar removal).		We agree, thank you
Innovative dryer designs would benefit from a wide range of technologies if successful, including the biochem projects.		Not sure what this comment means. We agree that a wide range of conversion technologies would benefit from feedstock processing technologies, including cost-effective dryers. Our interface with the feedstock platform work is addressing that.
Concern about what has changed that makes this attractive now, and worth reopening		Internal and external analyses have indicated that both gasificationa and pyrolysis of biomass for cost-competitive fuels production are cost competitive with biological conversion technologies. Commercial interest has validated the analyses as has 932 and 10% selections.
Subsequent to many years of funding projects to produce syngas, perhaps work should be oriented to separation of producer gas components. A review of current data should be accomplished to delineate relevance of simple and/or multiple technology procedures. Numerous projects were not focused; a shotgun approach often was evident. Economic assessments could have been made with current available information.		Our analysis, which is updated annually, shows that gas cleaning and fuels synthesis are the best areas for our investment. While gas separation technologies are fairly well-developed commercially. We agree that a review of separation technologies may be valuable. Agree, reviews such as this and the peer review help us to identify projects that need to be refocused and projects that should potentially be eradicated.

It is not clear that DOE has been under funding gasification and pyrolysis R&D once the DOD and DOE coal R&D activities and the commercial R&D investments are considered. Clearly OBP needs to integrate these technologies into their Bioconversion platform but a more rigorous effort is needed to define what needs to be done for OBP and OBP's goals, not necessarily to benefit the industry at large. I want to reiterate one of the reviewer's comments as I support these strongly. ▪ Techno-economic modeling is needed to help determine the priority direction for platform funding. ▪ The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach. ▪ The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE, (coal) and DOD R&D.		We continually try to coordinate and exchange info with other agencies. Successful implementation of this is difficult, at best. Agree, we perform this TECO modeling annually Agree Agree
Duplication of effort re cellulosic biomass gasification and coal gasification as they pertain to the use of the syngas produced.		Our primary activities focus on gas cleanup, and conversion of biomass-produced syngas to fuels. This syngas can often contain poisons to fuel catalysts). Once the syngas is cleaned syngas from coal and biomass can be used equally well to produce fuel, however, the fuels focus of OBP may differ from fuels important to DOE-FE resulting in complimentary programs.
The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.		We do partner with the feedstock platform. Due to funding levels this began in FY08. Potential interactions with DOE-Sc and NSF are handled through the Biomass Research R&D Board Conversion Group.
Project outlines need to be developed to focus on particular, relevant objectives.		Agree
Look for opportunities to share research and development with some of the fossil fuel programs**.**		Agree, we generally have done this via industry projects. We have discussed with DOE's coal gasification group, with limited results.
It would be beneficial (but probably very difficult), for the thermochemical conversion program to establish criteria to validate the claims of the plethora of companies purporting to have viable, operating gasifiers.		Agree, this is probably better suited for an industry group. However, the TC platform is developing a data base of companies/universities/labs involved in this technology—a first step.

Program Review Comments

Strengths

- The program is based on an excellent understanding of the issues.
- Good partnering with UOP who has experience in both petroleum processing and biochemical processing. Good university, industry and national lab cooperation. Using technology that for the most part has long experience.
- This platform has such potential in addressing multiple issues – biorefinery integration, integration with existing fuel infrastructure, utilization of multiple feedstocks, etc. In the gasification focus of the platform, there seems to have been an appropriate focus on bottlenecks (catalysts/tar removal).
- Innovative dryer designs would benefit a wide range of technologies if successful, including the biochem projects.
- Decision to increase focus on pyrolysis has tremendous opportunity. Focus on producing a range of biofuels, several of which would be attractive to the existing petroleum industry.

Weaknesses

- The weakness is in the goals as articulated in the MYPP, which seem to not be in agreement with the MYPP's statements about the opportunities and challenges with a wider variety of feedstocks. This platform is the primary platform to address their use.
- Concern about what has changed that makes this attractive now, and worth reopening.
- As previously noted on this form and in the platform review, the platform should widen its scope to reach its potential in achieving the President's goals.
- Subsequent to many years of funding projects to produce syngas, perhaps work should be oriented to separation of producer gas components. A review of current data should be accomplished to delineate relevance of simple and/or multiple technology procedures. Numerous projects were not focused; a shotgun approach often was evident. Economic assessments could have been made with current available information.
- Some of the projects seem unfocused; a shotgun approach often was evident. It seems that these are older projects and projects that were not solicited by the platform. The stronger platform focus on fuels should to remedy this.
- It is not clear that DOE has been under funding gasification and pyrolysis R&D once the DOD and DOE coal R&D activities and the commercial R&D investments are considered. Clearly OBP needs to integrate these technologies into their Bioconversion platform but a more rigorous effort is needed to define what needs to be done for OBP and OBP's goals, not necessarily to benefit the industry at large. I want to reiterate one of the reviewer's comments as I support these strongly.
  - Techno-economic modeling is needed to help determine the priority direction for platform funding.
  - The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach.
  - The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE, (coal) and DOD R&D.
- Duplication of effort in regards to cellulosic biomass gasification and coal gasification as they pertain to the use of the syngas produced.

R&D Portfolio Gaps

- There wasn't a separate slide for gas, but this matter was embraced in comments and recommendations. The most important gap is to increase funding. Other "gaps" cited is acceptable to this reviewer.
- The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.
- I agree with the platform review's analysis of the existing gaps.
- The potential of this platform is so great it deserves additional funding to determine whether the remaining challenges can be resolved. This may be the same state of affairs that existed when the platform was downsized some years ago, but the world has moved forward since that time.
- Project outlines need to be developed to focus on particular, relevant objectives. Perhaps because of considerable past work, the researchers did not feel the need to define specific items, rather to continue with general approaches which can be projected well with enthusiastic show persons. In particular studies, there appeared to be little awareness of DOE goals. Available dollars may have been spent on state of the art equipment; however, lack of securing researchers capable to utilizing the equipment as well as the data. There is a need to have given projects exhibit coherent approaches to posed questions.
- No additional gaps to those identified in the platform review report.

Additional Recommendations, Comments and Observations

- It would be beneficial (but probably very difficult), for the thermochemical conversion program to establish criteria for to validate the claims of the plethora of companies purporting to have viable, operating gasifiers.
- Look for opportunities to share research and development with some of the fossil fuel programs**.**
- Project outlines need to be developed to focus on particular, relevant objectives.
- The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.

Platform Review Feedback

Specific Responses to Select Comments

Considering the value and potential, the thermochemical platform has been under funded for several years.		Agree, however the funding increase is gradual.
The thermochemical route is a valid endeavor, and perfectly situated to handle a variety of feedstocks and solve problems that still exist in the biochemical side – producing real fungible liquid transportation fuels		Thank you
The panel feels that the expansion of the platform to include other products and fuels is		Agree

very positive, but suggests that the focus be broadened to include Fischer- Tropsch liquids and a more rigorous effort on pyrolysis oil.		
Would like to see some more fundamental approaches to pressing problems of the thermochemical platform.		Agree, we would like the Office of Science to engage the fundamental science around thermochemical conversion including how the mechanisms of how biomass deconstructs under heat (gasification or liquefaction).
The focus on tar removal maybe too limited in scope, the program should consider alternative gasification approaches that limit tar production, and other alternative research paths.		We agree and are seeking to improve gasfication and pyrolysis processes.
Techno-economic modeling is needed to help determine the priority direction for platform funding.		Yes, our analysis does just this.
The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach.		Agree
The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE office and laboratories that specialize in coal gasification.		Agree, see above
Needs to be an assessment of fossil vs. biomass vs. co-processing: policy, economic and deployment		Our analyses consider these issues, as well as several environmental issues.
Should not assume that gasifiers have to make high level of tars		See above
Standardized/consistent economic and process modeling should be done to provide a baseline for comparison of all project goals and work		agree

General Platform Comments

- Considering the value and potential, the thermochemical platform has been under funded for several years.
- The thermochemical route is a valid endeavor, and perfectly situated to handle a variety of feedstocks and solve problems that still exist in the biochemical side – producing real fungible liquid transportation fuels
- The panel feels that the expansion of the platform to include other products and fuels is very positive, but suggests that the focus be broadened to include Fischer Tropsch liquids and a more rigorous effort on pyrolysis oil.
- Would like to see some more fundamental approaches to pressing problems of the thermochemical platform.
- The focus on tar removal maybe too limited in scope, the program should consider alternative gasification approaches that limit tar production, and other alternative research paths.
- Techno-economic modeling is needed to help determine the priority direction for platform funding.

- The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a “Consortium for Applied Fundamentals and Innovation (CAFI)” style approach.
- The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE office and laboratories that specialize in coal gasification.

General Comments (applicable to all presentations)

- Understanding this is a reinvigorated program:
  - There was a great deal of variation in quality and focus within the Portfolio of projects.
  - There was a lack of continuity within the scope of several projects
  - Needs to be an assessment of fossil vs. biomass vs. co-processing: policy, economic and deployment
  - Several of the projects would have benefited from a guiding scientific hypothesis, novel technology or high through-put technology
  - Standardized/consistent economic and process modeling should be done to provide a baseline for comparison of all project goals and work
  - Should not assume that gasifiers have to make high level of tars
  - Current analysis work should be broadened

Initial Reviewer Feedback – Comment Summaries

Analysis Projects

Project Title: Syngas Platform Analysis/Thermochemical Analysis
Principal Investigator: Andy Aden, National Renewable Energy Laboratory

Strengths
- This work is "critical" to the platform
- It was technically competent analysis
- The PI is using industrial sound analysis methodology
- The thermochemical design report is a very valuable, publicly available document

Weaknesses
- Before selecting a process to be used in the analysis, there needed to be a back of the envelope analysis for multiple technologies processes.

Suggestions/Comments
- This type of analysis should be used in guiding R&D efforts, which currently may be understated
- Critical literature review of current pyrolysis reports before pursuing the new pyrolysis design report
- Need to work hard to get cost numbers that are representative of current industry

PI Response
- There was back of the envelope analysis performed, but not presented in the time allotted.

Gasification Projects

Project Title: Gasification of Biorefinery Residues
Principal Investigator: David Dayton, National Renewable Energy Laboratory

Strengths
- Good fundamental and supporting deployment work
- The completed feedstock comparison is valuable

Weaknesses
- Gasifier is fixed and tar is looked at as inevitable
  - Several large-scale demo gasifiers are available and should be considered in this task.

Suggestions/Comments
- Program needs to address how this project is coordinated. (there seems to be a little of everything happening)
- Should be using one process engineering model (ASPEN/ChemCAD)

- Should look at MFIX as an analytical tool

PI Response
- Tars are inevitable, it's more of a question of concentration and quantity
- ASPEN & ChemCAD have different uses

Project Title: Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant

Principal Investigator: Ed Gray, Antares

Strengths
- A focus on otherwise intractable waste
- Good recognition that the target has changed, and a good faith response to the initial plan

Weaknesses
- Need to critically look at the merit of this technology, the review panel sees limited impact and the need for good economics and catalyst performance evaluation

Comments/Suggestions:
- Technology has been extensively explored for a number of options, but technology does not seem to meet performance requirements
- Project was not related to current Program goals, but the shift towards utilization of biorefinery residue focus should be encouraged.
  - Methane is not a liquid transportation fuel

PI Response
- The process is supporting the Program, we are making power to facilitate ethanol production and developing another way of addressing other wastes

---

Project Title: Mississippi State University Sustainable Energy Center

Principal Investigator: Mark Bricka and Mark White, Mississippi State University

Presentation was not consistent with the presentation formatted, making this project difficult to evaluate

Strengths
- MTG element produces a fungible transport fuel.

Weaknesses
- Some project activities are clearly redundant and the remaining tasks are not aligned with the Program goals and priorities.
- Overall project lacked direction and clear justification
- The project was based on using regional feedstocks with off the shelf technology, not utilization of novel technologies or processing
- A poor understanding of literature led to duplication of prior work lacking novelty

Comments/Suggestions:
- Project activities are clearly redundant
- Take direction from program to better align with the Program goals and priorities (liaison with DOE office)
- Need to work hard to understand program goals and focus work on innovative technologies
- The project needs guiding outside committee to organize projects under this task
- Need outside collaborators

PI Response
- Presentation would have better address the issues with more guidance

---

Project Title: Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer
Principal Investigator: Kevin Whitty, University of Utah

Strengths
- Very well thought-out and executed around good sound science
- Outstanding technical approach
- Good collaboration

Weaknesses
- Gasifier technology weak

Comments/Suggestions:
- Not a current priority feedstock to the Program
- Continue to look for opportunity for use of facilities that would fit the program goals

PI Response
- Presentation would have better address the issues with more guidance

---

Gas Cleanup and Conditioning Projects

Project Title: Biomass Gas Cleanup Using a Therminator
Principal Investigator: Santosh Gangwal, Research Triangle Institute

Strengths
- Great approach
- Relevant to the Program goals
- Reasonable participants and plays to RTI's strengths

Weaknesses
- Unclear as to the innovation of the catalyst.

Comments/Suggestions:
- Focus majority of effort on truly making the tri-functional catalyst work.

- Reviewers had a hard time understanding the details of the technology presented. What was the funding for?
- CFD modeling should be performed to help with scale up

PI Response
- No response given.

Project Title: Engineering New Catalysts for In-Process Elimination of Tars
Principal Investigator: Larry Felix, GTI

Strengths
- Novel technology
- Multiple options for use and decoking
- Nice integrated approach with several collaborators

Weaknesses
- Novelty of approach may limit the implementation
- Poisons effect on the process should be evaluated

Comments/Suggestions:
- Economic comparison needs to be evaluated
- Suggest careful consideration of commercialization pathway

PI Response
- No response given.

Project Title: Catalyst Fundamentals
Principal Investigator: David Dayton for Kim Magrini, National Renewable Energy Laboratory

Strengths
- Good collaboration between national laboratories
- Good utilization of analytical tools
- Good integrated approach

Weaknesses
- Progress is incremental
- Innovation with new catalyst formulation is weak

Comments/Suggestions:
- Future purpose and direction is questionable
  - Suggest a “CAFI” like solicitation for testing
- Higher through-put screening of current or new catalysts is vital

PI Response
- The current work with the nickel catalyst is on further understanding the shape and activity of Nickel. Two aspects that are not well known, but once classified can improve with other metals.

Project Title: Integrated Catalyst Testing
Principal Investigator: Calvin Feik, National Renewable Energy Laboratory

Strengths

- There is value in having the capability (and using it) to test on a large-scale – with “real” syngas
- Methodical testing approach

Weaknesses

- Needs to run more catalyst evaluations in pilot scale reactor

Comments/Suggestions:

- The reviewers would like a closer inspection of the anomalies in the data presented

PI Response

- No response given.

Fuel Synthesis Projects

Project Title: Thermochemical Conversion of Corn Stover
Principal Investigator: James L. Gaddy, Bioengineering Resources Inc

Strengths

- Novel technology
- Pilot plant running – it looks like it works

Weaknesses

- No performance or economic\data supplied
- Didn’t approach the project with any optimization of the gasifier, fermenter, or gas clean-up system
- Separation of ethanol/water was under defined and seems to be problematic

Comments/Suggestions:

- Gasifier eliminates tar
- What is left to be done, project seems to be close to commercialization

PI Response

- Is being used in a 932 selected project

Project Title: Small Scale Biomass System (BioMax)
Principal Investigator: Robb Walt, Community Power Corporation

Strengths

- They are building on past successes
- Liquid fuels technology presented is revolutionary.
- Operational small scale unit

Weaknesses

- Provided no information on the liquid fuels technology to validate claims
- Not high efficiency conversion of biomass to fuel due to the power co-product

Comments/Suggestions:

- Need a long-term demonstration for liquid fuels production System as designed for producer-gas production, not supposed to operate 24 hrs, on/off system as needed. (amended based on comments in review)

PI Response

- No response given.

Project Title: Biomass-Derived Syngas Utilization for Fuels and Chemicals
Principal Investigator: Santosh Gangwal, Research Triangle Institute

Strengths

- Building on past success
- Good facility and capabilities for this project

Weaknesses

- Modest and undifferentiated catalyst advancements
- Focus on Fischer-Tropsch liquids vs. mixed alcohols is unclear
- An industrial partner needs to be replaced for the project to continue

Comments/Suggestions:

- Need to aggressively focus on catalyst evaluation with realistic gas streams

PI Response

- No response given.

Project Title: Syngas Quality for Mixed Alcohols
Principal Investigator: Jim White, Pacific Northwest National Laboratory

Strengths

- Sound technical approach
- Team demonstrated an understanding of literature and have looked at other options
- Plan for high through-put screening is valuable
- Good collaboration between NREL & PNNL

Weaknesses

- Target (for goals) selection does not seem to be done on sound economic model and mixed alcohol (vs. just ethanol)

Comments/Suggestions:

- Engineering solutions to reactor geometry would strengthen this project

PI Response

- Project (including the target goals selection) is being heavily driven by analysis work, early DOE focus on ethanol vs. mixed-alcohol. Will have internal discussions to broaden scope.
- Reactor design was never defined as priority, though always planned to examine reactor to demonstrate ability and look more at poisons.

Pyrolysis Projects

Project Title: Pyrolysis Oil R&D

Principal Investigator: Doug Elliott, Pacific Northwest National Laboratory

Strengths

- Standards development will benefit industry (amended based on comments)
- Seems like the project is evaluating design options and looking at new opportunities and concepts (and goals align with program)
- Project lays out a program direction for DOE
- Tied with the UOP effort
- Good collaboration between NREL&PNNL

Weaknesses

- Goals and technical plan could have been a little more ambitious
- Focus of overall project needs to be better defined

Comments/Suggestions:

- Project would benefit from a more intense computational and economic modeling effort

PI Response

- Please provide target specific comments on the draft targets established. The project is not far enough along to have economic modeling.
- Need a process model to a point to what we know needs to eliminate, modeling able to inform technical progress, right now no model, once get it to re-work will need specific variables.

Project Title: Pyrolysis Oil to Gasoline

Principal Investigator: Richard Marinangeli, UOP

Strengths

- Credible industrial player
- Good partnerships, partners playing to their strengths
- Exceeded DOE targets
- Good approach, nice development of both economic and technical work
- Environmental impact analysis is beneficial

Weaknesses

- Uncertain of initial economics (stage 1, understood, just be careful with the chart)

Comments/Suggestions:

- Team would be strengthened with the additional of a production partner
- The reluctance of government to give equal credits to this type of diesel as other diesel. It will be eligible for credit (renewable diesel), just not for the gasoline fraction (also LR – are people trying to reverse decision)

PI Response

- No response given.

Project Title: Developing Thermal Conversion Options for Biorefinery Residues

Principal Investigator: Vann Bush, Gas Technology Institute

Strengths

- Developing an universal front end processing unit for regional feedstock applications (NV and AL)

Weaknesses

- Project plan was unclear
- Didn't appear to have investigated potential technical and economics showstoppers small scale/portable complex systems
- Did not define economic analysis needs to be performed on the process
- Handling and cleaning of woody biomass has been extensively studied by the pulp and paper industry

Comments/Suggestions:

- The panel suggests an in-depth stage gate prior to initiation of new work
- This technology has been funded at very high levels (estimated at $70MM), and the added value for this particular project is unclear
- The panel suggests the team consider other pre-treatment technologies

PI Response

- No response given.

Project Title: Mississippi State University Sustainable Energy Center

Principal Investigator: Phil Steele and Leonard Ingram, Mississippi State University

Strengths

- Pyrolysis reactor is currently available and have identified a supplier that can manufacture it
- Recognized the need to narrow focus to areas of interest to the DOE program

Weaknesses

- No use of innovative technology was presented to the panel

- Prior to commencing R&D, engineering/process analysis to help define technical targets was needed to better guide this work
- Some project activities are clearly redundant and the remaining tasks are not aligned with the Program goals and priorities.
- Overall project lacked direction and clear justification
- A poor understanding of literature led to duplication of prior work lacking novelty

Suggestions/Observation:
- Take direction from program to better align with the Program goals and priorities (liaison with DOE office)
- The project needs a guiding outside committee to organize projects under this task
  - Need outside collaborators
- Presentation was not consistent with the format
- Project activities are clearly redundant
- Need to work hard to understand program goals and focus work on innovative technologies that

PI Response
- No response given.

Project Title: Applications of Thermo-Depolymerization Technology
Principal Investigator: Tom Butcher, Brookhaven National Laboratory and Gabe Miller, Society for Energy and Environmental Research

Strengths
- Process to economically convert waste material into a transportation fuel is beneficial

Weaknesses
- Representative of technology provider should have been present to help explain project goals
- This project is not in alignment with Program goals
- Impact on biofuels industry will be insignificant
- Technology will have to compete with credible industrial organizations that have processes that can utilize waste grease

Comments/Suggestions
- The panel suggests an in-depth stage gate prior to initiation of new work
- Inclusion of Brookhaven with the specialized analysis capabilities would strengthen this project
- This technology has been funded at very high levels (estimated at $70MM), and the added value for this particular project is unclear
- There are other technologies for conversion of fats that maybe a better process option.

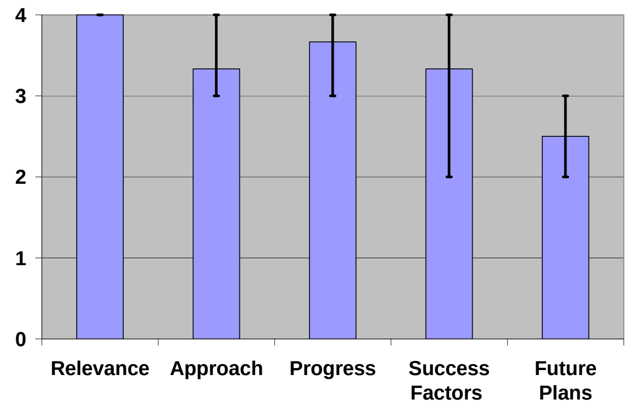
PI Response
- No response given.

Full Reviewer Comments and Scores

Analysis Projects

<u>Project Title: Syngas Platform Analysis/Thermochemical Platform Analysis</u>
<u>Principal Investigator:</u> Andy Aden, National Renewable Energy Laboratory
<u>Reviewers Comments on Stage</u> – Several stages hit; key to total process since Analysis provides economic foundation for all efforts.

Relevance	4.00	0.00	0.00
Approach	3.33	0.33	0.67
Progress	3.67	0.67	0.33
Success Factors	3.33	1.33	0.67
Future Plans	2.50	0.50	0.50
Average	**3.37**		



Question 1: Relevance to Overall Objectives.
- Very important work. Needs to include better validation from engineering firms with real life experience and cost information.
- This task defines the basis of all activities in the thermochemical area. It provides the measuring stick to rate optional technologies on a level playing field.
- Process design and engineering analysis as demonstrated in this study is an essential tool in both the evolution of design of renewable fuel plants and in the selection of research projects to support the technology development.

Question 2: Approach to Performing the R&D.
- Thermochemical conversion is complex, but this is a very good start.
- Need to keep focus on the current process, and not worry about addressing all the options. If someone wants additional analysis on new option then let them pay for it.
- Given the position that this task plays in the evaluation of the entire program, a better approach is needed. Pick and stay with an evaluation procedure.
- The approach should identify what technologies are being evaluated and why (what benefits are expected)
- Since no gasifier is commercial, the baseline needs to consider several of the pre-commercial gasifiers out there
- Need to assess data in e.g. Aspen data bases more carefully in a few cases.

Question 3: Technical Accomplishments and Progress
- Great progress with the current base case.
- This work is of the greatest importance and they have done a good job to date.
- Need to work with an engineering, procurement, and construction company to get good costing data
- Need to use one simulation package – suggest ASPEN Plus

- The key accomplishment is the completion of the design report. The report is very good.
- Room for improvement still exists in the using the economics to better target Program R&D goals. This work provides the foundation for all of the Program efforts and is absolutely essential.

Question 4: Success Factors and Showstoppers

- Need to include the LCA issues (more than cost) of converting biomass oxygen to water and CO_2.
- The project needs to be used for comparison evaluations of the products of the R&D activities. Head to head comparison to identify the expected benefit.
- That a technology will provide towards lowing the cost of the Fuel.
- Need to make sure there is detailed external review of models. Since too many assumptions are "buried" that impact the models
- The real shortcoming is in credibility of the capital estimates. NREL is in a position to be directionally correct but unlikely to be as accurate as an engineering or producing company.
- The analysis still requires some integration considerations.
- Economics and capital estimates are still need industrial input.

Question 5: Proposed Future Research Approach and Relevance.

- Good plans especially the integration with biochemical platform and other targets. Don't need to solve every problem.
- The specifics of the pyrolysis design need to be validated. These plants are "commercial" so how well do the ASPEN models follow these designs?
- It is not clear in the presentation how the future program will be used to evaluate the benefits from the other R&D activities.
- The effects of scale for pyrolysis need to be clearly defined. Different DOE/Lab studies at different times have different conclusions.
- What is new with this pyrolysis design report vs. prior work?
- Continuing to evaluate options is completely appropriate and necessary

Additional Comments

Strengths

- TC design report great base case and accomplishment
- It was technically competent analysis and important work "critical" to the platform
- This is a foundation area – key in understanding how other programs affect the key cost to production. The methods used are state of the art for the petrochemical industry
- Good balance of partners with regard to technical expertise
- Need is recognized for feedback from engineering analysis to guide technology development
- Engineering analysis is being applied across a range of feedstocks – residues, energy crops, wood
- Good approach: using engineering analysis to benchmark and then comparing alternative designs with the case benchmarked.

Weaknesses

- Need to work with an EPC for costing.
- Need independent engineering validation of models. This is more than a consultant who wants to come back for another subcontract. It is easy to talk about the cost of the feed or

price of product, but the internal details of the ASPEN Models are key and need their own review.
- Why focus on Pac NW for pyrolysis model?
- A weakness must be the lack of critical evaluation by outside engineering and producing companies.
- Integration issues and sensitivity effects on R&D targets are good, but could be improved.
- Not yet considered value of mixed alcohols as fuels (?)
- Too much confidence in Aspen Plus and its databases? Esp. on methanol-ethanol-1-propanolcharacteristics as zeotropes?

Technology Transfer/Collaborations
- Some subcontracts for parts of the modeling, but a true external validation by a large integrated engineering firm would be useful.
- Not Applicable
- Appears to be well integrated.
- Good balance of partners with regard to technical expertise

Recommendations for Additions/Deletions to Project Scope
- Good work. Plans look reasonable. The pyrolysis models should be done as a stand alone, but also give some consideration for how they will be integrated with the oil refinery.
- This program is very important. Careful attention needs to be paid to defining the baseline – part of which they have. All of the gasifiers need to be considered for the baseline. Then define a plan to modify the baselines to incorporate new technology being developed to overcome shortcomings in the process -- all to lower the cost of fuel
- None.
- Provide life cycle assessments in parallel to economic analyses
- Broaden scope to consider other alcohol products (e.g., butanol)
- Consider process integration with other fuel production options (e.g. fermentation) to improve utilization of low- to intermediate-level heat utilization between a net heat generating plant and a net heat-consuming plant

PI Response to Reviewer Comments

Question 1: Relevance to Overall Objectives.
- This is an ongoing process that is scheduled for the coming years as funding permits. A schedule of which unit operations will be done each year should be generated based upon the current level of uncertainty and the potential impact on total cost. Because these types of sub-contracts are expensive, perhaps a lower-level validation can be done for some unit operations based on an E&C's experience but without an extensive design being used for costing.

Question 2: Approach to Performing the R&D
- The current process has plenty of opportunities for improvements if the focus remains on ethanol production. As the call from industry to look at other fuels becomes louder, we will undoubtedly need to evaluate those processes also (e.g. Fischer-Tropsch). Our focus has to be on supporting the DOE OBP's needs for analyses to evaluate potential shifts in direction of the overall program.
- Different evaluation procedures are sometimes necessary depending on the level of development of a project. Full-blown design reports are expensive to do and can typically only be justified on projects that are further along in development. It would be

useful for NREL to document what evaluation procedures should be done for the various stages of project development so that it is clear what evaluations are merited.

- The decision to look at indirect gasifiers and moly sulfide catalysts were documented in the design report but time did not permit presenting this information in the review. As new technologies are evaluated, this will be increasingly important to do and compare with past evaluations. The thermochemical ethanol design report provided us with a starting point for future analyses.
- Other gasifiers will be evaluated as soon as possible within funding constraints. NREL has already started a report of an oxygen blown direct gasifier. To some degree, the impacts of using other gasifiers can be captured through sensitivity analyses that evaluate a range of costs, heat integration, oxygen needs, gas compositions, etc. without specifying a gasifier per se.
- The need to assess data used in ASPEN is always a concern for modeling. More guidance on which cases were of concern to the review would be helpful. Because of uncertainty with the VLE modeling, molecular sieves were used in the ethanol design report to avoid the question of azeoptrope formation with mixed alcohols separation.

Question 3: Technical Accomplishments and Progress

- The need to work with E&C companies to help validate and acquire better cost and performance information is noted in Question 1's response above.
- NREL uses ASPEN Plus and occasionally other spreadsheets for Mass and Energy simulations.
- The models behind the design report are used to guide R&D efforts to a degree. It would be useful for NREL to formalize and document how its analysis results get used to set R&D directions and targets. A more transparent feedback procedure between analysts, researchers, and program management would be useful.

Question 4: Success Factors and Showstoppers

- This is a good idea. LCA work is scheduled in the strategic analysis tasks.
- Comparisons of projects head to head are scheduled. The first step was to develop a peer-reviewed design report against which to compare other processes, products, etc.
- An external review of the models used for evaluation is a good idea. The cost of doing this is significant. Two subcontracts are being placed in FY08 to look at parts of the model as well as to compare the overall model to another model at a second independent research facility (non-DOE.)
- Updated costs for equipment are needed. The sensitivity of equipment costs was evaluated in the report. Installation factors are also a point of uncertainty associated with the equipment costs. It would be useful to the analysis models for DOE to facilitate the transfer of cost information from the 932 projects that are in progress.
- Integration issues within plant are complex and need additional evaluation. A pinch analysis was done for one scenario (base case) but not alternate cases. Each case may have a different integration optimum depending on the heat integration within the plant.

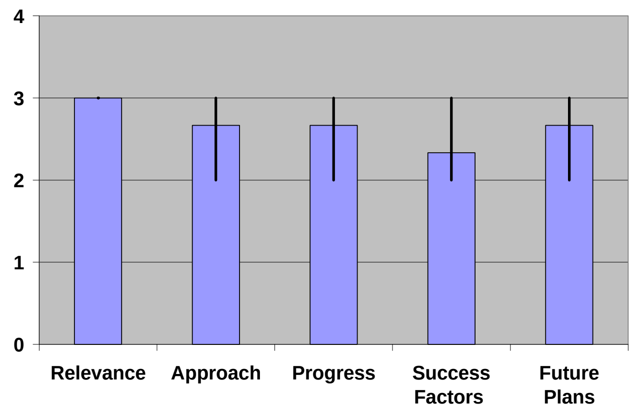
Question 5: Proposed Future Research Approach and Relevance

- The pyrolysis work ended several years ago and was just re-started in OBP. The current state of technology needs to be documented and used to evaluate the model assumptions.
- The need to make a more transparent process for connecting analysis results with future plans for R&D work was noted above in Question 3.

Gasification Projects

Project Title: Gasification of Biorefinery Residues (lignin/modeling and optimization)
Principal Investigator: Dave Dayton, National Renewable Energy Laboratory
Proposed Stage: A/B
Reviewer Recommended Stage: A/B

Relevance	3.00	0.00	0.00
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	2.67	0.67	0.33
Average	**2.67**		



Question 1: Relevance to Overall Objectives.
- Good approach to provide fundamentals that should inform many additional projects in future plants
- Actual running of the PDU with different feedstocks is very important. Need to have enough time on stream at steady state for the feedstock comparisons to be useful
- The project, all though needed, only partially supports the program in its present state.
- Problem is the study of model compounds as surrogates for lignin and the belief that the kinetics can be used to improve the byproduct yield.
- This is important support work for development of thermochemical conversion processes. The greatest problems wet gasification is associated with the inorganic components. They need relatively more attention in this work.
- The general goals were appropriate. However, the specific goals were not well delineated.

Question 2: Approach to Performing the R&D.
- Good approach and combination of work between labs and University partners, fundamental and pilot plant work.
- The program needs a gasifier that minimizes tar production and this program should be focused on finding operating conditions that minimize the tar formation.
- This is a gas-solid reaction. I just can't fathom that the fundamental model is the approach that will yield results.
- I have real problems with kinetic models being used for tracking what are close to trace components.
- Limitation to using the Ferco style gasifier is also too limiting
- The approach is reasonably good but the poor focus of the goals is reflected in an approach that sometimes leaves one wondering why specific things were undertaken in the approach.

Question 3: Technical Accomplishments and Progress
- Production of "real" lignin residue very important step.

- Need to validate that the PNNL work is actually adding value, e.g. how much faster and how accurate relative to ASPEN models
- Good progress with S removal
- The project has obtained good data in its limited cope at this time.
- I see little indication of true advancement.
- Part of the issue is the mixed nature of the project- ranging from model compounds and an operating pilot plant.
- Arguments about why a pilot plant is needed are circular and non-compelling.
- From the presentation it was very difficult to assess actual progress. Like one of the members of the audience, I wanted to know "what was the most important thing you learned in the last 12 months?" The answer (most feedstocks don't represent gasification problems) was not satisfactory, being well known by those who practice gasification.

Question 4: Success Factors and Showstoppers

- Very complex work, will be a challenge to make the work connect to the design and operation of gasifiers
- The project has obtained good data in its limited cope at this time.
- The success factors are ill-defined and nebulous.
- Showstoppers are simply the status quo.
- Did not well delineate what are the potential roadblocks let along explain how they would be overcome.

Question 5: Proposed Future Research Approach and Relevance.

- Not clean how the gasification work at the labs will connected to the deployment projects.
- Need to continue to routinely run the NREL PDU to validate models.
- Need to decide if the molecular modeling should be done at the labs or by partners.
- The kinetic modeling task will be very challenging and the labs will have to look at their staff skills to insure that this work can be effectively completed.
- I would favor more focus on other schemes to handle tar. I think that the programs seems to ignore outside, non-Battelle gasifiers

Additional Comments

Strengths

- The feedstocks comparisons are essential. Need to validate the effects of minerals and interactions.
- The project is a very good start, how ever it its scope is limited at this time.
- Existence of a pilot unit. Real biogas enables other facets of the program.
- Focus of linking fundamental molecular level reaction data to large-scale reactor performance is an excellent direction. The work is likely to be slow, and it will require patience by funders for this to succeed.
- Tar reduction focus is important.
- Can the kinetic parameters desired for pyrolysis be obtained from fluidized bed measurements, where the flow dynamics and therefore residence times are not well defined?
- Validation of e.g., Fluent model/laboratory fluidized bed data predictions with pilot-scale performance could be a valuable contribution
- The 300 kg of solid residue from fermentation studies obtained from this project is a valuable feedstock for future work – both at NREL and elsewhere.
- Recognizes the major issues in gasification. Excellent facilities.

Weaknesses

- Need to emphasize refereed publication/reports not simply presentations that have little archival value (weakness across TC program).
- Why is the PNNL engineering modeling work in this task instead of the analysis task? Where is the added value vs. ASPEN?
- Project scope needs to be broadened to determine the characteristics of a gasifier that minimizes tar formation.
- The major weakness is one of targeting. This project attempts to understand essentially trace chemistry through a mix of computational and kinetic tools. This is unlikely to work in a way that will produce game-changing results. If the project were sold as an analytical / explanation effort it might have more resonance. It is sold as a discovery effort with little foundation.
- A wider study of gasifier options for reducing or eliminating tar is what is called for.
- This project has a large number of sub-projects – too many?
- Not clear why work is being done with ChemCAD when ASPEN seems to be the primary process simulation tool used at NREL
- It seems like the NREL gasification program is being guided by annual shifts in Headquarters' current interests rather than a long-term strategic plan of research (the past year's focus on lignin gasification is prominent example). Goals and objectives are too "big picture" for presentation to a technical review panel. These overall goals are not easily reviewed in a stage-gate process. Give us more specific goals and justifications for pursuing them. Give us data in a form that would appear in a technical journal. Possibly the format required of the presenters does not lend itself to a "close to the ground" review.

Technology Transfer/Collaborations

- Should the selection of the biomass gasifier be a DOE function or left to industry? DOE/Labs should have the ability to run and operate gasifiers for the needed gas clean-up and fuels synthesis tasks.
- Interfaces well with downstream efforts
- Seems to be a good potential integration with Andy Aden's process simulation and engineering evaluation work.
- Appears to be good.

Recommendations for Additions/Deletions to Project Scope

- Continue to emphasis the interactions between the science and the data generated from the steady state operation of the pilot plant to valid the performance of the catalysts.
- Improvements in the project could be made by using MFIX and collaborating with the in-house research activities at NETL.
- Scope should be expanded to use the data that they have to date in simulated gasifier configurations to determine operating parameters that minimize tar formation.
- Pilot must run, but more consideration should be given to understanding those that claim lower to no tar production. There may be another way to skin this cat that doesn't look like the existing pilot gasifier. Be open to and incorporate those thoughts.
- Overall, this is important support work for development of thermochemical conversion processes. However, the greatest problems with gasification of biomass are associated with (a) tar and (b) the inorganic components; primarily alkali metals, S, Cl, and N. Tar and especially inorganic contaminants need relatively more attention in this work.
- Provide a clearer presentation on what has been accomplished

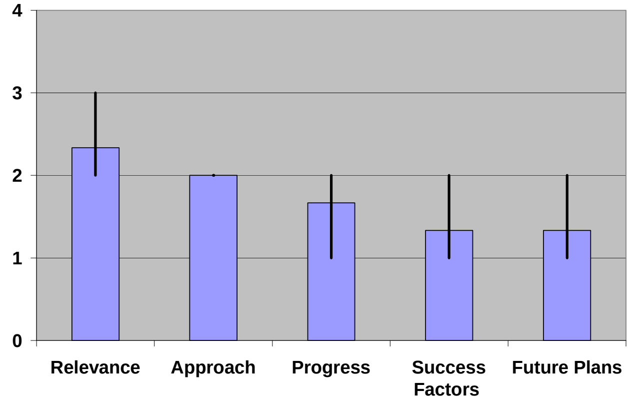
PI Response to Reviewer Comments

The PI for this task, Dr. David Dayton, has left NREL and this task is being significantly refocused for FY08. This task will focus on developing understanding of the chemistry and heat and mass transport that are important in biomass gasification. The goal will be to develop tools to help design efficient gasifiers that produce minimal amounts of undesirable products (tars, sulfur, alkali metals, etc). Computational Fluid Dynamics models will be developed and tested on bench scale gasifiers. Eventually these models will contain chemical models for gasification and tar formation, intra-particle mass and heat transport and bulk heat and mass transport. Chemical models will be focused on specific products, such as tar formation. They will be developed through quantum mechanical modeling, kinetic modeling, and careful experimentation using model compounds, model biopolymers and biomass fractions. Intra-particle dynamics will be modeled and measured using controlled experimentation. The knowledge learned through this effort will be transferred to the general scientific and technical community through the publication of peer-reviewed articles in topical journals and through presentations at technical conferences and review meetings.

Project Title: Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant

Principal Investigator: Chris Lindsey and Ed Gray, Eastman Chemical
Proposed Stage: 2
Reviewer Recommended Stage: 2

Relevance	2.33	0.33	0.67
Approach	2.00	0.00	0.00
Progress	1.67	0.67	0.33
Success Factors	1.33	0.33	0.67
Future Plans	1.33	0.33	0.67
Average	**1.73**		



Question 1: Relevance to Overall Objectives.

- Could fit in will the Biorefinery concept to handle waste streams. BUT need to much more clearly define the costs and energy balance.
- Project was not related to current Program goals.
- High water content wastes are key feed. Key is finding a particular, appropriate feeds.
- Original focus on bio-sludge was not a good match with the goals of the DOE Biomass Energy Program. Shift to biorefinery byproducts as feedstocks is a good one.

Question 2: Approach to Performing the R&D.

- Good recognition of the need to refocus and identify suitable streams.
- Technology does not seem to meet performance requirements.
- This looks like a disaster – failure and narrowing of focus
- Catalyst poisoning should have been recognized from the outset as the major impediment to success. I would have expected an approach to acknowledge this problem by focusing its efforts on implementing the appropriate desulfurization and demineralization technology.

Question 3: Technical Accomplishments and Progress

- Seems like very limited technical progress.
- Even with the problems that were discussed, the program has made very little progress.
- Milestones not met due to delay in getting PDU to Kingsport, TN.
- Modifications to PDU failed carbon conversion steps.
- Program is behind schedule. It is not clear that the new plan will address problems that placed the program behind schedule.

Question 4: Success Factors and Showstoppers

- The value of a “waste” processing technology, that requires “clean streams”, seems to be limited.
- What are the catalyst regeneration and Ru loss issues?
- Extremely dilute conditions are a show stopper.
- Way too finicky based on the feasibility diagram.

- The need to separate inorganic matter from the fuel prior to hydrothermal processing may be too overcome. A more contaminant-tolerant catalyst might be an easier solution.
- Show stoppers have been identified, but it is not clear that credible paths around have been identified. I fear the new feedstocks will still be problematic.

Question 5: Proposed Future Research Approach and Relevance.

- With 25 years of experience at PNNL it is not clear why the catalysts performance issues, economic and energy balances is not very well defined.
- The chemical composition of the Biorefinery streams can be collected pretty easy and screened for the composition range of interest.
- Even if they find a more suitable waste stream, the technology has commercially very little potential.
- The presentation convinced me that the process was not working and that they were developing new partners without some of the limitations.
- Although identifying alternative partners to continue this research is admirable, it is not clear that the underlying problems (high catalyst costs, carbon loss, and unproven sulfate removal) have been addressed.

Additional Comments

Strengths

- Could be good fit for the future.
- Focus on intractable wastes.
- The concept of processing low-solids content wastes economically is a useful one.
- Industrial partners who could apply this process
- Represents an alternative approach for thermochemical conversion of biomass, especially the high moisture streams.

Weaknesses

- This looks like a very old technology and still does not have a good fit. Technology looking for a home. As they look to refocus project they need to focus on the Biorefinery options, not pulp and paper, or dairy targets.
- Need to run sensitivity analysis on Ru price and decide if this is worth moving forward. They can assume that Ru goes back to the historic prices, if they assume that oil and ethanol go back as well; you can’t have it both ways.
- Doesn’t fit this program.
- The need to remove inorganic contaminants prior to conversion to fuel gas is a major weakness in this concept.
- This project seems to be struggling with more fundamental aspects that need(ed) to be dealt with prior to plant site PDU evaluations.
- I am surprised that such a project moved beyond the batch testing stage without having demonstrated novel and effective approaches to removing minerals and sulfur that compromise the process.

Technology Transfer/Collaborations

- Identified users that are credible partners both for original and modified research program.

Recommendations for Additions/Deletions to Project Scope

- It is recommended that no further work be conducted.

- Discontinue – use money on the major biomass efforts
- This project probably should not be continued.

PI Response to Reviewer Comments

Response not provided.

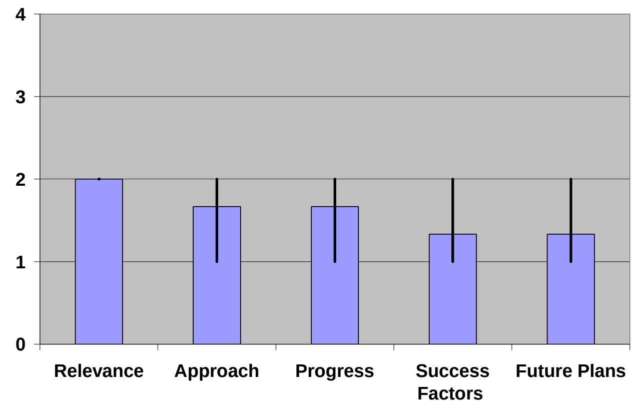
Project Title: Mississippi State University Sustainable Energy Center

Principal Investigator: Mark Bricka, Mississippi State University

Proposed Stage: Not Provided

Reviewer Recommended Stage: Stage A

Relevance	2.00	0.00	0.00
Approach	1.67	0.67	0.33
Progress	1.67	0.67	0.33
Success Factors	1.33	0.33	0.67
Future Plans	1.33	0.33	0.67
Average	**1.60**		



Question 1: Relevance to Overall Objectives.

- Several project elements are not of interest to DOE OBP goals. Little apparent relevance.
- No information of performance targets, are they making progress?
- No economic analysis, If they are making progress does it matter
- The plan is not well focused for the most part.
- The plan was not designed to integrate with the overall program.
- PI and other investigators seemed to just take available funds and do whatever they wanted regardless of how their activities might integrate with the overall program.
- Too many topics covered. Some fit, some didn't
- This project seems to be in early stage – largely equipment shake-down
- At first blush, the project appears to be very relevant to the objectives of the DOE OBP. However, the research appears to be covering well-trodden ground and offers little that is new to the field.
- This systems-level project should ideally have a commercial partner, which apparently is not the case.

Question 2: Approach to Performing the R&D.

- Re-scoped plan looks more promising, but still lacks performance targets
- The resulting approach, having no guiding plan, was fair at best.
- Working in a vacuum – not well referencing the patent literature or potential for collaborations with companies.
- This project seems to be in early stage – largely equipment shake-down.
- Much of the work consists of purchasing commercially available equipment or reinventing methodologies to set-up a small-scale biomass-to-liquids system. This is a systems-level project with many subsystems integrated. The question is whether the research offers much new information and whether it is relevant to developing commercial-scale systems.

Question 3: Technical Accomplishments and Progress

- Early in work, but very limited results and poor focus. They have a lot of money and looks like a bunch of individual academic projects.
- Gasoline catalysts work is not bench marked and was no apparent effort to understand the problems.

- Again as a result of no focus, accomplishments and progress were not to be found with the exception of cooking at the MTG process.
- too wide a number of projects covered
- This project seems to be in early stage – largely equipment shake-down.
- The approach to tar destruction is not well conceived. Results presented are already known. Benzene and naphthalene are known to be more difficult to destroy than any other aromatic or polyaromatic tars.
- The researchers have accomplished quite a bit in the past year (unless some of this was done with funding from other sources in earlier years). However, the results offer little that is novel or advances the goals of the DOE OBP.

Question 4: Success Factors and Showstoppers

- There biggest problem is running a program at the university that will help support DOE goals.
- Safety issues were not addressed in the presentation and are likely to be a significant issue in the University environment.
- The lack of an integrated plan with the program is a SHOWSTOPPER.
- Too many projects covered.
- This project seems to be in early stage – largely equipment shake-down.
- Showstoppers not clearly identified (this project not configured as a high-risk undertaking).

Question 5: Proposed Future Research Approach and Relevance.

- There was no plan for the future presented.
- Should focus on educating students not paying research staff or postdocs!
- They nave no plan and presented no plan and as a result
- There is little confidence that there will be any success from the program.
- This project seems to be in early stage – largely equipment shake-down.

Additional Comments

Strengths

- Limited strengths to point out in this project
- Methanol to gasoline look is a good direction to explore.
- Striving to demonstrate the production of gasoline from biomass via the syngas route.
- They have made progress in their work plan.

Weaknesses

- Mixture of projects with little focus.
- Safety issues with students handling CO, H2S could be a concern.
- MTG is known and has been commercialized in NZ, not clear how this work improves on this know process. There was no mention of the known MTG process then very concerned about the innovation.
- Limited innovation in other areas.
- Programmatically out of line with the program.
- Lack of focus leads to lack of success.
- Methanol to gasoline was fully commercialized by a US company. What will MSU bring that we don't already know?
- This project seems to be unfocused.

- The overall program is unfocused.
- There is no innovation in the research – most of the project is based on “off-the-shelf” equipment.

Technology Transfer/Collaborations

- Need industrial partners to help get focus.
- Need to closely study the DOE program goals, and prior work to make sure they are bringing innovative technology to the projects.
- No collaboration with industry or other institutions indicated.

Recommendations for Additions/Deletions to Project Scope

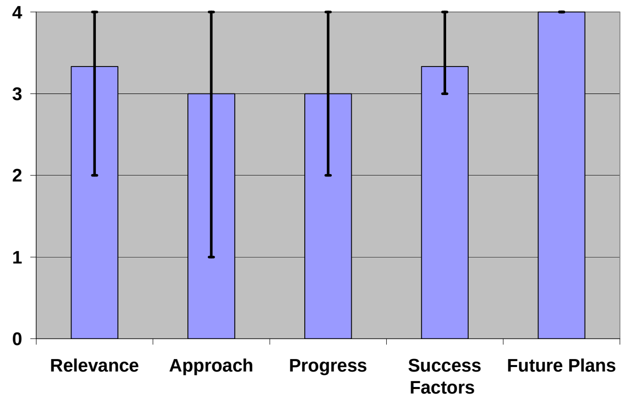
- Needs to work with one of the DOE analysis groups to get some targets.
- It is strongly recommended that, before any additional funds be added to the project, a detailed plan that is integrated with the program be prepared that has measurable milestones.
- The researchers should focus on specific issues. The current goals (“develop coordinated approach to biorenewable energy…”) are too broad to achieve significant advances.

PI Response to Reviewer Comments

Response not provided.

<u>Project Title: Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer</u>
<u>Principal Investigator:</u> Kevin Whitty, University of Utah
<u>Proposed Stage</u>: Stage C
<u>Reviewer Recommended Stage</u>: Stage C

Relevance	3.33	1.33	0.67
Approach	3.00	2.00	1.00
Progress	3.00	1.00	1.00
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.33**		



Question 1: Relevance to Overall Objectives.

- Black liquor gasification is a very narrow opportunity for the biomass program
- The project no longer supports the program goals as black liquor is not a target feedstock.
- The market potential for the technology essentially does not exist. The industry is making use of existing technology and is unlikely to change
- Black liquor is outside main thrust
- This project recently ended.

Question 2: Approach to Performing the R&D.

- Good combination of modeling and pilot plant work. Both bed modeling and process modeling are useful
- The gasification technology is unworkable as it does not scale. This is not to say that the presenter (Dr. Whitty) did a poor job, he did a great job modeling a pore system
- Building on commercial technology with company input.
- Approach is technically sound.
- This project recently ended.

Question 3: Technical Accomplishments and Progress

- Good work and progress.
- Analytical tools/approach are valuable
- Dr. Whitty did a great job, the technology does not move DOE towards its program goals
- Excellent progress – questionable overlap with broad DOE goals.
- This project recently ended.
- Excellent progress toward project goals, not necessarily aligned with DOE or USDA program goals.

Question 4: Success Factors and Showstoppers

- Good work plan.
- The gasification materials problem is the key limitation and outside the scope of this project.
- The TRI risks are not well-defined upfront, and have lead to the shutdown on the GP Big Island project, although Norampac continues.
- Dr. Whitty's analysis was very forthcoming, relating that the gasification technology cannot be scaled and that a mill would require 30 or more of these gasifiers.
- Project is over – challenges determined to be too difficult

- This project recently ended.

Question 5: Proposed Future Research Approach and Relevance.

- Project is ending
- Not applicable
- project is done
- This project recently ended.
- No plans to proceed, project complete.

Additional Comments

Strengths

- Good partnership, universities and private partners.
- Good combination of modeling and pilot plant operation
- Great technical work performed by Dr. Whitty.
- Very well thought out program with good science applied in a reasonable way.
- Good transfer of collected data to wisdom

Weaknesses

- Black liquor is a very narrow opportunity
- The overall operation and maintenance of Black Liquor gasifiers is a major concern, although not the focus of this work.
- The fundamental gasifier design limits ability to be scaled.
- There is no market for the technology.
- Black liquor is not critical to the biomass program.

Technology Transfer/Collaborations

- Good partnership including industrial partners
- Make tar sampling procedure public and promote it.
- Good collaboration with other academic institutions and industry.

Recommendations for Additions/Deletions to Project Scope

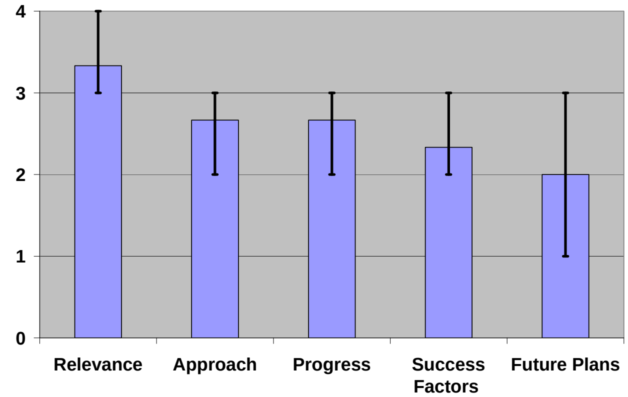
PI Response to Reviewer Comments

Response not provided.

Gas Cleanup and Conditioning Projects

Project Title: Biomass Gas Cleanup Using a Therminator
Principal Investigator: Santosh Gangwal, Research Triangle Institute (new PI: Dave Dayton, RTI)
Proposed Stage: Stage B
Reviewer Recommended Stage: Stage B

Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	2.00	1.00	1.00
Average	**2.60**		



Question 1: Relevance to Overall Objectives.

- Very good relevance.
- Very good understanding of how the project fits into the DOE goals.
- Able to refocus the project from its original focus to the changed DOE goals with fuels synthesis
- The project supports the DOE program goals.
- No market information was provided. RTI is a technology developer and not an OEM that will provide this technology to the market. As commercializing team member is required.
- Very relevant to current program
- Goal should be stated in terms of cost of syngas, not cost of ethanol.

Question 2: Approach to Performing the R&D.

- Good combination of science, modeling and experimental work.
- Good technology and process benefits (process intensification that will combine tar cracking and NH3/H2S/HCl clean-up.
- Project understands the interaction between both the technical and economic goals.
- The desire to develop a three-way catalyst is noble.
- RTI does not have a plan/method to develop the catalysis at this time. They are looking at placing three separate catalysts in the reactor as one alternative – where is the innovation.
- Very reasonable approach to clean-up reactors and material synthesis.
- Toluene cracking experiments produced benzene. Why no concern about this?
- Not very much detail given on approach (spent too much time justifying work).

Question 3: Technical Accomplishments and Progress

- Good start with lab work, but needed more information on the carbon balance (toluene, benzene, methane, CO, H2)
- Good recognition of need to combine chemistry and fluid bed modeling.
- RTI has done quite a bit of catalyst scoping, but has not done any multi-contaminant testing. This is needed soon
- On agreed timeline
- The project has made reasonable progress.

Question 4: Success Factors and Showstoppers

- Real strength in technology development.
- RTI has good experience with project management and technology development.
- Experience with Eastman on pilot scale and process development.
- Given RTI's background and experience with the reactor technology they have done a poor job at identifying showstoppers associated with the development of a three way catalyst and the reactor.
- Toluene cracking experiments produced benzene. Why no concern about this? Benzene is not an acceptable syngas component for catalytic fuels production.
- Showstoppers are not been well detailed.

Question 5: Proposed Future Research Approach and Relevance.

- Unlikely to finish in one more year.
- Good pathway forward.
- Need to have a fallback option for gasification partner/testing.
- Given that they are behind schedule and under spent, they provide no plan showing how they plan to get back on schedule
- Ambiguous definition of what success would really look like
- Toluene cracking experiments produced benzene. Need to be able to destroy benzene and any other C-ring compounds.

Additional Comments

Strengths

- Good focus and able to redirect the project on the DOE needs.
- Good reactor technology.
- Good experience with sorbent and catalyst development.
- Reasonable participants and plays to RTI strengths due to coal background.
- Can eliminate NH_3 and capture H_2S.
- Appears to be making good progress in obtaining results.

Weaknesses

- A gasification partner will be important for ultimate demonstration.
- Are not using their experience to drive the program to develop a multifunctional catalyst.
- Catalysts are NOT tri-function. They are adding several catalysts in hopes of managing varying reactivity
- Unsure why bubbling fluidized bed is selected (more difficult to both operate and model)
- The presenter had some problem explaining to reviewers what he was trying to accomplish.

Technology Transfer/Collaborations

- Would be useful to have the gasification manufacturer as a very active member of the team
- Very good experience with commercialization
- Need a commercializing partner.
- Looks to have path to commercialization
- Toluene cracking experiments produced benzene. Need to be able to crack benzene and other C-ring compounds.

Recommendations for Additions/Deletions to Project Scope

PI Response to Reviewer Comments

Since this project was awarded in FY04, the goals of the Thermochemical Conversion Platform have changed to focus gas cleanup and conditioning to achieve syngas quality targets for fuel synthesis instead of power production. Consequently, the goals and objectives of this project have been modified to align with the Office of Biomass Program goals to produce cost-competitive biofuels. Additionally, an interruption in project funding during FY06 and the subsequent loss of Cratech as a cost-share partner and biomass gasification host-site for Therminator testing required a revised project scope and work plan moving forward.

Question 1: Relevance to overall objectives

The goal of this project from the beginning has been to develop a thermodynamically efficient 2-stage gas cleanup up process with continuous catalyst regeneration for tar removal, ammonia conversion, and sulfur removal. The Therminator concept was developed to address OBP's goal of reducing the cost of the gas cleanup unit operation in an integrated biomass gasification system. Now that the focus is on liquid transportation from biofuels, the concept can still apply.

The cost goal of $1.07/gal of thermochemical ethanol was used as a benchmark to align with the NREL Design Case for an integrated, indirect biomass gasification mixed alcohol synthesis process. The $1.07/gal ethanol cost in this process equates to a syngas cost of $5.25/MMBtu. This design case was optimized for ethanol yield not syngas production so this value should not be considered ideal, but specific to the referenced process configuration.

A market analysis for the Therminator concept applied to biomass gasification for power production was completed in the early stages of the project. With OBP now focused on liquid transportation fuels, this is no longer relevant. A similar market analysis can be developed, especially with three of the six commercial demonstration projects (700 tpd biorefineries) selected by OBP focusing on biomass gasification. The work plan for FY08 was revised to include a techno-economic assessment of the Therminator technology by incorporating cost and performance data for this cleanup operation in the NREL Thermochemical Design Case.

Question 2: Approach to Performing the R&D

Catalyst testing is being conducted by our partners at Clemson University. They are using model compounds in microreactors to determine the optimum temperature ranges and regenerablility of various materials for cracking tars, converting ammonia, and removing sulfur. A variety of zeolite materials are being evaluated as tar cracking catalysts. Materials tested to date do yield benzene as a result of toluene cracking. Technically, benzene is not classified as a tar but could still pose problems in downstream fuel synthesis processes. We are currently investigating increasing the acidity of the zeolite materials to improve hydrocarbon cracking that could potentially also crack benzene. However, if the Therminator concept is successful, benzene and other light hydrocarbons could be removed in an additional downstream cleanup step. This precludes all gas cleanup being performed in a single step for the ultimate in process intensification, however, additional downstream gas conditioning/polishing steps have a greater chance of being effective if tars can be removed.

Novel catalysts are being formulated and tested for ammonia decomposition and RTI sulfur removing sorbents are being targeted for H_2S removal. The innovation is determining the optimum temperature, pressure, and gas composition window where these three reactions occur and how to regenerate the materials after they have deactivated (again optimum temperature and stoichiometry). A single material that has activity for all of these gas cleanup operations is desirable but a significant challenge that is beyond the scope of this project.

Question 3: Technical Accomplishments and Progress
Additional details of the carbon balance from the catalyst testing being performed at Clemson will be available after the completion of their work.

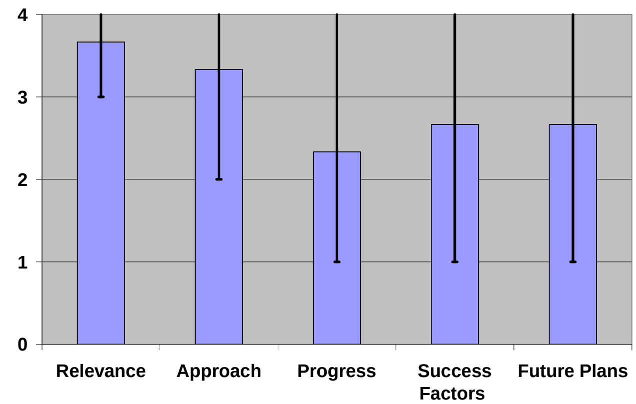
As stated, one of the near-term goals for this project is to find a biomass gasification host site and cost-share partner to test the Therminator. This will serve as the opportunity to test the process on actual biomass-derived syngas and determine the multi-contaminant performance of the unit.

Question 4: Success Factors and Showstoppers
One of the key challenges for having the 3-way mixture of materials perform the desired gas cleanup function is determining the operating temperature windows for the reactor and regenerator. Therefore, one showstopper would be poor temperature overlap between the tar cracking, ammonia conversion, and sulfur removal processes. We think we have identified a suitable window based on the testing of the individual materials, however, this needs to be verified in the integrated testing. Another potential showstopper is the integrity of the tar cracking catalysts when exposed to the high steam environments in biomass-derived syngas. This relates to the process temperature and will need to be carefully explored during the integrated testing.

Question 5: Proposed Future Research Approach and Relevance
Given delays in funding and the loss of our cost-share partner and gasification host site, we have requested to DOE that the project be extended for an additional year beyond the original FY08 completion date without additional cost. This no-cost extension is reflected in the FY08 Annual Operating Plan for the project. We are actively seeking a biomass gasification test site and additional cost-share partners. In the mean time, RTI is providing cost share towards the project to complete the fabrication of the Therminator unit as originally outlined. Successful long-term operation with biomass-derived syngas at measured target impurity levels will define the successful completion of this project.

Project Title: Engineering New Catalysts for In-Process Elimination of Tars
Principal Investigator: Larry Felix, Gas Technology Institute
Proposed Stage: Stage A/2
Reviewer Recommended Stage: Stage A/B

Relevance	3.67	0.67	0.33
Approach	3.33	1.33	0.67
Progress	2.33	1.33	1.67
Success Factors	2.67	1.67	1.33
Future Plans	2.67	1.67	1.33
Average	**2.93**		



Question 1: Relevance to Overall Objectives.
- Good understanding of the DOE Biomass Program goals and how their project fits into these goals.
- The project aligns with the program objectives.
- No Customers or Markets information was given or are identified as being important.
- Hitting one of the tar problems head-on

Question 2: Approach to Performing the R&D.
- Good understanding of how the technology will be used and the strengths of the different approaches.
- Several technical options for moving forward.
- Appropriate to make sure that their IP position is covered.
- Two approaches given. Appear unable to evaluate the better of the two and focus.
- Novel approach to catalyst production
- Good focus: on finding tar destruction/methane reforming catalysts that are attrition resistant and are sulfur tolerant. For Fl bed gasifiers; may have other applications.

Question 3: Technical Accomplishments and Progress
- Some technical progress. Good understanding of how the catalyst properties and performance will impact the overall process economics.
- PI presented no data that indicates that they are likely to achieve their goals.
- Moved from a good idea that turned out not to work, to a novel concept that seems to work well. Impressive performance by the research team.

Question 4: Success Factors and Showstoppers
- GTI has lots of experience in project development and commercialization, but a gasifier developer or catalysts company that will actually commercialize the process.
- PI gave lip service to toping in preparing a list of possible showstoppers, but gave no prioritization or indication of which were the most critical or indication that they could be overcome
- Thoughtful approach to attacking problems

Question 5: Proposed Future Research Approach and Relevance.
- Good plans to move forward.

- Project is behind schedule and no plan was provided to bring the program back on schedule.
- Will likely ask for no cost extension.
- No focused commercialization plan identified.

Additional Comments

Strengths

- Good technology, good skills with multiple options for use and for decoking
- Integrated approach, several collaborators
- Novel approach to fixing problems
- Well focused.
- Technically strong partner group.

Weaknesses

- Need to get the economics completed soon.
- Need to focus on one of the three systems to maximize the likelihood of success.
- Catalyst have very little surface area – will likely require a large reactor increasing the cost.
- Need to focus, pick one technology and move on, it cannot commercialize two new catalysts with funds for one
- Novelty of approach may limit implementation
- No mention of poisons or leaching of catalysts and attrition

Technology Transfer/Collaborations

- It would be useful to have a commercialization partner to move this forward.
- Good interaction with both companies and universities

Recommendations for Additions/Deletions to Project Scope

- Economic comparison needs to be evaluated, continue testing

PI Response to Reviewer Comments

- The project's revised Statement of Work includes facility design and economic analysis for different product conversion and direct use routes. This includes integration with a petroleum refinery for production of ASTM diesel. With the addition of consideration of alternative conventional uses for the brown grease feedstock, this planned effort should address the concerns raised by the reviewers.
- It has been estimated by NREL that trap grease, nationally, has the potential for production 495 million gallons of biodiesel annually. Given U.S. biodiesel production levels of 250 million gallons in 2006, it would seem that waste greases could make a contribution to the national situation. Further – any trap grease process is likely to actually incorporate yellow grease feeds, increasing the potential impact.
- While alternative pathways are possible and have been proposed, the management of trap grease remains a very significant local problem. Solution requires an integrated regional program including building codes, enforcement, collection, analysis and monitoring, conversion, product quality management, and product distribution. The solutions being explored under this project may be suitable for local implementation, avoiding logistical issues associated with large industrial facilities and providing a more consistent feedstock.

- The thermal process to be used in this project offers some advantages that could make it attractive relative to direct refinery integration of trap grease. This includes no requirement for hydrogen, no catalyst, and the ability to accept a very mixed and variable feedstock. The current plant in Missouri that processes turkey waste accepts considerable solids in the feedstock.

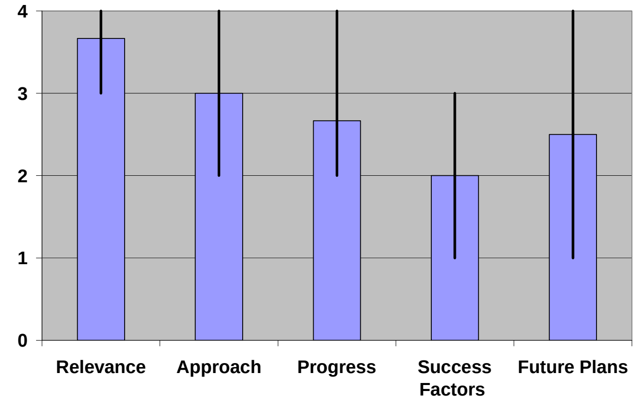
Project Title: Catalyst Fundamentals (Integration and sub tasks)

Principal Investigator: Kim Magrini (presented by Dave Dayton), National Renewable Energy Laboratory

Proposed Stage: Stage A/B

Reviewer Recommended Stage: Stage A/B

Relevance	3.67	0.67	0.33
Approach	3.00	1.00	1.00
Progress	2.67	0.67	1.33
Success Factors	2.00	1.00	1.00
Future Plans	2.50	1.50	1.50
Average	**2.77**		



Question 1: Relevance to Overall Objectives.

- Good understanding of how the work fits into the DOE goals.
- The project clearly supports the Program goals and objectives
- There is no path forward defined and no potential market or customers discussed.
- Puts all efforts into an assumption that tar is inevitable.
- Other methods for reducing or handling tars will render this approach moot.

Question 2: Approach to Performing the R&D.

- The team clearly understands the issues and has the infrastructure to test materials, but the tar cracking catalyst efforts seem like a small, sub-critical effort.
- The approach to get new catalysts is sound.
- Focusing an eye towards the future goals will define the critical path for the development. The projects are not purpose driven and as such wanders along the development path.
- Fundamentals approach to an awful mess of reactions – seems destined for difficulty

Question 3: Technical Accomplishments and Progress

- Good work but should focus on testing and evaluation of catalyst at micro and PDU scale.
- Development of catalysts less clear.
- Due to a lack in focus noted above, the progress falls short of what should and could have been obtained.
- Progress hasn't really progressed against goals – progress made has been against interim targets that may ignore the real issues.
- Project seems mired in reality that S is a poison for the catalysts selected. Baby steps taken when giant leap required.

Question 4: Success Factors and Showstoppers

- The project lacks the gasification developers or well recognized catalyst manufacturing partners (different than support manufacturers) that are needed for commercialization.
- The extent and strength of the partnerships listed in the presentation is not clear
- No efforts and thoughts, at least presented, have gone into the evaluation of the technology as a commercial product. When is it needed? What are the required minimum performance requirements?

- No real strategies illuminated for avoiding poisoning of conventional catalysts.

Question 5: Proposed Future Research Approach and Relevance.

- Plans are clear, but the Labs need to define the innovation and make sure that their catalysts development efforts do not limit their ability to help DOE compare different catalysts.
- This technology will be a technical success and a commercial failure if the continued development effort proceeds without a commercializing partner.
- No real plan for attacking poisoning

Additional Comments

Strengths

- Collaboration between NREL and PNNL catalyst group appears to be productive.
- Good collaboration between national laboratories
- Good utilization of analytical tools and integrated approach – small to pilot scale, with theory added in
- Good partnerships with other labs, universities.
- Solid plan for next years.

Weaknesses

- Good work, but appears to be less innovative than the other two tar cracking projects.
- Need to continue to publish their work in archival resources.
- Innovation with new catalyst formulation is weak
- There may be no solution
- This is a project seems to be headed toward the trap of explaining why something doesn't work rather than finding something that does. I have doubts that the described analytical regime will provide fixes to the problem of sulfur poisoning of Ni catalysts. These catalysts are know and industrially used. I can't help but feel that companies have investigated this space and, to their dismay, sulfur still poisons nickel reforming catalysts.
- Need detector for HCl to evaluate its removal and impact on catalyst activity (the research team recognizes this).

Technology Transfer/Collaborations

- Does fact that the national laboratories are developing catalysts limit their ability to serve as an honest broker for DOE? Some of these same issues were faced by the Biomass Program and the CAFFE (sp) pretreatment verification.
- Is there a way to get the catalysts testing tools and skill into the big demo projects to increase the likelihood of success?
- A commercialization strategy needs to be developed. How will these advancements be commercially introduced?
- Reasonable

Recommendations for Additions/Deletions to Project Scope

- It seems like some sort of comparison/round robin testing of the three catalyst projects should be considered.
- This project suffers because it solves some problems in parallel without the realization that a single failure means that nothing will work.

PI Response to Reviewer Comments

Question 1: With respect to the path forward, the Catalyst Fundamentals task is focused on developing moderately sulfur tolerant reforming catalyst that can operate in a fluidized reactor. Initial screening of the best available commercial reforming catalysts in a fluidized bed showed that losses from attrition were significant and economically unsustainable. Commercial fluidizable reforming catalysts are not available and we thus had to develop our own fluidizable catalysts based on novel attrition resistant alumina supports. Fluidization also simplifies catalyst regeneration. We produce up to 100 kg batches with industrial participation. Larger quantities will have to be produced with the help of catalyst manufacturers. GTI and NexTech took a similar approach to develop olivine-based reforming catalysts and we are working with them to test their emerging reforming catalysts in our reactors. We are collaborating with companies, who responded to a recent DOE solicitation to develop biomass-derived fuels, to provide and test emergent tar reforming catalysts. Thermal gasification of biomass produces tars with the amount produced dependent on process operating conditions. NREL's thermochemical ethanol from biomass process was developed based on overall process heat integration, waste stream reduction, and maximized syngas production from tar reforming. Other options considered included wet scrubbing, which results in significant aqueous waste streams; dry scrubbing; and hot gas cleanup. A significant benefit of this approach is that process methane can be recycled through the reformer. If tar reforming catalysts can not be efficient then wet and dry scrubbing are process options.

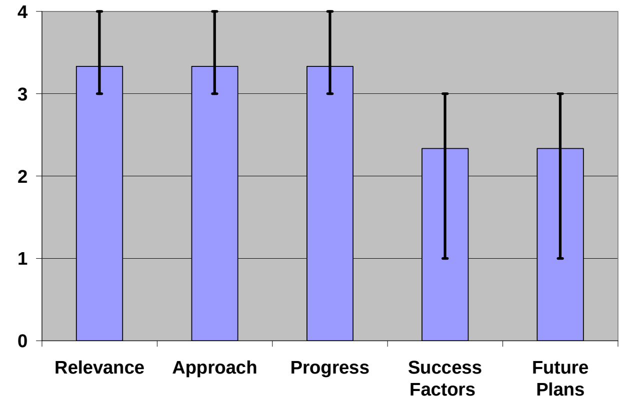
Question 2: This task operates on two levels: developing fluidizable tar reforming catalysts based on the best compositions that industrial catalysts offer for pilot scale deployment and testing and developing the fundamental understanding of catalyst structure/function relationships to rationally design next generation reforming and mixed alcohol catalysts. Tar reforming in the petroleum and coal industries is successfully conducted and thus is applicable to the "awful mess of reactions" generated by biomass-derived syngas.

Question 3: Sulfur is a significant problem for tar reforming catalysts as are other potential poisons contained in biomass-derived syngas and to be investigated (Cl and C). Our approach is integrated in that feedstock choice (determines H_2S level), placing a sulfur capture unit operation before the reformer, and developing a moderately sulfur tolerant reforming catalyst should provide a clean syngas that can be converted to mixed alcohols. The current alcohol synthesis catalyst, modified moly sulfide, requires approximately 25-50 ppm of H_2S in the feed syngas to maintain activity. So integrating H_2S into the overall process is reasonable for this specific process. Industry to date has not yet provided a giant leap forward with respect to sulfur tolerant reforming catalysts.

Question 4: Although the NREL tasks are not directly tied to commercial processes, as the current biomass gasification to fuel industry is nascent, the recent DOE funding opportunity announcements have provided the ability for NREL to develop biomass to fuels industrial partnerships. NREL is currently included in one of these potential partnerships to provide tar reforming catalyst development. We have discussed tar reforming catalysts and other approaches with Conoco Philips, WR Grace, Sud Chemie, Albemarle, and NorPro and no suitable catalysts have been identified for testing. We continue to talk with commercial catalyst suppliers. GTI and NexTech have emerging catalysts designed for tar reforming in fluidized environments and we are working with them to test these materials at NREL. We have and are testing emerging tar reforming catalysts and our ability to evaluate with real syngas allows us to objectively test tar reforming catalysts. We additionally are talking with the coal gasification community to identify appropriate catalysts. The addition of a sulfur capture unit operation before the tar reformer is underway.

Project Title: Integrated Catalyst Testing
Principal Investigator: Calvin Feik, National Renewable Energy Laboratory
Proposed Stage: Stage B
Reviewer Recommended Stage: Stage B

Relevance	3.33	0.33	0.67
Approach	3.33	0.33	0.67
Progress	3.33	0.33	0.67
Success Factors	2.33	1.33	0.67
Future Plans	2.33	1.33	0.67
Average	**2.93**		



Question 1: Relevance to Overall Objectives.
- The project clearly supports the Program goals and objectives
- There is no path forward defined and no potential market or customers discussed. See comments in questions 4 and 5.
- targets tar – key identified component
- Addresses need to evaluate catalysts at pilot-scale and validate laboratory scale testing.

Question 2: Approach to Performing the R&D.
- The approach to get new catalysts is sound.
- Focusing an eye towards the future goals will define the critical path for the development. The project is not purpose driven and as such wanders along the development path.
- Methodical and logical

Question 3: Technical Accomplishments and Progress
- Significant of value of having the capability (and using it) to test with “real” syngas
- Identified S, not carbon as key deactivator
- Making good progress on challenging pilot-scale evaluations of catalyst deactivation, catalyst regeneration, and sulfur sorbents.

Question 4: Success Factors and Showstoppers
- No efforts and thoughts, at least presented, have gone into the evaluation of the technology as a commercial product. When is it needed? What are the required minimum performance requirements?
- There may be no solution.
- Showstopper is inability to demonstrate a regenerable catalysis. No alternative paths suggested.

Question 5: Proposed Future Research Approach and Relevance.
- This technology will be a technical success and a commercial failure if the continued development effort proceeds without a commercializing partner.
- Pilot is run to get clean gas for other testing is OK.
- Hopes for real improvement and plan for getting it was ill-defined.
- Overlap with other programs means a merging of goals

Additional Comments

Strengths

- Methodical
- The large-scale catalyst synthesis and testing part of this project is essential in support of other, smaller-scale testing of catalyst candidates.
- Sulfur sorbent work with high steam concentrations is valuable.
- Good capability for testing at pilot scale.

Weaknesses

- Uncertain whether solution exists – deactivation is still too fast for commercial reasonable implementation
- The mix of discovery and pilot research is more detrimental than additive – the mixed focus is hard to evaluate
- Need better catalysts to test at pilot scale.

Technology Transfer/Collaborations

- Good interaction with both companies and universities
- Good. May be more opportunities to collaborate with others in catalyst development.

Recommendations for Additions/Deletions to Project Scope

- Investigator needs to take better care to fully characterize experimental facility. The observance of a periodic peek in the concentration slide 15 is an indication that some process oriented transient is occurring in forced period. This could lead to errors in the analysis of the data and need to be understood.
- continue testing
- Evaluation of the rate of loss of catalyst activity with alkali metals and chloride would be valuable.

PI Response to Reviewer Comments

Question 2: With respect to critical path development, the Integrated Catalyst Testing task is comprises a significant portion of the overall integrated gasification to mixed alcohol synthesis project at NREL. Task research focuses on producing clean syngas from gasified biomass via sulfur capture and steam reforming unit operations. These unit operations are guided by a progressive series of intermediate goals that produce clean syngas to meet the 2012 targets with overall task progress is guided by the operating parameters defined in the mixed alcohol design report.

Question 4: Although the NREL tasks are not directly tied to commercial processes, as the current biomass gasification to fuel industry is nascent, the recent DOE funding opportunity announcements have provided the ability for NREL to develop biomass to fuels industrial partnerships. NREL is currently included in several of these potential partnerships. Additionally, the Thermochemical Platform Analysis task provides an important link between industry and the current NREL R&D. The process models are based on commercial or pre-commercial systems. The research in this task is directed toward demonstrating improved catalyst performance and providing additional relevant data to improve the process models. The interaction and dual flow of information between tasks is key to improving the integrated process.

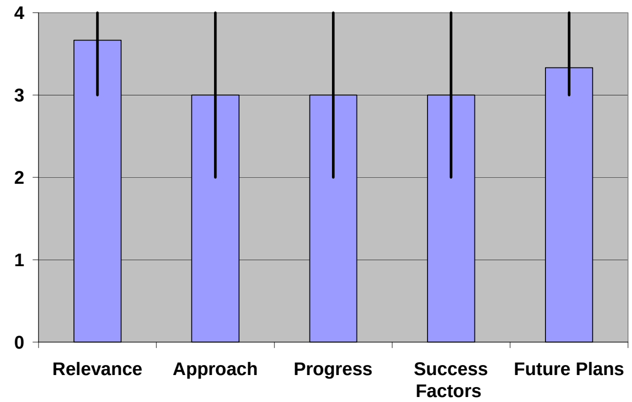
Catalyst performance and regeneration improvements are being conducted in the Catalyst Fundamentals task, which is closely integrated with this task. As noted by the reviewers, sulfur deactivation of catalysts is not new and catalyst regeneration and sulfur (and other heteroatom) mitigation will be key to successful integrated system success. Regeneration protocol research is ongoing with promising lab scale results to be demonstrated at the pilot-scale. The evaluation of sorbent materials is ongoing with several materials showing promise in the high steam environment. Full stream testing of available and promising materials is planned in the near future. We agree that coking and chlorine exposure may also significantly deactivate the reforming catalysts. FY08 and beyond will focus on evaluating the impact of adsorbed carbon and chlorine on catalyst performance. We are also engaged since the review in identifying commercial and emerging reforming catalysts that can operate under our process conditions. The best catalysts identified in laboratory scale evaluation will go on to pilot scale evaluation.

Slide 15 concerns: The upset peaks in the data s were caused by process adjustments (sample valve cycling) associated with startup and were not a factor during the experimental period.

Fuel Synthesis Projects

Project Title: Thermochemical Conversion of Corn Stover
Principal Investigator: James Gaddy, Bioengineering Resources Inc
Proposed Stage: Stage 3
Reviewer Recommended Stage: Stage 2/3

Relevance	3.67	0.67	0.33
Approach	3.00	1.00	1.00
Progress	3.00	1.00	1.00
Success Factors	3.00	1.00	1.00
Future Plans	3.33	0.33	0.67
Average	**3.20**		



Question 1: Relevance to Overall Objectives.

- Understands the DOE program goals.
  Good partnership that includes engineering Company.
- The project supports most aspects of the program goals
- All components tested from feed conversion through to fuels
- Supports DOE OBP goals with a novel approach to ethanol.

Question 2: Approach to Performing the R&D.

- Good team to help with the design and construction. Need to make sure they have good analysis team to help with characterization of the emissions
- Lacked details on how many other organics and how much cellular biomass
- The approach to thermally decompose biomass (fast process) coupled to a biological process (SLOW) is a weakness that is not being addressed. These rates need to be comparable or equipment sizes very significantly which adds complexity in scaling the technology.
- Didn't approach the project with any optimization of the gasifier, fermenter, or gas clean-up system
- Bio approach complements catalytic
- Scale of equipment is an issue. Currently, plants would be modular, limited in size by 150 t/d gasifier.
- This project is a continuation in the development of syngas fermentation that has taken place over 15 years. This project would have been a good opportunity to rethink gasifier design, reactor design, and ethanol recovery. This does not appear to have been incorporated into this project.

Question 3: Technical Accomplishments and Progress

- Seemed to gloss over some of the issues with long term operation and accumulation of tars and impurities
- Did not show any parametric data to provide confidence that technical barriers can be overcome.
- Looks very solid technically at this point. Would be useful to evaluate benefits of higher pressure.

Question 4: Success Factors and Showstoppers

- Quite a bit of experience with running the system and the focus is on the process economics.
- Economics need to be addressed.
- Indicates no technical problems remain
- No apparent technical barriers. Economic barriers? Need to evaluate economics.
- Clearly a number of challenges have been met and overcome. These were not well described in the presentation.

Question 5: Proposed Future Research Approach and Relevance.

- Well on the road to commercialization
- No market data were given
- Unclear what future work is required- things listed looked like pretty low bars and not critical to success.
- The future plan now should include economic evaluation and, if viable, a demonstration plant.

Additional Comments

Strengths

- Quite a bit of experience
- Good partnership and key to have engineering design partner
- Good gasifier, minimizing tar formation with long residence time, high temperature second stage.
- Integrated – working system
- Excellent fundamentals
- Very solid platform from basic & development work that has been done.
- Has taken a novel technology to the pilot-scale.

Weaknesses

- Near term they are focused on this one gasifier but this may be a limitation.
- Unclear how the carbon bed will be regenerated, biomass from the fermenter and other waste streams will be captured.
- Chemical analysis of the waste streams needs some more attention.
- Separation of ethanol/water was under defined and seems to be problematic
- Low productivity and slow fermenter start-up
- Does not appear that the project was approached with the goal of optimizing the gasifier, fermenter, gas clean-up, or ethanol separation equipment.

Technology Transfer/Collaborations

- Good interactions and collaborations.

Recommendations for Additions/Deletions to Project Scope

- Only gap is detail on how to get fermenter productivity up.

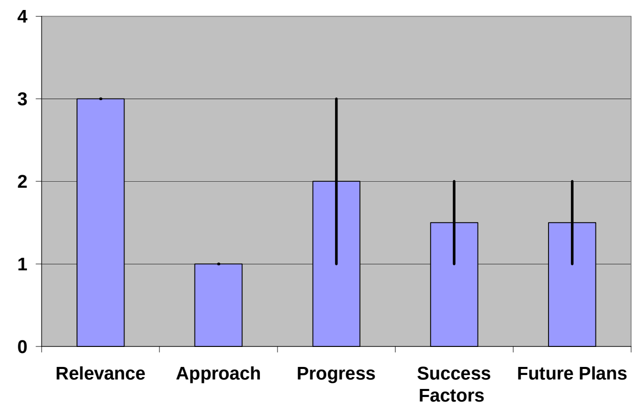
PI Response to Reviewer Comments

Response not provided.

Project Title: Small Scale Biomass System (Biomax)

Principal Investigator: Robb Walt, Community Power Corporation
Proposed Stage: Stage 4/3
Reviewer Recommended Stage: Stage 4/3

Relevance	3.00	0.00	0.00
Approach	1.00	0.00	0.00
Progress	2.00	1.00	1.00
Success Factors	1.50	0.50	0.50
Future Plans	1.50	0.50	0.50
Average	**1.80**		



Question 1: Relevance to Overall Objectives.

- Several interesting aspects, but not all aspects clearly focus on the current goals
- Production of a gasifier based liquids production aligns with the Program goals
- The power focus of the presentation does not.
- Liquid production on small scale – completely relevant
- It might be relevant but I am not convinced that on-farm production of diesel fuel is economical or efficient enough to pursue. CPC spent too much of their time talking about how successful they were rather than showing us that this concept makes sense.

Question 2: Approach to Performing the R&D.

- Focused on technical issues, but the economics are not well addressed. What is the cost of the liquid product per gallon?
- Approach was for power – fuels an afterthought with very little information provided regarding this aspect of the project.
- Success speaks
- Hard to evaluate from the presentation.

Question 3: Technical Accomplishments and Progress

- No data for the long term operation of the liquid fuels system.
- NEED some information/data! It is very difficult to evaluate the claims made in the presentation.
- There was no discussion on costs.
- Results are remarkable. Need to be verified by independently by NREL or other.
- Truly amazing results against liquid fuels catalysis development
- The focus seemed to be on past accomplishments (rather than the synfuels part of the project.
- I can't judge the technical merits of a project when no technical information is provided.

Question 4: Success Factors and Showstoppers

- The market driver for liquid fuels at the small scale is not clear
- Seems to need some partnerships.

- The catalyst performance discussed is nothing short of revolutionary and remarkable. Independent verification of the performance is required.
- If it holds up, results are revolutionary. Plans to further test are the only logical choice.
- Economics of small-scale systems.
- Meeting emissions standards
- Finding a workable catalyst given the constraints imposed by small, self-sufficient systems.
- Show stoppers: funding; durability of the gasifier system.
- Not presented.

Question 5: Proposed Future Research Approach and Relevance.

- Some real need for partners and real look at manufacturing costs.
- Need a long-term demonstration for liquid fuels production System as designed for producer-gas production, not supposed to operate 24 hrs, on/off system as needed.
- not discussed relative to liquids
- No information provided

Additional Comments

Strengths

- 24 systems built and 17 in operation, this is a real technology
- Interesting developments in catalysis – seems too good to be true
- Truly commercial products
- Fascinating presentation!
- Great showman.

Weaknesses

- No discussion on the costs of the technology and the details on how the manufacturing will be scaled-up.
- Need to refocus company to market catalyst if performance is verified by independent lab.
- Costs and economics are needed.
- Results are miraculous – need to validate with others in the DOE programs with more catalysis experience
- Will it really work?
- Provided us virtually no technical information on the synfuels part of the project.

Technology Transfer/Collaborations

- There may be interest in local production of liquid fuels, but this does not seem to be a real market. The fuel will be VERY expensive and the skills needed to keep the system running may not
- Good mix

Recommendations for Additions/Deletions to Project Scope

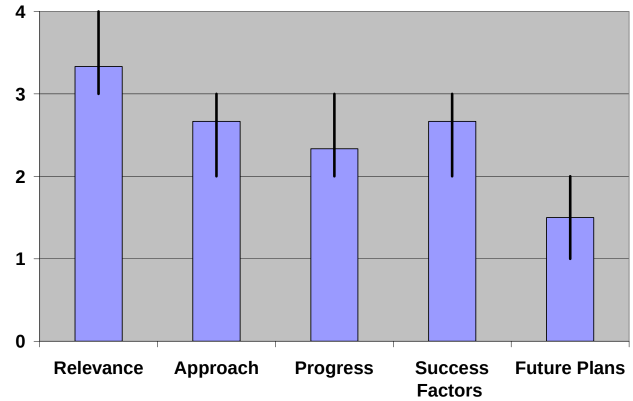
- Get catalyst tested.
- Economics on the liquids is clearly needed
- Catalyst testing to confirm results by other party needed.

PI Response to Reviewer Comments

Response not provided.

<u>Project Title: Biomass Derived Syngas Utilization for Fuels and Chemicals</u>
<u>Principal Investigator:</u> Santosh Gangwal, Research Triangle Institute (new PI: Dave Dayton, RTI)
<u>Proposed Stage</u>: Stage B/2
<u>Reviewer Recommended Stage</u>: Stage B/2

Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	2.33	0.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	1.50	0.50	0.50
Average	**2.50**		



Question 1: Relevance to Overall Objectives.

- Good relevance and understanding of the DOE targets
- Project supports goals and objectives.
- No information on customers and markets provided
- Attacking conversion improvements
- Providing the DOE OBP a systematic evaluation of synfuel catalysts.

Question 2: Approach to Performing the R&D.

- RTI has good experience and skills with technology development
- The approach is aimed at making only incremental gains in performance when revolutionary advances are required.
- Reasonable steps
- The program would be improved if it was based on some guiding scientific hypothesis, novel technology, or high throughput evaluation.

Question 3: Technical Accomplishments and Progress

- Good progress with the pilot reactors and FT work.
- In the case of the mixed alcohols it is less clear how much progress has been made.
- The performance and progress to date are modest at best.
- Project is significantly behind schedule.
- Progress is in infrastructure, not in new developments
- Progress is OK
- Review article is a duplication of existing literature reviews in an area where very little recent work exists
- Does not appear that superior catalysts have been produced as of yet.

Question 4: Success Factors and Showstoppers

- RTI has good experience with developing and deploying technology
- They have identified showstoppers, but have not identified a probable pathway to eliminate them.
- This is an evolutionary project

Question 5: Proposed Future Research Approach and Relevance.

- Future work plans identified and the success of the program depend on finding a partner to provide the cost sharing. This seems unlikely to me based upon the information presented
- No details given on path

Additional Comments

Strengths

- Good experience and technical skills
- Pilot reactors will be very valuable and remote running.
- Good facility and capabilities for this project
- Some past success
- Systematic approach to evaluating catalysts for synfuels.

Weaknesses

- Need partners to insure deployment of commercially viable
- No partner proving cost sharing for balance of program.
- Modest and undifferentiated goals
- A superior catalyst has not yet appeared from this project. The project would be better if it was based on some guiding scientific hypothesis, novel technology, or high throughput evaluation.

Technology Transfer/Collaborations –

- OK – nice to be with real catalyst vendor

Recommendations for Additions/Deletions to Project Scope

- Secure partner before conducting any additional work or expending any additional funds.

PI Response to Reviewer Comments

The objective of this project is to develop and demonstrate new catalysts and catalytic processes that can efficiently convert biomass-derived syngas into diesel fuel and C2-C4 alcohols. Our goal is to improve the economics of the processes by improving the catalytic activity and product selectivity, which could lead to commercialization. To achieve our goals, we will optimize the RTI-6 FT catalyst for use in a slurry bubble column reactor (SBCR). For the synthesis of higher alcohols, we will identify economically viable routes and develop stable and selective catalysts.

The project is divided into 4 major tasks that was originally to be carried out over a 24 month period. This schedule has been delayed with the loss of our original cost share partner, Eastman Chemical and the addition of a new cost-share partner. Task 1 will involve construction and commissioning of reactor systems. Task 2 will involve development of an attrition-resistant iron-based FT catalyst. Task 3 will involve development of selective catalysts for the synthesis of C2 to C4 alcohols. Modeling, engineering evaluation and commercial assessment of the catalytic processes developed will be performed in Task 4.

Question 1: Relevance to overall objectives

The cost goal of $1.07/gal of thermochemical ethanol was used as a benchmark to align with the NREL Design Case for an integrated, indirect biomass gasification mixed alcohol synthesis process. The new “20 in 10” goal established after the 2007 State of the Union Address is the new focus of the Biomass Program. This ambitious goal has led to a revised outlook on lignocellulosic biofuels production to include other “non-ethanol” biofuels. RTI has long history of developing Fischer-Tropsch catalysts that has culminated in the development of RTI-6; an attrition resistant, high alpha, Fe-based catalyst that has demonstrated high CO conversion to hydrocarbon wax product.

With OBP now focused on liquid transportation fuels, a market analysis can be developed, especially with three of the six commercial demonstration projects (700 tpd biorefineries) selected by OBP focusing on biomass gasification. The work plan for FY08 was revised to include a techno-economic assessment to include cost and performance data for developed fuel synthesis catalysts in the NREL Thermochemical Design Case.

Question 2: Approach to performing the R&D
We have completed the bench-scale testing of the attrition resistant Fe-based FT catalyst (RTI-6). Alcohol synthesis catalyst testing is being done in collaboration with our new cost-share partner, who will provide novel materials and formulations to evaluate in our bench-scale microreactors. We are relying on the experience of our cost-share partner (major catalyst supplier) to rationally and scientifically develop these novel catalysts based on their proven expertise. High throughput screening was never within the scope of this project.

Catalyst development and testing is only one aspect of this project where significant gains can be realized, Novel slurry bubble column reactors are also being considered for scaling up these fuel synthesis processes. Consequently, catalysts are being developed with optimum performance anticipated for this specific reactor design. Hence, the revolutionary advances may be in combining developing catalyst formulations in novel reactors designs to maximize yield and optimize performance.

Question 3: Technical Accomplishments and Progress
Much of the progress to date has been in the development of 2 reactor systems – a bench-scale catalyst microreactor test stand and a laboratory scale slurry bubble column reactor for process scale up. The microreactor system has proven to be a robust design that has been duplicated 3 times to meet RTI’s high demand for fuel synthesis catalyst testing from other government and private clients. The slurry bubble column reactor design is being scaled up in a Department of Defense project to produce FT-derived jet fuels for the Air Force. Long-term (500 hour) testing of the RTI-6 FT catalyst in a continuously stirred tank reactor was also completed as part of this project. This highlighted the exceptional performance of this catalyst in terms of CO conversion efficiency and wax yield and demonstrated the attrition resistance of the RTI-6 catalyst that is crucial for operation in a slurry bubble column reactor.

The progress in the mixed alcohol catalyst testing was hindered by the loss of Eastman Chemical as our cost-share partner after they decided not to pursue this technology development. This work has recently been re-initiated with a new cost-share partner and will continue through the completion of the project in FY08.

Question 4: Success Factors and Showstoppers
Cleary, one of the main showstoppers in producing biofuels through a syngas intermediate is synthesis catalyst productivity and selectivity. This drives the economics of the process and poses the greatest technical challenge. The development of RTI-6 for FT synthesis provides an excellent process option should less than expected progress be made in developing mixed alcohol catalysts. Additionally, RTI is developing partnerships with catalyst manufacturers to

explore the possibility of methanol as an intermediate for fuel (gasoline, ethanol, and mixed alcohols) production. Selectivity and productivity of methanol synthesis catalysts is very high (at least 3 times greater than mixed alcohol catalysts). These processes are beyond the scope of this project but are being considered for future work.

Question 5: Proposed Future Research Approach and Relevance

A new cost-share partner has been secured for this project and bench-scale testing of a variety of mixed alcohol catalysts is underway. Final construction and commissioning of the slurry bubble column reactor will culminate in a laboratory-scale demonstration of wax synthesis from syngas using the RTI-6 catalyst. This technology will be scaled up in a separate (non-DOE) project.

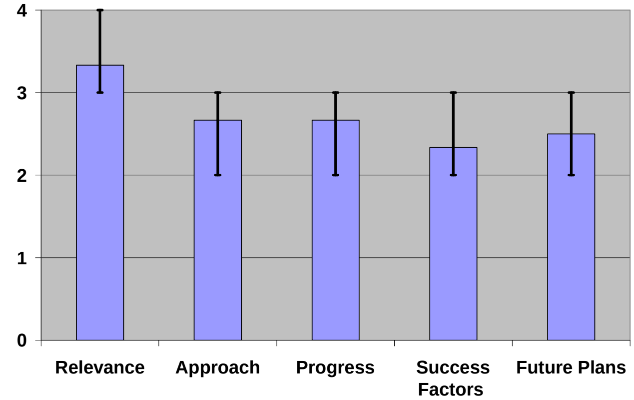
<u>Project Title: Syngas Quality for Mixed Alcohols</u>

Principal Investigator: Jim White and Steve Deutch, Pacific Northwest National Laboratory

Proposed Stage: Stage A/B

Reviewer Recommended Stage: Stage A/B

Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	2.50	0.50	0.50
Average	**2.70**		



Question 1: Relevance to Overall Objectives.

- Clearly understand the targets and barriers
- The project aligns with the program objectives.
- No Customers or Markets information was given or are identified as being important.
- Catalysis is key to enabling syngas to fuels
- Provided nice justification for mixed alcohols as a pathway to the DOE OBP goals.

Question 2: Approach to Performing the R&D.

- Good partnership between PNL and NREL, each is working is an area of strength
- No systematic approach to develop catalyst identified.
- Approach seems to be – try everything and maybe something will work
- Methodical, not revolutionary

Question 3: Technical Accomplishments and Progress

- Good facilities and experience within the team.
- No presentation of data on catalysts testing with real syngas.
- How is the syngas clean-up prior to fuel synthesis catalysts testing being done?
- Progress to date has been only modest
- Effort is reasonable but is far too focused on reproducing the past.
- Slurry studies should be encouraged
- Developed a systematic approach to improving mixed alcohol catalysts. However, the approach could have been improved if it was based on some guiding scientific hypothesis, novel technology, or high throughput evaluation.
- The project is generating data but I did not get the sense that the investigators see light at the end of the tunnel.

Question 4: Success Factors and Showstoppers

- Would help to get commercial partners into the project early
- Good understanding to the technical and economic challenges
- Some showstoppers have been identified as performance
- Targets, but no plan to overcome these was identified.
- Unclear that true critical issues are realized

Question 5: Proposed Future Research Approach and Relevance.

- An industrial partner needs to be replaced for the project to continue modest goals

Additional Comments

Strengths

- Very strong team, good experience, each lab is working in areas of strength.
- PNL access to high-throughput screening tools
- Looking both at fixed bed and slurry
- Systematic approach to developing new mixed alcohol catalysts.

Weaknesses

- Not clear how the testing with "real" syngas will be conducted, e.g., biomass feedstock, gasification operating conditions and gas clean-up.
- Poor target selection – no mention of methane make or CO2 rejection
- Lack of engineering investigation
- The approach could have been improved if it was based on some guiding scientific hypothesis, novel technology, or high throughput methodology.
- Missing an industrial collaborator.

Technology Transfer/Collaborations

- Need to work to find industrial partners.
- A bit self focused

Recommendations for Additions/Deletions to Project Scope

- An industrial partner needs to be replaced for the project to continue
- More focus on engineering solutions

PI Response to Reviewer Comments

General CommentsWe strongly agree with the reviewers comments about the need for collaborating with a commercial partner. This has been difficult as most catalyst manufacturers ceased active research in this area in the early 1990's. We are currently discussing collaborations with a large US chemical company and an oil company. These discussions should lead to a defined path forward for securing a commercial partner.

Question 2: Initial project focus was to identify the most likely commercial catalysts and begin alcohol synthesis evaluation using model syngas. Only one commercial source was identified, the existing catalyst literature was found to be dated and conflicted, and so we had to produce our own catalysts from the best of the literature claims. Future work will encompass catalyst discovery. Project guiding principal is focused on improving catalyst space time yields (STY) up to 4x by increasing the number, stability, identity, and activity of catalyst sites for alcohol formation.

Question 3: This project began in FY06 and difficulty in obtaining commercial alcohol synthesis catalysts required that these materials be synthesized at PNNL and NREL based on the existing literature, which is significantly conflicted with respect to catalyst compositions, process conditions and products yields. Since the review, PNNL has identified a promising promoted rhodium-based catalyst and NREL is performing a parametric study of process condition impact on alcohol synthesis with a $CoMoS_2$ series of catalysts in a slurry reactor. Both laboratories are exploring how computational catalysis can be coupled with surface analyses to develop catalyst structure/function relationships to be used in rational catalyst design. A new approach being developed at PNNL is homogeneous alcohol synthesis catalysts. Currently, NREL and PNNL do not have appropriate hardware tools for high throughput catalyst evaluation in the gas phase. Syngas cleanup is accomplished via tar and methane reforming as described in the Catalyst Fundamentals task. Future tests are planned with biomass-derived syngas and both fixed bed and slurry reactors are in use at NREL.

The project will continue to focus near term on maximizing ethanol production from biomass syngas, based on FY2012 technical goal from the Program's Multi Year Technical plan. However much of what is learned on catalyst requirements for biomass syngas quality would be applicable to a longer-range target of any liquid fuel from syngas. The project will rely heavily on the analysis project to help guide the future work to identify the fuel that can have the greatest impact in the overall energy picture, based on cost, technical feasibility, sustainable volume and acceptance into the fuel pool.

<u>Weaknesses</u> We recognize that hydrocarbon production is undesirable and research efforts will focus on minimizing this process through catalyst modification that includes varying reduction and activation conditions and reducing acidity. We also recognize that CO_2 is a necessary by-product of biomass derived syngas catalysis as biomass is oxygen rich compared to the intended products and CO_2 is a convenient oxygen rejection mechanism. Thus in absence of a “free” hydrogen source, modest carbon loss via oxygen rejection in the form of CO_2 is required as the alternate process rejects oxygen through water formation, which also rejects valuable hydrogen.

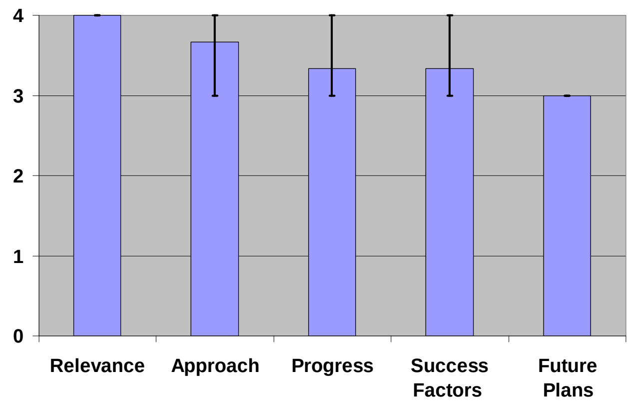
The help guide catalyst selection, rather then simple parametric tests to measure catalyst productivity and performance, a more systematic testing of the catalyst is being developed to include characterizing the general kinetics of a catalyst. This approach will allow us to 1) identify a more productive operating point for a catalyst in a way that can minimize the possibility of missing a prime point and 2) provide insight into why one catalyst is performing better then another. This opens the opportunity for ways to combine the best properties of several catalysts into a superior material.

The suggestion to add research into reactor geometries would help maximize alcohol productivity and allow the program to reach its target goals. However it is felt that adding this task to the project at this time is premature until a catalyst with suitable performance is identified and well characterized, since these characteristics will also help define a preferred reactor design. This issue can be addressed in later years as long term testing and catalyst stability is being addressed.

Pyrolysis Projects

<u>Project Title: Pyrolysis Oil R&D</u>
<u>Principal Investigator:</u> Doug Elliott, Pacific Northwest National Laboratory
<u>Proposed Stage</u>: Stage A/B
<u>Reviewer Recommended Stage</u>: Stage A/B

Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	3.00	1.00	1.00
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**2.93**		



Question 1: Relevance to Overall Objectives.

- Team has a clear understanding of the OBP goals and the market needs
- Project aligned with program goals
- Pyrolysis oil still requires integration into refinery, without it, there is no path directly to motor fuel.
- Taking leadership in developing a pyrolysis core to the DOE OBP.

Question 2: Approach to Performing the R&D.

- The team is focused on some specific targets and understands the connection to the other OBP goals.
- The targets for improvements do not seem very aggressive
- Good inclusion of industrial and international partners
- Plan/approach poorly identified.
- Where did targets come from?
- What is the basis of comparison?
- Heat transfer modeling is conspicuously absent
- Comprehensive. Much of it is “high level” as the participants develop a plan for pyrolysis technologies, which is important but detracts from the desire for the approach to be “sharply focused.”

Question 3: Technical Accomplishments and Progress

- There is a great deal known about pyrolysis and stabilization so some of the tasks do not seem very ambitious.
- New start – not really applicable – but comments above also apply.
- Just starting
- Reasonable set of technical targets although these should include targets for water content, stability as measured by viscosity, and particulate matter in the bio-oil.

Question 4: Success Factors and Showstoppers

- The project has identified some key barriers and the team has the skills to overcome barriers.
- Not presented well and appear not to be utilized in making program plan
- Too early to tell, economics are the key
- Uncertain path to market – three or more options
- Identified showstoppers but did not describe in much detail how these things might be overcome.

Question 5: Proposed Future Research Approach and Relevance.

- Team needs to aggressively publish work since much of the early work was not well disseminated.
- Not clear that the specific targets were justified based on large enough changes to "matter" to the end-user, e.g. reduction of oxygen from 30% to 28% over 3 years
- Where is the project going? What is needed from the technology to make the overall concept economic?
- Very reasonable and well integrated into other global
- efforts

Additional Comments

Strengths

- Good team with a great deal of experience.
- It is good that project is starting to layout a new path.
- Well integrated, still early
- Historic experience in pyrolysis research.
- Good team of PNNL and NREL.
- Team is developing a program (not just a project).

Weaknesses

- Seems like series of modest improvements.
- TEA should be done with ASPEN so that the models can be compared across the program.
- Goals and technical plan could have been a little more ambitious
- Focus of overall project needs to be better defined, lack of model development to insure successful scale up from bench to full scale
- Very early stage and lacking definitive targets.
- Work at the bench scale probably needs to be validated by work at the pilot scale (generally it will be much easier to meet performance targets at the bench scale).

Technology Transfer/Collaborations

- Tied into European efforts

Recommendations for Additions/Deletions to Project Scope

- Discuss how you arrived at the future goal values – like 67% conversion
- Utilize other work in the area that identifies the baseline – why is this part of the project – should have been done ahead to identify a need for a the project doing baseline to incorporate DOE standards for process simulations
- add a reactor model / chemistry model effort
- Continue and build on collaboration with VTT. The Finns are beginning to really take off in the renewable fuels area, and VTT is clearly their lead institution on this.

PI Response to Reviewer Comments

- The reviewers recognized that the project is well-aligned with OBP goals and that this project provides the leadership for developing core R&D for pyrolysis.
- The reviewers did not provide specific feedback on our draft goals but seemed to be suggesting that they were not bold enough. They recognized that these are under development as this project was just getting started. Our initial effort in modeling will provide the feedback we need to identify barriers and showstoppers and guide our future research efforts. The collaboration efforts with Finland were lauded at several points.

Specific Responses:
Question 1 and 2:
We agree that pyrolysis oil is an intermediate in the biomass to gasoline pathway and it has to be integrated into refinery operations for processing to motor fuel. Therefore, we assumed and have been developing two approaches leading in this direction: 1) hydrotreating of bio-oil in a stand alone reactor (possibly using a refinery infrastructure, especially for hydrogen supply) and 2) a modification of bio-oil to make it compatible with refinery processing to motor fuels.

The targets for improvement were proposed based on the PIs' long experience in the area. They may not look very aggressive but they reflect the progress in technology development in the last twenty years. With the increased research effort we hope to achieve faster progress and the though targets may change based on future results, they are sufficient to guide our research this time.

We acknowledge the importance of heat transfer in fast pyrolysis, however, our research is not focused on pyrolysis reactor development but rather on the existing product upgrading and on exploring catalytic processes that could potentially modify the bio-oil composition to make it more suitable for further conversion to motor fuels.

Question 3:
We acknowledge that there is some but not a great deal of knowledge on bio-oil stabilization. Our research in this area takes it into account and goes beyond what is known at present both with respect to stabilization by hydrotreatment and by "capping" of the reactive functional groups. Future work will characterize the chemistry of the modified oils and also water and particulate content and viscosity.

Question 4:
The project is in the early phase. Our ongoing effort in technoeconomic modeling will provide the feedback to identify barriers and showstoppers and guide our future research efforts.

Question 5:
The goal of the project is to develop a fast pyrolysis-based process for producing automotive fuels from biomass. The proposed targets specified improvements for each process step to be achieved during the five-year period. If these targets are reached the technology will be economic – 90 gallons of hydrocarbon fuel will be produced from 1 ton of biomass at a cost competitive with $1.31/gal ethanol.

Weaknesses
Technoeconomic models using Aspen are currently being developed to assess the feasibility of both pyrolysis/upgrading approaches and then to understand the minimum upgrading that will be required.

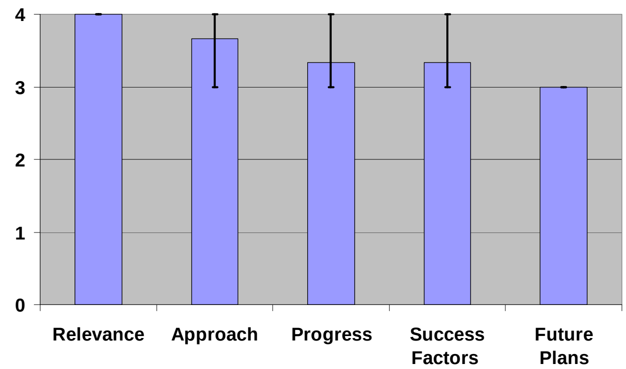
Recommendations:

The future goal values were set considering the best performances achieved so far in laboratory experiments. For example, 67% of biomass to bio-oil conversion (dry basis) is somewhat higher than that reported for a bench-scale system using clean (debarked) wood (65%). The product yields from larger-scale units are still lower but have a chance to match those from small systems.

We are aware of the VTT work, are following it closely, and cooperate with them on setting bio-oil standards and on hydrotreatment.

Project Title: Pyrolysis Oil to Gasoline
Principal Investigator: Richard Marinangeli, UOP
Proposed Stage: Stage 2
Reviewer Recommended Stage: Stage 2

Relevance	4.00	0.00	0.00
Approach	3.67	0.67	0.33
Progress	3.33	0.33	0.67
Success Factors	3.33	0.33	0.67
Future Plans	3.00	0.00	0.00
Average	**3.47**		



Question 1: Relevance to Overall Objectives.

- The team clearly understands the DOE OBP goals and needs, and the market needs
- The project is critical to and fully supports plan objectives.
- UOP as the entity commercializing the product knows the Customers/Markets
- Ties to real world refining

Question 2: Approach to Performing the R&D.

- Good combination of modeling and TEA, and experimental work
- Development approach is well though out.
- Good mix of model and experiment

Question 3: Technical Accomplishments and Progress

- Good progress in both experimental and modeling. UOP appears to bring a great deal of value to the project, and this is a very good example of the public/private partnerships
- Reasonable progress has been made against the project goals
- Still early
- Intriguing and very promising results.

Question 4: Success Factors and Showstoppers

- A major issue is the cost of the oil. Since biomass is 40-45% oxygen and you throw it away as H2O or CO2. This is both an economic cost and an environmental cost of not using the land very well.
- Very good understanding of the issues
- UOP has identified a number of potential showstoppers and identified possible strategies to overcome them
- Good progress in understanding. That said, risk analysis seems lacking
- Lack of subsidy versus ethanol, biodiesel
- Nearly the entire processing chain needs to be developed to reach commercialization
- Composition and characteristics of feedstocks and products needed
- Identified a variety of risks and appear to be proactive about overcoming them.

Question 5: Proposed Future Research Approach and Relevance.

- Good plans

- SSF residues look like a very attractive target to help with the economics and LCA
- The future work plan is defined well, building on the success of the project.
- Could be more aggressive

Additional Comments

Strengths

- Very good team!
- Good combination of experimental work and modeling.
- Great inclusion of LCA early in the process
- UOP is a credible industrial player
- UOP has identified good partnerships with each partner playing to their strengths
- UOP has identified a good approach
- It is a nice development effort for both the economic and technical work
- Credible industrial player
- Very reasonable approach
- Flexibility of pyrolysis to different biomass feedstock; conversion of oils needed badly.
- "Doing quite well relative to DOE targets."

Weaknesses

- The approach only uses 30% of the original biomass (no oxygen in product and only 50% of the carbon in the produce) so this is not a great use of land relative to some of the gasification options.
- none
- Not clear where they go from here (results are very promising and suggest a move toward commercialization).

Technology Transfer/Collaborations

- Good interaction with the government labs

Recommendations for Additions/Deletions to Project Scope

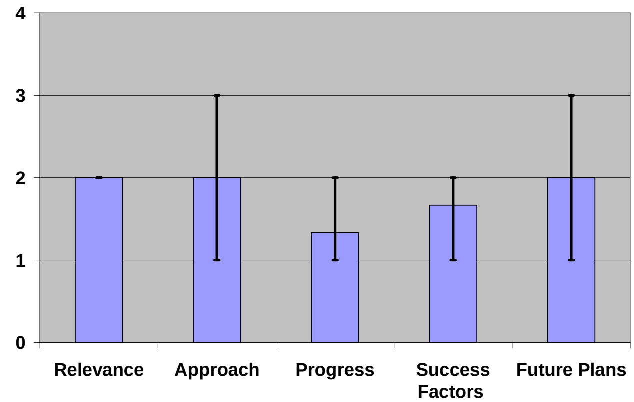
- Stay the course
- Consider separating lignin from bio-oil and hydro cracking it rather than the whole oil.
- Move work to pilot-scale.

PI Response to Reviewer Comments

Response not provided.

Project Title: Developing Thermal Conversion Options for Biorefinery Residues
Principal Investigator: Vann Bush, Gas Technology Institute
Proposed Stage: Stage B/Development Research, Stage 3 and 4/Development/Validation
Reviewer Recommended Stage: Stage B/3

Relevance	2.00	0.00	0.00
Approach	2.00	1.00	1.00
Progress	1.33	0.33	0.67
Success Factors	1.67	0.67	0.33
Future Plans	2.00	1.00	1.00
Average	**1.80**		



Question 1: Relevance to Overall Objectives.
- The project does not define the potential value of the technology if it were successful. They want a consistent feedstock but do not define the quality/cost targets
- The project provides little support to the Program goals and objectives
- No customers or market data are provided
- Clearly an attempt to place a square peg earmark into a round OBP hole
- Pretreatment of biomass to improve its subsequent processing is important to the DOE OBP program. However, it is not clear how pretreating biomass at 33 atm makes it easier to gasify at 10 atm.

Question 2: Approach to Performing the R&D.
- The base CWT technology is not reliable or well-documented and this work plan does nothing to increase confidence.
- The approach is not responsive and is unlikely to make any significant progress
- It is unlikely that the value of the product can support the capital and processing costs approach is defined based on location of feedstock, not rational target

Question 3: Technical Accomplishments and Progress
- The work has not begun. The history of the projects or CWT does not provide great confidence.
- The PI has made no progress towards its objectives
- No technical work done yet
- N/A: Project not yet started.

Question 4: Success Factors and Showstoppers
- CWT has a mixed image in the market place.
- Need an independent engineering company that can increase confidence
- There are a myriad of showstoppers, both technical and economic with very little discussion presented.
- It is unclear what is different from the existing pilot and commercial plant
- N/A
- This project is just beginning.

- Showstoppers identified but strategies for overcome not described.

Question 5: Proposed Future Research Approach and Relevance.

- GTI has a long history of project development, but this presentation did not give any insight into what they will actually do and why it makes sense.
- Realistic plans for future work were not given.
- goals seem modest

Additional Comments

Strengths

- None
- Universal front-end not requiring TDP reactors
- GTI is well qualified to perform thermochemical research.

Weaknesses

- Very disappointing presentation of the work plan.
- How the small scale process will work is not clear and naive. Loggers can not even afford a chipper they will have no ability or interest in a more expensive/complex project.
- The project plan was unclear
- PI did not appear to have investigated any of the multiple potential technical and economics showstoppers small scale/portable complex systems
- Nebulous goals
- Needs economic analysis to make a convincing case for this work.
- The team must force-fit a particular technology to a problem it was never intended to solve.
- CWT was not present for the review of their project.

Technology Transfer/Collaborations

- uncertain – collaborators seem to be chosen by congressional district, not capabilities
- Working with CWT, but not sure this is strength.

Recommendations for Additions/Deletions to Project Scope

- This project should be canceled because it is a poorly thought through alternative to the original project. For that matter, the original project represented a duplication of other federally-supported commercialization of TDP.

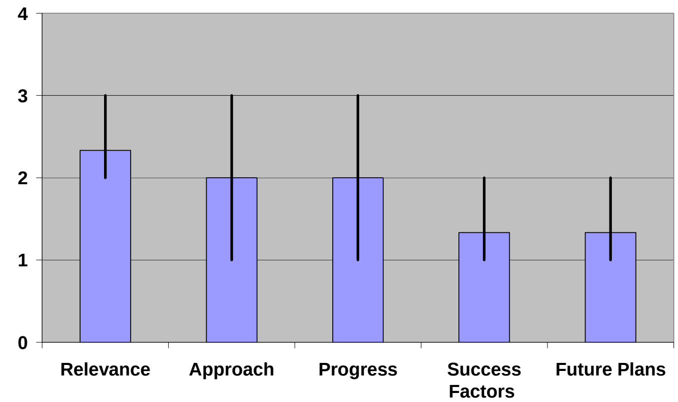
PI Response to Reviewer Comments

- The reviewers make two dismissive comments that appear to be grounded more in perception than fact. First, they assert that "This technology has been funded at very high levels (estimated at $70MM), and the added value for this particular project is unclear." Then they suggest that "the team consider other pre-treatment technologies." While thermo-depolymerization (TDP) technology has received extensive public support, the reviewer's comments imply that technologies for biomass pretreatment to facilitate gasification and pyrolysis that derive from TDP have been fully explored within the scope of previous DOE-supported research and found to be of minimal utility. We believe that this is an unsupportable, unnecessarily broad assertion. ***Indeed, GTI and its project partners are unaware of previous or current, domestic or international R&D efforts that are focused on deriving an effective biomass pretreatment technology from <u>components of</u> the TDP technology to facilitate gasification and pyrolysis**.* GTI and its project partners strongly believe that the technical approach proposed for these redirected projects represents a unique solution to a difficult, but general problem and that valuable intellectual property will result from our efforts.

- The two projects were treated by the reviewers as if they had been awarded and funded, which was not the case. At the time of the Thermochemical Platform Peer Review, a DNFA was underway at DOE Headquarters to determine if the redirected projects fit within the scope of DOE's legitimate interests. This circumstance was duly noted in GTI's presentation.
- The reviewers also appear to have overlooked the fact that project funds were not available to support GTI's preparation or their participation in a comprehensive project review process. In light of this reality, the review panel may have adopted a set of expectations that, in this instance, could not be accommodated for unfunded projects.
- The reviewer's comment with respect to "potential technical and economics showstoppers" is unclear; perhaps the concern is with development and deployment of a portable pretreatment system. Those issues, and many others directly related to the concerns expressed by the reviewers are addressed in the project management plans submitted to DOE.
- The reviewers cite as a weakness that "Handling and cleaning of woody biomass has been extensively studied by the pulp and paper industry." This is a gratuitous comment that does not address either the strengths or weaknesses of the proposed work and fails to take into account that while woody biomass is an important fuel, it is one fuel of interest in the broad suite of native biomass resources this project seeks to accommodate.
- The reviewers suggest that these projects would benefit from an in-depth stage gate prior to initiation of new work. In general, this is a useful comment that probably should be part of any project that seeks to develop a novel approach to a difficult problem.
- The reviewers apparently expected a technical exposition with detailed project plans. However, DOE's instructions explicitly requested a broad overview, with less emphasis on specific results or plans.

Project Title: Mississippi State University Sustainable Energy Center - Pyrolysis
Principal Investigator: Phil Steele and Leonard Ingram, Mississippi State University
Proposed Stage: Multiple tasks at different stages
Reviewer Recommended Stage: Stage 2

Relevance	2.33	0.33	0.67
Approach	2.00	1.00	1.00
Progress	2.00	1.00	1.00
Success Factors	1.33	0.33	0.67
Future Plans	1.33	0.33	0.67
Average	**1.80**		



Question 1: Relevance to Overall Objectives.
- Poor understanding of the DOE goals and the merits of their approach.
- CCA treated wood is way off the DOE target. This may be a local or EPA issue, but not a DOE target
- The project as presented does not support the Program at all.
- The project needs to conform with the Program
- Confuses technical targets (quantifiable metrics) with tasks.

Question 2: Approach to Performing the R&D.
- Simply a collection of academic projects with no overall focus or
- No plan/mechanism for selecting more useful, valuable projects
- No approach was presented.
- The presentation did not identify a systematic approach to solving problems associated with the Program
- Novel approaches and thorough analytical program that is well organized with specific tasks and targets.
- An extremely diffuse approach. It is hard to see where all this leads.

Question 3: Technical Accomplishments and Progress
- No focus or targets that let them know if they are making progress
- No progress was made towards the Program needs or was it possible to evaluate the scattergun methodology which the PI presented.
- Early stage – less than a year since inception
- A potpourri of results was presented. However, the relationship among the results was not clear and the significance o f many of the results are questionable (example: what is so surprising about find lower molecular weight products in the bio-oil).

Question 4: Success Factors and Showstoppers
- Without targets they don't know if they have overcome a critical barrier or are working on the most important tasks.
- No success factors or showstoppers were given

- Recognizes that cost of hydrogen for upgrading, low yield, and water solubility of are potential major problems.
- Only cursory attention, if any, was given to the issue of showstoppers and potential solutions.

Question 5: Proposed Future Research Approach and Relevance.

- Recognize the need to eliminate future work on CCA treated wood since it is not aligned with the DOE goals
- The plans for future work did not exist
- New target: rapid commercialization of upgraded oils.
- Specifics not clear.

Additional Comments

Strengths

- Limited
- Spending money
- Built mobile pyrolysis unit
- Recognizes that fast pyrolysis has good potential.

Weaknesses

- No economic analysis to justify/guide process selection
- Thermal treatment of CCA treated wood will have an Arsenic vapor stream that is hazardous
- The bio-oil preservative is not of interest to the DOE program
- Do not appear to understand the limitations of their analytical tools, need LC or NMR to understand the non-volatile components.
- The PI presented no innovative technology
- Prior to commencing additional R&D activities, engineering/process analysis is needed to help define technical targets to better guide this work
- Some project activities are clearly redundant and the remaining tasks are not aligned with the Program goals and priorities.
- Overall project lacked direction and clear justification
- Need economic analysis to justify value of project.
- Project lacks a coherent approach.
- Project would have been strengthened by the addition of external partners (universities and companies).
- The project would be better if it was based on some guiding scientific hypothesis or novel technology.

Recommendations for Additions/Deletions to Project Scope

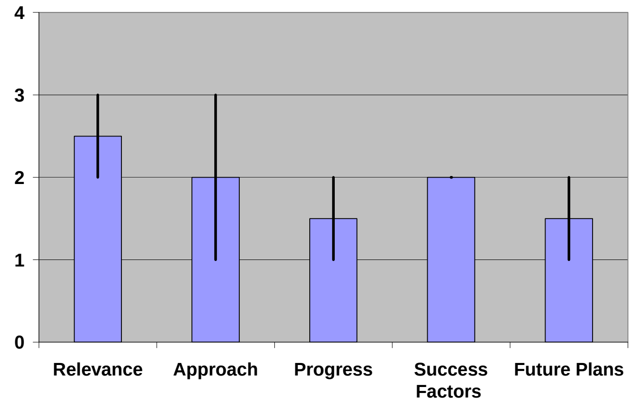
- Need to work with DOE program staff to identify the priorities for their work as if moves forward.
- Work with Program Director to better align project to Program goals and needs.
- Bring focus to the effort. Drop efforts that are not directly related to the goal of thermochemically transforming biomass to transportation fuels and focus on fast pyrolysis (drop the hydrothermal treatment task).

PI Response to Reviewer Comments

Response not provided.

<u>Project Title: Applications of Thermo-Depolymerization Technology</u>
<u>Principal Investigator:</u> Tom Butcher, Brookhaven National Laboratory and Gabe Miller, Society for Energy and Environmental Research
<u>Proposed Stage</u>: Stage B/Development Research
<u>Reviewer Recommended Stage</u>: Stage B/Development Research

Relevance	2.50	0.50	0.50
Approach	2.00	1.00	1.00
Progress	1.50	0.50	0.50
Success Factors	2.00	0.00	0.00
Future Plans	1.50	0.50	0.50
Average	**1.90**		



Question 1: Relevance to Overall Objectives.
- Little attention to DOE goals.
- Lots of claims from CWT but no success in the marketplace.
- Unclear how bio-oil is being refinery integrated
- Project on hold and goals being reevaluated. It appears targeted at waste grease (not one of the DOE OBP pathways) to transportation fuel (although it is not clear how the TDP oil is converted into commercial fuel).

Question 2: Approach to Performing the R&D.
- TDP could be useful for wet Biorefinery wastes.
- Fixing critical problems in the process
- How many TDP commercialization projects does the federal government have to support before the commercial destiny of the process is evident? This is unnecessary replication.

Question 3: Technical Accomplishments and Progress
- Need the engineering and process economics to be a major component of the future work
- Problem is determining why pilot unit
- Intriguing and very promising results.

Question 4: Success Factors and Showstoppers
- TDP provides a liquid product so has some advantage vs. wet gasification that makes CH_4
- Not at all clear what is unknown
- Identified a variety of risks and appear to be proactive about overcoming them.
- Missed an important showstopper: loss of their commercial partner.

Question 5: Proposed Future Research Approach and Relevance.
- There was no specific plan that could be evaluated. General discussion on trap grease does not provide technology or engineering detail.
- Project on hold.

Additional Comments

Strengths

- None
- Viable concept, large potential market, demonstrated in part on commercial scale at a Missouri turkey processing plant.
- Has potential for double winner: produce fuels and eliminate wastes.
- I find no strengths.

Weaknesses

- There is a real lack of clarity and to the plans and options. The partners should develop their plan, and then DOE should conduct a very detailed review of the merits of the detailed proposal.
- Need to identify industrial partner(s)
- CTW was not present for the review of their project.

Technology Transfer/Collaborations

Recommendations for Additions/Deletions to Project Scope

- Is it possible to just cancel this project?

PI Response to Reviewer Comments

- The project's revised Statement of Work includes facility design and economic analysis for different product conversion and direct use routes. This includes integration with a petroleum refinery for production of ASTM diesel. With the addition of consideration of alternative conventional uses for the brown grease feedstock, this planned effort should address the concerns raised by the reviewers.
- It has been estimated by NREL that trap grease, nationally, has the potential for production 495 million gallons of biodiesel annually. Given U.S. biodiesel production levels of 250 million gallons in 2006, it would seem that waste greases could make a contribution to the national situation. Further – any trap grease process is likely to actually incorporate yellow grease feeds, increasing the potential impact.
- While alternative pathways are possible and have been proposed, the management of trap grease remains a very significant local problem. Solution requires an integrated regional program including building codes, enforcement, collection, analysis and monitoring, conversion, product quality management, and product distribution. The solutions being explored under this project may be suitable for local implementation, avoiding logistical issues associated with large industrial facilities and providing a more consistent feedstock.
- The thermal process to be used in this project offers some advantages that could make it attractive relative to direct refinery integration of trap grease. This includes no requirement for hydrogen, no catalyst, and the ability to accept a very mixed and variable feedstock. The current plant in Missouri that processes turkey waste accepts considerable solids in the feedstock.

APPENDIX A

Agenda

Day 1 – Tuesday, July 10th

8:30 – 8:50	Platform Overview	*Paul Grabowksi, Office of the Biomass Program*
9:00 – 9:10	Stage Gate Overview	*Bob Wooley, National Renewable Energy Laboratory*

10:35 – 10:45 Break

11:05 – 1:00	➢ Gasification of Biorefinery Residues (lignin/modeling and optimization)	*Dave Dayton, National Renewable Energy Laboratory*
	➢ Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant	*Chris Lindsey and Ed Gray, Antares Group Incorporated*
	➢ Mississippi State University Sustainable Energy Center (MS)	*Mark Bricka, Mississippi State University*
2:00 – 2:40	Presentations on Black Liquor Gasification Projects	
	➢ Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer Project	*Kevin Whitty, University of Utah*

3:00 – 5:30 (3:45 – 4:00 break)	➢ Biomass Gas Cleanup Using a Therminator ➢ Engineering New Catalysts for In-Process Elimination of Tars ➢ Catalyst Fundamentals (Integration and sub tasks) ➢ Integrated Catalyst Testing	*Santosh Gangwal, Research Triangle Institute* *Larry G. Felix, Gas Technology Institute* *Kim Magrini, National Renewable Energy Laboratory* *Calvin Feik, National Renewable Energy Laboratory*

Day 2 – Wednesday, July 11th

10:20 – 10:35 Break

10:55 – 2:55 (12:00 – 1:00 Lunch)	➢ Pyrolysis Oil R&D	*Doug Elliott, Pacific Northwest National Laboratory*
	➢ Pyrolysis Oil to Gasoline	*Richard Marinangeli, UOP*
	➢ Developing Thermal Conversion Options for Biorefinery Residues	*Vann Bush, Gas Technology Institute*
	➢ Mississippi State University Sustainable Energy Center (MS)	*Phil Steele and Leonard Ingram, Mississippi State University*
	➢ Applications of Thermo-Depolymerization Technology	*Tom Butcher, Brookhaven National Laboratory and Gabe Miller, Society for Energy and Environmental Research*

2:55 – 4:15 Break

5:00	Adjourn

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Paul Grabowski Please copy Leslie Pezzullo (lpezzullo@bcs-hq.com)

You have been invited to serve as a Reviewer for the DOE Thermochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	**No**
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Syngas Platform Analysis/ Thermochemical Analysis	
Gasification of Biorefinery Residues (lignin/modeling and optimization)	
Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant	
Mississippi State University Sustainable Energy Center (MS)	
Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer Project	
Biomass Gas Cleanup Using a Therminator	
Engineering New Catalysts for In-Process Elimination of Tars	
Catalyst Fundamentals (Integration and sub tasks)	
Integrated Catalyst Testing	
Thermochemical Conversion of Corn Stover	
Small Scale Biomass System (BioMax)	
Biomass-Derived Syngas Utilization for Fuels and Chemicals	
Syngas Quality for Mixed Alcohols	
Pyrolysis Oil R&D	
Pyrolysis Oil to Gasoline	
Developing Thermal Conversion Options for Biorefinery Residues	
Mississippi State University Sustainable Energy Center (MS) – (pyrolysis)	
Applications of Thermo-Depolymerization Technology	

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Paul Grabowski (202-586-0478) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

________________________________ _______________________
Signature Date

____
Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session:

Reviewer Name: ______________________________

Title of Project: ______________________________

Presenter Name: ______________________________

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement:______________________________

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach** to performing the R&D.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

APPENDIX D

Letter to PI

(Requesting PI Responses to the Reviewer Feedback)

From: Leslie Pezzullo [mailto:LPezzullo@bcs-hq.com]
Sent: Tuesday, October 30, 2007 4:53 PM
Subject: Thermochemical Peer Review Draft Report -- Need your feedback by Nov. 30

PIs,

Thanks again for all your hard work at the Peer Review. We have had some difficulties in receiving the final feedback from the reviewers in a timely fashion and we are still waiting to hear from 1 reviewer. We've decided that we should not wait anymore and go forward with what we have so far. If we receive the comments from them we will send them forward.

As promised we will give all the PI's an opportunity to reply to the comments offered by the reviewers. For this we need your input and we would like to collect this information by COB Friday, November 30th. The draft report is available online at http://obpreview07.govtools.us/review/documents/FinalReport-Thermochem%20Review%2010-13-2007.pdf.

Please provide your input (bulleted in Word) to Leslie at lpezzullo@bcs-hq.com.

Thanks,
Paul and Leslie

Leslie Pezzullo
BCS, Incorporated
8920 Stephens Road
Laurel, MD 20723
(410) 997-7778 ext. 234

Office of the Biomass Program
Integrated Biorefinery Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Integrated Biorefinery Platform Review held on August 13-15, 2007 in Golden, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the type of biorefinery they were investigating (i.e. preprocessing and storage, processing and process integration). The platform review agenda is attached to this report in Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for response. Any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Larry Russo
Integrated Biorefinery Platform Technology Manager
DOE/EERE, Office of the Biomass Program

Project Title	Relevance	Approach	Progress	Success Factors	Future Plans	Average
Advanced Biorefining of Distiller's Grain and Corn Stover Blends	4.00	4.00	3.67	3.33	4.00	3.80
Du Pont integrated biorefinery	4.00	4.00	4.00	3.67	3.00	3.73
Making Industrial Bio-refining Happen!	3.67	4.00	3.67	3.33	3.67	3.67
A New Biorefinery Platform Intermediate	3.33	3.67	3.67	3.33	4.00	3.60
New Sustainable Chemistry for Adhesives, Elastomers and Foams	3.67	4.00	3.33	2.67	3.00	3.33
Integrated Biorefinery Platform Analysis	3.33	3.00	3.00	3.33	3.33	3.20
Separation of Corn Fiber & Conversion to Fuels & Chemicals: Phase 2	3.00	3.00	3.00	2.67	3.00	2.93
sugar-based ethanol biorefinery	3.00	2.67	3.00	2.67	2.67	2.80
Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries	2.67	2.67	2.67	2.67	3.00	2.73
National Agricultural Based Industrial Lubricants Center Project	2.00	2.33	3.00	3.00	2.50	2.57
City of Gridley Biofuels Project	2.67	2.67	2.00	2.33	2.33	2.40
Biorefinery and Hydrogen Fuel Cell Research	1.67	1.67	2.00	1.67	1.67	1.73

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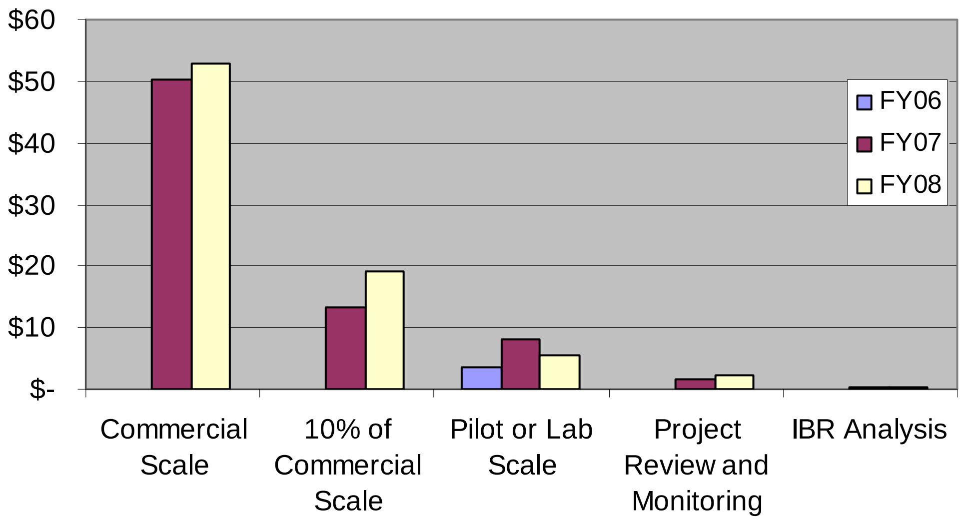
Program Peer Review Platform Results

Platform Direction

In FY2008, the IBR Platform will continue to support the awards made under Section 932 of the EPAct 05 and the 10% of Commercial Scale Biorefinery awards and the remaining awards from the 2002 solicitation. These demonstration projects will focus on completing their detailed engineering design, NEPA compliance and environmental analysis and permitting activities including more realistic feedstock production data, conversion processes and market evaluation.

By the end of FY2008, the platform will have also completed the initial construction phase for Range Fuels, completed pilot runs at the Abengoa Pilot Plant on stover, and restarted the work to produce 3-HP from cellulosic feedstocks. Finally, in FY2008, the platform will release the IBR analysis report that defines the market cost of biofuels based on feedstock logistics and conversion processes.

Platform Funding (in $M)[1]



Specific Responses to Select Comments

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
Too many WBS's, need to focus on the things that OBP is investing in (see examples in the Program Review Comments section)		Since the IBR element requires the integration of many technologies, the WBS is more detailed; however we clearly identify the priorities and the activities invested by OBP in our Annual Operating Plan and Multi-Year Program Plan

[1] Please note that FY 2007 Pretreatment funding included forward funding for FY 2008 activities.

The goals are critical but poorly defined at this time. Some good progress has been achieved such as solicitations and analyses. Some good partnerships have been developed. But all in all, the platform is still too nebulous to be as useful as it could be.		The IBR element has changed in the last year due to the demonstration and deployment activities; however, the goal of delivering a process that can produce a cost-competitive fuel remains the one goal that crosscuts all pathways.
The reviewer recommendation to publish more and encourage information sharing is understandable, but I question whether or not it is practical. Where possible, the use of public funds to develop resources that can be shared is to be encouraged, but the leveraging of private resources is so helpful it would not be wise to restrict it.		It is important to protect proprietary and company confidential information; however, it is also important to publish advances in the technology so as to attract continued private investments. It is also important to demonstrate the economic results are validated so the investors believe the results.
This platform is ideally situated, by virtue of its being at the interface with commercial implementation, to provide feedback to the feedstock, thermochemical and biochemical platforms as to what adjustments, refocusing, etc. is required in those platforms in order to assure commercially viable biorefinery processes.		The TM appreciates the reviewer's comments

Program Review Comments

Strengths

- Projects are well managed to meet specific goals.
- Liked the discussion of the options.
- The platform seems to have done a good job of assessing the barriers which are appropriate for the Program to address. The program is well funded. The development of commercial scale plants may be premature for technical reasons, but may also help identify new areas of research needed to remove impediments for future plants. The recognition that 10% scale plants are more desirable is to be commended. I applaud the program's utilization of "investment banker" philosophy and risk analysis in the 932 process. Risk mitigation is necessary for success. I am happy to see the platform planning to look at utilization of new feedstocks and conversion technologies in the months and years ahead.
- Good industry partnerships. Good synergy with the biochemical conversion platform.

Weaknesses

- There are many gaps in the program.
- Needs to have better explanation of how they fit together in this platform.
- Clarity of purpose and option development were expressed as concerns.
- No work on utilization of perennial crops, forest residues and post consumer waste. Insufficient focus on full life cycle analysis re full life cycle GHG emissions and energy balance.

R&D Portfolio Gaps

- There are many gaps in the program, as cited by the presentation. These include, little or no work on logistics of feedstock supply/ Issues around water supply and management need to be addressed/ No work on utilization of perennial crops, forest residues or post consumer waste/ Lack of full life cycle energy balance and GHG emissions/ Insufficient focus on unit process integration.

- The report noted little or no work on logistics of feedstock supply. While I agree that this is a paramount need for the overall program, I don't think it is a gap in this specific platform. I agree with the other four gaps noted by the peer review for this platform.
- Gaps were well pointed out.
- While I agree with the comment that the feedstock supply needs more attention from the Program as a whole, I am not sure that it fits under this platform rather than the Feedstock Platform. I agree with the comment that water supply issues need attention. There are opportunities in biorefinery integration to tell a good public relations story. I agree that perennial crops/forest residues could use more attention, especially regionally. Likewise wastes such as cobs are logical opportunities for attention. Full life cycle analyses are increasingly important in the investment and marketing world. In my experience, they are emerging as a real environmental and corporate investor focus.
- Agree with gaps identified in the platform review presentation.

Additional Recommendations, Comments and Observations

- The reviewer recommendation to publish more and encourage information sharing is understandable, but I question whether or not it is practical. Where possible, the use of public funds to develop resources that can be shared is to be encouraged, but the leveraging of private resources is so helpful it would not be wise to restrict it.
- This platform is ideally situated, by virtue of its being at the interface with commercial implementation, to provide feedback to the feedstock, thermochemical and biochemical platforms as to what adjustments, refocusing, etc. is required in those platforms in order to assure commercially viable biorefinery processes.

Platform Review Feedback

Specific Responses to Select Comments

Platform Peer Review		
Reviewer Comment		**Technology Manager Response**
Integration with the feedstock platform is extremely important, the review panel would like to see more integration between the platform performers		As a compliment to the new strategic planning process, more attention was focused on platform integration and the flow of information between IBR and the technology platforms. Identifying important data and other information which should be communicated on a regular basis.
Would like to see the work for IPA turn into research objectives that are working on the pieces of the plant		We are trying to incorporate more risk analysis and risk mediation into the platforms. It has been limited in the past due to methodology and the ability to quantify its impacts.
What does the development of ethanologens do for the rest of the biorefining industry? The reviewer team would like to see the Program focus on bug development to emulate the existing industry		The development of an ethanologen provides alternatives to the industry to produce fungible fuels from multiple feedstocks. This will allow them to develop their own processes and business models.
Water removal needs to be a topic of focus in the Program. Additional R&D topics of focus include: • Integrate a robust unit operation program within the program • Boosting the benefit of 45% of the capital (combustors, cooling towers, etc) - "balance		We agree and have added a technology area of sustainability to our research areas of interest. This was the application of the 10% scale demonstrations. It is important to move beyond a national laboratories perspective of

of plant” • Plant wide footprint – innovative way to address those energy sinks – crosscutting enabling technologies		the balance of plant used in the state of technology to one developed by the industry that will have to make money.
Second generation plants needs to be discussed (combining processes). Where you have other industries looking at separations/reactions in a unit operations (i.e., Consolidated Bio-Processing)		Since the program envisions more than one 10% solicitation, as the technology is developed our plan is to have industry incorporate more technology options into the demonstrations.

General Platform Comments

- The recent changes in the platform to focus on deployment activities is commendable and has lead to:
  - o More industrial involvement
  - o Seeing progress towards commercializing some of these technologies
- Integration with the feedstock platform is extremely important, the review panel would like to see more integration between the platform performers
- Combining the conversion platforms is essential and a good move, emphasizing the importance of utilizing biochemical and/or thermochemical processing to convert to principally a fuel (and/or heat/products)
  - o Utilization of tried and true processes (biodiesel) are not and should not be a focus
- Systems Integration and IPA are essential to analyze and provide feedback to the projects. Evaluation of risk is essential, and the results of the IPA work will help inform and educate OBP on the state of technology and the planned commercial demonstration projects
  - o Would like to see the work for IPA turn into research objectives that are working on the pieces of the plant
- Co-fermentation is key, but current effort focuses on two co-habiting organisms.
  - o What does the development of ethanologens do for the rest of the biorefining industry? The reviewer team would like to see the Program focus on bug development to emulate the existing industry
- Water removal needs to be a topic of focus in the Program. Additional R&D topics of focus include:
  - o Integrate a robust unit operation program within the program
  - o Boosting the benefit of 45% of the capital (combustors, cooling towers, etc) - “balance of plant”
  - o Plant wide footprint – innovative way to address those energy sinks – crosscutting enabling technologies
- Second generation plants needs to be discussed (combining processes). Where you have other industries looking at separations/reactions in a unit operations
  - o Consolidated Bio-Processing (CBP)
- Communication & outreach
  - o The communication needs to be expanded to both the public and scientific communities
    - ▪ Need to consider having a scientific best practices meeting in format of the 30x30 Workshop
- Need more connection b/w fundamental applications and the applications and needs in the deployment area
- Development of a sustainable lignocellulosic feedstock system to make sure the facilities are supplied 365 days a year

Initial Reviewer Feedback – Comment Summaries

Analysis and Strategic Planning Projects

<u>Project Title: Integrated Biorefinery Platform Analysis</u>
Principal Investigator: Bob Wallace, National Renewable Energy Laboratory (NREL)

Strengths
- Different scenario modeling is a strength
- Inclusion of capital costs in model is a strength
- Usage of model to show the difference b/w the by-product (PG and EG) showing why a pathway is better for selling the product
- Providing ASPEN models to the "public" is a strength

Weaknesses
- Financial assumptions need to be re-evaluated, decision based on IRR (100% equity) is unrealistic
- Concern is that they are getting away from "that" (above) to model the entire supply chain, need to continue to focus on important ground-truthing
- The way that the model is differentiating the economics. Concern is that the plans are to expand the modeling to the entire supply chain - need to stay illuminating those differences in the pathways

Suggestions/Comments
- Need to look at separation and individual processing for C5/C6 sugar stream
- Need to continue to do reality checks on their models
- Model feedstock transport system needs to be better defined (at the scale presented)

PI Responses
- Appreciate the comments. Financial assumptions are always something we struggle to adequately show. These are a baseline.
- There is more than one modeling issue. The models are to be integrated --- there are a couple different modeling efforts going on.

Corn Wet/Dry Mill Improvements Projects

<u>Project Title: Sugar-Based Ethanol Biorefinery</u>
Principal Investigator: Donal Day, Louisiana State University

Strengths
- Objective to get high value products from a unused feedstock is good
    - Extending the look at additional feedstocks that may be able be similarly processed
- AFAX pretreatment has found a potential home for commercialization
- Like the integration with the sugar industry

Weaknesses
- Needs achievable focused goals (focus is too scattered)
    - Focus on C6 fermentation for ethanol

- What else can you do with the C5s (value added products)
  - Optimize storage process for batch
  - Let someone else do the gasification work
- The technical integration of their technologies with the existing sugar mills did not appear well developed (annual cycling)
- Annual economic modeling didn't appear well thought out

Suggestions/Comments

- The market for products from lignin is not there, burn the lignin
- Harvesting equipment requirement maybe steep and has not yet been evaluated (is not yet clear)

PI Responses

- CLM will come in with the cane – you won't separate the leaf off the cane, but will require a "dry cleaning" process at the mill to separate the cane for the sugar mill
- John Deere is also investigating to modify cane harvesting
- Shutting down gasification
- We are working on a storage process optimization now

Project Title: Integrated Corn-Based Bio-Refinery
Principal Investigator: Michael Sanford, DuPont

Strengths

- Team is extremely strong and well suited to address the problem (both R&D and commercialization)
- Organized and balanced approach, addressing both economics and technical targets
- Good feedstock study to start the project (how much of the cob can be utilized)
- Looking to reduce the cost of pretreatment (Ammonia based pretreatment)
- Addressed reactor scalability (at NREL)

Weaknesses

- Lot more stress on the enzymes; if the enzymes don't produce and or are not cost efficient, the technology will fail
- Knocking out key genes to increase xylose fermentation needs clarification

Suggestions/Comments

- Reviewers encourage the group to focus on the cob rather than looking at stover
- High nitrogen in DDGS could be a problem and should be evaluated when using ammonia pretreatment (where are the beer still bottoms)

PI Responses

- None

Project Title: Separation of Corn Fiber and Conversion to Fuels and Chemicals
Principal Investigator: Nathan Fields, National Corn Growers Association (NCGA)

Strengths

- Focusing on creating high value products

- Working with the stuff in the mill, no transportation issues in the distribution chain
- Catalyst development for “plug in” technologies is a strength
- Using ethanol for oil extraction (extracting sterols, which are soon to be marketable)

Weaknesses
- Not applicable to alternative feedstocks
- Wet mill allowing 17% starch in residue is high and may not reasonable

Suggestions/Comments
- Reviewers encourage multiple licensing of these technologies

PI Responses
- None

Project Title: New Sustainable Chemistry for Adhesives, Elastomers and Foams
Principal Investigator: Scott Boyce, Rohm and Haas

Strengths
- Focus on replacing petroleum adhesives is a laudable goal
- Beneficial use of glycerol
- Scientific approach is sound
- Using established mechanisms to increase the chances of success

Weaknesses
- Need to make this available to applicable niche markets
- Niche market limited by the product being only 40% biobased

Suggestions/Comments
- Consider partnering to enhance a biodiesel facility (seems like a natural add on)

PI Responses
- None

Oil Mills Improvement Projects

Project Title: National Agricultural Based Lubricants Project
Principal Investigator: Wes James, University of Northern Iowa

Strengths
- Shotgun approach has merit in demonstrating said technologies
- Analytical analyses are comprehensive and team is well equipped
- Testing resources are needed for the industry

Weaknesses
- Project appears to be a more empirical approach rather than R&D
- This project is not researching clearly their two goals (cold weather applicability and oxidative state)

- Connection to the integrated biorefinery is not clear

Suggestions/Comments
- Reviewers question the applicability of this project to the Program goals

PI Responses
- None

Agricultural Residue Processing Projects

Project Title: Advanced Biorefining of Distiller's Grain and Corn Stover Blends
Principal Investigator: Bob Wooley, Abengoa

Strengths
- Commend the implementation of yield enhancements from pilot plant towards commercial ethanol plants
- Unique hybrid process
- Biocatalyst development for fermentation seems to be “breakthrough worthy”
- Overall hybrid concept gives scales to both utilities, e.g., distillation, evaporation (water integration, etc)
- Great team - partners are experts in their fields
- Considering back up organisms for the xylose utilization

Weaknesses
- Performance of pretreatment design reactor partner was poor

Suggestions/Comments
- Is there a concern of cross contamination between the fermentation tanks (yeast for xylose)
- Acid hydrolysis is corrosive and other pretreatment may need to be considered

PI Responses
- None

Project Title: Making Industrial Bio-refining Happen!
Principal Investigator: Pirkko Suominen, NatureWorks

Strengths
- Chemistry expertise is strong and impressive
- Development of low pH catalyst is an huge accomplishment
- Strong partnership, great team
- First indication of parallel conversion of C5 and C6 sugars

Weaknesses
- Demonstrated low pH catalyst on glucose, but not on a combined sugar stream
- Need to develop a stronger tie to the integrated biorefinery with a cellulosic feedstock

Suggestions/Comments

- Acetate tolerance needs to be demonstrated
- Clarification of contaminants the yeast is tolerant of would have helped the reviewers

PI Responses
- None

Project Title: A New Biorefinery Platform Intermediate
Principal Investigator: Hans Liao, Cargill

Strengths
- Looking at two different pathways to get to 3HP
  - 3HP is a building block chemical, adds versatility to the industry
- Energy consumption is reduced by 61% relative to the propylene pathway (petrochemical)
- Presenter alluded to competitive economics
- Strong replacement of a petroleum based product

Weaknesses
- Need to develop a stronger tie to the integrated biorefinery with a cellulosic feedstock
- Will the "experimental strains" scale up

Suggestions/Comments
- What technical risk revolves around the potential downstream separations issues

PI Responses
- None

Project Title: City of Gridley Biofuels Project
Principal Investigator: Tom Sanford, The City of Gridley

Strengths
- Concept of the thermochemical economic processing is fine
- Saying they found a gasifier technology with a longer residence time that allows for larger particle size (2-3 inch)
- Electromagnet is a solution to a major issue of silica
- Relatively high conversion/production of ethanol
- Reducing recycling/back half of the facility

Weaknesses
- Cleanup hurdle presented might be underestimated
- This is a long term project without any defined outputs, seems to be a small scale application
- Feedstock assumptions are underestimated (cost and transportation needs to be better estimated)

Suggestions/Comments
- Sounds too good to be true
- Why not going to Fischer Tropsch Liquids and power?

- Need to prove overcoming the barriers
  - Proof of catalyst and silica removal

PI Responses

- None

Project Title: Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries

Principal Investigator: Ed Lehrburger, PureVision Technology, Inc.

Strengths

- Separation is done for you in the process (three distinct streams)
- 60% yield of C5 without acid in the first stage
- Multiple benefits including removing solids benefit agitation (removes particles)
  - Removes technical risk for distillation in the back end
- Pure cellulose has opportunities for production of “high-value” products
- Solves a lot of issues for kraft pulping and the cellulose industry
- Removing the lignin has a huge impact on the enzyme costs

Weaknesses

- The scale up of the extruders is a massive undertaking (torque on the equipment)
- Selling lignin is more difficult than presented
  - Question as to where this could be marketed (polyphenol)
- Work on C5 fermentation needed to be better define, the fermentation is slow and may adversely effect the performance of the facility

Suggestions/Comments

- Need to consider the economics for multiple smaller units operating in parallel
- The GP mill referred, lignin product was shipped to Japan
- Need to do models burning the lignin

PI Responses

- None

Other Refinery-Related Projects

Project Title: Biorefinery and Hydrogen Fuel Cell Research
Principal Investigator: Cyrus Bhedwar, Georgia Environmental Facilities Authority

Strengths
- Two primary products of the pyrolysis reaction is interesting and something to build on (bio-oil and char)
- Concept of using the tree tops as a feedstock is unique (co-collected)

Weaknesses
- Project needed to be better focused
- Achievable goals need to be defined
- Focused relative to the Integrated Biorefinery
- Bio-oil stability is questionable
- Micro-algae work is not relevant

Suggestions/Comments
- The projects presented
- Char in the past have not proved to be a decent fertilizer
- Partner with a biorefinery for a feedstock and concentrate on pyrolysis-oil

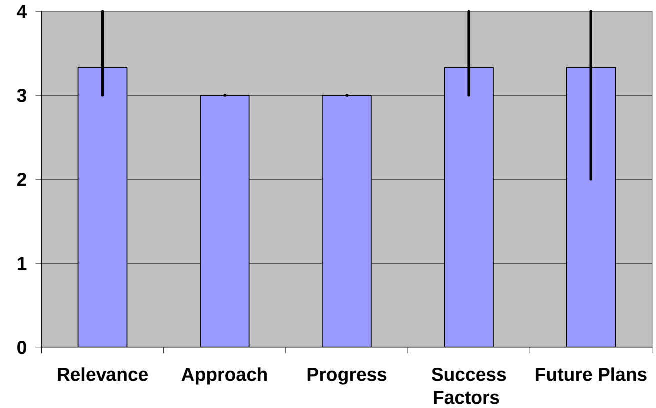
PI Responses
- None

Full Reviewer Comments and Scores

Analysis and Strategic Planning Projects

Project Title: Integrated Biorefinery Platform Analysis
Principal Investigator: Bob Wallace, National Renewable Energy Laboratory (NREL)
Proposed Stage: N/A
Recommended Stage: N/A

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.00	0.00	0.00
Progress	3.00	0.00	0.00
Success Factors	3.33	0.33	0.67
Future Plans	3.33	1.33	0.67
Average	**3.20**		



Question 1: Relevance to Overall Objectives.
- Overarching review of integrated biorefinery objectives are in line with office of biomass program objectives and long term goals.
- Various scenario models were important.
- Good work overall, although project financing assumptions are unrealistic, for example no project will ever receive 100% equity financing. Specific example (ethylene/propylene glycol) of economic Impact re co-products to current ethanol industry was good.

Question 2: Approach to Performing the R&D.
- Need to make sure that the model(s) remain tied to reality.

Question 3: Technical Accomplishments and Progress.
- This work directly relevant to and supports DOE programmatic goals.

Question 4: Success Factors and Showstoppers.
- The project demonstrates that critical technical factors have been identified; however, this may not be the case for critical business factors e.g. realistic assumptions re debt/equity ratios for project financing.

Question 5: Proposed Future Research Approach and Relevance.
- The project clearly demonstrates that it has and continues to build on NREL's recognized expertise in economic analysis and modeling.

Additional Comments

Strengths
- Excellent work on providing Aspen models for investigators to utilize for these and other DOE projects as well as for direction in parallel and unrelated studies.

- Models which will enable various integrated biorefinery designs to be compared on the same basis should provide a firm foundation for present projects to be utilized for planning of future investigations.
- Continues the tradition of NREL expertise in analysis and modeling. Provision of ASPEN models to industry.

Weaknesses

- There is a need to evaluate relative techno economics of attempting to ferment 5 carbon sugars and 6 carbon sugars simultaneously in one process as compared with utilizing separate, more efficient parallel processes for the fermentations.
- Underlying assumptions for C5/C6 processing needs clarification.
- Unrealistic assumptions re project financing.
- A concern that 100% equity may be unrealistic. There is a critical need to evaluate feedstock transport scenarios.

Technology Transfer/Collaborations

- The project needs to maintain and perhaps increase its effort to obtain “real world” technical and business input from technology developers to assure analysis/model credibility.

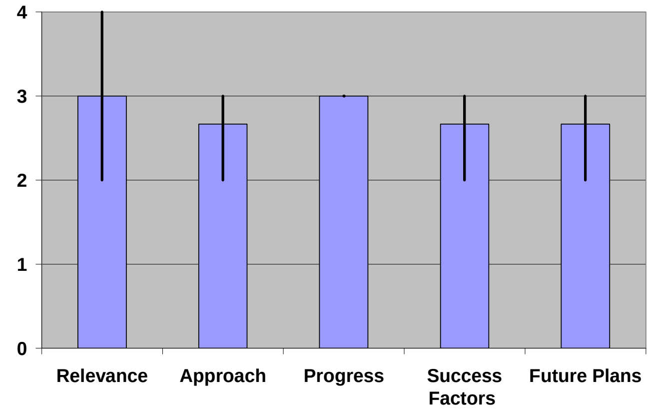
Recommendations for Additions/Deletions to Project Scope

- None

Corn Wet/Dry Mill Improvements Projects

Project Title: Sugar-Based Ethanol Biorefinery
Principal Investigator: Donal Day, Louisiana State University
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	1.00
Approach	2.67	0.67	0.33
Progress	3.00	0.00	0.00
Success Factors	2.67	0.67	0.33
Future Plans	2.67	0.67	0.33
Average	**2.80**		



Question 1: Relevance to Overall Objectives.
- Good guidance and the right type and level of analyses.
- There is a need for more economic assessment.
- The work on production of specialty chemicals from lignin should be stopped. These markets are limited and difficult to penetrate. The lignin should be burned for energy.

Question 2: Approach to Performing the R&D.
- Perhaps more focused scenarios would be of benefit.

Question 3: Technical Accomplishments and Progress.
- If the primary objective was to enhance biofuels, more emphasis should be provided in that area.
- The results from the pretreatment, hydrolysis and fermentation of the so derived sugars from biogases are encouraging.

Question 4: Success Factors and Showstoppers.
- Maybe not all were identified, but they have certainly taken a good shot
- The fermentation of pentose sugars is not considered critical and should be discontinued. The economic benefit work is essential.

Question 5: Proposed Future Research Approach and Relevance.
- Go forward to complete the whole picture.
- With the exception of the work lignin value-added chemicals and pentose fermentation, future work is well planned. The AFEX scale-up should focus only on batch processing.

Additional Comments

Strengths
- Investigators provided a number of findings, e.g., oligosaccharides as antimicrobials, molasses provides nutrients for fermentations.
- Consideration for continued work with batch process appears relevant.

- Work demonstrating the use of fiber mats was good as a potential co-product.
- Continue to focus on batch process.
- This project has the potential to ultimately provide significant economic benefits to the sugar refineries.
- Not looking at both C5 & C6 fermentation is the right approach. C6 focus conversion good.
- 6%ditilation looked at the economic impact using molasses to enhance conversion looking at value of other compounds i.e. vanillin C5 to succinic acid not competitive.

Weaknesses

- The list of lignin based coproducts was good; however, it was not apparent how marketable these items would be at the levels which they could be produced.
- Fermentation efforts should be focused on using 6 carbon sugars and not on simultaneous C5/C6 fermentations.
- Considerable work and evaluation of other crops for continuous utilization of the plant will be needed prior to pertinent economic assessments.\
- Planned work on: pentose fermentation; AFEX continuous processing and lignin value-added chemicals.
- Continued effort to provide ethanol concentrations of at least 6 to 8 per cent subsequent to fermentation appear necessary to commercialize this process. Levels of 3 to 4 per cent ethanol may not provide adequate primary product for economic feasibility.
- Pilot plant sizes for integrated biorefinery investigations need to be developed for continued work in this area.
- The potential for mutating *Pichia stipitis* for simultaneous fermentation of xylose and glucose was not clarified.
- Ascertain types of storage needed for batch processes. Gasification may be beyond the scope of the project.
- Use the lignin as a source of energy for operating the plant.
- Gasification - why pursue, keep focus on fermentation

Technology Transfer/Collaborations

- Ongoing interaction with sugar refineries should be maintained to assure that the technology can be effectively integrated into existing operations.
- Pichia to ferment C5's

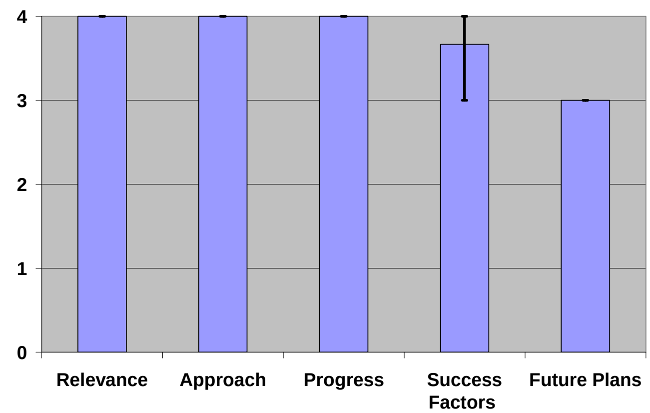
Recommendations for Additions/Deletions to Project Scope

- Question for OBP: How much are you able to take advantage of this strategic resource in publications/communication for the overall program?
- Discontinue work on: pentose fermentation; AFEX continuous processing and lignin value-added chemicals.
- Bagasse focus. high value product from cheap feed good displace bagasse as fuel
- 3 month sugar production limited
- Other feeds: harvest other stuff left in fields Cane leaf material
- Other products beside ethanol
- Economic advantage

Project Title: Integrated Corn Based Biorefinery (ICBR)

Project Investigator: Mike Sanford, DuPont
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	4.00	0.00	0.00
Success Factors	3.67	0.67	0.33
Future Plans	3.00	0.00	0.00
Average	**3.73**		



Question 1: Relevance to Overall Objectives.

- Thorough life cycle analysis. Use of ammonia to form acetamide, which is not inhibitory.
- The project seeks the solution of key technical issues relevant to commercial scale operation of an integrated biorefinery.
- Given DuPont's status, size and resources, its ability to attract customers is unlikely to be an issue.

Question 2: Approach to Performing the R&D.

- The focus on corn cobs as the sole feedstock is excellent strategy.
- The unit processes being focused on for improvement are that most directly relevant to ultimate economic viability.
- Addressing issue of sustainable quantity of feedstock is commendable.
- Balance of economics and technology

Question 3: Technical Accomplishments and Progress.

- The use of base catalyzed pretreatment avoids nasty issues associated with acid pretreatment processes.
- Operation of saccharification and fermentation at NREL PP mitigates risk re scale-up to larger and eventually commercial scale volumes.
- How much corn stover is recoverable- looked at impact
- Grain and cob result 50% mass of stover
  Cob = 65 gal/acre
- Ammonia pre-treat
- Scalable reactors
- Wanted 90% conversion, have 75% to glucose and 50% conversion xylose

Question 4: Success Factors and Showstoppers.

- Improving xylose transport as a solution to the parallel C5/C6 fermentation issue is an excellent approach.
- Cost of enzyme still an issue
- Too much focus on c5 to ethanol 72 hour fermentation…
- What happens If you ferment stream with typical beer yeast

Question 5: Proposed Future Research Approach and Relevance.

- The focus on enzyme development is key to obtaining acceptable overall process economics

Additional Comments

Strengths

- Review of life cycle analysis.
- Discussion of potential ethanol/acre from pericarp fiber, endosperm fiber and stover.
- Utilization of ammonia to convert acetic acid to acetamide.
- Knock out key genes to increase xylose fermentation.
- Use of corn cobs in conjunction with fiber from kernel.
- Excellent team for realization of achievable objectives.
- Great corporate strength re commercializing new products and processes.
- Very large and capable technical team.

Weaknesses

- A need to find simple, efficient systems to harvest, densify and transport corn cobs.
- Plan to also include corn stover as a feedstock in addition to cobs.

Technology Transfer/Collaborations

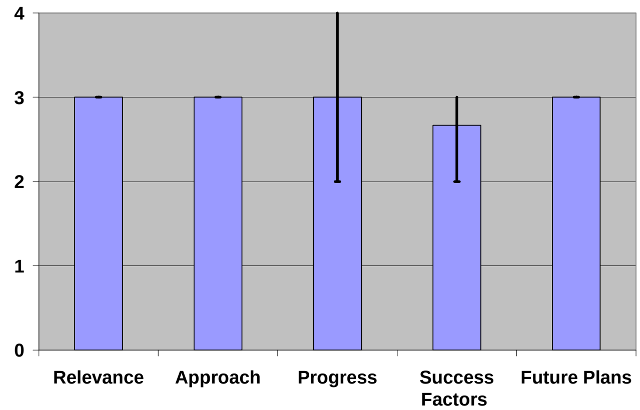
- Provides that framework

Recommendations for Additions/Deletions to Project Scope

- Suggest continued efforts be placed on work with corn cobs; cobs already to through the harvester.
- De-emphasize, or eliminate for the near- to mid term, work on corn stover i.e. getting it working for cobs then consider stover.
- Pre-treatment low cost

Project Title: Separation of Corn Fiber and Conversion to Fuels and Chemicals.
Principal Investigator: Nathan Fields, National Corn Growers Association (NCGA)
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	0.00	0.00
Approach	3.00	0.00	0.00
Progress	3.00	1.00	1.00
Success Factors	2.67	0.67	0.33
Future Plans	3.00	0.00	0.00
Average	**2.93**		



Question 1: Relevance to Overall Objectives.
- Focuses on maximizing total value of a corn wet mill via development of a suite of products.
- Feedstock to the plant corn fiber
- Alternative products to ethanol
- Starch, hemicellulose, oil

Question 2: Approach to Performing the R&D.
- Process design is good and use of ethanol to extract the oil is a positive feature.
- Use of existing pilot facilities good.
- Butanol, pet products
- Meets internal ROI

Question 3: Technical Accomplishments and Progress.
- Selection of performance indicators is appropriate and as are achievements measured against them.
- tons of fiber trialed
- Utilization of glucose and xylose using sachrimaisees?
- Time?
- Used ethanol for oil extraction

Question 4: Success Factors and Showstoppers.
- Xylose utilization is high.
- Low concentration of degradation/inhibitor compounds.
- Market for value added products
- Needed to make economics fly.

Question 5: Proposed Future Research Approach and Relevance.
- Capital cost estimates, economics and rate of return being evaluated by ADM.

Additional Comments

Strengths

- Well defined goals and objectives.
- Presentation of corn fiber composition was helpful in understanding the project.
- Good use of diverse projects at the University of Illinois.
- The use of ethanol for oil extraction was commendable.
- Utilization of a low cost feedstock for production of value-added co-products.

Weaknesses

- Few current publications and presentations.
- Production of polyols could be compromised by detrimental effect of fermentation broth on catalyst life during the hydrogenation step.
- Uncertain future re ultimate economics/rate of return/capital costs.

Technology Transfer/Collaborations

- Good/productive collaboration with ADM and PNNL.

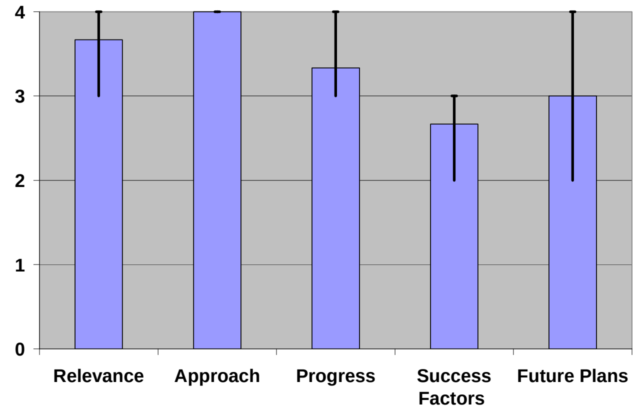
Recommendations for Additions/Deletions to Project Scope

- Market for nutraceuticals needs to be investigated.
- Assessment of impact on product acceptability due to use of genetically modified organisms for processing.

Project Title: New Sustainable Chemistry for Adhesives, Elastomers and Foams

Project Investigator: Scott Boyce, Rohm and Haas
Proposed Stage: 2
Recommended Stage: 2/3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	4.00	0.00	0.00
Progress	3.33	0.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**3.33**		



Question 1: Relevance to Overall Objectives.

- Use of glycerol from biodiesel production addresses the major issue of markets for rapidly increasing amounts of glycerol.
- Replace petroleum based adhesives
- Good market, approximately 90 million pounds

Question 2: Approach to Performing the R&D.

- Project didn't attempt to develop fancy new chemistry. Rather, focused on replacing petrochemicals with biomass derived chemicals in established adhesive/elastomer/foam synthetic processes.
- Used material that uses biketene chemistry commercially available

Question 3: Technical Accomplishments and Progress

- Significant technical progress in terms of making bio-based reactants as petro-chemical replacements.
- Developed commercially viable prototypes
- Esterification reaction
- Foam replacement has huge volume impact

Question 4: Success Factors and Showstoppers

- The show stoppers are more economic than technical and strategies to overcome them quite possibly outside the industry's capability i.e. may require government intervention via incentives, regulation etc.
- Economics in doubt
- Can't match epoxies, too expensive
- Technically works

Question 5: Proposed Future Research Approach and Relevance.

- Future work on foams and utilization of more biobased intermediates is planned.

Additional Comments

Strengths

- Elimination of isocyanate handling.
- Utilization of glycerol to form glycerol tris acetoacetate.

- Demonstrating technical feasibility of foams and elastomers.
- Impressive number of new biobased chemical intermediates synthesized.
- Interest in biobased intermediates has been triggered in other areas of Rohm and Haas.

Weaknesses

- Ascertain relevant niche markets.
- Economics of using the new biobased intermediates is not favorable

Technology Transfer/Collaborations

- Good collaboration with Eastman, Virginia Tech University and USDA.

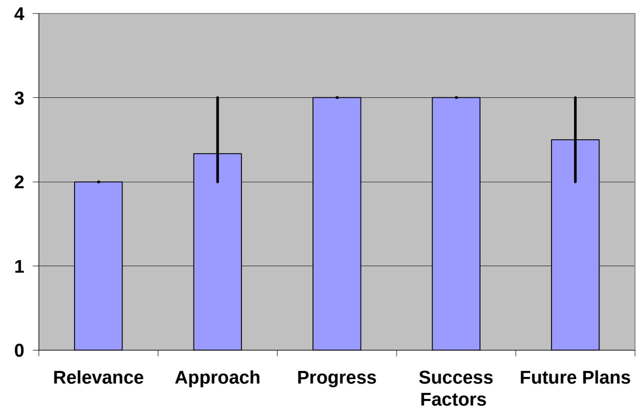
Recommendations for Additions/Deletions to Project Scope

- Partner with biodiesel production facilities.

Oil Mills Improvement Projects

<u>Project Title: National Agricultural Based Industrial Lubricants Center Project</u>
Project Investigator: Wes James, University of Northern Iowa
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.00	0.00	0.00
Approach	2.33	0.33	0.67
Progress	3.00	0.00	0.00
Success Factors	3.00	0.00	0.00
Future Plans	2.50	0.50	0.50
Average	**2.57**		



Question 1: Relevance to Overall Objectives.
- It's not clear how this is tied to the integrated biorefinery.
- Could be more appropriate for USDA support.
- Commercialize biobased lubricants
- $20 billion market.
- Important work with merit but not sure of relevance to this program.

Question 2: Approach to Performing the R&D.
- The approach is quite empirical in nature rather than true R&D. Nonetheless, that approach has been successful in producing near market-ready lubricants.
- The establishment of a test facility as part of the project is essential to expanded use of agricultural-based lubricants.

Question 3: Technical Accomplishments and Progress
- Commercialize products
- Syrup as feed used in drilling oil
- Testing

Question 4: Success Factors and Showstoppers
- Solutions to cold weather use and oxidation issues are essential.
- Cold temperature
- price
- Anything commercialized yet?
- What are the most likely feed and product?
- Soy based hydraulic?

Question 5: Proposed Future Research Approach and Relevance.
- Continuing to seek niche markets as an entry point for agricultural-based lubricants is reasonable.
- More focus on using waste or by-products stream as feed stock in lieu of virgin oils.

Additional Comments

Strengths

- Well equipped testing laboratory.
- Appears to fill a niche for lubricant testing.
- Establishment of a test facility for agricultural-based lubricants.

Weaknesses

- Overall objective to firmly establish a testing center is not consistent with DOE goals for an integrated biorefinery.
- Empirical rather than scientific approach to product development.
- Unclear connection to IBR.

Technology Transfer/Collaborations

- Unclear.

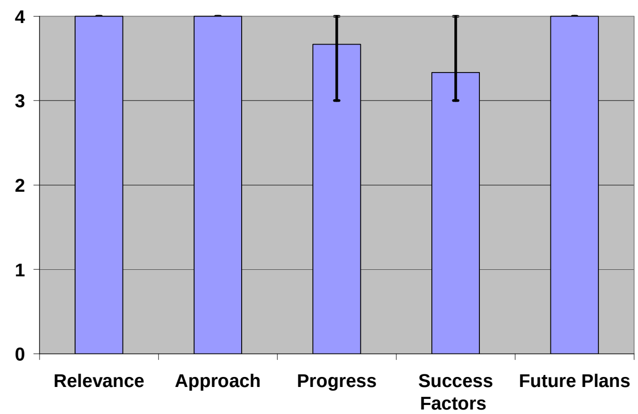
Recommendations for Additions/Deletions to Project Scope

- Important work with merit but not sure of relevance to this program.

Agricultural Residue Processing Projects

<u>Project Title: Advanced Biorefining of Distiller's Grain and Corn Stover Blends</u>
Principal Investigator: Bob Wooley, Abengoa
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.80**		



Question 1: Relevance to Overall Objectives.

- If successful, will result in an integrated biorefinery producing ethanol and valued added co-products from both starch and cellulosic feedstocks.
- Residual starch
- Yield
- Co-products
- Lab scale to pilot to production moving towards commercial
- Biocatalyst for xylose fermentation

Question 2: Approach to Performing the R&D.

- This project focuses on the key technical barriers: pretreatment; cellulose enzyme cost; and pentose fermentation.
- Team strong
- Integrated biomass into starch
- Xylose yeast

Question 3: Technical Accomplishments and Progress

- New process ready for implementation in company's corn dry mill plant and significant progress made on xylose fermentation.
- Variety of grains trialed
- Looked at economics
- Introducing into york commercial- yield improvement
- Animal feed in pilot
- Fractionation of stover
- 90%cellulose conversion
- Different strains of yeasts
- Enzyme cocktails

Question 4: Success Factors and Showstoppers

- A "back-up" strategy is in place in the event the intended route to improved C5 fermentation is unsuccessful.

- High protein beyond DDGs
- Xylose fermentation

Question 5: Proposed Future Research Approach and Relevance.

- The project team has many years of relevant, quality experience that it has brought to bear on all aspects of moving this technology to commercial scale operation.
- Co products going to users

Additional Comments

Strengths

- Good approach for developing a hybrid process.
- Development of biocatalyst is commendable.
- Laudable demonstration of increasing ethanol/acre as a result of integrating processes.
- A very strong technical team.
- Excellent partnerships.
- Use of yeast platform for xylose fermentation.
- Great project

Weaknesses

- Need to demonstrate cost effective fractionation technology.
- Failure to resolve the "Sunopta pretreatment issue" could require moving to an alternate pretreatment process with associated negative cost and schedule impacts.

Technology Transfer/Collaborations

- The degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.
- The collaboration with NatureWorks has contributed significantly to the success of this project.

Recommendations for Additions/Deletions to Project Scope

- None

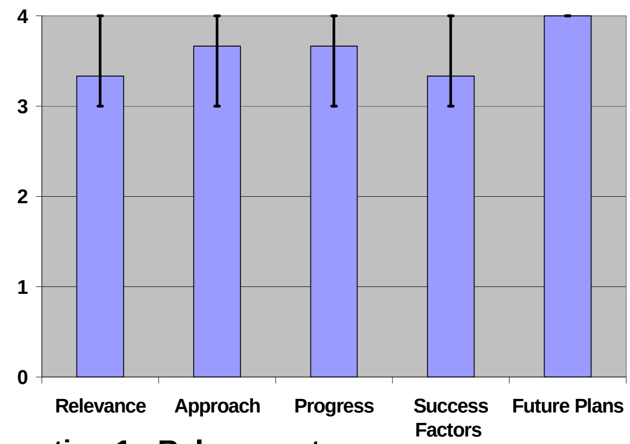
<u>Project Title: A New Biorefinery Platform Intermediate</u>

<u>Principal Investigator</u>: Hans Liao, Cargill

Proposed Stage: 3

Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.60**		



Question 1: Relevance to Overall Objectives.

- The development of 3-hydroxypropionic acid (3HP) from biomass derived sugar as a biobased intermediate for acrylic acid production is consistent with DOE/IBR objectives.
- 3HP can also be an intermediate for production of a number of other chemicals in an IBR.
- Glucose – 3hp- acrylic acid
- Market good 7 billion pounds /year
- 3 hp is platform chemical
- Economic advantage (based on biomass sugars?)
- Displace oil
- E coli is mechanism

Question 2: Approach to Performing the R&D.

- The project focuses on the key enzymes necessary to achieve product (3HP) specificity.
- Structure mechanism and enzymes to force 3 hp as only
- Pathway from glucose.

Question 3: Technical Accomplishments and Progress

- The required plasmid recombinant strains for each of the two selected biochemical pathways to 3HP have been successfully synthesized and 3HP production successfully demonstrated.
- Catalyst to take 3 hp to acrylic acid

Question 4: Success Factors and Showstoppers

- The selection of two pathways, one aerobic the other not, mitigates the risk of not achieving project goals.
- Fermentation titer and economic target

Question 5: Proposed Future Research Approach and Relevance.

- The plan to move to integrated strains for commercial scale production builds on the success with the plasmid bacterial recombinant strains
- Development both pathways in parallel
- Risk mitigation

Additional Comments

Strengths

- Production of an intermediate in a metabolic series which can be converted to other useful chemicals.
- Energy consumption reduced 61% compared to petrochemical route.
- Good replacement of petrochemical produced compound.
- Development two alternate biochemical routes to 3HP.
- Opportunity to use 3HP as an intermediate for at least 5 other compounds in addition to acrylic acid.
- Cargill's experience in biorefining as it pertains to the development and implementation of this 3HP production process.

Weaknesses

- No apparent connection with cellulose in a biorefinery realm.
- The integrated strains may not function as well as the plasmid strains.
- Large scale E. coli aerobic fermentations may be problematic.

Technology Transfer/Collaborations

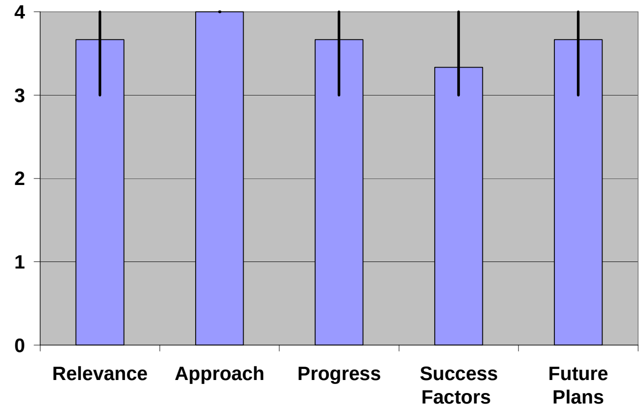
- The collaboration with Codexis was extremely fruitful with respect to strain development and selection.

Recommendations for Additions/Deletions to Project Scope

- None

Project Title: Making Industrial Biorefining Happen!
Project Investigator: Pirkko Suominen, NatureWorks, LLC
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	4.00	0.00	0.00
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	3.67	0.67	0.33
Average	**3.67**		



Question 1: Relevance to Overall Objectives.
- This work is critical to the development and deployment of IBR technology.
- Biocatalyst and fermentation
- Ethanol and lactic acid catalyst
- Low pH biocatalyst in hydrolyzate
- Petroleum based polymers replacement
- Lactic acid 30 billion # market PLA

Question 2: Approach to Performing the R&D.
- The key barriers are addressed for both ethanol and lactic acid production.
- Lower cost of PLA to compete with polystyrene
- Xplatfrom biocatalyst
- Robust yeast to ethanol and organic acid in PH<5

Question 3: Technical Accomplishments and Progress
- The demonstrated parallel fermentation of C5 and C6 sugars has not been reported to date in the literature. This is a major achievement for this project.
- Xylose biocatalyst to ethanol
- Lactic acid pilot trials done with biocatalyst
- Hydrolyze sugars to ethanol
- C6 and xylose yeast simultaneously
- PH<6 no xylose to ethanol
- Hydrolyzate tolerant strain
- Lactic acid commercial size fermentation

Question 4: Success Factors and Showstoppers
- A strong, experienced research team.

Question 5: Proposed Future Research Approach and Relevance.
- The future work builds on experience to date with respect to both key lactic acid and cellulosic ethanol production issues.

Additional Comments

Strengths

- Utilization of alternate pathway for xylose to be converted to ethanol.
- Yeast based biocatalysts which are resistant to contaminants.
- Methodical approach with achievable goals.
- Parallel conversions of glucose and xylose.
- Excellent partnership with Abengoa.
- Unique yeast platform for xylose fermentation strain development.
- Parallel fermentation of xylose and glucose.

Weaknesses

- A need to develop a direct association with a biorefinery concept.
- What is the xylose fermenting yeast's tolerance for contaminants/inhibitors in the "real world" sugar stream from acid pretreated cellulosic biomass.

Technology Transfer/Collaborations

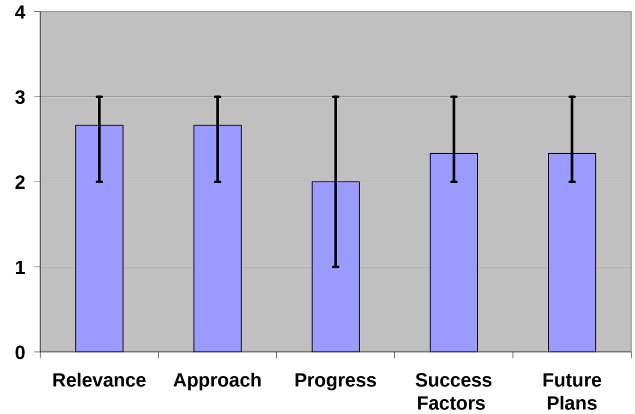
- The collaboration between NatureWorks and Abengoa has been a key factor to the success of this project.

Recommendations for Additions/Deletions to Project Scope

- None

Project Title: City of Gridley Biofuels Project
Project Investigator: Tom Sanford, The City of Gridley
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.67	0.67	0.33
Approach	2.67	0.67	0.33
Progress	2.00	1.00	1.00
Success Factors	2.33	0.33	0.67
Future Plans	2.33	0.33	0.67
Average	**2.40**		



Question 1: Relevance to Overall Objectives.
- Fits Integrated Biorefinery criteria – plan to produce ethanol, electricity, steam and silica.
- Markets for all four identified.
- Gasification rice straw
- Integrated electricity and steam produced too

Question 2: Approach to Performing the R&D.
- Gasification technology and catalyst(s) for synthesis gas to ethanol conversion have been selected.
- Silica separation technology is unique.
- Predicted yield of ethanol from syngas appears aggressive.
- 5 ton pilot plant
- Pyrolysis
- Can't bale right behind harvest
- Seasonal growth?

Question 3: Technical Accomplishments and Progress
- Not clear how much hard data (versus conjecture) was available from actual hours of gasifier operation, or at what scale.
- 99% conversion
- No O2 introduced
- 80-90 gallons/ton alcohol Fischer Tropsch liquids
- 550 kwh/ton electricity to grid
- 375 kwh/ton steam
- $1.12/gallon wow!!!!
- Longer residence time allows for bigger pieces into gasifier
- Extensive research on gasifiers

Question 4: Success Factors and Showstoppers

- Gasifier design, synthesis gas clean-up, silica removal and ethanol catalyst specificity have been correctly identified as key factors.
- Legal and regulatory issues were not addressed.
- Clean-up of gas? Prior to ethanol conversion
- Silica? Magnetic pulse removes silica (charged)
- Seasonal?
- $1.50/gal or $1.12?
- Range spin off from BCT

Question 5: Proposed Future Research Approach and Relevance.

- Lack of specific information on previous duration and scale of operation at pilot plant scale precludes assessment of adequacy of future plans presented.
- Commercial size unit in fabrication
- Not clear

Additional Comments

Strengths

- The documented capability of using 2 to 3 inch straw directly for thermochemical conversion.
- Removal of charged silica electromagnetically.
- Sourcing delivered rice straw for $30/ton.
- Reliable source of rice hulls (2.2 ton/acre) within a 30 mile radius.
- Overall concept is good.
- Catalyst for syngas conversion has high selectivity for ethanol.
- Syngas composition can be controlled.
- Alternate feedstock (fruit pits) has been identified.

Weaknesses

- For a project initiated in early 2003, the comment, “At this time, we have a plan; now we need to execute the plan.”
- Estimated cost for feedstock is considered too low.
- Lack of hard data from previous work.

Technology Transfer/Collaborations

- The degree of collaboration with local and state authorities and relevant technology providers is satisfactory.

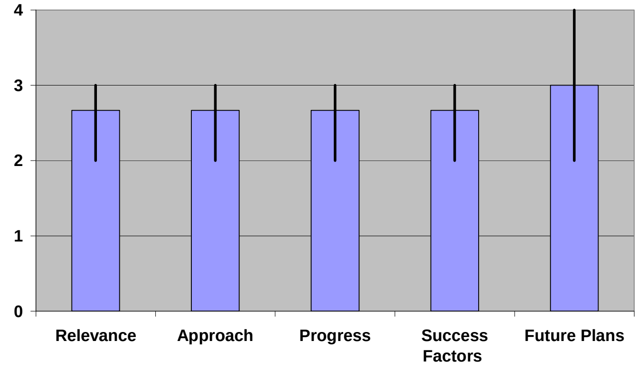
Recommendations for Additions/Deletions to Project Scope

- None

Project Title: Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries

Project Investigator: Ed Lehrburger, Pure Vision
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.67	0.67	0.33
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**2.73**		



Question 1: Relevance to Overall Objectives.
- The technology will refine cellulosic biomass into its three basic constituents each in its own stream. From these, ethanol and valued added co-products can be produced.
- Lignin to adhesives
- C5, lignin, cellulose
- Designed experiment
- Good partners pulp and paper industry involvement

Question 2: Approach to Performing the R&D.
- Based on experience from the pilot scale operation, the extruder-based process appears to adequately define key technical issues. However, scale-up of the extruder to the size planned may not be feasible.
- 70%yield of xylose
- Counter flow reaction
- No acid addition?
- High temperature second stage –cellulose degradation?

Question 3: Technical Accomplishments and Progress
- The data from the pilot runs is very encouraging.
- Progress has been satisfactory.
- Low furfural/hmf produced
- Lignin products concrete binder, animal feed
- Pure cellulose < .5% lignin
- Less enzyme for ethanol conversion
- C5 stream products
- Optimized corn stover

Question 4: Success Factors and Showstoppers
- The critical issue in doubt is the scalability of the extruder. This could be mitigated by the use of multiple smaller units, but likely with negative capital and operating cost impact.
- Legal and/or regulatory issues were not addressed.
- Scale up of reactor to 3 tpd or larger

Question 5: Proposed Future Research Approach and Relevance.

- The future plan is clear; however, optional paths were not presented in detail.

Additional Comments

Strengths

- Xylose recovery of 65%.
- Reduction of NaOH use from 0.1. to 0.06 g/g biomass.
- Possible separation of cellulose as a clean stream.
- Companies they are intimate with can build operational 200 mm extruders which work with counter current process.
- The dynamic plug proved to be miraculous.
- Relatively simple technology that produces the three cellulosic biomass constituents in distinct streams.
- The cellulose stream, or a portion of it, may have more valuable markets than for ethanol.

Weaknesses

- Need to define the specific uses of $35 mm/yr lignin as concrete binder as well as animal food binder.
- Issues re scale up of the extruder.

Technology Transfer/Collaborations

- Collaboration with ENTEK on extruder design is commendable.

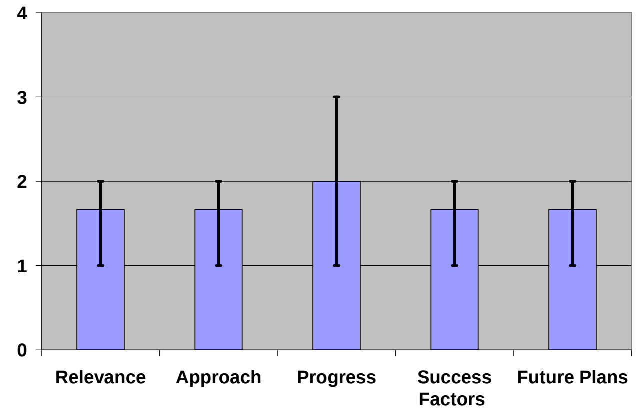
Recommendations for Additions/Deletions to Project Scope

- None.

Other Refinery-Related Projects

Project Title: Biorefinery and Hydrogen Fuel Cell Research
Principal Investigator: Cyrus Bhedwar, Georgia Environmental Facilities Authority

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	1.67	0.67	0.33
Approach	1.67	0.67	0.33
Progress	2.00	1.00	1.00
Success Factors	1.67	0.67	0.33
Future Plans	1.67	0.67	0.33
Average	**1.73**		



Question 1: Relevance to Overall Objectives.
- The project has potential to support the IBR but the R&D should be more focused.
- Gasification and H2
- Co product bio oil and charcoal products
- Bio oil blended in to diesel pyrolysis various forest
- Bio char is fertilizer
- Stability of bio oil?
- Use of solvents
- Cost of collecting forest residue
- Fermentable products
- Fuel cell
- Catalyst development
- Peanut hulls pyrolysis steam reforming H2 produced

Question 2: Approach to Performing the R&D.
- The project is too scattered and is dealing with too many sub-projects.
- Impact on ecology
- Develop catalyst from char reduce volatile organic compounds (VOC) cheaply
- Nh3 adsorption ozonating char enhances NH3 reduction
- Algae to treat waste water while producing renewable biomass.

Question 3: Technical Accomplishments and Progress
- Progress is indicated in some areas and not others.
- Performance indicators are not well defined.
- Miscible in biodiesel into petro diesel
- Vapor stream from pyrolysis
- Char as fertilizer results in productive soil

Question 4: Success Factors and Showstoppers
- Since the work is at best Stage B, many of the critical technical issues may not yet have been identified.
- ASTM certification

- Low pH of bio oil corrosive need to remove particulates to remove the corrosive particles.

Question 5: Proposed Future Research Approach and Relevance.

- Future work needs to be much more focused and strategically planned.

Additional Comments

Strengths

- Lots of ideas.

Weaknesses

- Need to focus on achievable goals; listing seven major areas may be energetic.
- For microalgae biomass production, working with mixed cultures may cloud findings with respect to important parameters.
- Use of algae as bioremdiator with respect to phosphorus removal from soil (which has been fertilized extensively with poultry manure) has not proved successful in the past.
- Not focused.
- Too scattered, too many things being researched – need to really focus

Technology Transfer/Collaborations

- None

Recommendations for Additions/Deletions to Project Scope

- Cut out everything except the work on bio-oil and char/carbon

APPENDIX A

Agenda

DOE Office of the Biomass Program

Integrated Biorefineries Peer Review
August 13-15, 2007

Day 1 – Monday, August 13th

Welcome and Platform Overview		
1:00 – 1:20	Welcome & Overview(s)	*Larry Russo, Office of Biomass Programs*
1:20 – 1:50	Project Management Overview	*Jim Spaeth or Gene, Golden Field Office*
1:50 – 2:10	Review of 932 Solicitation and Status	*Gene Petersen, Golden Field Office*
2:10 – 2:30	NEPA Requirements and Support for 932 and future Projects	*GFO NEPA (Kristen) representative, Golden Field Office*
2:30 – 2:50	Role of IE and IPA in 932 and future projects	*Cindy or Gene or Fred*

Break 2:50 – 3:00

Analysis and Strategic Planning		
3:00 – 3:30	Analysis Review and Strategic Plan	*Zia or Cindy*
3:30 – 4:10	➢ Integrated Biorefinery Platform Analysis	*Bob Wallace, National Renewable Energy Laboratory*

Corn Wet/Dry Mill Improvements		
4:10 – 4:30	Session Overview	*Gene Petersen - OR- Fred Gerdeman, Golden Field Office*
4:30 – 5:20	➢ Sugar-Based Ethanol Biorefinery: Ethanol, Succinic Acid and Byproduct Production and the Production of Ethanol, Chemicals, Animal Feed, and Biomaterials from Sugar Cane	*Donal Day, Louisiana State University AgCenter*

DOE Office of the Biomass Program
Integrated Biorefineries Peer Review
August 13-15, 2007

Day 2 – Tuesday, August 14th

Day One Review		
8:30 – 9:00	Day One Reviewer Feedback	*Dave Kelsall and Bill Cruickshank, Co-Chairs*

Corn Wet/Dry Mill Improvements (continued)		
9:00 – 9:50	➢ Integrated Corn-Based Bio-Refinery (ICBR)	*Michael Sanford, DuPont*

9:50 – 10:00 Break

10:00 – 10:50	➢ Separation of Corn Fiber and Conversion to Fuels and Chemicals Phase II: Pilot-Scale Operation	*Dr. Richard W. Glass , National Corn Growers Association*
10:50 – 11:40	➢ New Sustainable Chemistry for Adhesives, Elastomers and Foams	*Scott Boyce, Rohm and Haas Company / Rohm and Haas Chemicals LLC*

Oil Mills Improvement		
11:40 – 12:00	Session Overview	*Golden Field Office*
12:00 – 12:50	➢ National Agricultural Based Lubricants Project	*Wes James, University of Northern Iowa-NABL Center*

12:50 – 2:00 Lunch

Agricultural Residue Processing		
2:00 – 2:20	Session Overview	*Gene Petersen - OR- Fred Gerdeman, Golden Field Office*
2:20 – 3:10	➢ Advanced Biorefining of Distiller's Grain and Corn Stover Blends: Pre-Commercialization of a Biomass-Derived Process Technology	*Bob Wooley, Abengoa*
3:10 – 4:00	➢ Making Industrial Bio-refining Happen!	*Pirkko Suominen, NatureWorks, LLC.*
4:00 – 4:50	➢ A New Biorefinery Platform Intermediate	*Hans H. Liao, Cargill, Inc.*

DOE Office of the Biomass Program
Integrated Biorefineries Peer Review
August 13-15, 2007

Day 3 – Wednesday, August 15th

Day Two Review		
8:30 – 9:00	Reviewer Feedback	*Dave Kelsall and Bill Cruickshank, Co-Chairs*

Agricultural Residue Processing (continued)		
9:00 – 9:50	➢ City of Gridley Biofuels Project	*Tom Sanford, The City of Gridley*

9:50 – 10:00 Break

10:00 – 10:50	➢ Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries	*Ed Lehrburger, PureVision Technology, Inc.*

Other Refinery-Related Projects		
10:50 – 11:10	Session Overview	*Gene Petersen - OR- Fred Gerdeman, Golden Field Office*
11:10 – 12:00	➢ Biorefinery and Hydrogen Fuel Cell Research	*K.C. Das, Georgia Environmental*
NOT ATTENDING	➢ *Energy from Biomass Research and Technology Transfer Program*	*Consortium for Plant Biotechnology Research Inc.*

12:00 – 1:00 Lunch

NOT ATTENDING	➢ *Biomass Biorefinery for Production of Polymers and Fuel*	*Not presenting*

Plenary Session		
1:50 – 3:00	Reviewers Report-out	*Dave Kelsall and Bill Cruickshank, Co-Chairs*
3:00	Adjourn	

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Larry Russo
Please copy Melissa Harris (mharris@bcs-hq.com)

You have been invited to serve as a Reviewer for the DOE Integrated Biorefinery Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	No
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Technical Area or Project on Review Agenda	Nature of conflict of interest (Leave blank if none)

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Larry Russo (202-586-5618) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

______________________________ ______________________

Signature Date

____

Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session:

Reviewer Name: ______________________________________

Title of Project:____

Presenter Name: ____

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ____

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to Overall Objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach to Performing the R&D**.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

U.S. Department of Energy
Office of the Biomass Program
Biodiesel and Other Technologies
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Biodiesel and Other Technologies, held on August 14th and 15th in Golden, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the technology area they were investigating (i.e. fuels demonstration, combined heat and power, anaerobic digestion, or communications and outreach). The review agenda is attached to this report as Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the specific Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for comment, and any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Mark Decot
Biodiesel Technologies Manager
DOE/EERE, Office of the Biomass Program

Project Title	Relevance	Approach	Progress	Success Factors	Future Plans	Average
Missouri Biodiesel Demonstration Project (S2P5)	3.71	3.71	3.57	3.50	3.17	3.53
Regional Biomass Programs (S5P2)	3.33	3.00	3.20	2.90	3.20	3.13
National Biofuel Energy Laboratory (S2P6)	3.63	3.50	2.88	2.25	3.25	3.10
Alternative Energy Enterprise Program (S4P3)	3.29	3.00	3.14	2.93	2.75	3.02
Mississippi State University Sustainable Energy Center (S2P2)	3.25	2.94	3.00	2.94	2.75	2.98
O2 Diesel Demonstration (S2P3)	2.56	2.63	2.13	2.50	2.50	2.46
New York Biomass/Methane Gas Power Fuel Cell Project (S3P5)	2.13	2.88	2.43	2.63	2.25	2.46
Anaerobic Digestion (Ohio State University) (S3P4)	2.50	3.07	2.00	2.14	2.43	2.43
Ohio Solid Waste Authority Pyramid Resource Center(S4P1)	2.56	2.13	2.56	2.75	2.06	2.41
EERC Center for Biomass Utilization (S3P3)	2.50	2.63	2.38	2.13	2.29	2.38
E-Diesel Test and Research Project (S2P4)	2.19	2.50	2.06	2.25	1.75	2.15
Kentucky Rural Energy Supply Program (S5P1)	2.43	2.50	2.36	1.29	2.00	2.11
New Uses Information and Entrepreneur Development(S4P2)	2.21	2.00	2.21	1.43	2.43	2.06
Canola-based Automotive Oil R&D (S3P1)	2.25	2.00	1.38	2.00	1.38	1.80
Phillips Biomass Combined Heat & Power Facility (S3P2)	1.56	1.75	1.71	1.75	1.75	1.71

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Program Peer Review Platform Results

Platform Direction

Biodiesel and Other Technologies reviewers provided strong consensus on the need for renewed focus on biodiesel and similar areas within the Biomass Program's research and development (R&D) portfolio. The Program recognizes the need for an expanded biofuels scope (beyond cellulosic ethanol) in its Multi-Year Program Plan (MYPP) for 2007-2017. In this document, conversion technology platforms, infrastructure, and market transformation activities are outlined for ten years. Near-term cellulosic ethanol R&D and integrated biorefinery activities are intended to form stepping-stones to a more wide-reaching biofuels platform with industry support. Biodiesel, Bioproducts, and Other Technologies projects, while not the main thrust of the Biomass Program's efforts, continue to receive funding and staff oversight throughout the program.

Key to this approach is the Program's biomass-to-biofuels supply chain model. In line with reviewers' comments that the Program consider the end product and biomass' ability to serve as a petroleum replacement, the supply chain model aligns Program efforts along the chain of necessary events to bring biomass materials from the farmer's field to the consumer's vehicle, including any co-products of the process.

Reviewer concerns about a decrease in outreach activities will be addressed by the Program in the next few years as discussed in the MYPP section on Market Transformation, including educational and public outreach, as well as legislative communication with federal, state, and local entities. Implementation of these efforts will be facilitated by strategic stakeholder partnerships. Additional communication of Program structure to meet its goals has been undertaken in 2008 with increased participation in public expositions and trade shows and distribution of major reports at these events and via the program website.

Platform Funding (in $M):

Because Biodiesel and Other Technologies has not been a discrete Biomass Program Platform, funding for the reviewed projects is allocated across Technologies in the form of Congressionally Directed Projects. Due to the continuing resolution, there were no congressionally directed appropriations in FY 2007. None of the projects reviewed were funded in FY 2007, instead they were operating on carryover from funding in previous years. In FY 2006 these projects were awarded more than $28million.

Specific Platform Responses to Select Reviewer Comments:

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
• The need for middle distillates is known. It seems that a biodiesel or middle distillate platform is needed. • The recognition that the role of biodiesel in OBP is still very much TBD and needs to be significantly improved. • As the presentation indicates, a biodiesel platform does not exist. Much more work is		Achieving the President's Twenty in Ten goal to produce 35 billion gallons of renewable and alternative fuels by 2017 will necessarily include all types of biofuels. The Biomass Program will continue to address middle distillate barriers throughout its portfolio, while collaborating with industry to facilitate policy for increased production and distribution of commercially-

needed on this activity.		viable biofuels such as biodiesel. The Biomass Program seeks to combine its near-term focus on cellulosic ethanol with consideration of alternative biofuel approaches, including Fischer-Tropsch fuels and renewable diesel, in both the biochemical and thermochemical conversion platforms.
Biodiesel ought to be relegated to niche applications, such as mandated usage in recreational vehicles and boating where it is affordable. Biodiesel costs are prohibitive in view of other renewables. It has value to replace petro-diesel in ecologically sensitive areas.		The Biomass Program's support of biodiesel-related projects in recent years focused on infrastructure and testing issues. How biodiesel succeeds in the open market is beyond the scope of the program.
OBP should consider abandoning support for biodiesel (fatty acid esters) and instead focus on renewable diesel as supported by a strengthened thermochemical conversion platform. If the decision is to retain oil based biodiesel, the focus should be on new (as in economically viable) feedstocks.		To achieve the President's Twenty in Ten goal, the Biomass Program will combine its near-term focus on cellulosic ethanol with consideration of alternative biofuel approaches, including Fischer-Tropsch fuels and renewable diesel, in both the biochemical and thermochemical conversion platforms.

Program Peer Review Comments:

Strengths

- This is not a platform, rather a collection of mandated projects. It was a good review of the projects with many good suggestions/recommendations.
- The reviewers performed a valuable service in analyzing these "orphan" projects. Leveraging with private funding is to be commended. Pipeline testing projects may have use to the new infrastructure platform.
- The recognition that the role of biodiesel in OBP is still very much TBD and needs to be significantly improved – if that's a strength.

Weaknesses

- As the presentation indicates, a biodiesel platform does not exist. Much more work is needed on this activity.
- Didn't appear likely that many of the recommendations would be followed.
- There is no platform. Some of the projects could be moved into existing platforms for better review. However, I don't fault the Program for conducting the review in the manner they did.
- No focus.

R&D Portfolio Gaps

- Gaps are not indicated.
- The reviewers' comment that a biodiesel/renewable diesel platform is needed is interesting. I don't think that a separate program is appropriate, but should rather be integrated into existing platforms. That said we did not see much attention to biodiesel this week. As clean diesel engines have certain advantages over gasoline engines for improved fuel use, there is a need to give this some attention (at least a cost analysis). I would suggest that the Program follow up on the suggestion that the Program attempt to bring PIs from these types of projects together early and educate them on the Program goals and useful tools for project success.

- Overall, the projects presented were not focused on DOE Office of the Biomass Programs. Project timelines did not appear to be a major area of concern. As some of the projects were earmarked with a lack of coordination with more stable research programs, accomplishments were minimal. Inadequate data on cost benefits from utilizing biodiesel. Prior to demonstration projects, dollars should be spent on basic aspects of bioconversion and sourcing. Studies on engine performance and responses to regulatory requirements must be conducted. Relevant relationships with biorefineries were not apparent. Project innovations must be listed and acknowledged. Economic analyses are needed to ascertain relevancy to utilization of current and proposed materials.
- Too many to comment on.

Additional Recommendations, Comments and Observations

- Much work is required in this activity.
- The need for middle distillates is known. It seems that a biodiesel or middle distillate platform is needed.
- Biodiesel ought to be relegated to niche applications, such as mandated usage in recreational vehicles and boating where it is affordable. Biodiesel costs are prohibitive in view of other renewables. It has value to replace petro-diesel in ecologically sensitive areas.
- I agree with the ideas presented for managing earmarked projects. They can't hurt, and a few PIs might actually cooperate.
- OBP should consider abandoning support for biodiesel (fatty acid esters) and instead focus on renewable diesel as supported by a strengthened thermochemical conversion platform. If the decision is to retain oil based biodiesel, the focus should be on new (as in economically viable) feedstocks.

Platform Feedback

Specific Responses to Select Comments

Platform Peer Review		
Reviewer Comment		**Technology Manager Response**
The overall Biomass Program structure should change. • Technology Platforms could be based on petroleum replacement segment • Technology R&D should identify benefits in terms of the end product as well as process improvements. • The Biomass Program could broaden its definition of conversion, rather than using subheadings to restrict technology focus. • Congressionally-directed projects which cannot be directly aligned with a technology platform should be separately identified, with their focus technology linked to its respective match in multiple platforms. This approach could facilitate cross-fertilization.		The Biomass Program's current focus is the development of cellulosic ethanol in line with the President's Twenty in Ten Initiative. The Program structure mirrors these technology needs, funding extensive pre-commercial conversion research.

• The Biomass Program should communicate with the legislative branch that they are working hard to do good things with congressionally-directed funding. Support statements and a direct request for technology focus areas should be provided to staffers directly. • Projects could be required to undergo a review of their award and expectations prior to contract signing. Discussion with the Program would help projects to focus and plan their work.		
Project work would benefit from requirement that results be put into public domain		The Biomass Program agrees and will continue our effort to disseminate reports, studies and results on the website www.biofuels.energy.gov.
The Biomass Program should educate the public about its full range of technologies		In fiscal year 2008 the Biomass Program's plans to increase funding in the communication & outreach and has staff dedicated to the effort.
Given the needs of the 20 in 10 goal, the review panel recommended that OBP increase its support for biobased alternatives to petroleum products.		The program agrees that biobased products should continue to receive program support.
OBP should tie to HFCITP/H2A analysis of intense pressure on biomass feedstocks in medium transition years to the Hydrogen economy.		The Biomass Program will consider this recommendation in consultation with the Hydrogen Program.
DOE should pursue greater coordination of state and/or regional resources, with out-of-state review using same-level groups from other states.		The Biomass Program agrees and has included a regional/state/local effort in its new Market Transformation area.
DOE should have clear rule regarding commercial product funding, requiring at least 80 percent cost-share.		Current DOE policy states that EERE will fund process-related R&D that benefits no single company (i.e. specific product improvement). In addition, DOE does have a clear funding structure which requires increased industry cost-share as the R&D nears commercialization. The Biomass Program will continue to operate under these guidelines, while in consideration of industry preference for future solicitations.

General Platform Comments

- The overall Biomass Program structure should change.
    - Technology Platforms could be based on petroleum replacement segment?
    - Technology R&D should identify benefits in terms of the end product as well as process improvements.
    - The Biomass Program could broaden its definition of conversion, rather than using subheadings to restrict technology focus.
    - Congressionally-directed projects which cannot be directly aligned with a technology platform should be separately identified, with their focus technology linked to its respective match in multiple platforms. This approach could facilitate cross-fertilization.
    - The Biomass Program should communicate with the legislative branch that they are working hard to do good things with congressionally-directed funding. Support statements and a direct request for technology focus areas should be provided to staffers directly.

    - Projects could be required to undergo a review of their award and expectations prior to contract signing. Discussion with the Program would help projects to focus and plan their work.

- The Biomass Program should educate the public about its full range of technologies.

- Project work would benefit from requirement that results be put into public domain.

- The Biomass Program should focus on coordinating projects to avoid duplication of effort (and funding): Oxidative Stability, Lubricity, etc.

- Given the needs of the 20 in 10 goal, the review panel recommended that OBP increase its support for biobased alternatives to petroleum products.

- Sludge conversion work could be part of the processing and conversion platform's biochemical area.

- OBP should tie to HFCITP/H2A analysis of intense pressure on biomass feedstocks in medium transition years to the Hydrogen economy.

- DOE should pursue greater coordination of state and/or regional resources, with out-of-state review using same-level groups from other states.

- DOE should have clear rule regarding commercial product funding, requiring at least 80 percent cost-share.

- Encourage DOE to organize workshop with earmarks at project initiation (prior to contract development/final award) to discuss OBP goals and objectives.

- OBP should organize technical information transfer workshops after project work is begun.

- OBP platforms do not encompass broader, public, biomass vision, leading to a vacuum, creating more congressionally-directed projects.

- Potential topics for consideration:
    - Biodiesel
    - Biogas
    - Bio gasification
    - Hydrogen
    - Landfill gas
    - Chemical products
    - etc.

- DOE should establish program with strong management for outreach/regional/state efforts, including kickoff workshop involving all stakeholders. Suggest separate, targeted review for outreach projects.

<u>Comment:</u>

- Based on the projects reviewed by this panel, there appears to be a high level of interest in biodiesel and other alternative fuels that would displace or augment the use of petroleum diesel in the U.S. market. It is difficult for project PI's to address DOE goals and objectives when there is no specific platform for this area of research in the DOE portfolio.

Recommendation:
- Add a component to the multi-year plan that specifically covers research goals and objectives on displacement or augmentation of U.S. market demand for petroleum diesel.

Comment:
- Insufficient time is provided for Peer Review Panel to come to consensus on strengths and weaknesses of projects; similarly, there is insufficient time for PI's to form rebuttal comments.

Comment:
- Petroleum diesel is extensively used in the U.S. market for uses other than transportation fuel. These uses include electric power generation and residential heating. Displacing and augmenting these petroleum diesel uses with biodiesel and other diesel substitutes could substantially help achieve DOE's "20 in 10" goals and objective.

Recommendation:
- Add a component to DOE's multiyear plan to set goals and objectives, including research and development investment, to take advantage of this opportunity in the U.S. market.

- DOE should establish stronger information library, including historical results, for public use, data and information exchange, and elimination of research duplication or overlap:
    - State and university-funded information
    - Private R&D
    - National laboratory results
    - Federal agencies

- Demonstration projects should be required to present life-cycle cost and environmental analysis.

- All projects need to provide detailed statements of work for thorough background information with funding broken down by task

- Projects should be required to present expenditure summary and matching funds detail.

- Reviews can hold poster sessions for public information review, and simultaneous closed sessions to present proprietary information.

Initial Reviewer Feedback – Comment Summaries

Biodiesel and Fuels Demonstration Projects

Project Title - Mississippi State University Sustainable Energy Center
Project Investigator: Rafael Hernandez, Mississippi State University

Strengths

- Wide variety of potential fuels.
- Focused on unique feedstock niches (algae, primary and secondary sludge).
- Research program well laid-out with documented progress.
- Future funding support, meeting multiple objectives, with partners.

Suggestions and/or Weaknesses

- Could use clearer data about amount of biodiesel to be produced.
- Little incentive for ethanol producers' hydrolysate contribution.
- Some more economic analysis would strengthen project work.
- Needs stronger partners in waste industry.
- Acid esterification technology seems poorly focused.

Comments

- Needs overall focus to maximize funding and benefits.

PI Responses

- *Little incentive for ethanol producers' hydrolysate contribution.*
  MSU technology may enhance ethanol manufacturing. Transportation fuel may be maximized from an ethanol facility by utilizing recycle streams and waste streams (C5 sugars) as a source of carbon for oil accumulating microorganisms. The technology allows for economic optimization for markets, similar to how refineries shift yields between gasoline and diesel based on market conditions. MSU's technology permits economic utilization between ethanol to renewable diesel or biodiesel, thus upgrading the facility to a biorefinery.
- *Acid esterification technology seems poorly focused.*
  PI Response: This part of the project is focusing on feedstocks with a high content of free fatty acids. These feedstocks may require unique operating conditions. Most of the biodiesel producers in the U.S are not equipped to handle this type of feedstock.
- *Some more economic analysis would strengthen project work.*
  PI Response: The PIs agree with the reviewers. Funding is being requested from private and government sources to build a pilot system, demonstrate the technology, and improve the economic analysis of producing biodiesel and/or renewable diesel from sewage sludge.

Project Title: O2 Diesel Demonstration

Principal Investigator: Thomas Sopko, 02 Diesel, Ben Kaufman, 02 Diesel

Strengths

- Well-focused commercialization program to reduce regulatory barriers.

Suggestions and/or Weaknesses

- O2 diesel unlikely to become homogenous fuel (low volume).
- Product will have ongoing environmental and safety challenges.
- Define the incremental improvement of adding ethanol to diesel (performance enhancement?).
- Difficult to quantify improvements from adding ethanol to biodiesel blends.
- Environmental improvement data not adequate to justify fuel use.

Comments

- Recommend project achieves at least 50/50 cost-share.
- Project work does not fit biomass program objectives.

PI Responses

- It is well known that O2 Diesel, as a commercial fuel, is targeted solely for use in centrally-fueled fleets which represent at least 50% of the diesel market. Moreover, the components to blend O2 diesel, except for the additive, exist at terminals today, just like rack blending, which would support national efforts for growth in the centrally fueled fleet market. To characterize O2 Diesel as “unlikely to become homogenous fuel” is premature.
- The project has a written safety program which follows NREL guidelines with no instances of safety problems in a variety of fleets and operating environments under millions of hours of in-use testing. The use of flame arrestors in O2 Diesel capable centrally fueled fleet applications is a proven technology, which serves the same function in a number of E-85 flexible fuel-capable vehicles on the road today. Moreover, while complementary with other biomass products, the renewable and proprietary additive components of O2 Diesel provide environmental and energy security benefits beyond current biodiesel formulations.
- Aside from reducing the use of imported oil, O2 Diesel provided data showing significant emissions reduction benefits as compared to ULSD especially with respect to particulate matter and oxides of nitrogen (NOx) emissions. The positive improvements of O2 Diesel on diesel exhaust NOx emissions, as a precursor pollutant in the formation of ground-level ozone, is at a minimum directionally correct and could play an important roll in State Implementation Plans (SIPs) in compliance demonstrations should EPA decide to adopt a more stringent National Ambient Air Quality Standard (NAAQS) for ozone under its pending Notice of Proposed Rulemaking (NPRM). Further, the particulate matter benefit is synergistically improved with biodiesel blends greater than 12%. Based upon the positive data to date, we are encouraged about the potential for O2 Diesel to improve the performance of aftermarket treatment devices and new engine designs. Further research on the effect of ethanol diesel blends on the performance of after treatment devices and new engine designs would be important information.
- Finally, with regards the Comment that O2 Diesel Project work “does not fit the biomass program objectives” is puzzling. As touted on the DOE website “The Office of Energy Efficiency and Renewable Energy's Biomass Program works with industry, academia and our national laboratory partners on a balanced portfolio of research in biomass

feedstocks and conversion technologies. Through research, development, and demonstration efforts geared at the development of integrated biorefineries, the Biomass Program is helping transform the nation's renewable and abundant biomass resources into cost competitive, high performance biofuels, bioproducts, and biopower.

- In particular, our work is focused on
    - Making cellulosic ethanol cost competitive by 2012;
    - Contributing significantly to the Presidential goal of reducing gasoline consumption by 20 percent in 10 years through efficiency and alternative fuels; and,
    - Displacing 30 percent of gasoline consumption with biofuels by 2030."
    - What could be more fitting than the on-going O2 Diesel Projects?

Project Title: E-Diesel Test and Research

Principal Investigator: Nathan Fields, NCGA

Strengths

- Realistic evaluation of project data and appropriate decision to re-direct.
- Strong partnerships and OEM collaboration.

Suggestions and/or Weaknesses

- Nearly 80% of funding unspent.
- Emissions goal not addressed.
- Original durability research lacked follow-through to resolve barrier.

Comments

- Recommend tighter, phased task plans for future funding (outline go/no-go decision points).

PI Responses

- Project recognizes issue with unspent funds. Front-end issues affected the overall project timeline. The planned project re-scope should accelerate targeted fund disbursement.
- Emissions plans were addressed in the original plan of work, with results similar to those of the O2 diesel project, including documented benefits. The presentation failed to include this information.
- The original plan of work included a step to address product durability. Research did not advance past the first phase, and durability work was therefore never fully completed due to the severity of problems encountered and feasibility of 10% ethanol diesel actually reaching the market.

Project Title: Missouri Biodiesel Demonstration

Principal Investigator: Tom Verry, NBB

Strengths

- Well-constructed and implemented project.
- Achieved objectives in a timely manner.
- Results on BQ 9000 testing have industry-wide benefits.
- Strong partnerships with prime industry players including partnership funding.
- Strong outreach and education program.
- Addressed all three critical components: Quality/Distribution/BQ 9000.

Suggestions and/or Weaknesses

- Should have done wintertime pipeline testing.
- Pipeline test did not provide volume justification.
- Could use stronger, long-term future roadmapping.

Comments

- Bioheat is a beneficial market for pipeline use.
- Lubricity benefit comparison testing should include raw oil.

PI Responses

- *Should have done wintertime pipeline testing.*
- The pipeline runs were done at time that was convenient to the pipeline companies, and running in cold vs. warm weather was not an overall objective. The impact of 5% biodiesel on cold weather performance is small and little impacts would be expected even if run in colder weather. Pipeline runs in colder weather for confirmation purposes could be accomplished in future work. Cold weather runs will be more of a factor with higher blends like B20.
- *Pipeline test did not provide volume justification*
- The volumes needed to justify pipeline runs vary from company to company, and may be dependent somewhat on the results of pipeline testing for interface levels with biodiesel blends. At this point, our purpose is more 'proof of concept' on the technical aspects of using multi-product pipelines for biodiesel blends, rather than volume justifications.
- *Could use stronger, long-term future road mapping*
- We agree that stronger, long-term future road mapping would be useful. To a certain extent, the technical 'proof of concept' and implications of the transport of biodiesel blends at various levels are needed in order to develop good long term road mapping.
- *Lubricity benefit comparison testing should include raw oil.*
  We respectfully disagree that lubricity benefit comparison testing should include raw oil. Use of raw vegetable oils or animal fats has been demonstrated to have significant technical problems and should not be used. Please refer to Clean Cities Fact Sheet and Engine Manufacturers Position Statement on use of Raw Oils at http://www.biodiesel.org/resources/fuelfactsheets/ in the 'Engine Manufacturers' section.

Project Title: National Biofuel Energy Laboratory

Principal Investigator: Chuck Moeser

Strengths

- Very clear, targeted program to provide highly relevant information to biodiesel industry. Divided technical solutions among stakeholders well.
- Full industry coordination, including component manufacturers.
- Good technical support for B20 ASTM work.

Suggestions and/or Weaknesses

- Half the funding applied to facility enhancements/construction.
- Unclear how heterogeneous catalysts work in biodiesel production fits with overall goals.
- Did not address showstoppers/success factors.

Comments

- Recommend stronger, national data and information outreach approach.
- Project did not sample nationally to ID regional differences.
- Test should ID whether supply is BQ 9000.

PI Responses

- Project work started without an adequate laboratory. Funding used for construction was detailed as part of the original project proposal. Future plans will channel funding to testing work.
- The overall goal of heterogeneous catalyst work is to understand fuel composition for performance. Understanding of production will improve overall processing techniques, control quality, and render an efficient, competitive product.
- Success factors and showstoppers do exist, but the project acknowledges they strayed from the presentation template and did not include this information.
- The project leads regularly make presentations regarding their data at national conferences and send it to peer-reviewed publications. NextEnergy is conducting its own national event in 2008.
- The project did not address national sampling because NREL has already done similar work, though with unidentified sources.
- Bob Armantrout from NextEnergy, who was not present, would best be able to address BQ 9000 compliance.

Project Title: Canola-based Automotive Oil R&D

Principal Investigator: Ira Pierce, Green Oil Company

Strengths

- Good group of uptake core questions.

Suggestions and/or Weaknesses

- High funding allocation disproportionate to stated project goals.
- Market analysis methodology not described clearly.
- Lacks technical plan.
- Niche market without volume displacement potential.

Comments

- Recommend task plan with research barriers, cost assessment.
- Automotive oil application not clearly defined.

PI Responses

- Technical plan in development, to use secondary sources, no laboratory analysis, use others' work.
- Volume displacement numbers not yet agreed upon, but will be large.
- Testing of the product will be a research barrier, because those developed for petroleum are not applicable to bio-oils.
- The product application will be better defined in the future. At this time hydraulic fluid and metalworking applications are the base of a hierarchy to culminate in automotive oils work.

Project Title: Phillips Biomass CHP Facility
Principal Investigator: Carl Nelson, The Green Institute

Strengths
- Good urban outreach for energy efficiency.
- Generated regional biomass inventory data and associated costs.

Suggestions and/or Weaknesses
- Needs biorefinery relationship.
- Needs stronger technical support/development and analysis.
- Project lacks focus, R&D improvements and value-added.

Comments
- Recommend hiring experienced subcontractor with wood power knowledge

PI Responses
- For the work completed so far, we have had subcontractors with strong experience, including some of the top engineering firms in the world with biomass experience
- Due to the second stage of work still being in early development, we still need to build further partnerships and strong subcontractors, which we expect to resolve some of the issues brought up by the panelists.

<u>Project Title: EERC for Biomass Utilization</u>
Principal Investigator: Dr. Bruce Folkedahl, U. North Dakota

Strengths

- Generating regional interest in biofuels.
- Strong education/outreach meetings.
- Many cost-share partners.

Suggestions and/or Weaknesses

- Portfolio of projects too large and unfocused.
- Poor sense of potential economic impact (individual and combined).
- Poor sense of whether projects have chance of moving out of laboratory.
- Low level of project innovation.

Comments

- Future funding route unclear.
- Need fewer, stronger projects with national potential.
- Recommend stronger programmatic control over project portfolio.

PI Responses

- *Portfolio of projects too large and unfocused.*
- In general, because of the number of projects the EERC presented, there simply was not enough time to present all of the information on each project which would have addressed some of the weaknesses cited here. Indeed the portfolio of activities was large (there were ten), but we were trying to spur innovation in high-risk applied research and development in the key areas of biopower, biofuels, and bioproducts using a million dollars and 20% industry cost share. It is very easy to do a large demonstration of one idea but, usually, that type of project is limited in the fundamental sense. We have many partners involved in our work but still stress fundamental applied research. These projects cannot be very large, like a large demonstration, because the lack of cost-share commitment. Additionally, with more activities, there are more opportunities to develop new processes and principles that can lead to large pilot-scale experiments or demonstrations.
- *Poor sense of potential economic impact (individual and combined).*
- Perhaps the reviewer meant for a specific activity, because this statement is simply unfounded. Case in point is our work to develop a 150-kW biomass gasifier for real world uses in distributed energy. The economic impact of this system is well-documented and attested to by four projects going forward for long-term demonstration and real world electricity production. The microturbine for landfill gas also has a detailed economic assessment. Other economic assessments are still being done for laboratory-and pilot-scale experiments and, quite frankly, these activities probably will not generate reliable economic forecasts with respect to markets until scale-up versions can be produced and tested for better economic numbers.
- *Poor sense of whether projects have chance of moving out of laboratory.*
- All principal investigators involved in this overall program (about 10) have clear intentions, aspirations, and partners for moving their innovations out of the laboratory. There probably simply was not time to discuss all activities in detail. For example, the biomass gasification activity discussed above has clearly demonstrated a pathway out of the lab, and a near-commercial version is installed at the Grand Forks Truss Company. A higher-risk project such as the urea fertilizer project has the North Dakota, South

Dakota, and Minnesota Corn Growers anxiously waiting to see concrete results for the innovative electrochemical process testing, to be completed this fall. I don't think this comment is justified, just miss communicated.

- *Low level of project innovation.*
- This comment is fairly subjective. I don't see any 150–300kW biomass gasifiers making electricity anywhere in the United States. I don't see any fertilizer plants in the heartland making nutrients from anything other than 100% natural gas. These two examples are indicative of projects overall.
- *Future funding route unclear.*
- *Need fewer, stronger projects with national potential.*
- *Recommend stronger programmatic control over project portfolio.*
  We agree that the EERC (University of North Dakota) project needs to be more connected to the DOE EERE Office of Biomass Program portfolio. The EERC (UND) will put more attention toward coordinating future projects in conjunction with ongoing work at the DOE EERE Office of Biomass to avoid duplication of effort. We do visit with Golden Field Office and the Washington D.C. office every year to discuss our future direction for project activities. We also agree that fewer activities under one more focused project umbrella is a good idea.

Anaerobic Digestion and Waste Processing Projects

<u>Project Title: Ohio State University - Anaerobic Digestion</u>
Principal Investigator: Floyd Schanbacher

Strengths

- Integrated project into numerous Biomass Program objectives.
- Design and development of advanced controls for self-healing industrial digester beneficial.
- Reactor systems, even at bench level, nicely engineered.
- Good tie between inventory, economics, and energy policy.

Suggestions and/or Weaknesses

- Should coordinate with other high strength influent work to avoid duplicative effort.
- Should identify process improvement goals. Targets, goals, benefits, cost assessments not provided.
- Progress seems slow.
- Lack of fallback position if solid-oxide fuel cell system fails. Not necessary to rest of project.
- Relies heavily on price-to-value of renewable energy without comparisons.

Comments

- Should focus on pre-fuel-cell R&D.
- Bacterial species study might be valuable, if focused on process-improvement controls.
- Using Federal dollars for state-specific resource assessment is parochial.

PI Responses

- Federal dollars were provided for state specific assessments.
- Project includes assessment of food-processing/high strength influent not seen elsewhere, applicable to other states.
- Bacterial study looking at process improvement controls. Consortia is one of the rate limiting steps.
- Composite funding affects progress.
- Appreciate need to coordinate with other high strength influent research programs.

Project Title: New York Biomass/Methane Gas Power Fuel Cell

Principal Investigator: Dr. Caine Finnerty, NanoDynamics

Strengths

- Research plan well-developed and implemented, with progress metrics.
- Project making excellent progress towards stated goals.

Suggestions and/or Weaknesses

- Better path to commercialization needed.
- Need better sense of project's larger energy impacts.
- Lack of economic information provided could be show-stopper.
- Lack of commercial partnerships and solid-oxide consortium participation.

Comments

- Project work best fits in DOE Hydrogen program-solid oxide fuel cell development.
- How does work relate to 20 in 10 goal?

PI Responses

- The project is applicable to the 20 in 10 target, as small scale Solid Oxide Fuel Cell systems in the region of 1-5kW could potentially be used as auxiliary power units (APU's) in a variety of transportation applications, for example larger tractor trailer units idle their engines during the night to provide power for electronics and environmental control, under these operating conditions the engine is operating very inefficiently, a SOFC APU could provide the necessary power whilst reducing emissions, noise and more importantly reducing fuel consumption.
- We are not currently part of consortium, the fuel cell program at ND was developed around a vertically integrated model; however, now we have reached our current phase of development and commercialization we may look into this.
- On the commercial side we are currently pursuing several contracts representing near term markets in excess of $200M, we are confident that we can successfully implement this technology in a commercial arena. Based upon the power density and manufacturing approach associated with our cell technology, we believe that the economics of the NDE solid oxide fuel cell will be very competitive. Management has experience supplying high volume, engineered ceramic components to the energy (nuclear), telecom, and automotive markets and is confident in the scalability and economics of the current approach.

Project Title: Ohio Solid Waste Authority Pyramid Resource Center
Principal Investigator: Tim Berlekamp

Strengths
- Good leverage of DOE funding.
- Good Phase I construction progress.
- Provided good information about project stages.

Suggestions and/or Weaknesses
- No life-cycle cost analysis has been done.
- Lacks commercialization plan, market analysis for CO_2;
- Recommend cost and performance analysis for gas cleanup, methanol production.

Comments
- Innovative approach to processing landfill gas.

PI Responses
- Addressing the CO_2 sales issue, the project acknowledges its commercialization plan is lagging. Due to ethanol industry supply, CO_2 availability is high, reducing the price. The project is working with the Ohio Department of Natural Resources on oil and gas well recovery efforts in Ohio.
- Cost has been an issue. The project realizes internally that additional effort is necessary.

Communications, Outreach, and Partnerships

Project Title: New Uses Information and Entrepreneur Development
Principal Investigator: Mark Williams, Growth Dimensions

Strengths

- Re-focus on bioenergy.
- Strong government and other partnerships.
- Programs like this may identify small opportunities which may otherwise be missed.
- Provide critical business development support.

Suggestions and/or Weaknesses

- Capital awards lack progress.
- Program eligibility requirements narrow, very locally focused.
- Limited success to date.
- Need better leveraging strategy based on needs and benefits.
- Seems to lack strong technical development screening capability – ensure good industrial participants.

Comments

- Future efforts should be directed statewide.

PI Responses

- Growth Dimensions is a private/public economic development agency responsible for economic development in Boone County incorporated by the City of Belvidere, the County of Boone and the
- Belvidere Area Chamber of Commerce, with funding coming from both the private and public sectors of the Boone County area, and therefore is not a statewide agency. Growth Dimensions has spearheaded a regional initiative for the commercialization of new biomass-related products and systems. The strategic goals of the imitative include increasing the value of agricultural biomass and stimulating new manufacturing opportunities.
- Understanding that geographic constraints have limited the number of award proposals, we broadened the geographic region where eligible applicants must agree to relocate to or be primarily domiciled in, from only “Boone County, Illinois” to “Boone, DeKalb, McHenry, Ogle, Stephenson, and Winnebago Counties in Illinois.” The broader region aligns more with the congressional district. Other limiting constraints were removed from the RFP solicitation, including: removing the limitation of the award of $100,000 per award, because there is no award ceiling other than what we have allocated for the Award Program with DOE. Other limiting factors including the required cost share remained the same.
- We also increased the frequency of solicitations to monthly solicitations and broadened marketing outreach to attract more proposals.
- Other barriers that we can’t change that have limited the awards program are associated with
- NEPA requirements making it cost prohibitive with past proposals.
- We have also proposed a scope of work modification to add a contract with Northern Illinois
- University for the purpose of increasing support of the Biomass Product Development

- Commercialization Services and at the same time increasing support to the Capital Awards program by providing hands-on assistance to companies interested in applying to the award program. These increased efforts will add man hours from a part-time basis to a full-time dedicated position focused on moving the project along.
- We believe the review team does include strong technical development screening capability, in addition to key business and community development support crucial for successful implementation. In retrospect, these technical competences may not have been articulated strongly enough in the presentation. The team for reviewing these proposals includes:
- **John Noel**, President Illinois Technology Development Alliance
- **Tom McDunn**, Director of Advanced Manufacturing, Rockford Area Ventures/EigerLab (Manufacturing
- Innovation Center)
- **Greg Brown**, Chairman of AgTech Initiative and President of DareCloud Development
- **Dan Cataldi**, Executive Director for Rock River Valley Entrepreneurship Center (Affiliate Office of the
- Illinois Department of Commerce and Economic Opportunity)
- **Seth Snyder, Ph.D.**, Section Leader of Chemical and Biological Technology Energy Systems Division,
- Argonne National Laboratory
- **Ann Marie Cain**, Manager of Boone County Farm Bureau
- **Mark Williams**, Executive Director of Growth Dimensions (Economic Development)
- **Jerry Zielinski,** Executive Director, Northern Illinois Technology Enterprise Center, former technology
- Commercialization executive with AT&T and Lucent Technologies

Project Title: Alternative Energy Enterprise Program

Principal Investigator: Sumesh Arora, MS Technology Alliance

Strengths

- Well-organized program with clear goals, metrics.
- Good description of impacts resulting from money allocated.
- Strong peer review process including reviewers from outside the state.
- Good alignment of state program with DOE goals.
- Good assessment of showstoppers.

Suggestions and/or Weaknesses

- Private sector involvement was very weak.
- Large amount of goal funding went to universities, did not show potential economic development.
- Did not address specific environmental regulations.
- Relatively few funded projects.

Comments

- Suggest focusing on biomass technologies which lead to significant job creation in state.

PI Responses

- A total of 24 private sector entities are involved in the various projects that are funded through the Strategic Biomass Initiative
- A portion of the project was designed for a university funding approach, but universities were asked to undertake late-stage projects. All university projects have alliances with industrial partners, with four showing strong potential for economic and commercial outcomes.
- All projects underwent a NEPA compliance review. The projects could examine environmental benefits or show-stopping aspects. Due to the project timeline, DOE is not liable if projects are not NEPA compliant when the contract comes to an end.
- A total of 16 individual projects are expected to be completed by the end of the current funding period with awards ranging from $32,000 to approximately $230,000.
- In response to the comment, MTA is an economic development organization whose performance metric is not usually job creation. MTA is a technology-oriented company, which measures commercial outcomes such as technology licensing and company start-ups. The belief is that technology diffusion and company creation lead to job growth.

Project Title: Kentucky Rural Energy Supply Program

Principal Investigator: Cam Metcalf, University of Louisville

Strengths

- Excellent consortium.
- State cash match.
- Development of university program.

Suggestions and/or Weaknesses

- Grant program should more explicitly target industry, small business.
- Poor coordination of supported projects with ongoing biomass program activities.
- Some supported projects not aligned with biomass program.
- Ensure that project redundancy does not occur.
- Needs ongoing independent (outside state) technical review program.

Comments

- Recommend relating all funding to biomass program goals.
- Program would benefit from much more focus.
- Suggest using funding as opportunity to build nationally-competitive research program.

PI Responses

- *Grant program should more explicitly target industry, small business.*
- The consortium's objective was to position Kentucky to better compete for Federal Research dollars – targeting industry and small business would not accomplish this. The funding has been used to aid and build state universities' research capabilities and collaborative efforts. The consortium represents sixty-two organizations including private sector industries and small businesses that share expertise and provide input on our research and development directions. The reviewers' comments suggested using funding as an opportunity to build a nationally-competitive research program which seems to conflict with this weakness.
- *Poor coordination of supported projects with ongoing biomass program activities.*
- All funded projects addressed a DOE roadblock, however since our original funding mandate specified biomass and energy efficiency, not all projects included biomass. The Kentucky Rural Energy Supply Program was put into the biomass program because the majority of our funding targeted biomass.
- *Some supported projects not aligned with biomass program.*
- Because our original mandate from Congress required us to look at renewable energy (including biomass) and energy efficiency projects, not all projects included biomass. Dr. Eric Berson and Dr. Sue Nokes traveled to NREL representing KREC in August 2005 and discussed the overall project and goals with DOE staff. DOE did approve all seven research projects prior to the research beginning. Ensure that project redundancy does not occur.
- The Competitive Grants Program did ensure that there was no project redundancy. The Review Panel make-up included 14 individuals from Universities (10) & Federal Labs (4) from outside of Kentucky. Three reviewers were used on each proposal. This comment does not seem to have merit.
- *Needs ongoing independent (outside state) technical review program.*
- KREC has submitted quarterly reports to DOE NREL for review as an independent and out-of-state entity. DOE should provide feedback on a continuous basis during the

project period. The KREC project ends 12/31/07, so an ongoing independent review is not feasible at this point.

- Comments:
- *Recommend relating all funding to biomass program goals.*
- Because our original mandate from Congress required us to look at renewable energy (including biomass) and energy efficiency projects, not all projects included biomass. This would violate our original mandate from Congress.
- *Program would benefit from much more focus.*
- The KREC objective was to build research collaboration and strength in the State, therefore, the project started with our strong programs to reinforce them.
- *Suggest using funding as opportunity to build nationally-competitive research program.*
- The consortium’s objective was to position Kentucky researchers to better compete for Federal Research dollars and the strategy is working. The Sun Grant Initiative did fund one of the KREC supported researchers for $250,000 to progress her R&D project (biomass focus) to the next level.

Project Title: Regional Biomass Programs

Principal Investigator: Rick Handley, CONEG, Fred Kuzel, Coalition of Great Lakes Governors

Strengths

- Has potential to be powerful advocacy entity for biomass program (if program can provide role).
- Extensive involvement with broad stakeholders.
- Future plan for a legacy.

Suggestions and/or Weaknesses

- Funding R&D and demonstration through outreach program needed better coordination with biomass program.
- No defined role in biomass program.
- Poor articulation of project goals.
- Impact study has poor cause/effect relationships, could be more rigorous.
- Funding all 50 states dilutes program resources.

Comments

- Provide budget breakdown/cost-share information for future program reviews.

PI Responses

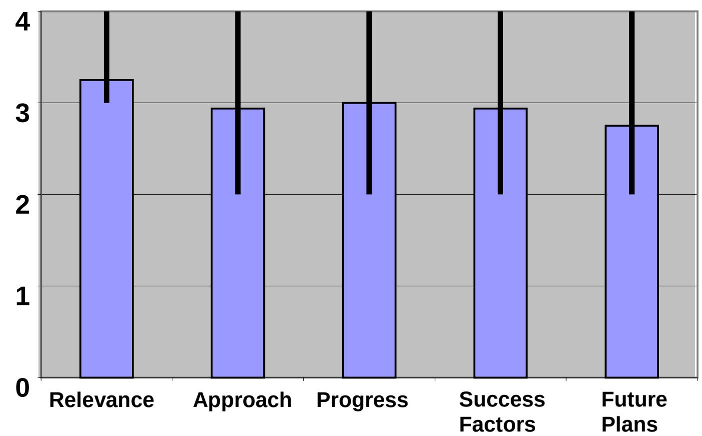
- Would have trouble selling idea to pick/choose which states to fund.
- Not having sufficient funds could be a weakness.
- Not having defined role is a weakness. Have tried communicating with DOE biomass program. A specific contact has not been provided to the regional groups. The projects are willing to coordinate, but have received no program response.
- Funding R&D/demo has not been done recently, mostly past examples. Outreach/policy/education most recent focus.
- Hope will be another program review that involves regional programs.

Full Reviewer Comments and Scores

Biodiesel and Fuels Demonstration Projects

Project Title: Mississippi State University Sustainable Energy Center
Project Investigator: Rafael Hernandez, Mississippi State University
Project Stage: Exploratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.25	0.25	0.75
Approach	2.94	0.94	1.06
Progress	3.00	1.00	1.00
Success Factors	2.94	0.94	1.06
Future Plans	2.75	0.75	1.25
Average	**2.98**		



Question 1: Relevance to Overall Objectives.

- Biodiesel is needed to meet the President's goal of 20 in 10.
- Lots of biodiesel RD& D work is underway. OBP should re-engage biodiesel.
- $.10/lb is a good target.
- New lipids work
- We strongly need new biodiesel feedstocks.
- This work is right on the mark of targeting new feedstocks.
- The use of waste water streams could be a novel source of biodiesel.
- The focus on the feedstocks is good but they have not done much to evaluate the market potential.
- Overall I rate good to fair
- Considering a range of feedstocks and the processing necessary for each. Most of the alternative feedstocks will not be high volume.
- Goal is ambitious.
- Reviewers made an effort to coordinate their projects with DOE's MYPP and Biodiesel program. Responded to the requests for goals, objectives. Provided some R&D targets
- R&D is focused specifically on biodiesel and biodiesel Feedstocks. There is a large need for biodiesel feedstock.
- The technologies under consideration are very exploratory. The market is attractive and viable. Reviewer is aware of all the potential customers, but did not have one specific one as a partner. Large, 750 MMGY, supply potential.
- Good overall program supported by defensible science.

Question 2: Approach to Performing the R&D.

- Methodical feedstock exploration and development
- Stronger economic analysis and production potential is fully developed would help.
- Nicely organized research program.
- Fair I am concerned that the project is not well focused
- They are trying to do too much

- Clear path: identify lipid sources – extract – convert to
- biodiesel – market development
- Approach is good but seems to focus on small volume sources. From an energy standpoint it does not consider alternative energy uses for the sources. Ex: Electrical power and heat energy from POTW sludges.
- Not a technically focused as typical DOE/NREL program. Project has an overarching economic target, 10 cents/lb lipids, but the technical targets are vague. A little bit of a scatter-gun approach than identifying a meaningful focus that could provide national visibility to their state. Project would benefit for more technical targets, especially on the microorganism development side. Some of the research was linked with cost assessments and value, which was good.
- More cost forecasting of envisioned processes would greatly improve the potential of this effort. Also, provides a critical
- Path development strategy for key R&D areas.

Question 3: Technical Accomplishments and Progress.

- Reasonable progress
- Tackling tough feedstocks – WWTF and tallow sources,
- How much volume in MGY analysis is needed
- Tall oil needs more progress.
- Good progress. Focus on PTOW sludges is interesting but has small yield potential.
- Insofar as there is no biodiesel program, it's hard to say what the progress looks like. However, at the strategic level, this program is making progress against DOE goals.
- Reducing the cost of biodiesel feedstocks
- They have a cost measure in cents per pound
- How will this be measured? It a good target goal but it is not clear how they measure?
- Their focus is expanding feedstock with meets DOE goals for 20-20 targets. Also trying to improve local technology for local producers, but they have not employed known technologies and are reinventing the wheel. They didn't provide enough detail on the research targets, except for feedstock cost per gallon. Local benefits were not identified. Technical barriers need to be better identified. A broader review team of highly technical experts in microorganism development and management technology would improve the project. They need to also refocus to a tighter project and get rid of the unnecessary parts, such as down stream technology which they have little expertise in.
- Good process – particularly given the basic nature of some of these tasks.

Question 4: Success Factors and Showstoppers.

- Oleaginous microorganisms growth a very positive step to improve lipid content and reduce cost at WWTFs
- Amount of biodiesel minimal; little incentive for ethanol plants to provide sugar feedstock to biodiesel plants.
- Some show stoppers have been identified such as the impact of microorganisms on water quality but they have not really looked at the business models for example would P & P industry invest in tall oil collection?
- May lead to multiple niche sources/processes.
- Economics might not be favorable.
- Well defined in presentation.
- Time frame may be too short.

- Reviewers appear to be knowledge about the key legal and EPA barriers in general, but specific barriers are vague. Their focus on non GMO for waste water is probably fine although there are ways to sterilize water before release, similar to the microalgae program issues. No recognition of issues associated with castor oil and meal, e.g., the oil is not really a biodiesel as it will have more than one alcohol on the fatty acids and they will be highly susceptible to polymerization. The meal contains ricin, which is extremely toxic. No discussion the oil or the meal barriers were presented.
- As stated earlier, more economic evaluations should be done much like the work they did with sewage sludge to biodiesel.

Question 5: Proposed Future Research Approach and Relevance.

- Specific Comments:
- Well thought through next steps.
- Keep Tall oil work going – multiple benefits.
- No particularly specific stage gate language used
- Unclear how closely cost targets depend on research success goals
- Focus on waste water lipids may be a poor choice because of the small volume potential of this source.
- Reasonable plans designed for the previous progress and current requirements
- Well thought out – suggest ensuring closer integration with DOE/USDA program objectives.

***Additional Comments*:**

Strengths

- Glad to see this work is going forward
- Very broad range of research
- Co-product nutraceuticals should help commercial economics
- WWTF feedstocks are nation wide in applicability (an important plus).
- Research looks reasonable, and results are being achieved.
- This is potentially a good feedstock market and the ability to collect the lipids or to grow more is a good idea
- I think this research needs to be done
- Broad scope/approach. Good for initial stage.
- Good professional approach to research program planning and executing.
- Progress in use of different oils for biodiesel production.
- Potential generation of more/different oils for biodiesel production.
- Integration of different research areas under one common goal.
- Focus on new feedstocks for biodiesel. Potential to expand supply. Potential to be competitive or reduce costs. Follows instruction and tries to support Program concepts.
- Well thought-out science with good academic flavor.
- Providing an educational foundation for developing more faculty active in biomass to chemicals/fuels along with the education of future biomass-savvy technologists.
- The potential of their novel feedstocks was undersold – I believe that billions of new lipids could be delivered to the market.

Weaknesses

- Need stronger economic and impact analysis – Especially alternative uses of the feedstocks.

- Response on anaerobic digestion alternative weak
- Availability and suitability of novel feedstocks could be a limiting factor.
- The team did not do enough to partner with others or review existing research
- I believe the stated volumes are too high and the potential then is much smaller than stated - this should be verified
- Nutraceuticals extraction relevance was unclear
- Doesn't seem to have a grasp on present operation of POTW's outside of the south.
- Seems to be spread thin across several different projects/programs.
- Need to consider utilizing other/additional resources/partnerships/collaborations to expedite progress with project(s).
- Some areas of research may not provide much of a volume benefit. Focus on biodiesel technology development is reinventing the wheel, has not identified good data from old technology (acid esterification). Some of the focus on the program does not identify key barriers that may either focus their research on or be used to eliminate those parts of the project. No go types of targets and milestones for technology.
- Needs a little more design development to better guide critical R&D initiatives.
- Narrow the focus toward a fewer number of projects that are hard-hitting in terms of establishing an even stronger program.

Technology Transfer/Collaborations

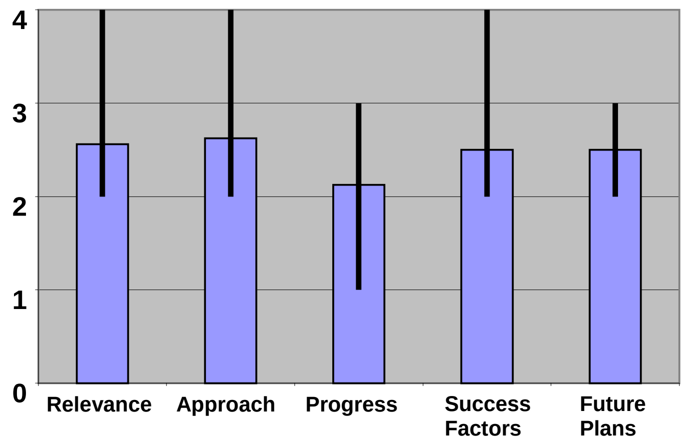
- Some presentations at national level would improve visibility and coordination with others doing similar research.
- Presentation focused almost completely on MSU activities, and there is little information given about tech transfer and collaborative activities.
- Upcoming conference.
- This does not seem to have been addressed adequately.
- Need to somehow get information out to other interested parties about the progress that is being made at MSU in feedstocks and oils.
- Good access to WWT facilities. Not much other interface with local biodiesel plants. The other relationships appear to be at arms length.
- Moderate level of effort – good improvement in program if more of this is initiated. Good to see USEPA involved.

Recommendations for Additions/Deletions to Project Scope

- None. Recommend letting MSU continue its work as planned.
- Validate the potential for biodiesel production
- Seem to be spread very thin across several different projects. May want to concentrate on one project at a time, especially biocrude generation.
- Try to focus the project into tighter focus with better detailed targets and strategies for success based on benefits.
- Determine the realistic potential for full funding in the future, then redirect their resources to the level that prediction yields.

<u>Project Title: O2 Diesel Demonstration</u>
<u>Principal Investigator:</u> Ben Kaufman and Thomas Sopko, O2 Diesel
<u>Project Stage</u>: Development Stage Company/Continuing R & D/Commercial Introduction

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.25	1.25	0.75
Approach	3.00	1.00	1.00
Progress	2.75	0.75	0.25
Success Factors	2.33	0.33	0.67
Future Plans	3.50	0.50	0.50
Average	**2.97**		



Question 1: Relevance to Overall Objectives.

- Another use for ethanol as blend to diesel
- Shows fuel improvement
- This technology is maturing to stage that OBP funding is no longer needed,
- What is ethanol displacement of oil additional benefit?
- Project may generate energy, but it is unclear that this is a reasonable process for new fuel development. Advantages are not well laid out.
- The original research was stopped due to problems with fuel injectors
- The plan is to redirect the project
- The proposed redirection is not well defined
- Not at all clear that this project advances cause of increased biomass-based fuel production.
- Appears to be more relevant to air quality concerns associated with petroleum diesel.
- Good relevance to program.
- Project moves DOE ethanol industry to new markets, but those markets are extremely narrow. This type of commercialization project has been industry funded in the past—see NBB EPA registration and ASTM development process. That process was 90% industry funded. Synergy with biodiesel is nice. Some ethanol will displace petro someday, if successful. This project does not lead to a homogenous fuel industry.
- Total market impact will be very limited, in the
- Millions of gal/year <25 because of the fleet limits.
- The topical area fits into the relevance category – yet, this effort does not seem to be adding any significant increase toward the body of knowledge.
- Not a compelling argument for using alcohol dilution when the market for the alcohol is so good right now.

Question 2: Approach to Performing the R&D.

- Good approach to combine demonstrations and research on fuel blend
- In its initial configuration this project did a good job at identifying technical barriers but the “phase II” is not sufficiently developed to know if technical barriers are identified
- Technical approach is sound

- Have demonstrated compliance with performance criteria.
- Strong focus on field performance
- Needs life cycle analysis for total impact of the fuel and additives. Emission reductions need to be balanced with fuel economic impacts. No specialized emission testing was performed which will be necessary to get EPA and CARB registration. Research targets were vague, what types of durability studies and are they the right studies, who is doing fuel injection studies for example. Where are the OEM peer reviewers. They only tested power and field performance. Who is doing the Tier II rat studies? Who is doing the dermal and aquatic toxicity for the additive? What are the remaining lists of environmental tests that have to be done and where is the schedule? Addresses technical barriers but all in very generic. Discussion of biodiesel blends with ethanol and additive confusing
- Unfortunately that no data were presented to justify conclusions.
- Really a product marketing effort.
- Not a lot of new information being produced.

Question 3: Technical Accomplishments and Progress.

- Solidly moving into market by resolving the various new fuel blends questions and issues.
- Lots of emissions testing and results plus lubricity, cold weather durability and handling.
- A material has been made, but its value is questionable. The PIs were not able to isolate the incremental improvements resulting from the use of B20, and the use of ethanol.
- Based on the research to date some progress on barriers has been made but overall it was good to suspend the project
- The Phase II is not well defined and it is unclear how it will benefit the goals
- This project does little to contribute to the 20 in 10 goal.
- Ethanol already has a growing market.
- Adding alcohol to diesel doesn’t contribute much to new uses of biomass-based fuels.
- This is all about selling a “proprietary additive.”
- Very good progress. Field demonstrations
- Most of this focus is commercial, the industry can afford to pay for this themselves, like the biodiesel industry did. Why should the government fund things that they should do themselves?
- No real performance metrics were provided, no analysis of the amount of ethanol that will be displaced in the petroleum diesel market? No impact on the consumer cost for the fuel? No impact on fuel efficiency. No life cycle analysis.
- Most of the metric claims (listed as goals) were not quantitatively supported.
- Good only if success is viewed as growing the company’s potential to enter the market – not that I agree with the benefits of the product.
- Need to use data that also compares B20 along with his other data points.
- Seems to lack defensible data – seems to use opinion without data supported basis.

Question 4: Success Factors and Showstoppers.

- ASTM specification and EPA registration are key next steps.
- Comparative costs will be a problem, and were poorly articulated in the presentation.
- Show stoppers were identified and the project sponsors
- Made a good decision to suspend work
- No information AT ALL concerning nature of additive.
- Cost/source/environmental impacts could all be serious show stoppers.

- U.S. is already suffering immeasurable environmental damage from fuel additives…
- Flammability can be a drawback for diesel use, (Low flash point)
- Need acceptance from OEM. Overall looks to have good potential for technical success but market acceptance not yet established
- Regulatory and legal program as superficial and does not address the complete set of analysis needed to get EPA registration or accept ASTM. Needs a outside peer review group, comprised of OEM, fuel injector manufactures, emission laboratory, and environment management. Some were identified – yet some critical issues, such as safety and water, are not well handled.

Question 5: Proposed Future Research Approach and Relevance.

- Good plan for final commercialization
- Within the context of their program goals, their research plan appears reasonable
- Future work progresses logically from previous activities.
- Not relevant to developmental goals of Biomass Program.
- The plan ahead is appropriate.
- Their future plans are not sufficient to meet EPA registration or ASTM standards. Their progress is good and there was a lot of duplicative testing, but they have not addressed key issues for success such as air toxics, injector durability, life cycle, etc.
- Seems to be moving well toward their commercialization plans. Yet, key issues of overcoming perception of safety and quality appear to be not well handled.

Strengths

- The major success – Approaching full commercialization.
- Several industrial tests ongoing.
- Helping to reduce petroleum diesel emissions – although if diesel is diluted with alcohol, we might expect reduced emissions.
- Good field testing approaches
- Evaluated safety and handling issues.
- Collaborations with multiple stakeholders
- Overcomes some perceived disadvantages of biodiesel,
- Focused commercialization program.
- They appear to be using a decent marketing strategy if E-diesel or E—BD-Diesel is the target.

Weaknesses

- Proprietary additive will be hard for state weights and measures folk to approve. How do you test for this at the pump? What is chemistry? OR situation is example.
- More education and outreach will be needed to fully introduce this new fuel blend.
- Safety
- Really difficult to see benefit of this procedure
- Improvements by adding ethanol poorly quantified, and difficult to justify process
- Relative cost
- “Proprietary additive” is a concern. What is cost of additive? What is feedstock for additive? What are the health/safety/environmental issues associated with the additive
- The actual benefit of the additive is unclear! What are properties/performance of diesel/ethanol, diesel/ethanol/biodiesel mixes without the additive or with other additives.
- Market viability/acceptability of yet another alternative fuel.
- Distribution network.

- Safety implications/issues.
- Niche market (centrally fueled fleet).
- How will weights and measures inspectors handle this?
- Will proprietary additive be a barrier to wide spread adoption?
- TOTAL MARKET IMPACT WILL be very limited, in the Millions of gal/year <25 because of the fleet limits.
- The commercialization program is weak, with little emphasis on the key technical barriers and how to achieve them, they appears to be too heavily dependent on fleet demos and criteria emission tests.
- No plans for rat studies or the other key studies needed by EPA (dermal tox, water tox, soil degradation, live rat studies).
- No data shown about the fuel economy, or other life cycle data needed.
- The safety and quality of product issue is difficult to overcome. Cannot understand the merit of this formulation over using BD blends and ethanol blends in their already established markets.

Technology Transfer/Collaborations

- A lot of education and outreach will be needed for this new fuel blends advantages. Need broad fleet only target marketing. Clean Cities will be a key audience..
- They appear to have made good industrial contacts
- Good collaborations.
- The research could carry-over into other projects.
- Working with public institutions like ASTM.
- Good linkages with industry, although the industry should be paying for this project themselves.
- Seems to be working with critical players – such as OEMs. A large fuel distributor would be a good partner.

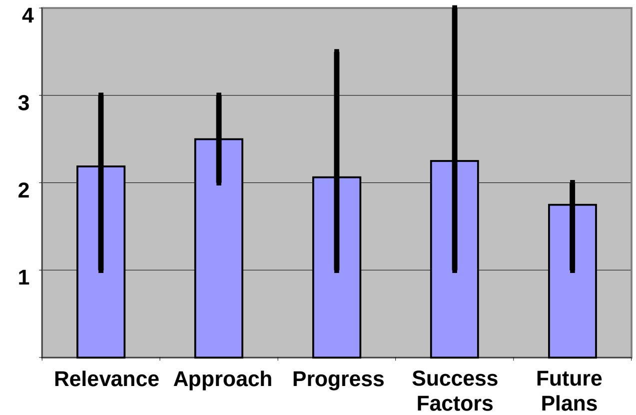
Recommendations for Additions/Deletions to Project Scope

- Role of OBP may be ending as full commercialization is achieved. Recommend strong work with state weights and measures.
- The project team made a good decision to suspend the project on ethanol blending in diesel. The proposed Phase II is not well developed and it is not clear that the project team has the necessary experience to do this
- Redefined work. I recommend that the project team submit a detailed program and justification for co-product research. This justification should include a literature search that demonstrates which areas are not being addressed. The project team should also indicate the experience of the researchers and potential teaming with other researchers
- This should not be a DOE R&D priority.
- It seems this project is a niche product and is designed around finding a use for the *proprietary* additive. While there may be some specific applications for this product, the industry is focusing on biodiesel blends (B-2, B-5, B-20) and is not going to be open to introducing another fuel to the mix. If it's not ASTM biodiesel, and it's not ASTM ethanol, then design- to-market deployment will be difficult. Additionally, O2 funding as a percentage of the total budget seems low.
- Sounds like need for R&D funds has ended and overcoming commercial resistance is now needed.
- NO future funding. Should be self funded. Otherwise, see above.

Project Title: E-Diesel Test and Research Project

Principal Investigator: Nathan Fields, National Corn Growers' Association

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.19	1.19	0.81
Approach	2.50	0.50	0.50
Progress	2.06	1.06	1.44
Success Factors	2.25	1.25	1.75
Future Plans	1.75	0.75	0.25
Average	**2.15**		



Question 1: Relevance to Overall Objectives.

- E-10 blend with diesel plus lubricity to replace more oil
- OEM focus for off-road - John Deere
- Rationale for E-diesel is a holdover from a desire to increase ethanol markets. However, it is not clear that this is the best way to get ethanol market increases. Moreover, explosion in ethanol markets obviates this rationale.
- Search for additional ethanol markets not really needed.
- Air quality benefits are questionable without further data.
- The little data presented could be interpreted as improvements
- coming from dilution of diesel – emissions decrease in direct proportion to dilution with alcohol.
- Support is applicable but perhaps on a very small scale
- The original research was stopped due to problems with fuel injectors
- The plan is to redirect the project
- The proposed redirection is not well defined
- The industry needs to commercial ethanol in many new markets. Funded or moved entirely into the DOE program that manages fuel and vehicle testing.
- New focus for remaining funds on biorefinery is a much better fit for the Biomass program.
- Fair because the over-arching goal to displace petro-based fuels is overlooked. The ethanol could go to gasoline displacement – in essence – it has a use already.
- New phase development approach is moving in better direction. Need to ensure that solid data are generated and realistically evaluated.

Question 2: Approach to Performing the R&D.

- Did not use biodiesel for lubricity and then ran into lubricity issues. Probably should have had a biodiesel blend as part of study.
- Project stopped for re-scoping and rethinking.
- Original project well done, and made some significant discoveries, even though the results were the opposite of what they wanted to see. Potential re-direct, which is almost 80% of remaining funding, is yet to be determined.
- Did not identify causes of failures. Essentially abandoned research.
- Lubricity approached using commercial additives.
- Research needed to address problems discovered, especially injector plugging.
- May need to rethink if this is better than the alternative.

- In its initial configuration this project did a good job at identifying technical barriers but the “phase II” is not sufficiently
- Developed to know if technical barriers are identified
- Very limited focus of research.
- Technical targets were clearly defined, well designed.
- The approach is problematic so far. Needed a better technical review team to help identify the barriers and fine tune the approach to testing those strategies. Gave up on the durability product too easily. Project planning appeared weak, the project took too long to conduct very little research.
- Not sure that team has the technology experience with new program direction which is biorefineries.
- The methods used seem valid and reasonable.
- New to ensure that good science/research methodology are incorporated into Phase 2.

Question 3: Technical Accomplishments and Progress.

- Ethanol helps viscosity so less loss of power than expected
- Injector issue as lubricity broke down.
- Engines struggling at E-10
- A rethinking work is in progress
- The engine test appears to be a good, well designed project with a qualified outside subcontractor, leading to some important E-diesel discoveries.
- Demonstrated unexplained failures of diesel engines using ethanol/diesel blends. Did not address objective re emissions.
- Did not address fleet testing objectives.
- Program stopped for good reason.
- Based on the research to date some progress on barriers
- Has been made but overall it was good to suspend the project
- The Phase II is not well defined and it is unclear how it will benefit the goals
- The effectives, efficiency, cost and benefits of this project were not well define or in some cases defined at all. Barriers were vague and did not appear to take previous R&D into account in a full manner.
- Some good data evaluating the potential of this product.

Question 4: Success Factors and Showstoppers.

- Original plan did not work
- Reasonable evaluation of engine issues w/E-diesel
- They punted.
- Injector plugging and other fuel delivery problems is a problem. Rebuilding engines are an impractical solution.
- Show stoppers were identified and the project sponsors made a good decision to suspend work
- No legal or regulatory issues.
- Focus was limited on technical engine performance and durability barriers. The other showstoppers appear to be poorly defined and the approach to overcome the show stoppers was weak.
- The R&D focus on E-Diesel as a homogenous fuel was good, as it would have achieved a larger impact of oil displacement.
- I sense that the project looked at the data using a realistic viewpoint. I do like the new direction, but showstoppers for Phase 2 must be defined.

Question 5: Proposed Future Research Approach and Relevance.

- Questionable
- Unclear…project is being redirected, and very few details were given. Project could be seen to be fairly diffuse. However, good partners have been chosen.
- Difficult to rate due to radical redirection.
- Future R&D is good start but just a start. No targets, no Research team, no discussion of future plans in detail except list of project areas which are too broad and too aggressive. They need a better step by step program with go no-go types of decision points and a strong independent technical review team.
- Will contract to Michigan State University Chemical Engineering group
- The project appears to be searching in some regard for what to do with the funding – does not some potential.
- Once their new research plans are matured, a better sense of worth can be derived. At least a good R&D team has been selected.

Additional Comments:

Strengths

- Learned what the problems were. Stopped progress and saved the money.
- Good job on E-diesel portion of effort
- Good testing of ethanol/diesel mixes on major OEM engines of varying sizes. Demonstrated problems with fuel delivery in all engines.
- Strong partnerships
- OEM Collaboration
- Tightly focused program on engine durability for E-D. Focus on the homogenous fuel provides larger potential market than O2.
- An honest evaluation was performed and the negative results well handled. I also like the new direction – highly encourage that solid data are generated to support potential new products and good process costing performed to support concepts and drive critical path developmental initiatives that will arise.

Weaknesses

- Future direction unclear but being thought through.
- Missed opportunity to do biodiesel blend.
- Somewhat unclear on redirect, although the program appears to be using reasonable partners.
- Did not address emissions. Did not address fleet studies.
- Barriers may be insurmountable.
- Suggested new program looking at very low volume markets.
- Incorporating yet another alternative fuel into a market that has not yet fully embraced alternative fuel.
- Development of yet another transportation/delivery system for E-10 diesel blend.
- Problems with engine performance/power loss/engine wear.
- Use of additives.
- Off-road focus of project.
- Needs to address emissions

- Not enough planning in avoiding some of the problems in durability with ethanol diesel blends that were known to occur. Project concluded that the original approach is a no go.
- No real ones at this time. Phase 2 will be interesting.

Technology Transfer/Collaborations

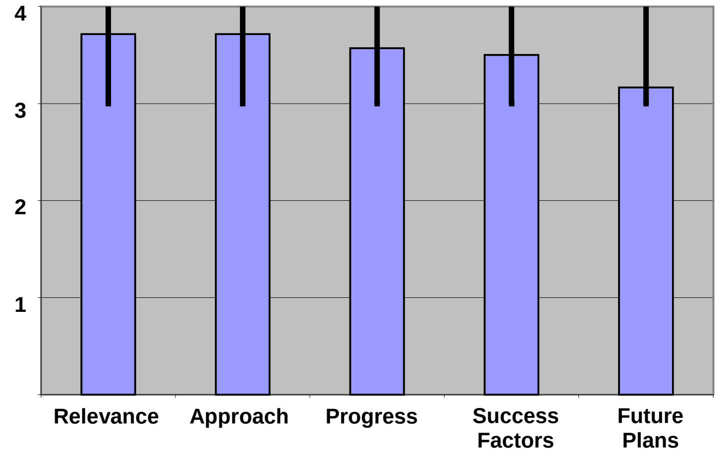
- Not ready for major tech transfer other than lessons learned.
- Not yet applicable.
- Project certainly adds value to the Program if for no other reason but to enforce this is not a good direction to pursue. Good information and research.
- Strong partners but we have to ask why there wasn't a better plan with these partners before the testing began.
- Fairly strong.

Recommendations for Additions/Deletions to Project Scope

- Engines not designed for E-10 diesel fuel. Would take a determined OEM engine compatibility effort to proceed or other fuel blends to resolve
- New proposed research directions are so different from original, and since original work failed to try and overcome barriers, I would not support DOE money funding this group.
- Delete the project.
- This project seems to not fit well with DOE goals and objectives for the Biofuels Platform.
- The project team made a good decision to suspend the project on ethanol blending in diesel. The proposed Phase II is not well developed and it is not clear that the project team has the necessary experience to do this
- Redefined work. I recommend that the project team submit a detailed program and justification for co-product research. This justification should include a literature search that demonstrates which areas are not being addressed. The project team should also indicate the experience of the researchers and potential teaming with other researchers
- Future R&D is refocused on biorefinery and specifically on coproduct development with MSU. This project will be better focused for the Biomass Program and may add value.

Project Title: Missouri Biodiesel Demonstration Project
Principal Investigator: Tom Verry and Jill Hamilton, National Biodiesel Board
Project Stage: Research completed

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.71	0.71	0.29
Approach	3.71	0.71	0.29
Progress	3.57	0.57	0.43
Success Factors	3.50	0.50	0.50
Future Plans	3.17	0.17	0.83
Average	**3.53**		



Question 1: Relevance to Overall Objectives.
- Targeting key biodiesel issues.
- Pipeline use, economics, re-prove lubricity of ULSD, terminal blending capability and fuel quality
- Context – 20 in 10 needs biodiesel
- Critically needed for biodiesel market challenges
- Within context, this program is measuring important criteria of importance to the biodiesel industry. This will result in standards allowing BD to contribute to higher level OBP goals in renewable fuels. DOE link is nice, in that they don't support biodiesel production work, but has a strong interest in qualification of a growing fuel stream.
- Increasing usage requires demonstration and education.
- This project directly addressed these needs.
- This project is very relevant and will help to improve the distribution of biodiesel.
- Large scale development for biofuels will depend on pipelines
- Colonial pipeline was an excellent partner for moving the data
- Into other pipeline firms.
- Project appears premature for the size of the US biodiesel industry. Clear economic benefits from reducing transportation costs.
- Good applied market-driven project that addresses real issues.

Question 2: Approach to Performing the R&D.
- Well thought out set of goals
- BQ-9000 for quality
- Within context, the program appears to be highly focused and directed toward important goals.
- Very careful/deliberate approach covering many limitations.
- Good comprehensive approach to pipeline testing and lubricity evaluation.
- Outreach work well planned and executed.
- The basic Technical barriers were well defined except for cold flow. The detailed technical barriers of pipeline logistics were not included in this study and may appear later as a barrier in the future.
- They should have done the pipeline test in the winter.
- The BQ-9000 education was well defined and met the objectives.
- The lubricity testing was duplicates older data with no new value..
- The petroleum education goals was well conceived but

- The industry should carry it forward.
- For their stated goals, the approach appears good.

Question 3: Technical Accomplishments and Progress.

- Pipeline test successful
- BQ-9000 now self funded
- Tackled MN quality problem head-on.
- Major milestones met, and good data regarding use of BD has been generated.
- Accomplishments well-documented in presentation.
- All testing was completed and satisfactory.
- Outreach activities well received
- The impact on the performance factors was not quantified and there is a real issue with respect to the future volume of fuel produced. We may not ever need a biodiesel pipeline.
- The program in general was well defined with specific goals.
- They appear to have completed what was promised and at the same time appeared to have generated reasonable data of value.

Question 4: Success Factors and Showstoppers.

- All goals are well along
- Reasonable evaluation of showstoppers.
- No show stoppers exist.
- The project moved with clockwork precision and achieved most of their objectives. Legal and regulatory barriers, such as the ASTM standard and fuel quality, were addressed to the benefit of the entire industry.
- This project essentially addresses showstoppers for the industry.

Question 5: Proposed Future Research Approach and Relevance.

- Finishing efforts already underway - jet fuel and pipeline
- Could use more next steps thinking
- Future work is reasonable and continues a nice focused effort on useful questions,.
- No additional research is needed.
- Not enough information was provided, but any issues were obviously resolved in a timely way without impacting the quality of the project.
- No future work is anticipated. The program is ending.
- Really not applicable since the project is almost over.

***Additional Comments*:**

Strengths

- This project has very strong performance in a very challenging time for biodiesel industry growth
- Tightly focused, pertinent questions being addressed on getting biodiesel infrastructure and awareness improved. Testing of key operational and commercialization issues.
- Very practical approaches to overcoming real and perceived limitations to biodiesel usage, including public education and developing new markets, i.e. bioheating oil.

- Clearly one of the best projects reviewed by this panel.
- A very good program that succeeded.

- Strong partnerships with prime industry players, including partnership funding.
- Strong outreach and education program.
- Addressing all three critical components – fuel quality, distribution and BQ-9000
- A well constructed and implemented project. Achieved the objectives in a timely manner. Results generated industry wide benefits (BQ-9000). Colonial pipeline was a strong partner for the project.
- Good practical project that answers some questions for the industry.

Weaknesses

- Stronger roadmapping would help future needs.
- Few
- Pipeline test should have been done in cold winter weather
- Should have run the pipeline test in the winter. May have to be redone now.
- Need to include raw soya oil mixing as a lubricity enhancers in your tests. This will provide some critical data for many folks who are thinking this option.

Technology Transfer/Collaborations

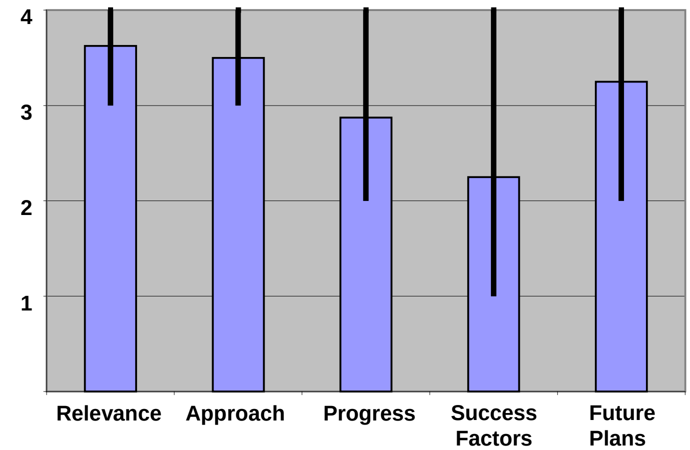
- BQ-9000 workshops and other outreach with MN are real successes.
- Excellent tech transfer and education efforts.
- Outreach activities generated a lot of interest.
- Good dissemination of information to stakeholders.
- Excellent TT partners.
- Very strong given the nature of the organization.

Recommendations for Additions/Deletions to Project Scope

- Recommend continued funding
- **Keep this group funded and applying themselves to other barriers/limitations!**
- Explore the use of untransesterified soy oil on lubricity
- I do appreciate the funding of organizations such as this because they appear to be addressing key market issues – as long as they are true to the data and et conclusions favorable or not become public.

<u>Project Title: National Biofuel Energy Laboratory</u>
<u>Principal Investigator: </u>Chuck Moeser
<u>Project Stage</u>: Various

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.63	0.63	0.38
Approach	3.50	0.50	0.50
Progress	2.88	0.88	1.13
Success Factors	2.25	1.25	1.75
Future Plans	3.25	1.25	0.75
Average	**3.10**		



Question 1: Relevance to Overall Objectives.
- Targets feedstock supply issue
- Goal - Feedstock neutral biodiesel with database
- Within the context of high level OBP strategic goals, then this program will provide important information. The lack of a separate biodiesel program makes it harder to place given the current single minded interest in ethanol.
- Good basic data collection re characteristics that are critical to increased use.
- Relevance is pertinent and will provide guidelines for fuel development.
- Given that fuel demand is key to the development of biodiesel production and that fuel and engine compatibility are important for demand – this project is well defined and will help to build market demand for biodiesel.
- These barriers can ultimately derail the biodiesel industry and this testing will provide critical data. The research will benefit the customers directly. May lead to improved engine design and durability. May also be moved into the Advanced vehicle engine program.
- Good experimental effort that is somewhat redundant to other works, but still of value to the Fed mission.

Question 2: Approach to Performing the R&D.
- Sorting out the characteristics of the biodiesel feedstocks is important work and will broaden the feedstock supply
- Strong engine testing and emissions
- The lab appears to have all of the correct components to do extremely relevant data generation for B20.
- Technical approach very clear, very sound, very focused.
- Excellent scientific qualifications and efforts.
- Framework for setting goals and identifying critical factors is sound.
- This is one of the best-designed research projects for biodiesel for on-road applications. It addresses nearly all the key manufactures questions about biodiesel use in diesel engines and for tailpipe emissions, and effects on after treatment equipment
- One of the best defined projects I’ve seen in a while. The technical design with objectives, targets, partners, and the quality of date and the uniqueness of the data is outstanding.
- Well organized project for the listed goals. Appears to have used sound methods and data handling techniques.

- A significant amount of the project was spent on facilities enhancement and not research.

Question 3: Technical Accomplishments and Progress.

- Precipitates above cloud point by feedstock plus other characteristics is important progress.
- A number of key findings – transition metals, engine testing, SCM
- Project has defined goals and is addressing important questions. However, the catalysis work is a distraction because it's biodiesel production which is not of interest to the program.
- Good basic research to date. Not so much progress re overcoming barriers
- This seemed to be more an identification and, to some extent, quantification of problems, barriers, etc. Some of this was very interesting research but did not support the program. It can lead to additional research that will be supportive of the DOE program.
- It is not clear what the performance metric are for this project and the project has not made significant progress in its research to date with most of the effort focused on establishment of the testing facilities. However this pace does not should not take away from the overall value of the effort
- The goals defined are critical
- Very specific performance targets are being used, with their selection generated by EMA, ASTM, NBB, USDA, and biodiesel producers. The project is focused on discovery at this level.
- I would expect that the next steps are cost effective solution.
- Improving biodiesel use for fuel transportation and its changing EMA technology is critical.
- Generated a significant amount of data – would help if a summary of what the data means for the involved industries.

Question 4: Success Factors and Showstoppers.

- Strong technical basis for ASTM B-20
- Missing
- Success factors and showstoppers not clearly pointed out.
- Little was done to address show stoppers or success factors.
- This project could do a better job at articulating the showstoppers and success factors. One of the difficulties is to separate the success factors of the research project with the success factors of biodiesel use
- The researchers clearly know what the show stoppers are in engine components, emissions, and durability.
- This area could be better presented and potentially better thought-out. Does appear to may be slightly reinventing the wheel so to speak.
- Need to start producing peer-reviewed papers.

Question 5: Proposed Future Research Approach and Relevance.

- Looking forward to future progress and next steps
- Annex to ASTM is needed.
- The lab appears to have established a center that will be a credible clearinghouse for information related to biodiesel properties and impact on engines, performance and markets.

- Limited information presented. Will continue with current approach.
- The future research is well founded. It appears to be more results oriented.
- Very methodical plans with go and no-go decisions and a research plan that produces unique, high value research data that will be critical for biodiesel users across the world.
- Not a lot was presented. The lab has plans to grow their program it appears, but future work via this funding is not well stated.

***Additional Comments*:**

Strengths

- Very clear program to develop vital information of use to the biodiesel industry. Appears to be a good investment of DOE funds related to biodiesel qualification.
- Very good research and progress – Well done in a needed area.
- ASTM spec focus technical support is crucial.
- Industrial partners
- Sound scientific approach to basic data collection on characteristics of biodiesel before, during, and after combustion in engine.
- This data is absolutely necessary for acceptance of fuels by OEMs.
- This will support the ASTM specification work.
- Outstanding partnerships.
- Have divided technical challenges among different stakeholders for solution.
- Good assimilation of information.
- The research proposed under this project is well positioned to help build demand for biodiesel in on-road use. This is important in building national demand for biodiesel and displacing petroleum. The project has assembled a strong project team with good technical capability respect and reputation with the original equipment manufactures.
- Addressing key R&D needs for biodiesel use in engine oils to prevent future barriers that may derail the biodiesel industry. Project plans are focused, based on previous experience in OEM component testing, developed stakeholders to develop the objectives and goals and develop the research agenda and the type of information needed by the customers.
- Solid R&D methods appeared to have been used.

Weaknesses

- What is on the horizon?
- Better public information needed.
- Basic data collection so far. Not much progress to overcoming barriers.
- This project seems to stress process or activity rather than results that support the DOE program.
- Need additional samples from around the country to see if there are regional differences.
- Test does not identify if supply was BQ-9000 or not.
- Limited NOx reduction scope.
- Slow progress to date. Failure to leverage its resources with others such as establishing research facilities
- Defining metrics directly tied to the research project. It would also be good to see a plan to fund the NBFL beyond the initial federal funding.
- Heterogeneous catalyst work does not fit. Need broader samples of existing biodiesel blends or coordinated with the BQ-9000 or not. Not enough address the showstoppers.

- A lot of funds went to facilities enhancement and not developmental activities. Granted, establishing new capability is good for the region – that is appreciated.

Technology Transfer/Collaborations

- B-20 summits are great. This research needs much greater publication of results and outreach. A trove of information broader than just B-20. Some reports and public domain publications are needed
- Excellent industrial partners. Including manufacturers whose products will need to operate successfully with new fuel types.
- Many presentations have been given.
- Outstanding technology transfer to industry.
- Good assortment of industrial partners along with a university.

Recommendations for Additions/Deletions to Project Scope

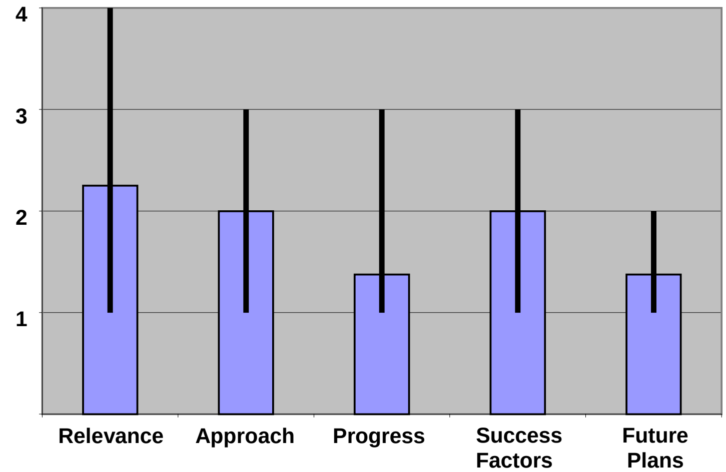
- Recommended for further funding.
- Expand scope across US. Stratify BQ-9000 fuel against other supplies. Look at other technologies for NOx reduction such as lean-burn, catalytic, etc. Even though original cost of non-SCR NOx reduction technology is higher, may need to perform a lifetime cost analysis to ensure SCR is still the best fit – show analysis in presentation. Work closer with NBB to get information out to public. Need to address emission concerns for using urea SCR (urea slip).
- Plan to continue and or expand the effort beyond federal funding. Metric for the research.
- Needs broader data outreach, SAE, etc.
- Invest more funding on experiments and seek out partnerships with other groups active in the same exact areas.

Project Title: Canola-based Automotive Oil R&D

Principal Investigator: Ira Pierce, Green Oil Company

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.25	1.25	1.75
Approach	2.00	1.00	1.00
Progress	1.38	0.38	1.63
Success Factors	2.00	1.00	1.00
Future Plans	1.38	0.38	0.63
Average	**1.80**		



Question 1: Relevance to Overall Objectives.

- Biolubricants – Green Oil company
- Canola
- More lubricity offsets oxidation
- Co-product/petroproduct offset
- Fit to 9002 USDA
- This is a huge expenditure of money without a clear reason why. The PI could gather a lot of the desired information with much less money.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Bio-oil is supportive of the DOE goals and programs.
- This project is not well defined with regard to the DOE USDA mission. It did not detail the energy saving potential of its products.
- Did not say what the goals of the program are except “reliable metrics for canola based automotive”
- Type of crop research very vague and no real coordination with USDA and other key stakeholders.
- A lot of money for absolutely not focus or plan
- No estimates of volume production of feedstock
- Only good thing appears as a focus on canola oil
- Does support conversion of petro to biomass-based goals.
- However, the effort does not appear to add any new knowledge to program goals.

Question 2: Approach to Performing the R&D.

- Proved product works and viable but not a market
- Need to get out of batch process so cost competitive and readily available.
- Need 9002 preferable procurement
- Market research – Triad sessions
- For 1.3 million, there should be a much more detailed and integrated approach to analysis. Much more information for the dollar should result.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Big issue is cost but process is batch, not continuous.
- No detailed technical plan was presented.

- The focus group approach to markets and customers is sound.
- The presentation was a rambling story rather than a focused discussion on the project. Following the presentation it was not at all clear what the approach would be or why it would be better than alternatives
- Need a more detailed feasibility analysis
- No focus on specific crop R&D goals or objectives, no
- Quantitative targets
- Not sure what the benefits of the survey will be, or how to estimate the value of the survey for the crop project.
- Not much information presented on the exact methods.
- What was presented – a reasonable marketing plan is proposed.

Question 3: Technical Accomplishments and Progress.

- None to date
- The evaluation is very narrow, and applies only to the PIs product and potential impacts.
- No specific objectives.
- Nothing, apparently, has yet been done.
- This reviewer could not determine what if any progress has been made
- No discussion on existing data from USDA and other canola producer --current yields, current pesticides, current cropping programs, current costs and barriers. No discussion of which barriers they are looked at.
- No estimates of benefit of this interest in canola oil.
- Just started.

Question 4: Success Factors and Showstoppers.

- Needs more progress
- Shelf life concerns
- Realistically, economic and market evaluations have few show-stoppers associated with them. One gathers data and presents a conclusion with a short shelf-life. Thus, in that context, the success factors et al appear to have been evaluated.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Price is the big show stopper. Other success factors and show stoppers will be identified as the project progresses.
- This project needs to identify the technical and business factors limiting this fuel and feedstock area, including showstoppers, research strategies, and everything else.
- Seems to have identified most – suggest no ignoring the meal issue.

Question 5: Proposed Future Research Approach and Relevance.

- The plan to proceed and the methodology are quite limited. This could be much more effective if one would look at a much broader cross section of biobased products.
- All about marketing one company's product.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Marketing study not relevant to Biomass Program goals.
- It is premature to consider future research.
- Need a more detailed planning structure. Not sure how the survey will be translated into future planning.
- Hard to gauge that is was recently initiated.

***Additional Comments*:**

Strengths

- Market analysis was needed
- Good application of biobased products as offset to petroleum-based.
- Improved lubricity is a major strength.
- Strong group of stakeholders/partners.
- Good group of uptake core questions if these questions are not available other places.
- Behavioral Insights subcontractor may be solid, I've heard of them before.
- Will further develop a relatively new market for bio-based lipids.

Weaknesses

- Progress has been slow
- No technical plan
- The amount of funding for a market evaluation study is exorbitant. This could have been done for a tenth of the level of the earmark. Frankly, the amount of money allocated to this activity is outrageous.
- The methodology for the market analysis is very poorly defined. Much clearer description of process is required.
- No details on budget, specific quantitative objectives. What processing is necessary to produce the various lubricants? What are energy inputs, environmental impacts?
- Price is a major weakness.
- Explanation of why Government (DOE) money should be used for Green Oil Company to meet the Preferable Procurement requirements of the 2002 Farm Bill.
- This project appears to be an investigation into and the establishment of metrics to test canola based lubricants
- However there was no discussion of why this metric is need other than to say the consumers would not buy
- This product unless they know it was reliable – despite the fact that the company has been selling the product for 17 years. The discussion alternated between the need for test metrics to encouraging farmers to grow canola, to a marketing survey for biobased lubricants.
- Denigrates DOE and its processes while they expect to take their money. "They don't do feasibility studies correctly. They don't know anything about it."
- Did not follow power point format, so we have a large number of unanswered questions.
- Used too may "buzz" words to confuse the purpose of the study, it took the entire presentation on "off-takes" to understand they want to do a product marketing study.
- The engine oil market is small, very fragmented, highly technical and requires close coordination with the engine manufacturing for large scale production. This project appears to be self serving.
- The project offered nothing of value.
- Not a lot of information presented on methods – get the impression that the method proposed is neither well-defined nor thought-out.
- Not considering the meal nor extraction issues.
- Not offering up a plan to initiate significant testing.
- A niche market – not a lot of volume displacement potential.

Technology Transfer/Collaborations

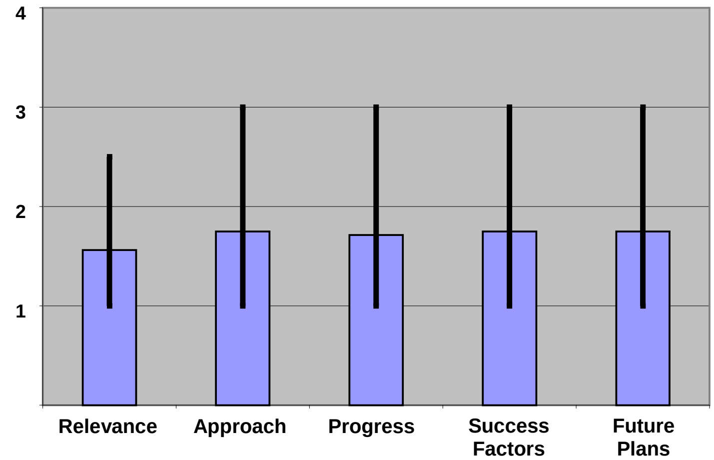
- Has large industrial clientele
- Nothing was said.
- None I could tell.
- Very minimal - based on the presentation.

Recommendations for Additions/Deletions to Project Scope

- Large potential market but very fragmented
- This project is not appropriate in this program. It has nothing to do with Biobased fuels or meeting the 20 in 10 goals.
- This project does not seem to fit with DOE's goals and objectives for the Biofuels Program.
- Require a focused test program for canola based lubricants what are the parameters, why are they important, how will they be tested, who are the partners, what are the results.
- Provide a detailed task plan with research barriers, targets for improvements, methodologies for conducting the studies, estimates of benefits if some or all successes occur. I
- Need to really focus on user machinery testing using a well-respected testing service along with considering turn-key issues pertaining to oil production.

<u>Project Title: Phillips Biomass Combined Heat & Power Facility</u>
<u>Principal Investigator:</u> Carl Nelson, The Green Institute
<u>Project Stage</u>:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	1.56	0.56	0.94
Approach	1.75	0.75	1.25
Progress	1.71	0.71	1.29
Success Factors	1.75	0.75	1.25
Future Plans	1.75	0.75	1.25
Average	**1.71**		



Question 1: Relevance to Overall Objectives.
- Two projects – CHP & then new work plan
- Not good fit to OBP
- Minimal relationship to 20 in 10 goals.
- The project is relevant but is not new. You can go out and buy commercial CHP for this use. There is no R&D involved
- The biomass actions are very fringe to the goals of DOE
- Although a good idea the efficiency work is out of scope
- No justification for government support where a feedstock that receives a tipping fee and a green power rate that averages 25 cents/kwh should be great but major barriers are present (bad site, limited MSW supply, etc.) . No need to commercial a old and well established industry unless they can identify what new development will be included in the technology , such as NOx reduction, or more efficiency, or cheaper drying.
- No integration into liquid biofuels, chemicals, or other coproducts.
- No real technological developed appears to be happening.

Question 2: Approach to Performing the R&D.
- 20 MW CHP for local community with district heating and energy efficiency program through energy coop
- So, shift to anaerobic digestion CHP and pellet wood stove study.
- Upfront analysis missing when originally targeted.
- Clear definition of the project, both the original Phillips activity and the subsequent redirection.
- No R&D at all to date. Some nice community energy-conservation outreach.
- There seem to be no technical barriers. There are other alternatives to the identified biomass boiler. Approach is simple and commercially available.
- Technical barriers -contracts for wood were not addressed
- In fact they are doing the same thing with Rock-Tenn
- No technical barriers were identified, all of their barriers are lack of planning or lack of reality, they want to make it work so they believe it will work. They were really wallowing around looking for answers. Their feasibility study has not well defined, comprehensive or complete. No novel technical barriers are being explored. Their biomass waste wood inventory database is good.
- Very scattered list of activities and little directed focus on an achievable value-added product.
- The inventory of available biomass will provide usable info.

Question 3: Technical Accomplishments and Progress.
- Plan B appears to be better for CHP. No lasting OBP accomplishments to date.
- Original project didn't work out, however, the research team recognized shortcomings and have redirected in a reasonable effort.
- Virtually no accomplishments relative to DOE R&D
- Nice urban energy efficiency outreach
- Just getting started with resource survey.
- No metrics included
- The project need to have a much better fined set of barriers and would benefit for a professional, experienced feasibility development firm.
- Not a lot of substance presented in terms of accomplishments. However, there has been completion of some activities that appeared to have been part of their scope.

Question 4: Success Factors and Showstoppers.
- Spring/Fall district heating and cooling load not there
- MN lowered biopower mandate
- Long term wood waste supply contracts missing
- Evaluation for original and redirected projects seems to spend an appropriate amount of time defining barriers and opportunities.
- Progress based on the possibility of cooperating with ONE commercial entity. No solid technical plans for achieving goals.
- Funded investigators looking for something to do with the money
- A poorly done plan. Not related to DOE goals and objectives in this program.
- This project should have done a sensitivity to the electric
- Revenue and would have realized early on that it was not feasible or at least linked to electric contract
- They have identified some of the key show stoppers but only through trial and error.
- No a significant effort in this critical aspect was presented – quite frankly, it appears that they have funds and looking how to spend it.

Question 5: Proposed Future Research Approach and Relevance.
- CHP biomass supply is uneasy.
- 20 yr financing is uncertain.
- An apparently comprehensive evaluation of inventory, impact, cost, etc. has been carried out to justify the redirection of DOE funds.
- No significant R&D identified.
- Unlikely to contribute ANYTHING to 20 in 10 goals.
- No plan.
- Their plans to continue are poorly defined at this time.
- Minimal value is expected to be gained from more effort other than stimulate regional interest.

***Additional Comments*:**

Strengths
- Stopped original plan when project proved unfeasible.
- Good use of DOE funds for societal impact
- Homework has been done on paper to provide case for redirection of funds

- None. Three+ years into project they don’t have a plan.
- The concept is good (although not part of DOE biorefinery platform) the use of biomass for combined heat and power is practical the waste wood inventory was well done
- Generated inventory data. Good community relationships.
- Growing regional interest in alternative E and energy conservation.
- Generated some regional biomass inventory data and associated costs.

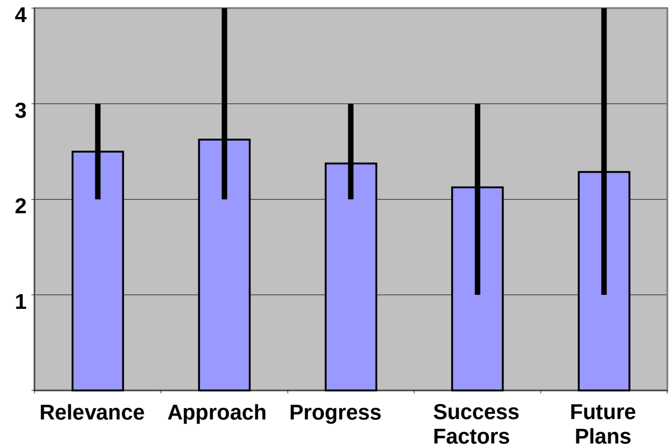
Weaknesses
- Needed stronger upfront analysis
- St. Paul district heating competes for urban biomass availability.
- Uncertainties in the infrastructure for collection and delivery of fuel
- Has their project evaluation document been carefully peer reviewed by experts for accuracy?
- Very limited technical progress.
- Planning is not well advanced.
- Infrastructure is not developed.
- Weak, weak overall plan.
- Does not know what type of CHP going to be utilized – if you don’t know what generation source you are using then how can you plan for fuel needs.
- No emissions plan.
- No long range fuel plan.
- The project should not have been so large to start with a smaller co-gen project may have been easier to work with. If the wood availability proved to be problematic for the co-gen then it will be for Rock-Tenn too and this project was not a good refocus of this effort
- Everything. No benefits offered to DOE research or even commercialization as R&D barriers were identified. No focus on technology optimization—gasification for liquids and power for example.
- Need technical support.
- Little focus with no real technology development nor advancement expected to occur.

Technology Transfer/Collaborations
- Local energy coop model is a good base to build from in local community.
- Minimal
- Technology transfer was not addressed.
- Questionable
- Minimal – no real collaborations were illustrated.

Recommendations for Additions/Deletions to Project Scope
- Strong caution for future funding from OBP.
- Very weak component of this DOE Program…
- Possibly a good example of community outreach/energy efficiency programs.
- Not relevant/does not fit well with DOE goals for the Biofuels and other Technology platform.
- Consider smaller dispersed biomass co-gen projects
- Recommend closing program and returning funding to either US Treasury or other Biomass Program projects.
- Find an area that capitalizes on regional assets and dive into technological development.

Project Title: EERC Center for Biomass Utilization
Principal Investigator: Christopher Zygarlicke and Dr. Bruce Folkedahl, University of North Dakota
Project Stage: Various

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.50	0.50	0.50
Approach	2.63	0.63	1.38
Progress	2.38	0.38	0.63
Success Factors	2.13	1.13	0.88
Future Plans	2.29	1.29	1.71
Average	**2.38**		



Question 1: Relevance to Overall Objectives.
- Biofuels, biopower & bioproducts for biorefinery of future
- Many activities-& Cross-cutting
- Cuphia feedstock
- H2 from ethanol plant
- Biojet fuel
- Urea fertilizer as ethanol plant co-product
- Pyrolysis oils
- Hard to see how this eclectic collection of projects combines to make an impact relating to OBP goals.
- Supports a wide variety of approaches to meeting program objectives
- Plan support is not entirely clear and markets not identified in some cases.
- The shotgun approach was bound to hit something.
- The project meets the DOE objectives in the broadest sense
- The customer potential is identified – EERC says they
- Identify projects based on customer need
- The market potential from these project / technologies Is not explored
- Little real focus on specific areas with major impacts.
- Does not try to coordinate with DOE. They show a stage gate but it's not clear that this concept is used in their myriad research programs.
- Not particularly novel developmental effort.

Question 2: Approach to Performing the R&D.
- Multiple pathways
- Issue identification and resolution
- Good list of challenges
- Too many
- Landfill Microturbine CHP is more common than acknowledged
- Barriers seem to be addressed
- Excellent – addressing multiple goals, objectives, and approaches.
- Outstanding number and variety of partners.
- Very scattered number of topics and unrelated. But, everything is moving along well. Biojet fuel is a good goal with a large potential market.

- The approach is “shotgun” at best with little focus
- The barriers are too broadly defined
- There could be more integration with other research
- Technical R&D targets are poorly defined with respect to benefits that may be justified. Appears to be a scatter gun with no focus. NO integration evident. The key barriers and targets are not identified in detail, primarily as they have too many projects involved. Would benefit for a tighter focus on a few number of projects that might achieve something substantial. Some of the testing work does not have any specific targets, but just appear to be demonstrations for additional data. In many cases they are reinventing the wheel, such as steam reforming wet ethanol, demonstrating commercial microturbine applications, etc.
- Very broad scope of activities. Suggest investing more defined focus to gain expertise and a sufficient tech base to contribute to DOE mission and the lab’s growth as well.

Question 3: Technical Accomplishments and Progress.

- Lots of work in progress
- Results forthcoming
- Too many undone activities
- Cuphia – No go
- Generally low level of innovation.
- Good progress on most projects. Landfill methane project is based on fallacy.
- I saw little evidence of metrics in the in the review
- It seem to be almost exclusively based on technical
- Evaluation no cost and benefits
- The project researchers tend to have a cursory evaluation
- Process for efficiency, benefits, risks, etc. but they don’t
- Tend to use the results in a better focused strategy.
- Some benefits may occur but real benefits not clear.
- Good for their planned scope.

Question 4: Success Factors and Showstoppers.

- Hard to name successes
- No indication that this work will offer any new insight into solving barriers in gasification, new products, biodiesel production, etc
- Good Cooperation, commercialization progress.
- Using landfill gas in a microturbine has been proved impractical.
- This project has not looked at regulatory or business showstopper in depth
- This is the key weakness for this project area.
- In some cases, their effort is not very novel therefore does not address showstoppers.

Question 5: Proposed Future Research Approach and Relevance.

- Activity specific completions only
- Unless innovation improves, it’s hard to believe that OS will be supporting this work.
- Clarification on where funding will come from would be useful
- Future plans not clearly delineated.
- This work is mostly preliminary little future work is defined
- The program would benefit for future planning, a future focus and a goal to achieve from the program rather than a random group of projects.

***Additional Comments*:**

Strengths

- Great list of ideas and challenges
- Very nice education and outreach meetings
- Lots of cost share partners
- Diversity
- Good matching of needs and Federal funds with cooperators
- Strong group of both cash cost-share funding partners and in-kind partners.
- Good education program.
- Industry partners good resource capability
- Good partnership and cost share.
- Good educational outreach.
- Building capabilities of the group and expanding regional interest/expertise in biofuels.
- Providing an educational foundation for developing more faculty active in biomass to chemicals/fuels along with the education of future biomass-savvy technologists.

Weaknesses

- Too broad for dollars available – spread too thin
- Too many works in progress – no results
- Way too many projects
- No good sense of economic impact
- Poor sense of whether projects have a realistic chance of moving out of the laboratory
- Very low level of innovation…lots of this has been done again and again
- Diversity
- Too many subprojects.
- Some projects already proved impractical.
- No mention of an emission component to gasifier.
- Too many projects going on at one time – focus.
- Presenter did not address the corrosive effect of landfill gas on microturbines.
- Regional focus
- There is little focus to this project it appears that the Center will do whatever the research dollars will cover
- Portfolio too broad and no sense of benefits or economic value. Some of the projects have been done before.
- Needs to coordinate with DOE Biomass Program to get better value of the project.
- Way too broad – lacks focus. Should spend effort in focused area that fits well with ND region and the DOE interest areas. Also, their work lacks economic analyses.

Technology Transfer/Collaborations

- Annual workshop – Attendance growing,
- Strong panel of partners.
- Excellent
- This project could do a lot more with working with other groups to coordinate it projects. The laboratory and its many partners have substantial intellectual and outreach resources that should be more focused.
- Needs a single big project.
- If needs several projects, then need a gate keeper.

- Appears to have limited direct industrial involvement with research – need to enhance this area.

Recommendations for Additions/Deletions to Project Scope

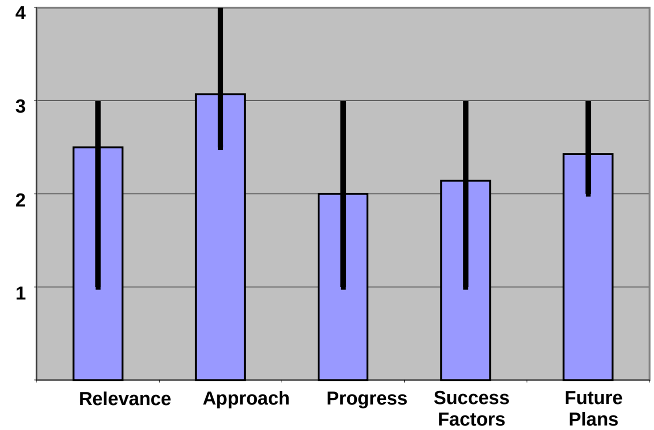
- Need strong focus, Caution on any future funding unless stronger filtering.
- Reduce the number of activities and focus the money on very few promising and high market potential possibilities.
- Narrow focus. Work toward building capabilities that have a future for competitive funding – need to fit DOE and USDA future R&D goals. I also believe that you are missing an opportunity to utilize regional feedstocks and other associated regional assets. Build capability around technologies with a funding future coupled with a strong component of using feedstocks from your region.

Anaerobic Digestion and Waste Processing Projects

Project Title: Anaerobic Digestion (Ohio State University)

Principal Investigator: Floyd Schanbacher
Project Stage: 2 – Detailed Investigation

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.50	1.50	0.50
Approach	3.07	0.57	0.93
Progress	2.00	1.00	1.00
Success Factors	2.14	1.14	0.86
Future Plans	2.43	0.43	0.57
Average	**2.43**		



Question 1: Relevance to Overall Objectives.

- The project will generate energy in the larger context of biomass platforms, but the innovation is not particularly high.
- Has integrated project into numerous DOE objectives.
- Excellent partnerships
- Comprehensive
- Relevance is pertinent. Market potential is highly questionable.
- The market potential was not well defined this technology
- Is not farm scale but industrial There is not much outreach and there should be more coordination with other states
- Oil displacement benefits not identified. The market is biopower with novel fuel cell end technology that appears to have good technical justification. Conversion technology appears to benefit a waste stream issue and low cost feedstock.
- No new information being generated. Very redundant effort too many projects already done.

Question 2: Approach to Performing the R&D.

- Performance is reasonable, but innovation is low.
- Well-conceived and integrated project.
- Cost may be the primary barrier.
- Feasibility of fuel cells for processing biogas was proved earlier in other locations.
- I like the research on microbes and the controls
- A self-controlling digester is a good outcome
- more focus should be put in this area and less on the
- resource assessment
- The technical barriers were address only once we dragged that info out of the reviewer with questions. They did not offer key targets at all saying it was premature, while in discussion they clearly had some type of go no-go types of strategies. The self-healing, self diagnostics, self operating digester looked unique but potentially expensive.
- Their approach is good for their stated objectives. The engineering and project plan is well thought out.

Question 3: Technical Accomplishments and Progress.

- Project appears to be moving slowly
- Most effort to date has been planning and facility construction. High potential for valuable contributions in several areas.
- Some progress on bacterial characterization. Optimizing organisms for anaerobic digestion is very important with potential to increase gas yield and improve overall efficiency by possibly reducing energy input requirements.
- Progress is adequate but has not reached the stage of generating data.
- Bacterial species studies may be the most valuable part of this work.
- Why was fish processing waste not included?
- There are no performance indicators it is very difficult to
- Measure any success or progress
- The reviewer did not provide any discussion as to how the project will benefit the 2020 goal, or DOE's program direction, nor did he provide any cost benefit estimates or cost targets, or efficiency targets. Need some economic analysis. The focus on the project is higher efficiency of biogas production and the approve is fairly innovative but needed more specific microbiology R&D.
- Very limited new information will be generated from this effort as planned.

Question 4: Success Factors and Showstoppers.

- Project tried to identify show stoppers, but at a pretty high level. Did not address details.
- Excellent analysis of showstoppers. Honest assessment of success factors.
- Fuel cell component is important, but is not necessary for project to be successful.
- Identified show stoppers are true and good. Did not address alternative energy conversion technologies for biomass.
- The success factors And showstoppers seem to rely on
- Policy and Renewable incentives
- The reviewer provided some justifications for their research direction that looked legitimate. The project has not processed to the point where regulatory barriers or environment barriers are integrated into the project.
- Minimal true show-stoppers have been identified.

Question 5: Proposed Future Research Approach and Relevance.

- Plan forward is reasonable, but is treading well worn ground.
- Good plans.
- The future plan looks good.
- The future plans are a little vague and tended to focus on more operational data and adding another digester to their infrastructure. Neither research target dates nor any research or economic targets were provided.

***Additional Comments*:**

Strengths

- Reasonable coordination between engineering and development of efficient new anaerobes
- Addresses an issue in OH with an available waste stream.
- Reasonable leverage of DOE funds
- Good research plan.
- Results could be very useful but positive result highly unlikely.
- Strong partnership between industry and academia

- Comprehensive focused approach
- Commercial potential with broad appeal to municipals
- Good engineering
- I like the research on microbes this will lead to better understanding and potentially improved efficiency
- I like the controls research and development of better self operated systems
- Novel approaches to better microorganisms and better instrumentation feedback systems to better reliability and higher operability targets.
- Appears to be well engineered systems.
- Well laid out experimental plan for their stated objectives.
- Good outreach initiative with industries who may not seriously consider biogas utilization.
- Building new expertise within their state along with additional R&D capability that could grow their program.
- Providing an education to students who will be biotechnologists of the future.

Weaknesses

- Larger national impact is not clear, as the project is quite OH-centric
- Low innovation – anaerobic digestion is well studied and employed
- Project appears to be moving somewhat slowly. Only at batch scale so far. Two large scale ups still necessary before completion.
- Need not demonstrated
- No fallback position if SOFC fails because of biogas contaminants
- Relies heavily on price/value of renewable energy
- Did not address SOFC generation price/kW
- Did not address kW/gal of digestion or btu/gal of digestion
- Lack of coordination with other researchers
- No assessment of the market potential
- Too much federal dollars for resource assessment
- No R&D targets, no milestones, no quantitative benefits, no feedback loop to DOE, no integration into other researchers in the field.
- Project has been slow.
- Don't see any significant technology advancement presented thus far.
- Efforts on the dairy wastes are not considered of significant value – already been done by many groups.
- The waste inventory assessment seems of little value.
- The connection of microbial population identification efforts to improved process control/production was not clearly made.
- Lacks process economic analysis and the supporting economic benefits.

Technology Transfer/Collaborations

- Excellent
- Good collaboration with commercial sector.
- Poor
- Reasonably good – like the mix of feedstock producers along with process equipment vendors.

Recommendations for Additions/Deletions to Project Scope

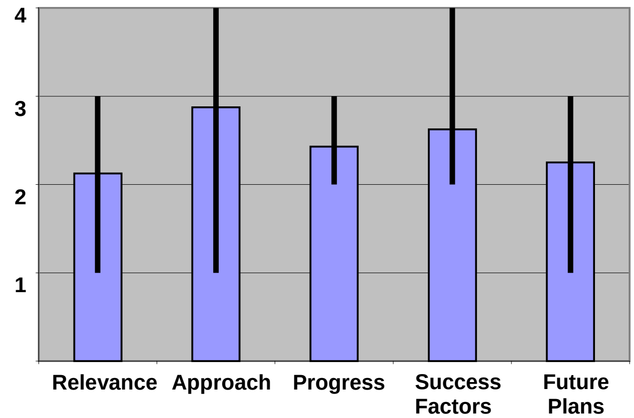
- Fuel cell work does not contribute much to this project. Focus instead on biogas production research.
- Emphasize development of new bacteria.
- Project needs to identify other types of power generation if SOFC fails. Show comparison of cost/kW of other types of power generation. Identify emissions profile of different types of generation.
- Reduce work on resource assessment more focus on controls and interface with fuel cells
- Fine tune the project and provide good quality management processes such as Microsoft project and better technical targets and milestones. How do you know when you succeed or making progress?
- Recommend focusing exclusively on industrial wastes and oriented process automation toward industrial plant operators where their training level is much higher than farmers for process controls, plus their comfort zone for process controls/operations are much more established.
- The project has potential good merit if it strives to break new ground or attempts to bring industries on board that have been hesitant to give this technology a realistic look.
- Ensure that a plan is in place to manage digester residuals – look toward possibly marketing the residuals, i.e. digester tea or fertilizer value – keep in mind that the industry may be concerned about their materials going out into the market.

<u>Project Title: New York Biomass/Methane Gas Power Fuel Cell Project</u>

<u>Principal Investigator:</u> Dr. Caine Finnerty and Praveen Cheekatamarla, NanoDynamics, Inc.

<u>Project Stage</u>: Stage 4: Technology Development

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.13	1.13	0.88
Approach	2.88	1.88	1.13
Progress	2.43	0.43	0.57
Success Factors	2.63	0.63	1.38
Future Plans	2.25	1.25	0.75
Average	**2.46**		



Question 1: Relevance to Overall Objectives.

- Belongs in HFCITP portfolio
- SOFC distributed size
- Provides a user of the biogas or even syngas that will be produced from biomass.
- Falls within the hydrogen project
- Relevance is pertinent
- Not closely related to Program objectives.
- Fuel cells have their own program.
- Not biomass related.
- Operation with biogas/syngas is important goal for future fuel cell adoption/use.
- The use of renewable fuel for the fuel cell is a good
- Approach but the focus on biogas and the research is really focused on improving the fuel cell which makes this a better fit in Hydrogen
- PIs gave poor indication of how the project will affect DOE program goals. Difficult to evaluate and PIs need to be more integrated with OBP programming goals.

Question 2: Approach to Performing the R&D.

- Small scale – lab level
- Gel casting is good approach – problem to tackle
- Their experimental approach appears solid for their stated objectives:
- Clear R&D targets, focused strategies for achieving the targets, innovative R&D on materials formulation and practical construction, focus on efficiency conversion, and verbal discussion on capital and operating cost targets. Barriers were fairly well defined but not linked for specific market end application issues.
- Very small scale. One can already buy a bigger one.
- Not clear what the goal is
- Good research plan
- For a fuel cell project this is very well organized and designed
- The performance measures are clear and are being met
- I would have scored higher if the project had been more in line with the OBP program
- Project is highly focused on one thing: making a cell that generates 20W. Activity is at the expense of placing work in larger energy context. However, highly focused research appears to be progressing along a defined path.

Question 3: Technical Accomplishments and Progress.

- Making steady progress from fuel cell development perspective

- Fit issue with OBP
- If this were a HFCITP project would grade higher
- Significant work appears to have been performed and considerable amounts of data were presented.
- No performance target indicators were provided specific to the DOE program and its goals, but the project did have well defined efficiency and cost targets.
- Had good focus on robustness and durability.
- Good progress has been made but it is not clear that this is worthwhile. They seem to be behind other industrial players.
- The reformer catalyst studies and development seem worthwhile.
- Some good progress, but unrelated to needs of this Program.
- Fuel cell development should focus on direct utilization of biogas without reforming step.
- This project has mead very good progress The only thing
- That brings it down from outstanding is that it is more of a
- Fuel cell development than biomass
- Great proportion of effort is on cell design and making one that meets certain parameters with little apparent understanding of what targets should be met on a national scale, and how this technology might address those targets.

Question 4: Success Factors and Showstoppers.

- Planar cells success is important for cost cutting
- I believe this project is well run and moving in a reasonably positive direction.
- Business and regulatory issues were not addressed in detail. Commercialization targets were verbally addressed in feedback (Japanese market).
- Commercial scale up of electrode manufacture not clear.
- Reliability.
- Tolerances may too wide.
- Discussion of biogas neglected to address effects/removal of SO2
- The market for this package appears to be a real showstopper
- That is not addressed. The small fuel cell works well but the
- Biogas fuel to supply the fuel cell in a home is not practical
- By focusing so strongly on cell design, the larger impacts appear to have been ignored. Vague description of eventual deployment and application.

Question 5: Proposed Future Research Approach and Relevance.

- Concept C success is important capstone of work
- Their appeared to have demonstrated a vision for how they will fully meet project goals.
- Not a clear idea of how it is going to commercialize the technology. May need partner, such as GE, to commercialize larger systems (2-5 MW).
- Future plan looked to be somewhat repetitive of what has been done.
- Future work not expecting new innovations – incremental improvements.
- In my opinion the only way to make this be a biomass project is to look at biodiesel as a fuel
- In short term, project needs a much better sense of how their project fits into the larger national energy strategy, quantifying potential opportunities and impacts.

***Additional Comments*:**

Strengths

- Making good progress
- Good SOFC R&D targeting
- Appears to be a well thought-out and implemented project.
- Advances the potential for using biogas for use in fuel cells.
- Also, provides more development work on fuel cells.
- Strong R&D plan has clear goals and objectives, clear plan to achieved, achieved their research in a step by step manner, and reported results that nearly achieved target.
- Good research program
- Uses a wide variety of fuels
- Well-designed project from the fuel cell research side and if the plan was to build bigger fuel cells for stationary power generation then it would be OK
- In depth investigation of cell construction and performance

Weaknesses

- Not partnered with the SOFC development consortium
- Poor fit to OBP
- No economic information was provided – with these technologies – could be your ultimate show-stopper.
- Didn't address sulfur issues.
- The stated technology economics don't match up to the volume of biogas that is produced nor do the costs/scale match up.
- Weak commercialization plan
- Not clear where it is positioned for cost effectiveness or compared with other technologies.
- The way forward (commercialization) was not described.
- Lots of data but few conclusions.
- Questionable scalability to residential application
- No partnerships
- Does not address cost/kW
- Addresses Japan market and not U.S. market
- Too expensive for American market
- Not relevant to this DOE Program
- The potential market is weakness To focus on a small package for homes or apartments makes this project problematic because the biogas can't be generated cost effectively at that scale
- Poor sense of larger impact of work; needs to have a much better idea of path to commercialization, and for DOE, a much better indication of broad energy impact.

Technology Transfer/Collaborations

- No partners
- It appears that they have minimal interaction with other groups.
- Looks like no activity in this area. No clue about target market.
- Fair
- Very poor. Presentation specifically noted no industrial partners, although the Q/A period revealed that some industrial partnerships may be developing.

Recommendations for Additions/Deletions to Project Scope

- Move this project out of OBP to the SOFC effort

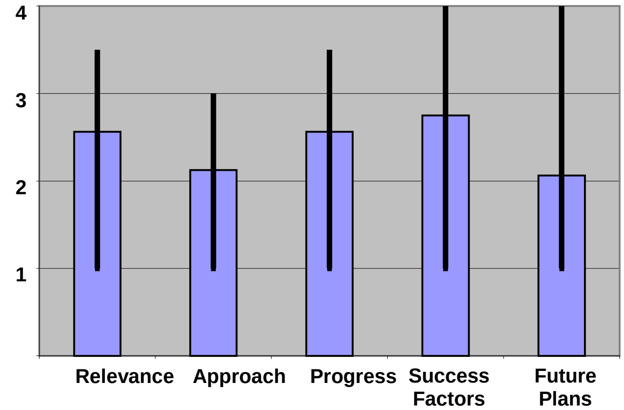
- Need to spent significant time on scale-up and the derived economic benefits.
- Need to address scale-up to match with the biogas sources – a lot of biogas is produced at production facilities with very limited storage capacity – need to ensure that these match up.
- This belongs in the Hydrogen Program.
- Misplaced project – belongs in hydrogen program
- Belongs in another DOE program.

Project Title: Ohio Solid Waste Authority Pyramid Resource Center

Principal Investigator: Tim Berlekamp, Solid Waste Authority Pyramid Resource Center

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.56	1.56	0.94
Approach	2.13	1.13	0.88
Progress	2.56	1.56	0.94
Success Factors	2.75	1.75	1.25
Future Plans	2.06	1.06	1.94
Average	**2.41**		



Question 1: Relevance to Overall Objectives.

- Biopower is not currently in OBP target zone but is in the new Vision document
- The project is successfully tapping an existing but unused fuel source. The project, although of somewhat low innovation, is still doing an excellent job of moving from opportunity toward commercial production of renewable energy.
- The project is a demonstration project not research
- It should have an outreach component
- Good plan and relevance to DOE Biomass programs and
- existing commercial MSW landfills
- Relevance is pertinent.
- Good project but not real linkages to Biomass Program except for expand distribution of green CNG for fueling and possibly for facilitating B20 distribution.
- First commercial scale application of CO2 wash which may be one of the solutions for gasification clean up.
- Provides a developmental program that will demonstrate renewable fuel production technology.

Question 2: Approach to Performing the R&D.

- Good commercialization of biogas scrubbing – CO2 Wash
- Uses refrigeration to separate CO2 from methane
- Closed loop energy system
- Methane to methanol as feed to biodiesel
- Very integrated including CNG fueling for garbage trucks
- Scaling for small landfills and large
- Project is well designed, focused, and is on a path to convert a generally untapped fuel source. Variability of landfill gas pressure could be a problem.
- The technical barriers – small landfills don't have the technology At a scale to develop
- It is not clear no comparison of # of landfills and comparison to more typical LFG generation projects
- Reduction of NOx
- Very thorough.
- Everything seems to depend on trademarked "CO2 wash."
- Landfill gas clean up to methane is existing technology.
- This approach may be a little different but the result is the same.

- Rated poor because the project is not needed to reach the goal.
- Technical targets were not provided, nor does the implementation plan show any coordination with the DOE program. The team has very experienced technical people involved and the project is well designed and appears to be technically feasible. For a demonstration project, we don't know how to measure it to see if it's successful. No real economic research targets either.
- Their Phase II program with methane to methanol conversion production and their biodiesel production facility needs to be better justified economically.
- Limited actual approach was presented – appears to be reasonable – however, little justification of scrubber choice was presented.

Question 3: Technical Accomplishments and Progress.

- Almost complete as first generation commercialization
- Project is well described and quantifiable, and presentation is able to deal with key questions.
- This is not a biorefinery it is more of a waste reduction recycling project
- The fuel / petroleum reduction will be small
- The environmental benefits could be a positive factor
- Planning, design, and installation for Phase I nearly complete. Not yet operational.
- Good progress being made
- Some performance metrics were discussed such as natural gas and kWh green production. The methanol production would reduce fossil fuel imports. Cost appears to be effective at really low Btu cost from landfill gas production. No discussion about how this technology can role out nationally and what that benefit might be.
- Appears reasonable for stated goals.

Question 4: Success Factors and Showstoppers.

- Good sense of economic impact and potential problems in dealing with this source of energy.
- It seems that the only success factor was if the project sponsors could make this a commercial technology
- Everything seems to depend on trademarked "CO2 wash."
- Market for CO2 critical for success?
- Applicability to lesser-managed landfills?
- Operator skills, time requirements?
- Most listed showstoppers were overcome 10 years ago in California. The other showstoppers are unique to Ohio.
- Some success factors and show stoppers were identified but without any quantitative numbers. Regulatory and legal issues are high with this project but the team appears to be experienced to overcome these.
- I believe that they have not adequately addressed project cost benefit for this project.

Question 5: Proposed Future Research Approach and Relevance.

- Very good plan to make green methanol for biodiesel plant
- Plan for additional activities are focused on commercialization, and construction is proceeding to develop a fuel production and distribution facility.
- The CO2 sales was not well addressed – what happens to the commercial value if the CO2 market is lost
- Still waiting for demonstration of concept for Phase I. Ambitious plans for phase II, scaling and marketing to various-sized landfills

- Phase II can also be achieved with existing technology.
- The project is overly complex and does not have any go/no-go decision points. Needs a better planning process for why some of the down stream sections are included. Their progress on construction to date is good, but plans for going forward were generic.
- Not many real future activities were presented.

***Additional Comments*:**

Strengths

- Commercialization of potentially needed product in biogas scrubbing – CO_2 wash
- The small scale is especially appreciated for smaller landfills – new market
- Renewable methanol
- Very good leverage of DOE funding: 40% federal/60% private
- Excellent progress toward commercialization.
- Team is highly informed regarding all technical, regulatory and production issues surrounding their process.
- Nice demonstration of moving from concept to commercial reality
- Good cost sharing
- Good plan to produce CLEAN, multi-use fuels from landfill gas. Possibility of CO_2 capture is worth exploiting – though not part of DOE program. Decrease in greenhouse gas emissions also important.
- Strong partnerships
- Good environmental benefits of this technology
- Variability of CO_2 Wash btu output
- Strong team with good commercial technology.
- Good project with little benefit to the nation over all, but maybe good benefit to Ohio.
- Using an energetic resource that is currently wasted.
- Expanding utility of landfill gases.
- Demonstration of new technologies.

Weaknesses

- Stronger economic analysis needed for easier commercialization
- The ideas are not new, except for the CO_2 wash, but the progress and potential impact mediates this issue.
- This is an expensive project Given the barriers that the sponsors say they will be addressing why did they need to build such a large installation? Most of these issues have or are being addressed – this is more of a commercial project designed to sell additional units.
- Everything seems to depend on trademarked “CO_2 wash.” Unclear why they are specifically tied to this technology.
- Verbally expressed energy recovery efficiencies seem wildly optimistic considering the compression, refrigeration, etc. steps in processing.
- Market/use for “purified CO_2”?
- Little discussion of byproduct CO_2 that is heavily contaminated with LFG components.
- Need to address cost/kW of micro turbine vs. other types of generation
- Acceptance of these synthetic fuels, both Biodiesel and CNG
- Presented not cost/benefit projection or performance analysis
- Nothing new in this project
- Market may be very limited.

- Land fill gas only lasts so long, and no real consideration to adding a gasifier in the future has been considered.
- Minimal new technology development is being accomplished.
- No life-cycle cost analysis has been done.
- A mass balance analysis of carbon particularly considering methanol and methane volume calculations should be presented.

Technology Transfer/Collaborations

- Good partnership team
- Appropriate team to carry out the research and development activities.
- Although they have a number of partners they don't have outreach partners Where is the EPA LMOP program?
- Good partnerships/collaboration.
- Fair/poor
- There appears to be a good interface for technology, but no activity was proposed.
- Seems to have significant collaborations. Strong vision toward future partnering.

Recommendations for Additions/Deletions to Project Scope

- Add economic analysis component
- It would be best if DOE could get some benefit from its investment
- What are the "problematic" CNG fuel specs?
- What LFG Vehicle Fuel commercial issues need to be explored?
- What is the market potential?
- Not sure this project belongs under this platform
- Badly need to perform an IRR analysis of project life cycle.
- Consider other types of carbon dioxide scrubbing units.
- NOTE: The CO2-laden stream derived from your process cannot be considered an equal stream, chemically composition-wise/quality, as those generated from ethanol plants – significant health issues if the stream is intended for human consumption/application markets – will have to prove your stream safe (likely via FDA)

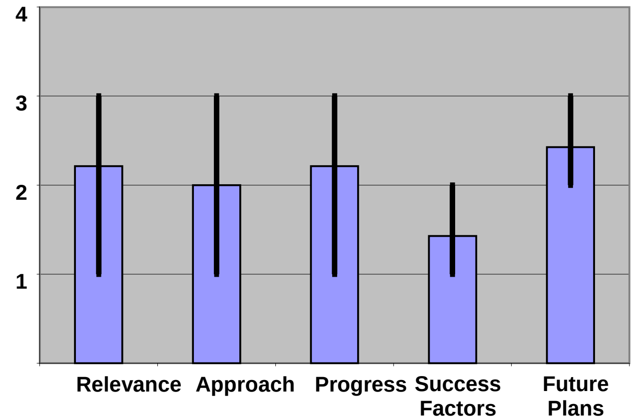
Communications, Outreach, and Partnerships

Project Title: New Uses Information and Entrepreneur Development

Principal Investigator: Mark Williams

Project Stage: Project Management of Biomass Commercialization Awards and Full-time focus on commercialization support services

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.21	1.21	0.79
Approach	2.00	1.00	1.00
Progress	2.21	1.21	0.79
Success Factors	1.43	0.43	0.57
Future Plans	2.43	0.43	0.57
Average	**2.06**		



Question 1: Relevance to Overall Objectives.

- Bioenergy business development cross-cutting fit
- Working in bioproducts area improves fit
- Program may be duplicating existing funding efforts that are part of the normal DOE funding opportunities. However, the program may also be able to identify groups that are inexperienced in finding federal funding to support new commercial opportunities.
- Need to develop markets for biobased fuels.
- This project is more focused on biobased products.
- Will not contribute much to 20 in 10 goals.
- Relevance OK.
- Limited program eligibility requirements
- The project is too narrow—one county—to have a significant impact on a national program. They need to broaden out their focus on bio-based products to a support biorefinery development. They need to develop some way to measure the attractiveness of their market projects and a better way to identify customers.
- Some of their projects were counter productive, for example, the Biodiesel symposium was a forum for the NBB to develop stakeholders to reduce incentives on the Renewable diesel industry.
- Addressing commercialization within a region – which is good, but not really part of the focus or the DOE Biomass Program.
- Information provide makes it difficult to asses further.

Question 2: Approach to Performing the R&D.

- Economic development award program targeted to biomass
- Looking for existing IP for commercialization
- A bit scattered
- The barriers were not particularly well defined, nor were the approaches to their solution. The programs were described, but the actual process for allocating funding could have had a clearer explanation.
- This project seems to duplicate services/programs already offered by many universities/small business development programs.

- The approach is pertinent to the goals. Education of inventors in these areas is very worthwhile.
- Capital Awards element may need more attention and rework
- They are integrating into a broad group of similar or related organizations (universities, economic dev., private industry, manufacturing association) to broaden out their expertise. Their use of angel investment groups and other support agencies are good. Once they get a project though, they are weak on the identification of barriers, research targets, economic analysis to achieve those targets, etc.
- Difficult to assess with information presented.

Question 3: Technical Accomplishments and Progress.

- Not a lot of businesses up and running due to this effort
- Work in progress
- Re-tooling awards program
- It may be important to provide an opportunity for groups that might get overlooked to have access to funding, however, this group should focus strictly on the small entrepreneur, rather than providing funding to large, existing companies well versed in finding their own funding, or supporting the work internally. None of the projects described appeared to be high risk.
- Excellent progress in forming partnerships, increasing public awareness, and specific product/industry projects.
- However most of these are not relevant to Biomass Program
- Will not contribute to 20 in 10 goals.
- Local outreach effective with media and targeted partners.
- They have not developed key metrics for their program. They have not developed any way to measure their benefit.
- Addresses outreach.

Question 4: Success Factors and Showstoppers.

- Not a good set of success factors
- Not part of presentation
- Hard to tell. The program is quite straightforward: provide support and funding to new biomass opportunities, thus, there aren't many showstoppers to be identified.
- Not well-defined.
- Presenter did not address these factors.
- Capital Award element needs attention to avoid becoming a show stopper.
- The identification of key barriers and their relationships to the bioproducts and DOE goals is weak.
- Project tea, appears to be working with their companies in terms of helping them ID stoppers along with providing services to address them.

Question 5: Proposed Future Research Approach and Relevance.

- Given the stated goals of the project, the team has defined a reasonable path forward.
- Future planned work is a logical extension of past work and will strengthen the program.
- Continuing what they have already started.
- More fully integrate partners with entrepreneurs.
- They take what is a general business outreach and entrepreneurial organization and refocus it on biomass energy commercialization. However, Not much planning is shown, it seems to be very serendipity. They do have plans for a symposium for biobased

products in Chicago that has the potential to develop projects, but good projects will depend on who speaks at the symposium and who attends.
- Reasonable for the type of program this is.

***Additional Comments*:**

Strengths

- Has an awards program with $$ for business development
- Biobased products is good area
- May identify small opportunities that may not have experience in finding support for promising programs.
- Local focus increases effectiveness.
- Strong partnerships with government and others
- Might help some opportunities which could drop between the cracks
- Focusing in regional economic development using biomass.
- Program design does provide critical business development support.

Weaknesses

- Need to focus more
- It is unclear how this group's role differs from existing funding opportunities for potential commercial opportunities.
- Their "clients" also include very large companies (Chemtool). Did Chemtool try the traditional routes and fail?
- Does not contribute to 20 in 10 goals.
- VERY locally-focused.
- Some funding supports efforts of LARGE company…
- Duplicative of other resources already available to entrepreneurs.
- Staffing may a bit under funded.
- Very narrow program eligibility requirements
- Local focus
- Limited success to date (only one joint venture accomplished)
- Duplication of effort with other state/national funding opportunities (SBA, USDA, etc.)
- Relatively weak project, with only a fuzzy idea of what to do with it. No metrics to speak of, little focused planning is occurring, no barriers (regulatory, economic, technical) are being identified with any consistency.
- Focus on one county too small, and limits their potential impact for the program for DOE.
- Seems to lack strong technology development screening capability to ensure good industrial participants are involved.
- Have not presented any info on IP.

Technology Transfer/Collaborations

- Partnerships are solid – Argonne, USDA, universities, local government
- This is a strength of the program.
- Poor
- Very strong given the nature of this project.

Recommendations for Additions/Deletions to Project Scope

- Future funding should be state and local
- Not relevant to DOE Biomass Program.

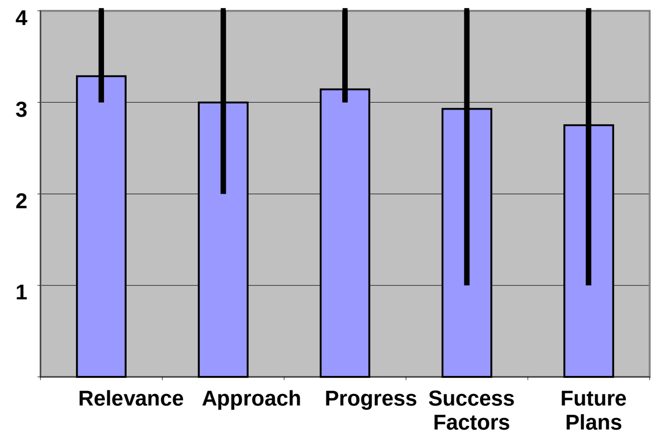
- My opinion is this is questionable/poor use of federal funds. This project should be funded at the State or even local level and not with federal tax dollars.
- Increase access of industrial participants to university expertise – ensure the university side is properly supported to ensure critical investment interest from the faculty/staff.

Project Title: Alternative Energy Enterprise Program

Principal Investigator: Sumesh Arora, Mississippi Enterprise Institute

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.29	0.29	0.71
Approach	3.00	1.00	1.00
Progress	3.14	0.14	0.86
Success Factors	2.93	1.93	1.07
Future Plans	2.75	1.75	1.25
Average	**3.02**		



Question 1: Relevance to Overall Objectives.

- Cross cutting
- Biofuels focus – Cellulosic and biodiesel
- This project is an excellent example of how to set up a state program lined up with DOE goals.
- Addresses overcoming limits to commercialization of biomass-energy projects and economic development.
- Relevance OK
- Tightly coordinated with DOE Biomass Program goals, 2525 initiative, becoming self funded, estimating benefits, using quantitative metrics, etc.
- Supporting 10 (5 Ethanol, 5 Biodiesel) projects.
- Biorefinery focus.
- Project could be a template for other state outreach programs. The project is focused biomass and biodiesel feedstock, conversion technology, and commercialization.
- Somewhat Advancing biomass-based industrial development.
- Not an outreach program.
- Does focus on projects that are within program goals.

Question 2: Approach to Performing the R&D.

- Good understanding of Mississippi feedstocks
- Region appropriate
- Advisory board
- Funding to get things done – both R&D and business start-up
- Scaled for region
- The project has done a good job of picking projects that are aligned with DOE/OBP goals, and also has a nice management system in place to make sure that those research paths are maintained.
- Organization is appropriate to the goals and operations.
- University partners are appropriate but private sector
- Involvement is weak
- Very well designed program, clear metrics and very strong project portfolio management. Their approach is very well integrated into DOE research and how to take those needs and screen the various projects to select only the projects that also meets DOE. The barriers that would have been addressed will be reduced through this project.
- Presented a reasonable path to implement their program.

- Good business development presence.
- Not comfortable with the level of oversight for the individual projects.

Question 3: Technical Accomplishments and Progress.

- 14 projects selected
- Glycerin – commercially saleable product
- Slash bundler - John Deere
- Just getting started
- The project is well organized and appears to be aligned with the goals of the DOE/OBP programs.
- Good start forming partnerships and a few funded projects
- 12 projects thus far.
- Good outreach effort.
- Providing access to capital
- Program measures metrics, measures benefits, identifies goals and objectives and how they were identified, quantified and achieved. There is a clearly defined, documented progress in this project. It has great integration with business partners, cost share funding, audit trails. Etc.
- Reasonable program development has been accomplished.

Question 4: Success Factors and Showstoppers.

- Effective Communications
- Low price of fossil fuel alternatives. Analytical list
- Very clear articulation of the showstoppers, which are harder to define for a research support function, rather than an actual hands on research investigation.
- Most identified.
- Doesn’t mention environmental regulations, which, if not
- explicitly considered, might inadvertently inhibit progress.
- Appeared to be aware of legal and regulatory barriers, although more specific types of contingency planning might improve the project.
- Not well defined - appears to need work in this area.

Question 5: Proposed Future Research Approach and Relevance.

- Late start impacts future work
- At beginning stage
- The plan forward is reasonable based on the activities that are currently supported.
- Continue what they are doing.
- Not so crazy about funding universities with these $$$. Universities have many funding sources. Should go to assist small private entities.
- Fund universities only as partners with commercial entities.
- This topic was not addressed.
- Plans to become self-sufficient are excellent. Has a clear view for future planning and succession. I did not get enough input about how the resources are allocated or whether the schedule is on time, etc.
- Reasonable plan to advance the project.

***Additional Comments*:**

Strengths

- Has funding for university R&D and for business development
- Partnerships and advisory board
- Well organized program with clear goals, and a good description of impacts resulting from money allocated.
- Broad state based activity, with attempts to move more widely into SE region.
- Good alignment of state program with DOE goals
- Best of the various state projects evaluated.
- Well balanced program.
- Strong list of partners including universities and private-sector
- Use of an outside-the-state advisory board
- Broad commercialization opportunities
- Regional approach is national and not local (southeastern U.S. vs. local counties)
- Tracking/auditing funds after awards are given
- 501 (c)(3) status
- Strong outreach network with many partners, great metrics, tight integration into Biomass Program goals and objectives. Shows budget allocation and cost shares. Does an enormous amount of work for a short period of time. Covers both ethanol and biodiesel projects and avoids investment in too much power, gasification, etc. Has a very nice set of out-of-state technical reviewers that reduce domestic policy influences that might dilute the program goals.
- Good mix of technology development stakeholders.
- Outside review.
- Competitive program.

Weaknesses

- Need to focus on results of 14 funded projects – What happens? Not just financial audit
- Local focus without local funding
- Private sector funding is lacking, very few non-university projects funded
- Too much money to universities.
- Seems to significant private sector funded projects – the stated goal.
- Not showing a strong model of how the universities are dramatically impacting economic development.

Technology Transfer/Collaborations

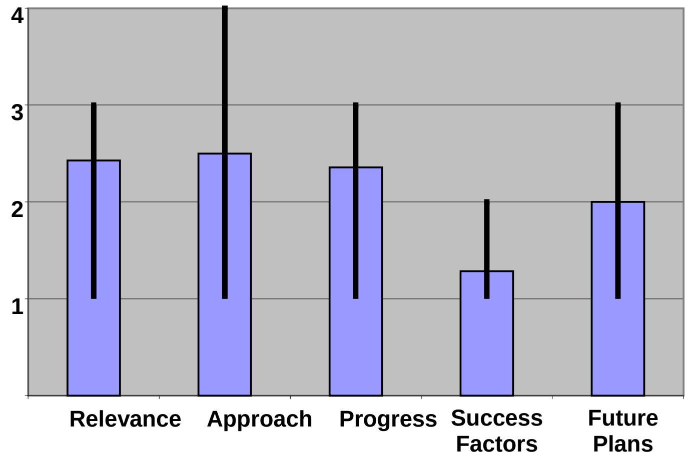
- Good outreach efforts noted
- This is a strength of the program.
- Excellent
- Seems to be good – but needs more industry involvement

Recommendations for Additions/Deletions to Project Scope

- Future funding should be state and local
- I'm not completely comfortable with federal tax dollars/funding going toward a local initiative program. This should be funded with State and local funds.
- Carry on.
- Try to encourage more technology development that will result in a larger job creation potential – seem to have a lot of little companies with minimal experience with business development.

Project Title: Kentucky Rural Energy Supply Program
Principal Investigator: Cameron Metcalf, Kentucky Pollution Control
Project Stage: Exploratory Research

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.43	1.43	0.57
Approach	2.50	1.50	1.50
Progress	2.36	1.36	0.64
Success Factors	1.29	0.29	0.71
Future Plans	2.00	1.00	1.00
Average	**2.11**		



Question 1: Relevance to Overall Objectives.

- Energy efficiency and biobased products
- Beyond OBP for some of work
- Used OBP platform for review and selection
- Several of projects funded with OBP money are used to support KY projects that would be placed in other non-biomass parts of DOE
- Good advisory board membership.
- Education and support of biobased energy and product development
- Relevance is pertinent.
- No industry participate just university funding and the governor's office. No focus on providing projects that might benefit DOE, too much money to solar, and energy efficiency, and other non-biomass program. Obviously not strong enough to direct the project to meet DOE goals and objectives and does not appear to know what those are or how to achieve it. Showed a stage gate picture, but they clearly do not know how to use the process to help improve their projects.
- A portion of the work fits within the program.
- However, some projects did not fit within the mission.

Question 2: Approach to Performing the R&D.

- Lots of organization structure and coordination
- Tech assistance and clearinghouse
- External review of funds
- IAC
- Project seems to be a reasonable attempt to seed and develop additional biomass programs for the state, but there is poor technical control over the programs WRT alignment with OBP goals and program directions.
- Need more focused program.
- Need better technical oversight/review of funded projects.
- Too much funding to universities. In just the few cases shown during presentation, the same investigator appears in several projects – implies that either few Kentucky universities have interested/qualified researchers, or good review - effort to incorporate other approaches is lacking.
- Program plan is reasonable.
- Communications with private sector is good.
- Strongly based on university research projects.
- Better technical reviewer would improve technology, also tighter management for selection in better focus projects on projects to support DOE's program. Too many

projects that don't do anything for biomass, and too much charlatans, such as the Bio-oil people, which many people have tested and found that the product is unreacted soy oil despite their claims. Has no technical goals for the projects and little understanding of the technologies and cannot develop a strategy to achieve those goals. Project director does not bring enough technical support and does not have any.

- Scattered program with little in common, does not appear to be much oversight for university researchers.
- Lacks program oversight of R&D activities.

Question 3: Technical Accomplishments and Progress.

- 7 funded projects
- Microbes at higher concentrations of ethanol – One of two in the world
- Catalytic upgrade of BioOil – Found catalyst for deoxygenation
- And now moving to commercialization
- Corn stover pre-treatment
- Biomass briquettes
- Developed soy based transformer oil
- Several projects seem duplicative of work that OBP is already paying for. Better coordination needed at the project level with ongoing DOE projects.
- Good partnerships
- Some projects beginning to show results.
- Progress on specific projects is good.
- No benefit analysis, no efficiency improvement or any other metrics to show that the projects invested will make any R&D progress.
- Little information was presented to make this decision.

Question 4: Success Factors and Showstoppers.

- No presentation on this topic
- Showstoppers and success factor assessment pretty weak
- Not addressed in presentation.
- None were addressed.
- Legal and regulatory issues were not address even though potential lawsuits over the Bio-oil claims might have resulted from this investment. No milestones are provided, no show stopper provided.
- Program does not address these issues based on the presentation.

Question 5: Proposed Future Research Approach and Relevance.

- 25 X '25 roadmap coming – state funding
- Project appears complete, in that all the allocated money appears to have been sent out, but project choice needed better control and oversight.
- Plan to continue what they have been doing.
- Need to focus on biomass-based fuels. Not solar, etc.
- Future plan is to continue on same path.
- Project is poorly planned, funded non biomass R&D and does not a strategy or a focus to try to build a biomass-based capability in KY.
- Not much information presented addressing this factor.

***Additional Comments*:**

Strengths

- Competitive grants R&D program with cash cost share from state
- Biobased products
- Economics and net energy balance
- Good project targeting and economic impact analysis
- Good research team chosen as a result of grant program
- Good oversight activities, meetings, reporting program, energy impact assessment program…not frequently seen in other projects evaluated
- Implementation is generally good.
- University and government partnership in addition to consortium members
- Must apply through State for funding
- Consortium Advisory Board
- Developed a vision statement - focus
- Developing capability within KY universities.

Weaknesses

- Too broad – All of EE plus OBP
- Build capability
- Future planning needed
- Grant program should have more explicitly targeted industry and small business
- Supported projects duplicate ongoing DOE research
- Poor coordination of supported projects with ongoing DOE activities
- Some funded projects do not fit within OBP goals, and align much more closely with other programs within DOE
- Bio-transformer oil is already a commercial product
- Use of federal dollars to fund State projects – this project should be a State funded.
- Should target small business concerns
- Way too broad – needs to focus
- Needs independent, outside review of projects (too much opportunity for a breach of integrity)
- No planning, funding way too much non-biomass money spend to useless projects. No multiple or focused biomass solicitations after the first solicitation failed to generate much interest. No real focus on the DOE program even though he did intend to focus, there wasn't any follow through. Too much money to universities and not enough money to private partners. No research targets, identification of barriers, or strategies to achieve the barriers or research goals.
- Lacks close integration with industries.
- Lacks focus.
- Basically, another university R&D funding mechanism with minimal commercialization potential presented.
- Lacks strong and knowledgeable technical oversight.

Technology Transfer/Collaborations

- KY consortium and advisory board website
- Good if information is widely disseminated
- A lot of government entities, however – needs more industry partners.

Recommendations for Additions/Deletions to Project Scope

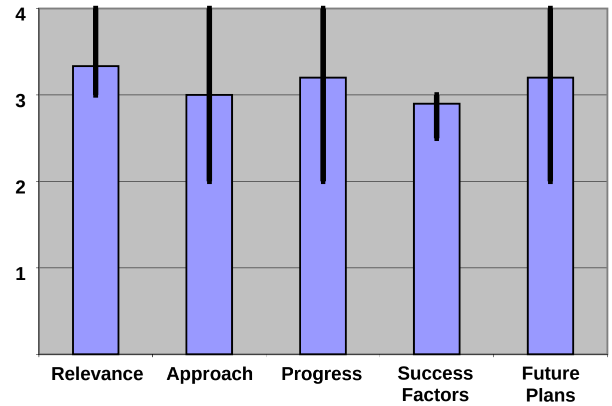
- Need to have some type of federal oversight with these federally funded, state run programs
- Need to recommend to OMB for elimination. If you have to keep it, then: see above for all.
- Attempt to position each university with a large focused group that can position themselves to be more competitive on a national basis.
- Suggest significant tightening up program focus.
- Badly need to have industries directly involved.

Project Title: Regional Biomass Programs

Principal Investigator: Rick Handley, Coalition of Northeastern Governors, Frederick Kuzel, Coalition of Great Lakes Governors

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.00	1.00	1.00
Progress	3.20	1.20	0.80
Success Factors	2.90	0.40	0.10
Future Plans	3.20	1.20	0.80
Average	**3.13**		



Question 1: Relevance to Overall Objectives.

- It is a reasonable investment of money to find a way to connect biomass opportunities within a region with policy makers needing information.
- Critical need for this level of coordination, education, outreach, policy, and economic development.
- Very supportive. Funded by DOE.
- Good focus on issues
- At this time, the RBEP is tightly linked with the Biomass Program and has tried to "direct" local and state towards ethanol and lignocellulosic R&D, but the way the "each state gets a piece of the pie" approach was used, directed solicitation did not occur. The funding provided by the Program and each Region was insufficient.
- The change from R&D and demo was good but too slow. The program did not have 2-3 key objectives and goals that were tightly linked to the success of the outreach effort. Part of this problem is the inability for DOE to identify these goals that could be developed in a 1-5 year timeframe that will support the introduction of a technology towards the end of that timeframe. Obviously the highly technical side of the DOE program has a disconnect to the marketing and outreach side, but DOE failed to consider a broader vision and balance for the whole and how to benefit from the RBEP infrastructure.
- Provides effective coordinator among governmental entities and industry interest groups.

Question 2: Approach to Performing the R&D.

- Program very diffuse and needs better focus in order to address barriers effectively.
- Good "high-level" barriers assessment.
- Good national-level partners
- Communications with many state and NGO organizations.
- Prepare technical reports.
- Collect and analyze data. Outreach and analysis.
- Regional networking groups and direct technical assistance to states.
- These results are a mix, some of the projects were well tightly selected, targets, goals, metrics, results, and approaches were well designed. And some of the projects were scattergun approaches which resulted by the "state pieces of the pies" approach. The Regional programs has been very successful, and would be improved by developing a broad pool of experts, good experts, selected by DOE, NREL, ORNL, PNL, etc., (such

as 150 to 200 researchers) to bring in technical support and program review. This approach would also provide better value to DOE.

- Appears to be a good effort toward meeting goals of the project along with assisting DOE with key coordination of efforts.
- Really need to show the breakdown of just how the funds are allocated.

Question 3: Technical Accomplishments and Progress.

- The metrics evaluation and its cause/effect conclusions are poorly justified. The PIs were unable to address this issue as they felt that Antares and their method was imposed upon them.
- The impact evaluation needs to be compared to other groups that are well established in market analysis.
- Partnerships led to inclusion of biomass in state policies
- The RBEP's projects begin adding metrics in 2000 and were integrated into the state proposal or project proposals slowly and the quality of those numbers were weak. Over time these metrics improved, but a better technical group of reviewers could improve the quality of the results of the projects as well as the metrics produced. RBEP should have developed a better set of metrics for the 2-3 key directions used in their program.
- RBEP has an excellent idea of commercialization barriers, the understanding of the technical barriers is weak, but once again, a broad group of technical reviewers would be improved. Many of the RBEP projects were slow to finish. Better project management skills may be needed through training or an expert consultant.
- Appears to have accomplished goals and advanced communication among involved parties.

Question 4: Success Factors and Showstoppers.

- Critical success factors and showstoppers are not well defined. The Antares evaluation does not appear to be a valid method of evaluation, based on the information presented.
- Good, realistic assessment
- Policy can be a show stopper. As can consumer awareness.
- Few show stoppers for a very complex program
- RBEP has an excellent network of regulatory and environmental agencies, NFP organizations, and legal network. Many of these issues were employed in commercial development, demonstrations, etc.
- Good leverage of federal funding but the quantification of the leverage was not always fully quantified.
- There wasn't enough funding to be successful, and internal struggles for funding between R&D and outreach were poorly managed by DOE and damaged the program. At least $5 million for the five regions are required.
- Eliminating the program will cause 50 states to begin contacting DOE directly for anything they need.
- Work with key trade organizations for biodiesel and RBEP accelerated the progress of the industry and the favorable development of local policies for biodiesel can be directly linked to the state in with RBEP and NREL worked together with the State soybean boards and NBB. A similar focus on ethanol distribution can be shown where RBEP partnerships with Clean Cities broaden out the Clean Cities programs into biofuels and predictable expansion in biofuel sales. Program did not have specific research target goals or barriers to eliminate because their focus was too broad. Needed to refocus program into 2-3 key barriers to succeed.
- Works well with constituency to ensure barriers are addressed and identified.

Question 5: Proposed Future Research Approach and Relevance.

- The value of the program so far is unclear, but diffuse and unfocused nature of program indicates a need for more targeted future programming.
- The RBEP has planned its final funding very carefully, and they are currently trying to transition their dying program into NSEO and governor coalition groups. Details about the transition were vague.
- I like the "creating legacy" view to the future
- With some redefining, this program could be an asset to overall program goals.

***Additional Comments*:**

Strengths

- Reasonable to have activities coordinating government interest with information providers in various regions
- Proven track record of accomplishments
- Regional approach
- Independent review of program
- Good effort to try and bring in all biomass stakeholders
- Strong partnerships with different states and federal governments including universities, farmers, petroleum
- industry and consumers
- Principals hold meetings on a consistent basis
- Excellent approach to project (forums, workshops, conferences, technical reports, etc.)
- RBEP has the potential to be a powerful advocate program for the Biomass Program if the Biomass Program can direct what is needed.
- Properly directed, REBP could reduce the earmarks and the confusion of having 50 individual and uncoordinated states doing their own thing, particularly where some of these earmarks are duplicative of the outreach program.
- Has a tremendous network of contacts and stakeholders.
- Has the potential to be a leader and a catalyst for state policy makers, regulatory agencies, and economic development groups.
- Has the potential to bridge the Vision of Biomass Program (e.g., just ethanol) and convey that message to the public which has a different and much broader vision (power, gasification, biogas, biodiesel, etc.).
- Provides critical interchange of information between involved parties.
- Long history of involvement and contacts which allows a potential high level of success.

Weaknesses

- Poor articulation of project goals, and unreasonable time overrun in presentation. Unfair to other speakers.
- Low innovation in chosen activities
- Impact of chosen activities unclear despite the metrics. They've been involved with several projects, but the cause/effect relationship is not there. What evidence is there in the Antares report that can credibly allow credit to be given to the partnership that cannot be attributed to other factors or advocacy groups? Especially in the period described, when biomass was growing? Cause and effect is hard to justify.
- No link to OBP.
- No defined role from DOE

- No breakdown on where money was spent including cost-share information
- Not enough technical support to help manage the R&D part of the projects.
- Too much diffusion of funding to make each state happy.
- Should provide better quality metrics, differentiate short term impacts (1 year) vs longer term (5 yr)
- Did not become a leader in the regions in all cases. DOE needed stronger oversight on personnel selection.
- Should have shown budget distribution.
- Hard to determine goals.
- Mission is somewhat weak – very broad and not easy to clearly define from a reviewer perspective

Technology Transfer/Collaborations

- This is a major strength of the program.
- Excellent
- A lot of partnerships – which is good.

Recommendations for Additions/Deletions to Project Scope

- Expand the partnership by incorporating new stakeholders into program
- Need to review information on PowerPoint slides to make sure it is correct, current and easily explainable
- Need cost-share requirement from DOE and report cost-share requirements from states
- DOE has squandered its opportunity to make and deploy a powerful outreach tool for biomass feedstock, production, and distribution that could have grown federal funding for the Biomass Program.
- DOE needed to identify a HQ leader that could direct the program is a tightly integrated manner with a clear purpose, 2-3 key targets, strategies for achievement, and quantifiable measurement of metrics.
- A powerful program would have prevented the growing earmarks for similar, discrete programs for each state, or even within each state. For example, the earmark money for the IL, KY, and MS outreach funding would have been sufficient.
- Recommend placing a DOE HQ rep and a DOE lab rep – a USDA one would be good as well.

APPENDIX A

Agenda

Denver West Marriott
1717 Denver West Blvd.
Golden, CO 80401 USA
303-279-9100

Day 1 – Wednesday, August 15th

Welcome and Platform Overview		
8:30 – 8:40	Welcome	*Mark Decot, Biodiesel Technologies, Office of the Biomass Program*
8:40 – 8:50	Program Biodiesel Overview	*Bob McCormick, National Renewable Energy Laboratory*
8:50 – 9:00	Process Overview	*Leslie Pezzullo, BCS, Incorporated*

Biodiesel and Fuels Demonstration		
9:00 – 9:20	Session Overview	*Roxanne Dempsey, Golden Field Office*
9:20 – 12:00 (10:20 – 10:30 Break)	Presentations* on Biodiesel and Fuels Demonstration Projects	
	➢ Mississippi State University Sustainable Energy Center (MS)	*William D. Batchelor, Mississippi State University*
	➢ Oxydiesel Demonstration in California and Nevada	*Thomas Sopko, O2 Diesel*
	➢ E-Diesel Test and Research Project	*Nathan Fields, National Corn Growers' Association*
	➢ Missouri Biodiesel Demonstration Project (MO)	*Tom Verry and Jill Hamilton, National Biodiesel Board*
	➢ National Biofuel Energy Laboratory	*Chuck Moeser, NextEnergy*
12:00 – 1:00 Lunch		

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Associated Products, Combined Heat and Power, and Other Technologies		
1:00 – 1:20	Session Overview	*Golden Field Office*
1:20 – 1:50	Presentation* on Products ➢ Canola-based Automotive Oil R&D (PA)	*Ira Pierce, The Green Oil Company*
1:50 – 2:20	Presentation* on Combined Heat and Power Projects ➢ Phillips Biomass CHP Facility	*Carl Nelson, The Green Institute*
	2:20 – 2:30 Break	
2:30 – 3:00	Presentation* on Other Technologies ➢ EERC Center for Biomass Utilization 2005	*Dr. Bruce Folkedahl, University of North Dakota, Energy & Environmental Research Center (EERC)*
	3:00 – 4:00 Break	

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Plenary Session		
4:00 – 5:00	Day 1: Review Chair Report-out and Project Investigator Rebuttals	*Shaine Tyson, Review Chair*
5:00	Adjourn	

Day 2 – Thursday, August 16th

Anaerobic Digestion		
8:30 – 8:50	Session Overview	*Golden Field Office*
8:50 – 10:20	Presentations* of Anaerobic Digestion Projects ➢ Research on Anaerobic Digestion: Optimization and Scalability of Anaerobic Digestion of Mixed High Strength Food Processing Wastes for Renewable Biogas Energy ➢ New York Biomass/Methane Gas Power Fuel Cell Project ➢ Ohio Solid Waste Authority Pyramid Resource Center	*Floyd L. Schanbacher, The Ohio State University Research Foundation* *Dr. Caine Finnerty, Nanodynamics, Inc.* *Tim Berlekamp, Solid Waste Authority of Central Ohio (SWACO)*
10:20 – 10:30 Break		

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Communications, Outreach, and Partnerships		
10:30 – 10:50	Session Overview	*Golden Field Office*
10:50 – 1:50 (11:50 – 12:50 Lunch)	Presentations* of Communications, Outreach, and Partnerships Projects ➢ New Uses Information and Entrepreneur Development ➢ Alternative Energy Enterprise Program ➢ Kentucky Rural Energy Supply Program ➢ Regional Biomass Programs: · Coalition of Northeastern Governors · Council of Great Lakes Governors · Southeastern Biomass State & Regional Partnerships · Western Governors' Association	*C. Mark Williams, Growth Dimensions, Inc.* *Sumesh Arora, Mississippi Technology Alliance* *Cameron Metcalf, University of Louisville Research Foundation, Inc.* *Rick Handley, CONEG Policy Research Center, Inc. and Frederic Kuzel, Council of Great Lakes Governors*
2:20 – 3:15 Break		

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Plenary Session		
3:15 – 4:15	Day 2: Review Chair Report-out and Project Investigator Rebuttals	*Shaine Tyson, Review Chair*
4:15	Adjourn	

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Mark Decot)
Please copy Harriet Foster (harriet.foster@ee.doe.gov)

You have been invited to serve as a Reviewer for the DOE Thermochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	No
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Technical Area or Project on Review Agenda	Nature of conflict of interest (Leave blank if none)

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Mark Decot (202-586-6501) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

______________________________ ______________________

Signature Date

____

Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session: ☐2 ☐3 ☐4 **Reviewer Name**: ____

Title of Project: ____

Presenter Name: ____

Reviewer Self Assessment of Subject Knowledge (Circle One)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ____

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan or the missions and objectives of USDA Programs, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments:
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach to Performing the R&D.**

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments:
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE or USDA goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments:
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments:
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research Approach and Relevance** (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments:
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

U.S. Department of Energy
Office of the Biomass Program
Feedstock Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Feedstock Platform Portfolio Peer Review held on August 21st through 23rd in Washington D.C.

The work evaluated in this document supports DOE, and the results of the review are major inputs used by the Department in making future funding decisions.

The projects were presented to the reviewers organized by the type of Feedstock R&D activity they supported (i.e. supply and sustainability; logistics; and systems integration). The platform review agenda is included in Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four-point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The name of the reviewer who provided the individual comments will remain anonymous.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Sam Tagore
Technology Manager – Feedstocks R&D
DOE/EERE, Office of the Biomass Program

Project Title	Relevance	Approach	Progress	Success Factors	Future Plans	Average
Feedstock Supply System Design Report	4.00	4.00	4.00	3.67	3.25	3.78
Feedstock Logistics - Storage & Queuing	4.00	3.33	3.50	3.50	3.75	3.62
University of TN Switchgrass Demonstration Project	3.75	3.67	3.75	3.67	3.25	3.62
Feedstock Logistics - Harvest & Collection	3.75	3.75	3.75	3.25	3.50	3.60
Feedstock Logistics - Preprocessing	3.75	3.75	3.50	3.50	3.50	3.60
Biomass Resource Supply Analysis	3.75	3.75	3.50	3.33	3.33	3.53
GIS-Based Biomass Resource Sustainability	4.00	3.75	3.25	3.00	3.50	3.50
Feedstock Logistics - Handling & Transport	3.50	3.75	3.25	3.25	3.25	3.40
Alternative Fuel Source Study	3.00	3.33	3.67	3.67	3.33	3.40
Regional Biomass Energy Feedstock Partnerships	3.50	3.50	3.00	3.50	3.00	3.30
Supply System Logistics	3.00	2.67	2.67	2.67	2.67	2.73
MSU Sustainable Energy Center	2.75	2.25	2.50	2.25	2.50	2.45

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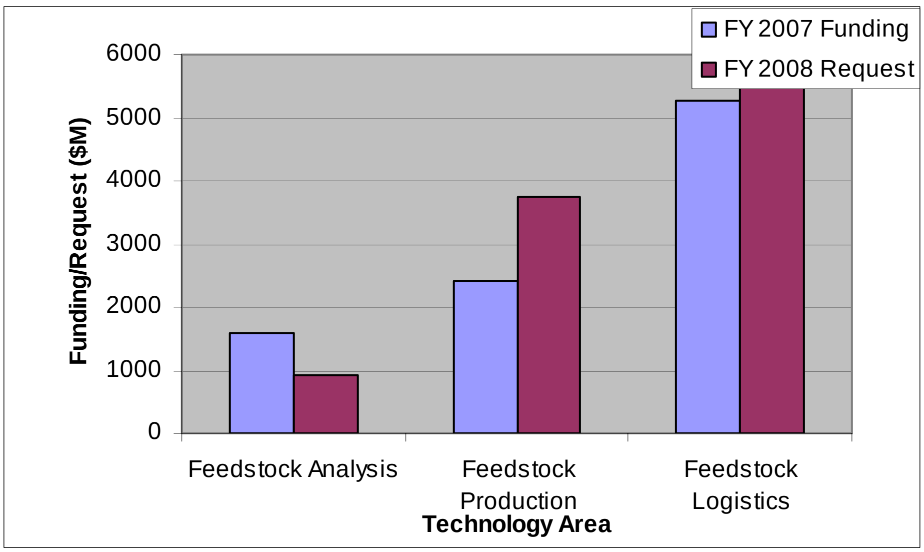
Program Peer Review Platform Results

Platform Direction

In FY2008, the Feedstock Platform will continue work through the Regional Feedstock Partnerships and/or by leveraging OBP biorefinery demonstration projects to conduct large crop demonstration trials in order to collect more realistic feedstock production data, ultimately leading to more informed decision-making regarding specific energy feedstocks on which to focus programmatic efforts. By the end of FY2008, the platform will have also completed the first phase of the GIS-based resource assessment tool, which will also better inform platform and programmatic decision-making. Finally, in FY2008, the platform will release a solicitation for industrial-scale feedstock logistics projects, which will help lower feedstock costs.

Platform Funding (in $M)



Specific Responses to Select Comments

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
• Well directed and well focused. Strong teams working on gathering this important information. • As explained, the parts of the platform are working together well and are logically derived. • The program is making progress on complex issues. The realization that a diversity of feedstocks is needed to fulfill program goals is positive. This will be important in regions outside the Midwest. • Good organization using good science. Work at INL on storage and queuing as well as harvest and collection appears to be on target.		The TM appreciates the reviewer's comments regarding the overall strength of the Feedstock Platform in terms of being well directed, organized, and focused. The TM further acknowledges the good work at INL. Further, the TM recognizes the challenges that lie ahead, particularly outside of the Midwest.

Work at INL on storage and queuing as well as harvest and collection appears to be on target.		Same comment for INL as above.
• Not enough switch grass has been collected to get a handle on real cost. The fertilizer the biomass removed does not appear to be factored into the cost of the biomass. Current phosphate, nitrogen and potassium costs are significant. • The real cost of biomass has not been convincingly determined. • Scaling up to handle corn stover will create new challenges. Need to lay out a plan now.		Only under the Charitan Valley project was switchgrass collected in sufficient quantities to provide meaningful costs. Fertilizer costs are figured into feedstock production estimates, but are not included under the feedstock logistics element. The TM agrees that corn stover represents some new challenges. It is planned that corn stover logistic costs and operations will be developed in conjunction with appropriate 932 or 10% validation integrated biorefinery projects, and their industrial partners.
• I appreciate the Program's (and platforms) growing consideration of sustainability issues. I think that many of the issues which may emerge have readily available answers, but the Program and Department need to be prepared to respond when questions are raised. An example is the realm of nitrogen and phosphorus contamination of water. In the short realm, there are concerns about the expansion of corn production for biofuels. However, there are long-established production practices and agronomic research which can be implemented in production to mitigate these concerns (if implemented). Also, a sustainable harvesting technique to protect soil carbon levels may assist (but will not completely mitigate) this effort. Additionally, a long-term shift to perennial crops may involve dramatically lower nitrogen and phosphorus needs, depending on the crop species selected and the production practices which emerge. Some research on these emerging species is needed, but likely would not take much effort. • The gaps identified by the review team are OK, but they do not go far enough. The yield productivity anticipated by the Billion Ton Study requires sustained funding of genetics and breeding programs across most production areas. Likewise, there is an urgent need for longer term sustainable production research.		The TM appreciates the reviewers' comments pertaining to sustainability issues. Under the feedstock umbrella, sustainability practices will be developed and supported. As the reviewers suggest, some long-established practices should be implemented to mitigate concerns. Under the regional feedstock partnership effort (launched in 2007-2008), the Program will foster the development and adoption of more advanced sustainable agronomic and silvicultural practices. While the platform supports perennial energy crops, in part because of their intrinsic sustainable root profile, the program will encourage the sustainable production of feedstocks among all of the different feedstock pathways. The DOE feedstock platform acknowledges that it will probably not have the fiscal resources for sustained funding of breeding and genetics across most production areas, but believes that USDA, land grants, and private companies will engage in this area to help meet the Billion Ton vision.
Critical concern for separation of biomass components must be reviewed with appropriate scientists and engineers. Perhaps this area is for early treatment studies; however, some separation may be accomplished in the field.		This concern calls for synergy between the feedstock platform and conversion platforms, as well as integrated biorefineries. The feedstock platform will pursue this avenue.
• Lack of industry partnership/involvement. Lack of clarity as to how DOE and DOA activities are complimentary/synergistic. • It screams for DOE and USDA involvement that don't appear to be happening sufficiently		FY 2008 is the first year that the Feedstock Platform will have sufficient funds to procure funds for industrial partnerships. The Biomass R&D Board has established a feedstock interagency working group between USDA and DOE (and other agencies) to enhance interagency coordination.

The need for life cycle analyses likewise is an important area for attention. Increasingly, the science of environmental analysis is focused on this methodology, as are international corporate social reporting standards. I don't have the resources/information to analyze the recommendation to resolve different cost targets; however, it was reported that this effort has already progressed. Similarly, I don't feel prepared to comment on the econometric recommendation. The comment that the platform should conduct statistic analysis on yield trials is worthy of attention from the Program. Yield variability is a fact of life and is well document for grain crops.		Life cycle analyses are now required as part of the implementation of the recently signed Energy Independence and Security Act of 2007. The comment of statistical validity of crop trials is well taken; and an individual with a strong statistical base will help design the crop trials that will be planted during the 2008 growing season. The "Uniform-Format Feedstock Supply System Design for Lignocellulosic Biomass" (November 2007) by INL provides a better basis for developing cost targets.
If giant biorefineries are needed in order to obtain low operating costs, logistics is crucial. That critical weakness in the Program justifies research to identify conversion technologies that can operate at acceptable cost at smaller scale (thermochemical processing is one option). Pyrolysis oil is much more energy-dense than wheat straw. A number of feedstocks were identified (MSW, forest residues) were identified that are quite different from wheat straw, and will have quite different handling, storage, and pretreatment needs. They will broaden the research challenges even more than corn stover will.		There are many potential alternative biorefineries at different scales. The 932 and 10% validation solicitations should provide different scenarios with a broad range of feedstocks. Where possible, the feedstock platform will interact with these industrial partners to develop acceptable feedstock logistics.
A critical area of interest for accomplishing the overall goals with respect to conversion of cellulose (and perhaps hemicellulose at a later date) is procurement of feedstocks. Considerable discussion has occurred about source of material as well as delivering functional, microorganism free fiber. However, minimal data are available for ascertaining realistic economic numbers with respect to possible tons to be delivered during the next five years. Also, conflicting information has been presented with respect to cost/ton delivered. A specific area of need is for appropriate interagency personnel involvement for convincing growers (farmers) to select change with little enticement for: • Sale of present planting, tilling and harvesting equipment and purchase of needed equipment; however, necessary modifications to possible equipment have not been achieved. • Ability to collect straw, stover, corncobs etc without contact with the soil (which will result in hydration as well as bacterial and fungal contamination • Storage sites and equipment • Equipment to transport chips, straw, stover etc, which often is ¼ the density of cereal grains and debarked trees.		The TM agrees with the reviewers that appropriate interagency personnel are needed to interact with the growers. The regional feedstock partnership will develop extension opportunities to help address this need. The feedstock platform will also explore various feedstock scale-up projects that already receive State and private financing for leverage opportunities to help convince growers. In addition, it is anticipated that the upcoming Farm Bill may provide enticements for growing energy crops.

A major need is to identify opportunity costs of fiber production. Tons/acre often do not encompass duration from planting to harvesting, altering soil quality, need for nutrient replacement or productivity of land utilized. Duress to plants grown without pesticide protection, adequate nutrients and concern of harvesting time is paramount; this may result in plant chemical production and/or cohabitation with fungi to produce appropriate chemical compounds to repel predators. Cooperation with machinery manufacturers should proceed early in the overall game plan, rather than after arbitrary decisions on source materials have been made. Subsequent to elucidating enhanced value of current products or value of to be identified fractionated products, contact can be initiated with possible agricultural and forest producers. Questions about drying of material in the field or forest need to be identified and answered. Harvesting dates and methods will be site specific, e.g., dry air in KS is a bit different than wet air in SD; also, ability to harvest without deleterious effects on soil quality must be delineated		The reviewer comments point to a need for a greater understanding of plant requirements during its life cycle, the importance of machinery manufacturers to improve the source materials and appropriate fractionation of the products, the importance of drying in the field and forest, and the potential to cause deleterious effects on the soil through the harvesting cycle. These are all important considerations for the feedstock platform.
I would have appreciated hearing about the Regional Biomass efforts in conjunction with this platform. I understand that this is a new endeavor, but the presentation on Thursday afternoon about the NW regional study seemed to indicate that there are opportunities in this realm.		Sorry the Regional Biomass efforts were not better explained in the full program review, but this is a relatively new effort and will be much more fully covered in the next peer review meeting.

Program Review Comments

Strengths

- Well directed and well focused. Strong teams working on gathering this important information.
- As explained, the parts of the platform are working together well and are logically derived.
- The program is making progress on complex issues. The realization that a diversity of feedstocks is needed to fulfill program goals is positive. This will be important in regions outside the Midwest.
- Good organization using good science. Work at INL on storage and queuing as well as harvest and collection appears to be on target.
- Work at INL on storage and queuing as well as harvest and collection appears to be on target.
- The platform has identified the key areas necessary to achieve program goals.

Weaknesses

- Not enough switch grass has been collected to get a handle on real cost. The fertilizer the biomass removed does not appear to be factored into the cost of the biomass. Current phosphate, nitrogen and potassium costs are significant.
- It screams for DOE and USDA involvement that don't appear to be happening sufficiently.
- I appreciate the Program's (and platforms) growing consideration of sustainability issues. I think that many of the issues which may emerge have readily available answers, but the Program and Department need to be prepared to respond when questions are raised. An example is the realm of nitrogen and phosphorus contamination of water. In the short realm, there are concerns about the expansion of corn production for biofuels. However, there are long-established production practices and agronomic research which can be implemented in production to mitigate these concerns (if implemented). Also, a sustainable harvesting technique to protect soil carbon levels may assist (but will not completely mitigate) this effort. Additionally, a long-term shift to perennial crops may involve dramatically lower nitrogen and phosphorus needs, depending on the crop species selected and the production practices which emerge. Some research on these emerging species is needed, but likely would not take much effort.
- Scaling up to handle corn stover will create new challenges. Need to lay out a plan now.
- Critical concern for separation of biomass components must be reviewed with appropriate scientists and engineers. Perhaps this area is for early treatment studies; however, some separation may be accomplished in the field
- Lack of industry partnership/involvement. Lack of clarity as to how DOE and DOA activities are complimentary/synergistic.

R&D Portfolio Gaps

- I agree with the gaps assessment which was identified.
- The gaps identified by the review team are OK, but they do not go far enough. The yield productivity anticipated by the Billion Ton Study requires sustained funding of genetics and breeding programs across most production areas. Likewise, there is an urgent need for longer term sustainable production research.
- The real cost of biomass has not been convincingly determined.
- As noted above, I agree with the need for sustainability attention. The need for life cycle analyses likewise is an important area for attention. Increasingly, the science of environmental analysis is focused on this methodology, as are international corporate social

reporting standards. I don't have the resources/information to analyze the recommendation to resolve different cost targets; however, it was reported that this effort has already progressed. Similarly, I don't feel prepared to comment on the econometric recommendation. The comment that the platform should conduct statistic analysis on yield trials is worthy of attention from the Program. Yield variability is a fact of life and is well document for grain crops. It will surely be an issue in future feedstocks.

- If giant biorefineries are needed in order to obtain low operating costs, logistics is crucial. That critical weakness in the Program justifies research to identify conversion technologies that can operate at acceptable cost at smaller scale (thermochemical processing is one option). Pyrolysis oil is much more energy-dense than wheat straw. A number of feedstocks were identified (MSW, forest residues) were identified that are quite different from wheat straw, and will have quite different handling, storage, and pretreatment needs. They will broaden the research challenges even more than corn stover will.
- A critical area of interest for accomplishing the overall goals with respect to conversion of cellulose (and perhaps hemicellulose at a later date) is procurement of feedstocks. Considerable discussion has occurred about source of material as well as delivering functional, microorganism free fiber. However, minimal data are available for ascertaining realistic economic numbers with respect to possible tons to be delivered during the next five years. Also, conflicting information has been presented with respect to cost/ton delivered. A specific area of need is for appropriate interagency personnel involvement for convincing growers (farmers) to select change with little enticement for:
  - Sale of present planting, tilling and harvesting equipment and purchase of needed equipment; however, necessary modifications to possible equipment have not been achieved.
  - Ability to collect straw, stover, corncobs etc without contact with the soil (which will result in hydration as well as bacterial and fungal contamination
  - Storage sites and equipment
  - Equipment to transport chips, straw, stover etc, which often is ¼ the density of cereal grains and debarked trees.
- A major need is to identify opportunity costs of fiber production. Tons/acre often do not encompass duration from planting to harvesting, altering soil quality, need for nutrient replacement or productivity of land utilized. Duress to plants grown without pesticide protection, adequate nutrients and concern of harvesting time is paramount; this may result in plant chemical production and/or cohabitation with fungi to produce appropriate chemical compounds to repel predators. Cooperation with machinery manufacturers should proceed early in the overall game plan, rather than after arbitrary decisions on source materials have been made. Subsequent to elucidating enhanced value of current products or value of to be identified fractionated products, contact can be initiated with possible agricultural and forest producers. Questions about drying of material in the field or forest need to be identified and answered. Harvesting dates and methods will be site specific, e.g., dry air in KS is a bit different than wet air in SD; also, ability to harvest without deleterious effects on soil quality must be delineated.

Additional Recommendations, Comments and Observations

- I would have appreciated hearing about the Regional Biomass efforts in conjunction with this platform. I understand that this is a new endeavor, but the presentation on Thursday afternoon about the NW regional study seemed to indicate that there are opportunities in this realm.

Specific Responses to Select Comments

Platform Peer Review		
Reviewer Comment		**Technology Manager Response**
The Feedstock Platform has developed a sound plan to address the Administration's current goals.		The TM, on behalf of the Feedstock Platform, greatly appreciates the reviewer comment.
• Coordination between multiple agencies/stakeholders is improving. Cooperation with Extension is identified as a need to be addressed and can be strengthened by consistent funding. • Progress is being made across a variety of complex issues. The tools being developed by platform R&D have the potential to be widely applicable to existing and future industry. • There is a need for enhanced coordination with USDA, the Sun Grant Initiative, etc. on breeding timelines.		The TM appreciates all of these comments from the reviewers. The TM is also cognizant that there is an enhanced need for coordination among DOE, USDA, the Sun Grant Initiative, etc. on breeding timelines as well as other crop development activities.
• The means to address issues of sustainability (such as soil carbon) have begun to be identified, but not yet to the full extent necessary. • Life cycle analysis in the feedstock platform is encouraged. • There is an ongoing need to understand competing food, feed, and fuel interactions while maintaining global economic and environmental sustainability. • The largest portfolio gap is in looking at opportunity costs of increasing the use of agricultural products for fuel and the impact on soil quality and productivity, as well as pest and disease pressure, by shifting agricultural practices.		The Feedstock Platform agrees with regard to the increasing importance of sustainability, life cycle analysis, and macro economic issues such as the food versus fuel. The Billion Ton vision was produced with the consideration that biofuels would be produced in a sustainable way and not have a major negative impact on food markets. However, there may always be some tradeoffs. Public policy will sort these out to some degree and it is important for the program to scientifically-based information to help address these important issues.
The diversity of the feedstock pathways that have been funded is positive.		The program appreciates this comment. Portfolio management has been a challenge.

• There is a need to resolve cost targets and estimates between the design report (as reported by Richard Hess) and the IBSAL model (as reported by Shahab Sokhansanj). • Many of the cost models used by the Platform have econometric implications, and therefore need to reflect market implications and include an estimate of accuracy.		Reported cost discrepancies between IBSAL and the Uniform Format Design (UFD) are the result of differences in assumed cost and performance parameters (e.g., machine lifetime, annual hours, travel speed, field efficiency, etc.). IBSAL uses standard ASABE/ANSI costing methodology and data as the source for these cost and performance parameters, whereas the UFD analysis used the best available data including field/lab data, manufacturer/dealer estimates, operator estimates, and ASABE/ANSI methods and data. To resolve these differences, the costing methodology will be updated to include the use of nonstandard (i.e., "best available) data for assessing unique feedstock designs. This provides a common method for insuring that all modeling efforts are using the same cost estimating methods regardless of the data source, and that the UFD, as well as other innovative supply system designs, will interface seamlessly with the IBSAL computational engine.
The Platform needs to accumulate and conduct statistical analysis of yield trials		The Program agrees and has insisted that someone with statistical expertise be added to the energy crop team.

General Platform Comments

- The Feedstock Platform has developed a sound plan to address the Administration's current goals.
- Progress is being made across a variety of complex issues. The tools being developed by platform R&D have the potential to be widely applicable to existing and future industry.
- Coordination between multiple agencies/stakeholders is improving. Cooperation with Extension is identified as a need to be addressed and can be strengthened by consistent funding.
- The means to address issues of sustainability (such as soil carbon) have begun to be identified, but not yet to the full extent necessary.
- Life cycle analysis in the feedstock platform is encouraged.
- The diversity of the feedstock pathways that have been funded is positive.
- There is a need to resolve cost targets and estimates between the design report (as reported by Richard Hess) and the IBSAL model (as reported by Shahab Sokhansanj).
- Many of the cost models used by the Platform have econometric implications, and therefore need to reflect market implications and include an estimate of accuracy.
- The Platform needs to accumulate and conduct statistical analysis of yield trials.

General Comments (applicable to all presentations)

- Overall it is apparent that the stage gate review methodology is still being learned by Program collaborators.

General Comments (on multi-agency issues)

- There is an ongoing need to understand competing food, feed, and fuel interactions while maintaining global economic and environmental sustainability.
- The largest portfolio gap is in looking at opportunity costs of increasing the use of agricultural products for fuel and the impact on soil quality and productivity, as well as pest and disease pressure, by shifting agricultural practices.
- There is a need for enhanced coordination with USDA, the Sun Grant Initiative, etc. on breeding timelines.

Feedstock Supply & Sustainability Projects

Project Title: Biomass Resource Supply & Sustainability Analysis
Project Investigator: Bob Perlack, Oak Ridge National Laboratory and Tris West, Oak Ridge National Laboratory

Strengths
- This project is critical to future feedstock efforts.
- There is depth of thought around linkages and a commitment to good data.
- The tool is flexible and able to integrate data from multiple sources.
- There is a strong link between this project and other programs (i.e. IBSAL, ORIBAS, POLYSYS).
- Project performers have a good understanding of the data available and computational requirements.
- This is a good communication tool as well as an analysis tool.

Weaknesses
- Project performers need to verify the benefits of using 30m resolution.
- The year to year variability of the data being used could become an issue.
- The tool is not yet open source.
- Project performers need to increase attention to soil erosion data set.
- The Platform needs to ensure quality control of the model through continued funding.
- This project will require several years of data to reduce the uncertainty of estimates being used.

Comments
- The tool should be designed to capture year to year (or seasonal) variability.
- Soil carbon and denitrification data should be added to the project.
- There needs to be confirmation that there are enough local people to supply data to the project.
- Potential production vs. farmer acceptance is a concern.

Project Title: Regional Biomass Energy Feedstock Partnerships
Principal Investigator: Jim Doolittle, SDSU (with Terry Nipp, National Sun Grant and Kevin Kephart, SDSU)

Strengths
- The project brings local involvement and ground-truthing into the portfolio.
- Land Grant universities have a high amount of credibility, are an unbiased source of information for farmers, and have a proven record of introducing new technologies.

Weaknesses
- Sun Grant universities may not be as equipped to address forest residue issues as other organizations.

- The Sun Grant initiative is broader than the Feedstock Platform's and may at time conflict. However, there are also many synergies and alignment of objectives.

Comments
- Progress within the Sun Grants has been slow, potentially due to lack of consistent funding.
- Project performers need to ensure communication between all Sun Grant centers and/or other portfolio initiatives.
- There needs to be continuous monitoring of the link between local Extension and Land Grants.

<u>Project Title: Mississippi State University Sustainable Energy Center</u>
Principal Investigator: Michael Collins, MSU

Strengths
- An initial screening trial of potential feedstocks has been completed.

Weaknesses
- Geographic coverage is narrow; the results are not applicable to a larger region and are in some cases below economic size.
- Longer term studies are needed to address the sustainability of double-cropping oil seeds.
- Project results would be improved if research design considered factors relevant to the use of biomass in subsequent processes.
- The research design, as reported, lacked measurable outcomes.
- Increased communication with other Feedstock Platform elements is needed.
- A more rigorous agronomic design would improve the quality of project results.

Comments
- The project would benefit from an independent review from ORNL/INL experts to ensure the funded work has broad applicability (possibly should be incorporated with the RFP).

<u>Project Title: Switchgrass Demonstration Project</u>
Principal Investigator: Burt English, University of Tennessee

Strengths
- The project incorporates a good agronomic design.
- The project will be able to affect change at the grassroots level.
- The project uses a rational approach to introducing an entirely new crop to the region.
- This is a high-risk project that has gotten good results.

Weaknesses
- The selection of pyrolysis as a downstream processing area of research is questionable.
- The addition of a chemical processing expertise would benefit the project.

Comments

- Some of the lessons learned on this project should be shared with other Sun Grant regions.

Project Title: Alternative Fuel Source Study
Principal Investigator: Ralph Zee, Auburn University

Strengths
- The project includes a cooperative and committed industrial partner.
- A wide variety of alternative fuels are tested (though this may not address the Platform focus).
- Project performers recognize the need for a bench-scale burn simulator.
- Quantification of the limits of fuel substitution has been addressed (phosphorus and chlorine).

Weaknesses
- Generic economic data and/or project drivers/context would have been useful.
- Some of the feedstocks used may not be available for free beyond this project.
- More explanation of the significance of emission results would be helpful.

Comments
- Project performers have infectious enthusiasm.

Feedstock Logistics Core R&D Projects

Project Title: Harvest and Collection
Principal Investigator: Kevin Kenney, Idaho National Laboratory

Strengths
- Good fundamental study.
- Detailed, high-quality engineering and cost analysis associated with the project.

Weaknesses
- Project needs more inclusion of existing technologies for densification.

Comments
- Should assess the nutrient impact of fractionation, including denitrification.
- Further development of the single pass approach to fractionation is needed.

PI Response
- Reviewer Item: "Need more inclusion of existing technologies for densification"
  - Response: There are indeed many existing technologies and processes for densifying biomass, primarily for the feed industry. The results of a literature review were briefly discussed in the presentation, but since the technology to densify crop residues within the engineering limits posed by a harvesting machine does not exist today, the presentation focused more on the deficiencies of current technologies rather than the opportunities to learn from existing technologies. Successful development of densification process suitable for integration with single-pass harvest

technology will certainly require inclusion of existing technologies, and as we progress with this task considerable attention and effort will be devoted to this issue.

- Reviewer Item: “Nutrient impact of fractionation including denitrification”
    - Response: The nutrient impact of fractionation is a major focus of a current stover removal project involving the INL, Iowa State University and the National Soil Tilth Lab. A paper discussing this issue has been published per the following reference:
    - Hoskinson RL, Karlen DL, Birrell SJ, Radtke CW, and Wilhelm WW. Engineering, nutrient removal, and feedstock conversion evaluations of four corn stover harvest scenarios. Biomass and Bioenergy 2007;31:126-136.
    - This publication represents data and findings from the first year of the project, and the project is currently approaching the third harvest season of the study.

- Reviewer Item: “Further development of single pass approach to fractionation needed”
    - Response: Since the single-pass fractionation material presented focused on small grain crop residues, I assume this comment is referring to the single pass fractionation of corn stover. Single-pass fractionation of corn stover would certainly require a different approach than that presented for small grain residues, since unlike cereal residues, not all of the corn stover passes through the harvester during grain harvest. This issue is being addressed on two separate fronts. First, the INL is involved with a stover removal project involving Stuart Birrell at Iowa State University and Doug Karlen at the National Soil Tilth Laboratory. This project is evaluating different stover harvest scenarios, and evaluating the impacts on machine performance as well as agronomic impacts. Secondly, plans for another project to evaluate yield potential, moisture and complete stover mass balance for material other than grain (MOG) collection with typical grain combine configurations is being planned, and these plans were presented in one of the slides titles “Path Forward.” This project will establish baseline data that will help drive the engineering systems for single pass approach to corn stover harvest, including fractionation based on either compositional differences or moisture differences of the stover fractions.

<u>Project Title: Preprocessing</u>

Principal Investigator: Chris Wright, Idaho National Laboratory

Strengths

- Good framework for investigation.
- Detailed, high-quality engineering and cost analysis associated with the project.

Weaknesses

- There is a need for further investigation of existing engineering aspects of grinding technologies.
- The project performers should investigate shear shredding as a grinding option.

Comments

- Grinding is a size preparation step that may be specific to bioconversion. For thermochemical conversion, other methods of densification and size modification may be appropriate.

PI Response

- Reviewer Item: “Need further investigation of existing engineering aspects of grinding technologies”
  - Response: This is a very relevant comment based on the general maturity of the grinding industry. As the INL preprocessing task moves forward, particularly in conjunction with grinding industry partners, a more focused effort to identify current grinding technologies that may impact the size reduction and densification of a wide variety of biomass feedstocks will occur. This effort will primarily rely on the expertise of INL partners and other research organizations, which have tested preprocessing equipment, because of their intimate knowledge of grinding processes. The preprocessing task will document these technologies and their implementation into a grinding system as part of the FY08 preprocessing hardware development and fundamental bulk biomass characterization subtasks.

- Reviewer Item: “Should investigate shear shredding as a grinding option.”
  - Response: This identified weakness is very perceptive on the part of the reviewers, since INL/ORNL researchers and their industrial partners have identified shear forces as key parameters in the development of herbaceous biomass grinder designs. The INL full-scale grinding test plan (delivered as an E-level milestone in May 2007) identifies research scope that will evaluate shear grinding designs as they apply to current industrial machines. As the INL preprocessing task continues in FY08 with different industrial partners, the scope of the work will include using grinding designs that incorporate significant shear force characteristics.

- Reviewer Item 1, investigation of existing grinding technologies, and Reviewer Item 2, investigation of shear shredding options, will be two of the basic guidelines for FY08 and FY09 biomass feedstock preprocessing validation and prototype development scope.

<u>Project Title: Storage and Queuing</u>
Principal Investigator: Corey Radtke, Idaho National Laboratory

Strengths
- Project considers qualities that are not normally considered in this type of analysis (i.e. fundamental biochemistry and biophysics; water activity for example).
- Detailed, high-quality engineering and cost analysis associated with the project.

Weaknesses
- There is a need to identify the health risks associated with storage activities.
- There is a need for better definition of the current state of dry storage.

Comments
- The “revolution not evolution” approach is interesting.

<u>Project Title: Handling and Transport</u>
Principal Investigator: Judy Partin, Idaho National Laboratory

Strengths
- Impressive instrumentation.
- Project assesses state of the art science.

- Important characterization of data is not readily available.

Weaknesses
- Would like to have heard abrasiveness data in the presentation.
- Characterization should be developed with equipment manufacturers.
- Problems need to be defined more clearly (i.e. designing trucks for unloading).

Comments

- The most suitable application may be in the hoppers and loading/unloading aspects of transportation.
- Rheological data for biomass slurries is lacking and needed in processing, and could be supplied by this project.

PI Response
- Reviewer Item: “would like to have heard abrasiveness data”
    - Response: The PI does recognize the need for this type of data and has included it in recent status reports as a parameter of significant interest in the design of pipeline conveying systems. Since the design and testing of these advanced systems is not scheduled to begin until FY-08, this work has not yet been initiated. We have, as part of our fundamental rheology task, looked into various types of wear testers. In particular, we have looked at some rotational shear testing systems that could be used to evaluate abrasion. We are also familiar with the wear tester used by Jenike and Johanson, Inc. Again, as with our other property characterization techniques, we are looking at adapting these measurement systems so that they can be used over a range of compaction pressures, particle sizes, and size distributions. In light of the reviewer comments, we will expedite completing the design and fabrication of our measurement system so we can initiate this data collection.

- Reviewer Item: “should develop characterization with equipment manufacturers”
    - Response: The PI agrees that collaborating with industry is very important to the success of the project and should be pursued at every opportunity. Prior to initiating the rheological experiments, the project personnel had multiple interactions with Mike Belingheri of Johanson Innovations, Inc. and Lee Dudley and Kristin O’Quest of Diamondback Technology, Inc. These interactions included the exchange of sample materials for testing and helped shape the testing protocols and approaches used in our work. In particular, in view of their independent test results, we decided to not purchase a commercial hang-up indicizer, but rather build our own system adapting concepts used in the commercial device and reported in the literature.

      The project work which supports aspects of harvesting and collection, preprocessing, and storage is leveraged by a number of industrial partnerships that are associated with these efforts. In particular, a consulting contract with Diamondback Technology is providing specific input to the harvesting and collection task and feedback on the use, and limitations, of rheological property attributes for the design of various handling and conveying systems. And, while we do not yet have formal relationships, we have interacted with a number of equipment consultants and vendors in the areas of material compaction and pumping to collect valuable data and insight for use in the design and evaluation of advanced systems.

- Reviewer Item: “Need to define problems more clearly (i.e. designing trucks for unloading)”
    - Response: The PI admits that in presenting the overview emphasizing the rheological property testing some of the project scope described in the work plan may not have been conveyed to the reviewers very effectively. The initial focus of the work is to obtain physical and rheological property data that will allow us to understand how these properties impact the capacity, efficiency, and in some cases, the quality of the various feedstock assembly operations, including loading and unloading trucks. This data will then be used to help us develop material formats and modify assembly processes to optimize these operations.

      For example, in the case of transporting materials via truck, we know the material bulk density we need to achieve the maximum load limits for different handling scenarios. We also know from our testing the pressure required to produce that bulk density for a particular biomass material and screen size. Consequently, one of our project tasks is looking at the efficiency, capacity, and cost of compacting auger and tamping systems that could compress feedstock materials of a particular grind fraction to the desired density as part of the truck loading operation. In addition, we have measured the material consolidation strength as a function of particle size and compaction force, and from this data we can determine the properties of the feeder systems used in the operation. In some cases, we know the hang-up potential due to material strength will require us to use live-bottom, or other active, means of unloading the material from the truck once it is compacted. Any losses in handling efficiency, or added equipment cost, will be assessed and used to determine if the compaction of feedstocks using these types of techniques has the potential to reduce the cost of truck transportation systems.

      We envision that as we continue to collect property data as function of the various assembly operations, and investigate scenarios for manipulating those properties to increase handling capacities and efficiencies, we will be able to define the material properties, or format, that will lead to both optimizing the feedstock assembly operation and standardizing the feedstock commodity delivered to the plant.

Feedstock Systems Integration Projects

Project Title: Development of Engineering Data for Feedstock Supply Operations/Supply System Logistics
Principal Investigator: Shahab Sokhansanj, Oak Ridge National Laboratory

Strengths
- Good attack on a challenging problem.
- Integration of INL work.
- Useful tool for normalizing and sharing information.

Weaknesses
- Complexity of the model may end up masking potential inaccuracies.

Comments

- Model validation and verification are essential to the project and should be a focus in later presentations.
- Linking the model with GIS could be challenging.
- The model needs to include a range of accuracy or error bars.

Project Title: Feedstock Supply System Design Report
Principal Investigator: Richard Hess, Idaho National Laboratory

Strengths
- Depth & breadth of the analysis provided.
- Organization & clarity of the project are positive.
- Some cost targets have been met (i.e. Idaho straw).

Weaknesses
- There is a need more flexibility of separating biomass for thermo- or biochemical conversion.
- There is a need to tap further into existing outside expertise.

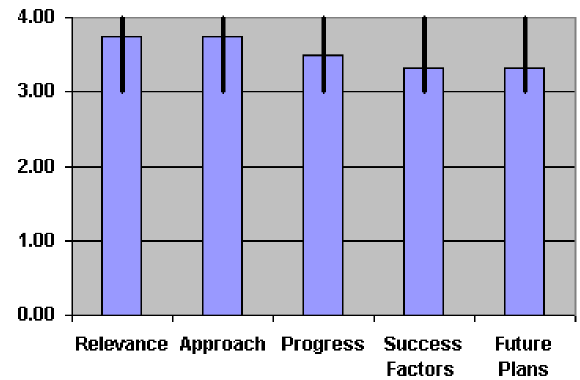
Comments
- The portion of DDGs considered cellulosic should be clarified.
- It is difficult to evaluate multi-year project when only one year of project milestones is presented (timeline would be helpful).
- Wet storage may be the mostly costly logistics element & therefore may require additional resources – other parts of the program should work to assist this portion (i.e. selection strategy, address downstream costs, depot concept).

Full Reviewer Comments and Scores

Feedstock Supply & Sustainability Projects

<u>Project Title: Biomass Resource Supply Analysis</u>
<u>Principal Investigator:</u> Bob Perlack, Oak Ridge National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.75	0.75	0.25
Approach	3.75	0.75	0.25
Progress	3.50	0.50	0.50
Success Factors	3.33	0.33	0.67
Future Plans	3.33	0.33	0.67
Average	**3.53**		



Question 1: Relevance to Overall Objectives

- This project is critical to all future biomass program projects.
- GIS Analyses are CRITICAL, as distances=dollars, and are critical for overall sustainability (long-term). This is a positive aspect of the modeling.
- This project covers some projects that are clearly needed area of analysis.
- Sustainability has not been addressed, as yet. This cannot be added as an afterthought. You've got to build it in from the beginning.
- Good approach and pretesting.
- Good tool for managing resource data and issues.
- This is highly useful work, in that knowing the feedstock
- Potential is key to forecasting bioenergy success.

Question 2: Approach to Performing the R&D

- Well thought out, but a big job. Is 30 meter scale really needed? Even if the data are free, there is a cost to utilize such a vastly larger amount of information.
- Using NASS data has problems. I have hit this myself. Yet, it is critical.
- Resource availability and costs of production are crucial elements to model. This seemed to be a real strength of the program.
- The County level scale is not a bad way to go.
- The amount of data and use of the database presented shows thorough pretesting has been done.
- The real challenge is getting and verifying low level data from the field. 30 m may be too ambitious.
- Nutrient replacement cost work should be expanded to look at how much of the nitrogen in the stover/straw actually gets into next year's crop, vs. being lost in denitrification. This will vary by region. A model was developed, I think by Michigan State, to model denitrification. Bruce Dale would be one contact regarding this model.
- Store multiyear data so stochastic modeling can eventually be related to actual historical data.
- I assume that the model can be expanded to include specific properties for biomass, e.g. alkali content of straw.

Question 3: Technical Accomplishments and Progress

- The conclusion of 1.3 billion tons of resources is a bit optimistic. I am not against biofeedstock use and development. However, I am concerned that there was not more attention.
- The assumption of 25-50% yield increases is a bit optimistic vs. declining fertilizer availability due to energy (natural gas) constraints. 99% of all nitrogenous fertilizers come from natural gas.   We've seen what even a "little" blip (Katrina) can do to that supply. You have to have the fossil fuels to even approach the yield estimates given here. HAS A CALORIE IN VS. CALORIE OUT ANALYSIS BEEN DONE?
- I am less able to judge the assumptions of forest lands. However, Western forest resources (slow growth forests) are much more constrained that Southern forests (fast growth forests). Hence, I am disagreeing in the rather optimistic.
- I agree that tillage practices may affect the residue availability. I was glad to see that you addressed that.
- Good developing effort.
- Very high level of database development.
- Problem will be to maintain focus on feedstock objectives and continual verification of results.
- Quantifying sustainability issues will be the major contribution of this work.
- This and the billion ton study are good working platform for discussion at the state and local level.
- The level of detail in the model today is impressive, as is the ability to manipulate the model and test cases with it.

Question 4: Success Factors and Showstoppers

- I appreciated your note regarding private vs. public lands. This is a critical factor in the Western forests. Obviously, there are more constraints there. Is someone representing these, primarily public forests, on your team?
- I really think a GIS modeling approach has REAL potential!!
- I applaud your efforts there.
- Don't you need some significant ECONOMIST input? It may be there, but I missed it.
- Budget may be the biggest limitation.
- Can the data show risk of ability to harvest the resources identified?
- Grower cost data is always a challenge and will be for this project.
- Can the data show the shifts in production e.g. CRP to corn acres?
- Linking the model to work in siting and also in logistics (IBSAL) is a positive factor, as well as its ability to model future scenarios (POLYSIS).
- Knowing the collection density (tons per total square miles in the collection area) is key for forestry data. The key problem with forest harvest residues is that they are highly scattered in any given year due to long rotation times.

Question 5: Proposed Future Research Approach and Relevance

- Can the move to 30m scale be justified? Do the benefits justify the costs? I assume you have answered this, but it wasn't made really clear.
- The presentation reflects good planning. Obviously a number of issues have already been confronted and addressed.
- It's not clear what state-level tools and personnel are available to provide the information for this effort.
- Apparently good integration or links with other models.

Additional Comments

Strengths

- I really feel that the GIS approach is a great idea. The existing elements of arcGIS, etc. to analyze the effects of transportation and distances needs to be tapped.
- I agree that modeling efforts are the ONLY way to do the projects. I applaud your use of remotely-sensed NDVI (greenness index) data. Yet, there are some assumptions that must be admitted.
- The multiplicative model of yield is a good approach.
- I, very much, appreciated the reference to Agronomy Journal, January 2007 (Graham, et al.) which showed depth of research into the CONSEQUENCES of the use of corn stover.
- Appropriate tool for a “moving target.”
- Good integration to other tools.
- A flexible tool that embeds known data and allows simulation and modeling of future scenarios. This is good work.

Weaknesses

- The Billion Ton follow-on study looks like a huge undertaking, increasing both the fineness of resolution and the breadth of topics covered. The results will be important, but it will require a large amount of resources to meet the goals you have set.
- Opportunity costs (alternative, competing uses and net returns) must be considered in the resource supply models. Things are changing rapidly in the agricultural commodity pricing area, due to existing effects from biofuel production. This is a difficult area to model. I have empathy for you!!
- Show trends ad historical data. Can Stanford Research Institute biomass inventory (nationwide county level) from the 1970s be used for comparison?
- Need to organize data acquisition from local level.
- Need to further develop sustainability criteria.
- None that are not already acknowledged as part of the research program.

Technology Transfer/Collaborations

- Define explicit rules for sustainability with NRCS, Extension etc.
- Add risk analysis to harvestable resources (timber, residues).
- Extremely high: answers the question “what’s out there?”

Recommendations for Additions/Deletions to Project Scope

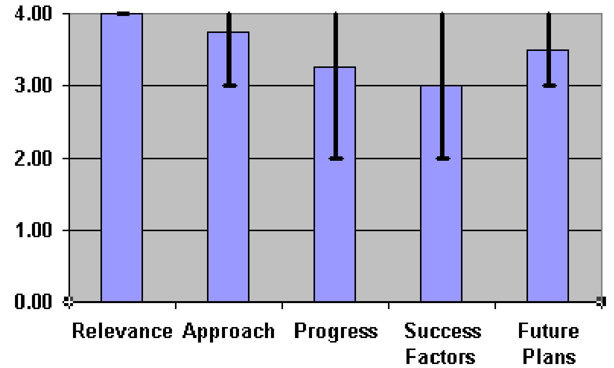
- Somehow, we need to build some links to existing USDA-CSREES Sustainable Ag. Efforts. Yah, I am biased, but I think there are some synergies there that could add real credibility to your efforts in this area. I am not against biofuels, in fact I’m very much “for” them – but I think the overall “system” (on-site effects, off-site effects, and longer term effects) must be considered. Surely there must be a way that we can work together on this, beyond simply the USDA-ARS efforts.
- Need to account for year to year environmental changes.
- Reassess yield projections. These have been most criticized area of billion ton study.
- Is urbanization and land use accounted for? This is a major impact on farm and forest (4% per year?)
- As noted above, two items that I think should be added over time are a geographically specific model of denitrification (and soil carbon impact, if possible), and the storage of

multiyear data so that it can be ultimately recovered and perhaps used for stochastic modeling.

Project Title: GIS-Based Biomass Resource Sustainability

Principal Investigators: Tris West, Oak Ridge National Laboratory

Project	**Average Score**	**Delta Minimum**	**Delta Maximum**
Relevance	4.00	0.00	0.00
Approach	3.75	0.75	0.25
Progress	3.25	1.25	0.75
Success Factors	3.00	1.00	1.00
Future Plans	3.50	0.50	0.50
Average	**3.50**		



Question 1: Relevance to Overall Objectives

- If all this can be accomplished, it will increase the certainty with which investments in bio-based industries are made.
- There is no question that these data are needed.
- Clearly focused on goal of refining information.
- Highly relevant to all subsequent work: it answers the question "what resources do we have to work with". It will only stay relevant if it is rigorously updated. Storing the history in a recoverable manner, i.e. letting a model user see the actual history of yields and crops for a given area, will add to the relevance of the model.

Question 2: Approach to Performing the R&D

- SURGO/STATSGO efforts are laudable. NASS-CDL link is also laudable. However, the references of "hope that regional partnerships will help" shows that much of these links have not been made, as yet.
- Feedstocks at 30m resolution is going away (LANDSAT is going away) – what are your options??
- NLCD vs. NASS-CDL is a difficult data "mesh" to achieve. What are your plans for this? THIS IS DATA INTENSIVE. Wow! Do you have the capabilities? I have worked with NASS on their CDL…you have a big tiger by the tail here!
- CO2 emissions from POLYSYS? Hmmm….
- Barriers clearly identified and alternate systems have been identified or tested to resolve data issues.
- Recognition of, and attempts to address conflicts between data sets is a good component of the planned research.

Question 3: Technical Accomplishments and Progress

- Plan of attack has been developed.
- It seems that more was given as "will do" than any "have done."
- I am not convinced that CO2 sequestration vs. feedstock production has been addressed adequately.
- There are HUGE assumptions in both EPIC and SWAT.
- This is obviously an overview study at the START GATE -- with many things that still need to be filled in.
- Good base established for further development. Main advantage is ability to following changing data quality and changing results.
- This is a work in progress; progress to date is excellent, specifically the ability of the model to interact with other systems such as IBSAL, stochastic modeling.

Question 4: Success Factors and Showstoppers

- Can the Regional Partnerships do all the work expected of them?
- This seemed to have all the right buzzwords and models…but the findings seem to be rather limited and narrow at this point.
- Models have provided for development of technical and business related factors with coefficients.
- Business data apparently has placeholders.
- Competing uses of resource not clearly identified. Water identified as an area for development.
- The key success factor is the quality of the data and its updating.

Question 5: Proposed Future Research Approach and Relevance

- Sustainability issues and the stability of supply over time need to be included. The late frost in Tennessee wasn't expected, but brings supply stability into question, for example.
- Certainly most of this still REMAINS to be done. The GIS computational needs will be ominous.
- I agree much of the data is still becoming available.
- Well developed plan for highly complex project.
- Decisions will have to be made to focus analyses and use of data.
- Outstanding.

Additional Comments

Strengths

- WELL aware of the current models and buzzwords.
- This fellow is extremely bright and his breadth of knowledge is impressive.
- I am concerned about the depth of the approach and real research, as displayed here.
- Flexible tool. Apparently good talent and equipment to realize objectives.
- Ability to integrate different data sources greatest strength.
- This is a very versatile model, and the key strength of the research is the determination of the research team to improve the usefulness of the model. The team is looking at conflicts in data from different sources, and at extending the usefulness of the model. One example of this is linking it to DOE work on carbon sequestration and linking it to water quality. This is a very valuable research program, in my opinion.

Weaknesses

- Not a darn thing done, except a word in last slide, regarding sustainability….but it seemed, primarily lip service.
- Where is a link to the USDA-ARS Wind Erosion Lab at Manhattan, KS? You say that it is difficult to get at for a national level. I am not convinced that you are looking deep enough.
- Problem of getting and validating local data. Factors are site specific.
- Budget? For 30 m resolution at local level? State level tools and personnel may be a problem.
- Can risk analysis be added to feedstock availability (e.g. farmer willingness to provide feedstock, agency ability to make wood resource available, etc.)?
- How can this tool be made useable by Sun Grant and energy people at local level? What interfaces are planned?
- How will data be accessed or integrated into general economic modeling?

- I am aware of no weaknesses that have not been identified by the research team.

Technology Transfer/Collaborations

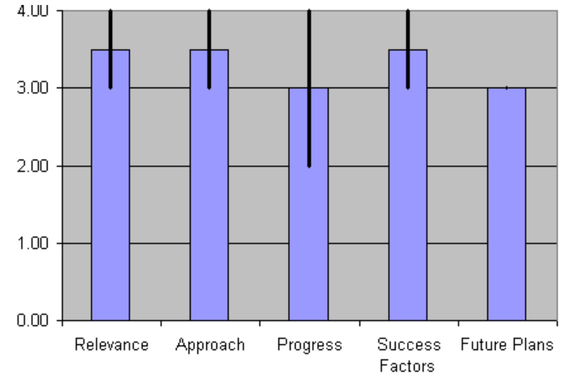
- Seemed to have a good links with NASS – which is an outstanding source.
- Clear list of data and interface needs. Major problem may be ability of local information sources to handle and enter data. Do local entities have the budget and personnel to accomplish this? How much support is needed from regional program budget?
- This model is critical for all subsequent analysis of biomass energy projects.

Recommendations for Additions/Deletions to Project Scope

- You have to have been links with the opportunity costs of carbon sequestration and both on-site and off-site effects (such as soil erosion). The on-site effects (such as groundwater pollution) seemed to be addressed much better than any other off-site effects.
- Series of local validations will be very useful.

Project Title: Regional Biomass Energy Feedstock Partnerships
Project Investigator: Jim Doolittle, SDSU; Kevin Kephart, SDSU; Terry Nipp, SGI

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.50	0.50	0.50
Approach	3.50	0.50	0.50
Progress	3.00	1.00	1.00
Success Factors	3.50	0.50	0.50
Future Plans	3.00	0.00	0.00
Average	**3.30**		



Question 1: Relevance to Overall Objectives
- Regional Partnerships will provide local "ground truth" on all aspects of local biomass production.
- Good overall approach identifying local sources of data.
- Feeding data up to a national data base / GIS system is very relevant; this activity should not be devolved into five regional data bases.
- The bioweb activity is a national activity; it can be done by the structure outlined, but in a year or two it is worth checking whether this method of implementation is effective.
- The cited goals in Kevin's part of the presentation are disturbing: agricultural diversity and rural economic development as interpreted by 50 land grand universities through five regional associations is not relevant if the objective is bioenergy.
- Certainly, this is relevant.
- Key partnerships with Land-grants are critical for many for the accomplishment of important objectives.
- The Land-grant partnership has elements in each COUNTY -- MAKE THIS A PRIORITY…don't let it die at the Ag. Exp. Station level! This should be an integrated effort between extension and Ag. Exp. Stations. I don't see reference to this. Utilize the key clientele that Extension can bring to the table.

Question 2: Approach to Performing the R&D
- Uniform procedures will enhance the value of the test results. The list of agronomic factors covers a lot of important issues.
- Regional focus for local issue.
- Local partners identified.
- GI Compatible goals. Market oriented, coordinating role.
- Builds on Land grant capabilities.
- Need to incorporate former USDOE regional partners that are now supported by the states. There is a wealth of information that the Sun Grant link needs to take advantage of. Where are the reports? You have a new team that needs to understand what has been done since 1979.
- Sun grant folks are mostly agriculturists and need an education in Energy as demonstrated in the western region meeting after the review.
- Is there room for universities other than land grant universities to make a contribution?
- Using universities to be educational outreach is a good idea: there is a need for better knowledge about bioenergy, and there is a need to challenge standard but erroneous assumptions.

- The merit of a bioweb run by a regionally oriented entity isn't clear; hence check if it is effective.
- I am a true cheerleader for the COMPLETE Land-grant mission. Hence, I'd like to see more extension and farmer/rancher involvement at the grass-roots level. Too often, the Ag. Exp. Stations neglect the grass-roots level. To date, what I have seen in the Sun Grants has been limited to the "academic elite," who, understandably aren't really elite.
- Have you considered ways to involve farmers/ranchers on key Sun Grant advisory councils? Of course, a key is to ensure that these farmers/ranchers are truly involved and not merely names listed on a proposal or report.

Question 3: Technical Accomplishments and Progress

- Regional meetings could have been accomplished sooner. Goals are well-formed and deal with important issues.
- Regional workshops have limitations. The Regional workshop at SD was more productive than at Portland. The latter was asking groups to come up with a wish list for grant money.
- Bioweb should include interactive forums moderated by local experts in soils, crops and energy.
- Need to identify existing local expertise in all institutions not just Land Grants.
- Should develop functional teams in regions of technical people.
- It is too early to rate this higher than fair, as only two regional meetings have been held. A key question in my mind is whether this structure will provide true help and efficiency or a cumbersome layer of bureaucracy; let's hope for the former.
- The grass roots elements (farmers/ranchers/county agents/etc.) are a key to getting reliable data and "ground truth" in into the proposed GIS Atlas. Pretty pictures are nice, but REAL ground truth is ESSENTIAL.
- The climatic data that is available at Land-grants is also a big "PLUS" for the Sun Grant partnership.   How are you going to integrate this across the regions? Many states are very protective of these data.
- Some of the details in your tables RUSLE2 vs. RUSLE showed "attention to detail" in your efforts. Some investigators would have overlooked this.

Question 4: Success Factors and Showstoppers

- Are there sufficient incentives to induce participation by qualified scientists at these institutions? Promotion and tenure policies and committees really influence research plans.
- Problems clearly identified.
- Big diversity in needs and understanding between forest resources and agricultural resources. This program could provide a valuable link between energy, agricultural extension and NRCS.
- Resource issues are very site specific especially in mountain forest and dry land agricultural areas.
- Bioweb could be a useful tool but needs to be managed (that's from 12 years of running bioenergy discussions a websites).
- My sense is that this is in the early stage, so the ability to assess whether "showstoppers" are identified and resolved isn't clear. Coordinating cross state research will be daunting.
- Certainly, a success factor is the Land-grant system.
- The POWER is in the SYSTEM. However, it is "easier said than done" to integrate the total system into your program.
- It is so very easy to have farmers/ranchers involved in only a "token" way. How are you going to ensure (and measure for OMB) the real impacts on the farms/ranches?

- I'm not sure how the alternative crops (oilseeds, such as camolina, etc.) fit with the cellulosic model of this program. I understood, from the review instructions that "cellulosic" was the model here.

Question 5: Proposed Future Research Approach and Relevance

- The plans presented here address the issues that seem most pertinent to the supply issue.
- Well-organized programs, good organization.
- Good balance of budget.
- Main problem is integrating interests and organizations. There is a lot of good information and activity out there but it needs to be managed. The regional biomass program (1980-2002?) was an outreach program. Sun Grant looks like a research program.
- This is an early stage project but there are plans in place for future activity.
- This seemed a little "fuzzy" at this point. Perhaps, it is due to the late arrival of the funds?

Additional Comments

Strengths

- Local involvement.
- Building on existing infrastructure good concept.
- Regional level of information.
- Built in educational components.
- Local field trials experience will be essential.
- Communication with stakeholder good focus.
- Enthusiastic use of 50 universities, including their outreach educational capabilities.
- The "strength is in the SYSTEM" (Land-grant system)…Therefore, this program has many, many built-in advantages. There is no way to overstate this. It is a powerful feature to enable outreach to the grass roots sector.

Weaknesses

- Delay in implementation. It has been 12 months since the second regional meeting.
- Balancing efforts of other crops.
- Problem identified quality of information – recognized.
- Keeping economic relevance.
- The only way the GIS data base contribution will be effective is if it is very capably integrated into ORNL's national work.
- However, that same strength (of the Land-grant system), is often overlooked or underutilized by the "academic elitists" of those same Universities. Don't let this happen!! Make sure that Extension [especially the County adult educators (a.k.a. County Agents)] are involved at the get go. How many, for example, are coming to the regional workshops? I've yet to see any county educators who even knew about Sun Grant, much less know of the regional workshops. Nonetheless, some will find it on their own (via Google) via BioWeb. However, I have used BioWeb and VERY LITTLE IS THERE. A search for Camolina brings up ZERO. Why aren't you using eXtension's community of practice as an option? This is cheap, easy and effective – but not used.
- There is an assumption here that Coop. Extension is "connected" to Sun Grant. IT HASN'T HAPPENED!!!

Technology Transfer/Collaborations

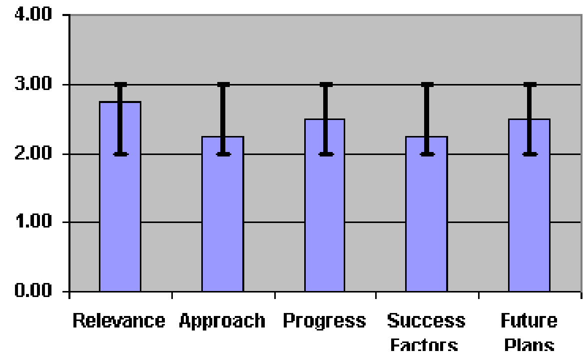
- Full interaction with existing programs like regional biomass program (now funded individually be states.) Organized and disseminate information from prior programs.
- If successful, the degree of collaboration will be high.
- Somehow, we need to build some links to existing USDA-CSREES-SARE Sustainable Ag. Efforts. Yah, I am biased, but I think there are some synergies there that could add real credibility to your efforts in this area. I am not against biofuels, in fact I'm very much "for" them – but I think the overall "system" (on-site effects, off-site effects, and longer term effects) must be considered. Surely there must be a way that we can work together on this, beyond simply the USDA-CSREES-AES and USDA-ARS efforts.

Recommendations for Additions/Deletions to Project Scope

- Add local expert forums to Bioweb.
- Assess in one to three years whether the bioweb is better run through this entity vs. a separate national contract issued by the Department of Energy.
- How do you really get "force" interstate research when you can't even get interdisciplinary work? Terry is a terrific person – and an effective lobbyist. However, I worry that he cannot see the forest for the trees here. If you are letting the Sun Grants be lead by the Agricultural Experiment Stations, you have not really involved Extension. They have a whole different set of leaders, ECOP for Extension vs. ESCOP for Ag. Exp. Stations. At many institutions, they don't even talk to each other. Ask Mike Harrington (WAAESD), Extension Dirs. in the West cut him totally out of their loop (a mistake, I admit – but they did).

<u>Project Title: Mississippi State University Sustainable Energy Center</u>
<u>Principal Investigator:</u> Michael Collins, Mississippi State University

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.75	0.75	0.25
Approach	2.25	0.25	0.75
Progress	2.50	0.50	0.50
Success Factors	2.25	0.25	0.75
Future Plans	2.50	0.50	0.50
Average	**2.45**		



Question 1: Relevance to Overall Objectives
- Certainly relevant in several areas.
- Field plots across soil types are a strength. Most PI's in this area ignore the critical element of the plethora of soil types.
- I just have to admit that I like the emphases that come to mind in the name: Sustainable Energy Research Center.
- Local screening study good exercise developed local data.
- This is a first step project that identifies opportunities for further work.
- The highly focused small area analysis limits the applicability of the work, which is compounded by what appears to be limited research design. For example analysis of pine residue usage should extend past the state boundary, and the work on switchgrass does not appear to systematically study establishment issues such as seeding rate, nutrient supply and weed control.

Question 2: Approach to Performing the R&D
- This seems to be totally focused on Mississippi vs. a regional or national approach. Wouldn't there be economies of scale if it were not simply a state-based approach?
- Are three years of data sufficient for a perennial crop?
- Extremely broad coverage makes success very uncertain.
- Market orientation?
- Not as thorough a market and application study as the Tennessee work.
- Need to integrate with other activities in the state.
- This is really just a scoping study.
- I have some reservations about the concepts embedded in the approach to this research. Two examples: thinking that energy crops would be used for forage or energy at the whim of the producer (what does the bioenergy plant do for feedstock if much of the normal supply goes to forage). Second example: limiting transportation distance for forest thinnings from pine to 50 miles: is there enough wood within this diameter to make ethanol at a meaningful scale? Is wood envisioned as being converted to ethanol in the same plant as other biomass? My sense is that the research focuses on all biomass in one state but with a low level of focus on ultimate processing. Switchgrass trials would benefit from a systematic agronomic design.

Question 3: Technical Accomplishments and Progress
- Measurable outputs seemed to be looking in this project.
- Just getting started. Estimates of woody biomass availability and production costs estimates for lignocellulosics are useful if they are reliable. Data on the performance of

so many new crops are not very reliable, since there are no established management practices for many of these crops.

- Discussion in 06.
- Example of what can be done by regional approach.
- Field trials.
- 300k t rice straw.
- Management recommendations for producers.
- Good oilseed results.
- Economics screening results good for Switchgrass and miscanthus shows potential.
- There is some interesting data of a very site specific nature generated from this study, but there is no evident agronomic design, which limits the usefulness of the data. There is the comment about the difficulty of establishing switchgrass, but as noted above no data was presented on seeding rate, weed treatment. The linkage of the results from this study to other work isn't clear. As well, I am not aware that concepts of scale of end usage have entered into the research design or analysis of results.

Question 4: Success Factors and Showstoppers

- Poultry litter biofeedstocks research appears to be the only work in this area. Although, I should have looked in the other big poultry area (DelMarVa peninsula).
- Uncertainty of funding hasn't been overcome.
- Good local demonstration of suitability.
- Identify comparison of Switchgrass with cotton.
- Good data to feed into regional program.
- As noted above, I am concerned that some business factors have not been adequately identified, especially the scale of usage of bioenergy crops. The ultimate goal of a bioenergy program isn't biomass; it is the conversion of biomass to useful energy.

Question 5: Proposed Future Research Approach and Relevance

- There seemed to be limited thought given to this – perhaps, because this funding is ending?
- Too many tasks to do them well.
- Project complete.
- Good plans, future funding?
- 3 year data collection.
- Low cost SWG potential with risks identified.
- To what extent were agronomic issues systematically investigated; to what extent will they be if extended?

Additional Comments

Strengths

- This project has some links to the farm level.
- The integration of economists into the project seemed to be implemented at the very first…but it was unclear.
- Addresses risk of grower familiar with new crops.
- Can fold into regional efforts.
- Identification of multiple uses (e.g. range Switchgrass field).
- Detailed data at a local level. Thoughtful observations re the difficulty of establishing a perennial crop.

Weaknesses

- This seemed to be a final report, rather than a “get up and go” interim report.
- Could be best with multi year program.
- 3 year data insufficient for perennial crop.
- Need additional funding.
- Insufficient thought about the ultimate use of biomass, including scale; based on the presentation, limited systematic exploration of agronomic factors.

Technology Transfer/Collaborations

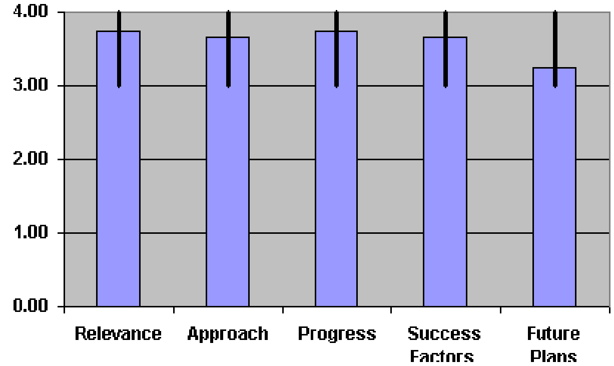
- Co-funding with plant breeders.
- Data is very locally focused.

Recommendations for Additions/Deletions to Project Scope

- Align with regional program.
- Address scale of biomass, e.g. is there enough thinnings from pine to make ethanol in a real plant? Systematize the exploration of agronomic variables.

<u>Project Title: Switchgrass Demonstration Project</u>
<u>Principal Investigator:</u> Burton English, University of Tennessee

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.75	0.75	0.25
Approach	3.67	0.67	0.33
Progress	3.75	0.75	0.25
Success Factors	3.67	0.67	0.33
Future Plans	3.25	0.25	0.75
Average	**3.62**		



Question 1: Relevance to Overall Objectives

- The three questions are pertinent to the future of a biomass industry. Identifying the needed inducements will be important to encourage private industry to invest.
- Certainly this is relevant, based on the President's State of the Union. However, part of what makes this VERY relevant was that this was one of the few that clearly showed a farmer/rancher link from the beginning. Clearly, this immediately brings it to a low "publishable research" level – but, it always gives it credibility with the folks who MUST BE CONVINCED TO GROW THE FEEDSTOCKS. I basically dislike "earmarks" – but this one may give everyone some MEASURABLE IMPACTS which are difficult to identify and measure.
- Testing and developing basic variety tests data.
- The rating of this project is based on the agronomic component only. I consider the upgrading component to be very weak, but I accept that the results weren't presented to this session. The feedstock component includes and interesting agronomic study of the factors affecting switchgrass establishment and productivity. I have concerns about pyrolysis: light off oil for a coal fired power plant doesn't seem to be a large enough end use to be relevant to a national bioenergy program, and pyrolysis product is bad stuff (acidic, toxic, prone to polymerization, and inefficient unless the char is used). If DOE has interests in pyrolysis then consider discussing a program at the German Federal research entity, Forschung Zentrum in Karlsruhe, Germany. Their processing concept recovers the char, vastly improving the overall process efficiency.

Question 2: Approach to Performing the R&D

- Good plan to identify missing information on switchgrass culture and go get it.
- Objectives gleaned from the presentation:
  - Alamo is assumed to be the standard variety.
  - Estimate RN farmers' willingness to plant an energy crop.
  - Also looked at bio-oil from switchgrass
  - Wanted low-input
  - This is an earmark…
- Enough funding to keep research for 5 years & farmers for 4.
- 4 farmers participating.
- Tyler is both soil scientist & general agriculturalist.
- BID PROGRAM TEST IS A GOOD IDEA…
- Field trials with applications.
- Good awareness of needs of early adopters.

- Good approach re agronomic component; the systematic exploration of weed control in response to an unexpected result (weeds not being out competed by switchgrass) is well done.
- In future I suggest clarifying that pyrolysis results are presented elsewhere so that reviewers don't think it should be included in their evaluation.

Question 3: Technical Accomplishments and Progress

- Information on stand establishment, labeled weed control, combustion properties.
- Yes, I realize that this research is VERY applied vs. much of the sophisticated engineering that has been shown in the review. However, this is one that can yield some real "OMB-mandated" results:
  - # of acres impacted
  - # of farmers who have changed attitudes/actions
  - # of growers who will PRODUCE measurable amounts of biofeedstocks
  - # of weed control agents tested and eliminated or labels could be acquired.
- You just have to give them credit for this.
- This is "no brainer stuff" – BUT, IT MUST BE DONE BEFORE THE FEEDSTOCKS WILL BE AVAILABLE.
- Field trials.
- Management practices – weed control needed- not learned from other sites.
- Tested transportation.
- Bio-oil at BECON.
- Gadsen tests.
- Before frost and after frost tests.
- Recognize equipment needs.
- Identification of the agronomic issues regarding switchgrass is a valuable contribution, e.g. seeding rate, weed control, nutrient response.

Question 4: Success Factors and Showstoppers

- No unidentified risks, but the identified ones are bad enough.
- Clearly, the strengths of this project are the link to the grass (no pun intended) roots level.
- 29% who will, 45% need info, 25% will not follows EXACTLY the Don Dillman (Rural Sociologist, WSU) model for adoption of technology (ANY) by farmers/ranchers.
- Example of "early adopter" farmer who contacted extension having zero weeds, vs. the "early adopter" who did not, should be documented and measured.
- Field trials.
- Management practices – weed control needed- not learned from other sites.
- Tested transportation.
- Bio-oil at BECON.
- Gadsen tests.
- Before frost and after frost tests.
- Recognize equipment needs.
- As noted above, the agronomic component seems well founded, the processing component is not.

Question 5: Proposed Future Research Approach and Relevance

- Yield measurements are crucial to this project and to all other switchgrass projects.

- As much as I love the grass roots approach of this project, I didn't see the rationale for further applied research.
- Putting in 5 million gallon ethanol plant need 8,000 acres.
- Carryover to 2009 good.
- Finding funding from variety of sources.
- The agronomic work is likely to succeed and lead to a very valuable contribution.

Additional Comments

Strengths
- Local involvement with some real people.
- Clearly, the strengths of this project are the link to the grass (no pun intended) roots level. You are NOT going to get growers to grow the feedstocks (in any significant "billion ton" way) unless SOME HOW, SOME WAY, you find funds to fund THIS TYPE of outreach to farmers/ranchers. Yet, the only way this received funding was through an earmark. A sad commentary on the Land-Grant system…
- Both field and experiment station data.
- Good data developing and interactions.
- Good systematic agronomic work.

Weaknesses
- Can you justify the estimated yields? This is the most critical piece of information in the whole program.
- This is not flashy or publishable…just needed…
- Need market assurance to grow SWG from state.
- Seed production critical issue.
- Equipment needs identified.
- The choice of pyrolysis isn't clearly explained or justified; it is almost as if "we had to do something with the biomass, so we chose pyrolysis.

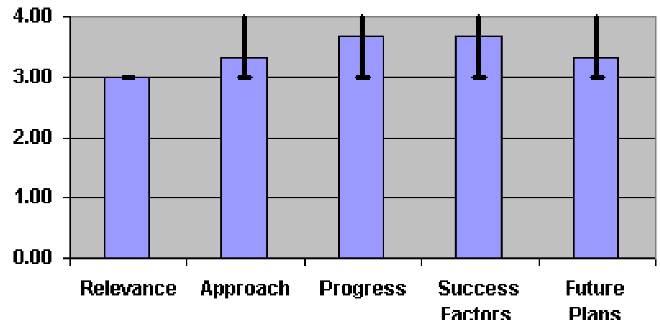
Technology Transfer/Collaborations
- Survey and bids.
- Discovered role of Extension for seed planting at right depth and weed control.
- Farm Field Day.
- Let farmers resolve harvesting problems on their own good solution.
- The switchgrass work will, I think, make a significant contribution.

Recommendations for Additions/Deletions to Project Scope
- Find a way to fund this type of applied research and outreach in the "system."
- You need to get a rural sociologist involved to look at "if" growers will shift and "when" (see Dr. Don Dillman's "early adopter" research).
- Continue support for this project. It has generated good information in area where switchgrass is an unfamiliar crop.
- Include a survey of other work in the area of pyrolysis.

Project Title: Alternative Fuel Source Study

Principal Investigator: Ralph Zee, Auburn University

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	0.00	0.00
Approach	3.33	0.33	0.67
Progress	3.67	0.67	0.33
Success Factors	3.67	0.67	0.33
Future Plans	3.33	0.33	0.67
Average	**3.40**		



Question 1: Relevance to Overall Objectives

- Seems to be less relevant due to lack of direct "agricultural link." However, I started to see the link later on.
- Lafarge is largest cement maker in the world.
- Lafarge is using switchgrass, wood waste, broiler litter, scrap—tires, recycled plastics instead of coal. They can burn these low quality fuels because of very high temperatures. Interesting that this is one of the ONLY users who can use landfill wastes, etc. because of high temperature kilns.
- Some fuels are relevant.
- Does not demonstrate advanced technologies for fuels but it does demonstrate feedstock issues for handling and feeding while using an existing market.
- OBP should find a good way to integrate these congressionally directed programs in the overall program plan to show relevance. It demonstrates delivery system and co-production.
- Cement manufacture is a wonderful outlet for biomass, reducing carbon emissions.
- The gasification component is of high relevance to other projects.
- The results of this research will have a high relevance to cement manufacturers around the world.
- Cement production was identified as a high energy consuming industry, so this is relevant to overall energy consumption, but not to liquid fuel replacement goals.

Question 2: Approach to Performing the R&D

- VERY WELL DESIGNED STUDY…(or, very well EXPLAINED).
- They are going into a lab study AFTERWARD, which is sort of backward – but totally understandable in this situation.
- Goal is replacing 50% of coal with waste, which Europe has done already.
- Poultry litter is at least 40-50% energy content of coal.
- A VERY detailed and intense sampling procedure was observed.
- A VERY GOOD "systems approach dealing with on-site and off-site (pollution, safety, health) effects…"
- Biomass handling not germane to large scale production but appropriate to specific application. Pilot testing at full scale is useful.
- The research design is thoughtful and rigorous.
- The presentation of data for concrete properties should include error bars (standard deviation of testing) so that one can judge whether the variance between runs is significant.
- The work seems very well thought out and executed.
- Well planned.

Question 3: Technical Accomplishments and Progress

- I was very impressed with the sampling procedures and experimental design. The detail of the presentation was immense.
- I am not sure that I am convinced that hydrocarbon emissions are zero…but I am not competent to judge!
- Testing – broiler litter and plastic.
- Good industrial testing.
- Good screening trial.
- I don't believe the model or simulator will have as much general value as proposed but it should be developed and tested.
- Test burns are half completed: this is a major accomplishment.
- Work seems well underway.
- The industrial partner is particularly well committed.
- This project has contributed to two goals: saving energy and cleaning up the environment. I hope LaFarge and its industry will implement this to the maximum extent possible. Burn simulator is a very useful idea.

Question 4: Success Factors and Showstoppers

- It seems to me that you have discovered an industry that can use complex and hazardous (high hydrocarbon) wastes, without a problem. Any residuals go into the cement – but are probably "bound" in the environment – so it is a smaller consequence. FASCINATING! The Phosphorous pollution problems are solved, because: who cares about high-P cement!
- What a great way to use poultry waste!
- Established some burn rates.
- Successful burn rates.
- Simple feed system.
- No showstoppers evident; success factor is the commitment of the industrial partner.
- You identified a number of potential showstoppers, including some social issues, and got the information needed to address them.

Question 5: Proposed Future Research Approach and Relevance

- Interesting…but funding may be difficult to obtain…
- Gasification technologies – thee are well known. This could be a minor part of effort. (Look at California energy commission PIER program projects by GEEER for kiln scale gasification).
- Burn simulator – to be developed.
- The decision to include a burn simulator is a good addition. The decision about gasification by oxygen vs. air needs to be critically based on an economic and technical analysis; oxygen separation is expensive and the merit, if burning the resulting gas, isn't clear.
- Completed project, but provides useful information for others to use in future applications.

Additional Comments

Strengths

- Again, it seems to me that you have discovered an industry that can use complex and hazardous (high hydrocarbon) wastes, without a problem. Any residuals go into the cement – but are probably "bound" in the environment – so it is a smaller consequence. FASCINATING! The Phosphorous pollution problems are reduced.

- What a great way to use poultry waste!
- Test burns and emission results good.
- Variety of fuels tested well.
- Good research design and an outstanding industrial partner.

Weaknesses

- High Phosphorus cement can be a problem.
- Need economics in results.
- Not evident that cement chemistry has been included in proportions of fuels co-fired. Alkali in cement is critical and should be highlighted or tested as the potential limiting factor in alternative fuel such as Poultry Litter.
- Large scale storage and handling should be addressed.
- None evident.

Technology Transfer/Collaborations

- Coordinate with RAM – Rubber Manufacturers Association – which handles tire co-firing for assessment of general application of this model to other kilns around the US.
- Cement is an “everywhere” industry, so the results of this work will have a very high relevance to that industry. The gasification work will be of interest beyond the cement industry.

Recommendations for Additions/Deletions to Project Scope

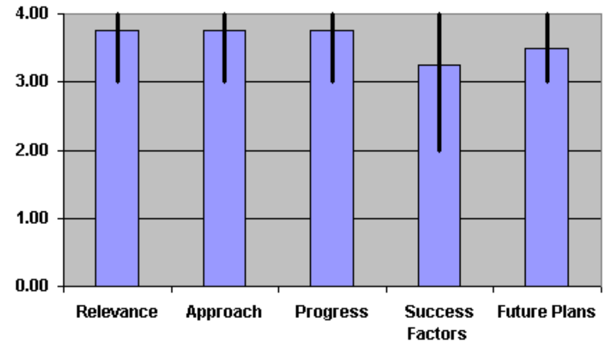
- I am unsure as to whether I am qualified to address this. However, the project is fascinating!
- Continue this work and find ways to bridge work to goals off feedstocks program. This represents a potential “front end” to providing energy or feedstock for conversion.
- The analysis to support the selection of a gasification process should be included in the project report.

Feedstock Logistics Core R&D Projects

Project Title: Harvest & Collection

Principal Investigator: Kevin Kenney, Idaho National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.75	0.75	0.25
Approach	3.75	0.75	0.25
Progress	3.75	0.75	0.25
Success Factors	3.25	1.25	0.75
Future Plans	3.50	0.50	0.50
Average	**3.60**		



Question 1: Relevance to Overall Objectives

- Key issues have been identified.
- Well-organized approach with clearly specified target toward large scale harvesting of feedstocks for conversion.
- Given that all biomass processing plants will need material transport, the high quality of this work will ensure its relevance.
- "Only link to sustainability" according to presenter.
- This is another essential link – so it is assumed to be critical to the systems analysis.

Question 2: Approach to Performing the R&D

- Good fundamental study, similar to the process used to develop the cuber many years ago. Good plan to gain fundamental understanding.
- Account for significant factors.
- Better integration with engineering and accomplishments of existing industry needed.
- Thoughtful analysis of the work of others, e.g. cob and chaff harvesters. Very good fluid dynamic modeling.
- I have a bias against pelletizing that reflects my understanding of its relatively high cost. I don't want to impose any bias on this work, so I simply caution that the program should not commit to pelletizing without a thorough analysis of other options and an analysis of the cost of pelletizing. The program has recognition of costs and a focus on it, i.e. a good approach.
- The analysis of fractionation is of very high quality.
- The key need is a better understanding of how much biomass needs to be left on the field for sustainability. Part of this needs to be consideration of denitrification, including whether fractions denitrify at the same rate.
- The depth and breadth of the analyses seemed well-planned and comprehensive….well done!

Question 3: Technical Accomplishments and Progress

- Good application of the CFD research.
- First steps given the state of the program. Project should continue to maintain cost and energy efficiency criteria in harvesting technologies.
- Excellent results to date. For example, the work on fractionation has excellent results of major impact.
- The presenter seemed to understand the complexities of the total system, as well as the various harvester systems.

- Obviously, you have some real constraints here, including horsepower, etc. However, the presenter was not afraid to admit the problems and then go on to identify a probable solution.
- I like the first principles approach -- to identify the bulk properties that are critical – then, to go from there to develop analytical techniques.
- Interesting “reverse engineering” approach.
- The use of Johanson indices is applauded!!! I had not heard of them – however, I found them on the web and the description is a vindication of your approach and knowledge of the subject!!!

Question 4: Success Factors and Showstoppers

- A critical issue is maintaining harvest capacity of current crop harvesting systems. Producer participation will hinge on not reducing current capacity.
- GMO,MC, pellet
- Depends on single pass system which has had many problems in the past 30 years. Single pass depends on identifying and quantifying enhanced value of fractionated products. Good approach but needs to be developed further.
- Need better definition of what a “pioneer Plus” system with existing technology can do. It is not accurately characterized.
- Too much emphasis on ¼ minus particle size and densification. This needs to be thoroughly reviewed by those of us in industry who have years of experience working on this. Cost and energy are critical showstoppers unless added value can be clearly identified.
- Potential of single pass to produce higher value co-products should also be identified.
- The key success factor is the high quality of both research design and execution. I see no showstoppers to the research and engineering, although the targets themselves are daunting.
- “To take what we should take and leave what we should leave” is an exemplary mantra. KEEP THIS! YOU ARE ON-TARGET!

Question 5: Proposed Future Research Approach and Relevance

- Baseline data will be invaluable. Needs to include corn harvest in central Corn Belt where field drying may be slower than in Kansas and Nebraska.
- Field test – good idea but not large enough. Need 25,000 bales per feedstock with different technologies used for baling (hydraulic vs. mechanical balers).
- Realign work plan to spend more time on aspects with good potential such as single pass and fractionation.
- Excellent plans to proceed.
- Looking at socio-economic factors is essential.
- Your Sustainability Index flowchart is terrific. Keep at it. This is, admittedly, VERY difficult. However, I APPLAUD YOUR EFFORTS. “Hang in there,” as this will take both time and money. However, THIS IS ESSENTIAL TO THE SUCCESS OF THE OVERALL EFFORT.

Additional Comments

Strengths

- Systems approach is good. Good basic information gathered as first step.
- Excellent engineering and cost analysis and a broad ranging focus.
- The depth of breadth of the PROPOSED analyses (this project is just getting under way) is startling. However, the discussion by the presenter showed an unusually broad knowledge of the subject. This is a winner! Keep this effort going!

Weaknesses

- Densification characterization is very weak. There is more to science and technology that realized. Major changes have been made to the engineering and process of densification in the last 10 years. Many field trial shave been made for using densification as an intermediate product.
- Pioneer systems are not adequately characterized. Actual densities and capabilities are higher 14 lb/ft3 and reliability. Apply to harvesters and balers. Specific energy consumption 50 kWh/ton.
- Relate fractionation to specifications from platforms. Some platforms (thermochemical) do not need ¼ minus from the field.
- Need to move further in understanding and experience from existing industry. There are hundreds of mechanical and agricultural engineers who could contribute to this topic in both private and public organizations. Need to engage existing industry more.
- None evident.
- The emphasis on a “sustainability index” could be superficial. I’d like to reserved judgment until another year.

Technology Transfer/Collaborations

- This will be high because of the high quality of the work and its impact on all residue biomass projects.
- Industry collaboration is ABSOLUTELY ESSENTIAL to this projects success. However, to this point…it seems fairly low.

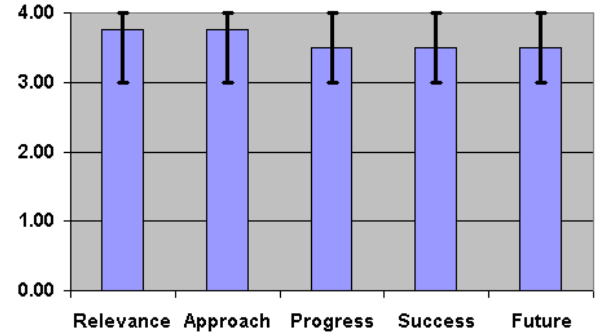
Recommendations for Additions/Deletions to Project Scope

- Get together with existing engineering and industrial experience.
- Feedstock needs to be reliable and of good quality. Feedstock quality starts at harvest with harvest decisions made by harvester. Develop systems that take need for decisions away from harvester/baler etc.
- Ensure that denitrification is included at some point in analyzing nutrient and sustainability issues: this will affect the grower payment.

Project Title: Preprocessing

Principal Investigator: Chris Wright, Idaho National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.75	0.75	0.25
Approach	3.75	0.75	0.25
Progress	3.50	0.50	0.50
Success Factors	3.50	0.50	0.50
Future Plans	3.50	0.50	0.50
Average	**3.60**		



Question 1: Relevance to Overall Objectives

- Seems tightly tied to dry straw process. Need to make it as broadly applicable as possible. Is there a possible collaborator like Diamond Z somewhere in the corn belt?
- Well-prepared and focused project plan.
- The high quality of the work and the fact that cellulosic ethanol plants will require processed biomass ensures the relevance of this work. Note that if combustion or gasification applications become of interest in the future the size requirements for biomass will be different. Given the current focus on ethanol, the work is well designed.
- Admittedly, preprocessing is another essential element in the "system" of feedstock and conversion processes.

Question 2: Approach to Performing the R&D

- Good that you are working with Al Womack. The $6 per ton goal needs to have a good definition of what is being done in the process (input size, output size, etc.) or you may not be making valid comparisons.
- Good overall organization. Thoughtful consideration of problems and aspects of preprocessing. This step should identify critical costs and alternatives of preprocessing.
- Good broad thinking. One caution I have is to recognize that storage may occur more than once in a chain, e.g. a farmer, might store bales on farm and take them to a depot at a flexible time; the depot might then process it and store the biomass in a different form. The general concept that packaging and then undoing to repackage is uneconomic is a good observation, but one needs to be careful not to over apply this.

Question 3: Technical Accomplishments and Progress

- Grinding and compression studies have added to a better understanding of these processes. The test plan will expand this to other materials.
- Overall aspects of problem have been identified and some preliminary work has been done. Much more work should be done on alternative methods of sizing, densification and fractionation.
- Very good results to date based on good thorough research.
- Excellent analysis in terms of both depth and breadth.
- The detail in looking at particle size, etc. is excellent.

Question 4: Success Factors and Showstoppers

- Cost targets, both in money and energy, are important.
- Good basics to move forward. Need better integration with existing industry. Too dependent on mobile tub grinder as processing unit. Need to consider that preprocessing will probably be in stationary setting connected to storage.

- Results to date are outstanding and are the basis of future work.
- No showstoppers are evident in the research, although the targets themselves are daunting.
- Again, this is not “showy” stuff – but the analyses are essential to the success of the overall program.
- Looking at density, particle size, etc. – as related to compression and etc. – are key factors.
- The radiography studies were intriguing.
- The varietal difference data from the laser ultrasonic analyses are extremely interesting.

Question 5: Proposed Future Research Approach and Relevance

- Good plan.
- Not clear what resources will be used to move forward or how project will integrate and benefit from experience in wood and fiber technology, grinder manufacturers and engineering, etc. Need clear definition of the range of specifications of conversion platforms.
- Plans for future research are appropriate and build on past work.
- It appears that the radiography, spectroscopy (UV), laser, and other particle analyses are proposed, rather than complete. The explanation is a little fuzzy. I am assuming this is because this research is proposed rather than done.

Additional Comments

Strengths

- Good approach.
- Good basic background work.
- Excellent engineering and cost analysis supporting a broad approach to a key problem.
- The 3 analytical techniques may not be all inclusive – but they are intriguing and logical extensions of the technology.

Weaknesses

- Need further development of grinding. Include shear shredding (SSI) as a process. Consider and contact existing grinder manufacturers. Send them materials and pay for them to grind to your specifications. (E.g. Chariton valley Biomass Project). Many engineering decisions used in grinder design have not been considered in this study.
- Too much reliance on ”deployable uniform feedstock”. Feedstock for our fuel and fiber industries takes on many characteristics and specifications. Objective should be the most economic and energy efficient form on just a uniform form.
- Design and testing of mobile or field equipment has many challenges that are not identified in these studies.

Technology Transfer/Collaborations

- The high quality of the work and the fact that all lignocellulosic ethanol plants will require pretreated material insure that this work will be used by many.

Recommendations for Additions/Deletions to Project Scope

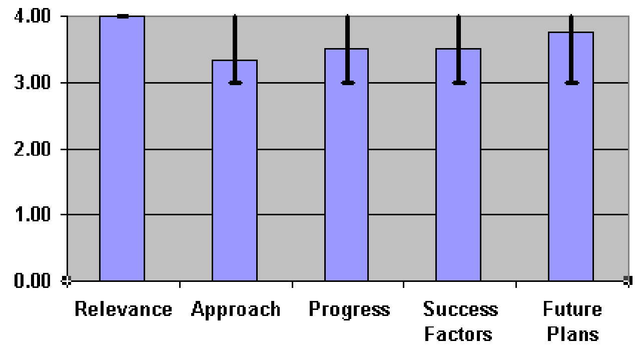
- Improve grinder engineering.
- Better definition of feed and final product qualities.
- Contact and better integration with existing industry in grinding, densification and field equipment.

- Why hasn't the modular big bale system used successfully for more than 1 million tons of straw per year in Europe (and panned for Chariton Valley) not been included in preprocessing or handling options?
- I see no need for changes to the research scope.

<u>Project Title: Storage & Queuing</u>

<u>Principal Investigator:</u> Corey Radtke, Idaho National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	3.33	0.33	0.67
Progress	3.50	0.50	0.50
Success Factors	3.50	0.50	0.50
Future Plans	3.75	0.75	0.25
Average	**3.62**		



Question 1: Relevance to Overall Objectives

- There is no question that this is an essential element of designing a sustainable system.
- Given that almost all biomass is seasonal, work on storage is highly relevant to virtually all biomass processors. The very high quality of the work ensures its usefulness and relevance.
- Critical part of process. Clearly focused.
- Storage is an integral part of the overall system. The possibility of preprocessing biomass in storage may offset some storage costs.

Question 2: Approach to Performing the R&D

- "Needs revolution not evolution" is an interesting comment regarding this area of analysis.
- These analyses seemed in-depth, as well.
- Very good systematic analysis. The recognition of where a revolution rather than evolution is required is a good contribution. Investigation of cost is systematic. In general this is a very well designed project.
- Good integration of broad knowledge in moisture etc. Main challenges appear to be clearly identified.
- Wet storage is clearly a challenge.
- Creative. I'm sure the list of possibilities is very large. Keep other possibilities open.

Question 3: Technical Accomplishments and Progress

- The depth and breadth of the analyses were impressive.
- Excellent results to date. An example of this is the systematic analysis of the current cost of drying.
- Good outline of options.
- Storage and water activity.
- Equipment bids basis.
- Good concepts and principles.
- Can ethanol generated in storage be recovered by the processes currently considered? If not, does ethanol act as a sufficiently good preservative to justify the loss of soluble sugars?

Question 4: Success Factors and Showstoppers

- This isn't a flashy topic, but the analyses seemed to be "spot on."
- There are no show stoppers as regards the project. The success factor is the rigorous and thoughtful approach.
- Good progress
- Need to extend storage characterization across regions and conditions.

- Cost will be main showstopper.
- An industrial plant needs reliable quality.
- To what degree can drying/preprocessing be integrated with storage to add value to fractionated product?
- This wasn't clearly called out.

Question 5: Proposed Future Research Approach and Relevance

- The recommended areas of future research seemed logical.
- However, I could have used some more detail. Three bullets seems a bit low to me.
- This is a work in progress, and plans for future research are appropriate.
- Very impressive approach. It is clear that it is in early stages of development.
- Identified a number of potential issues to look at.

Additional Comments

Strengths

- The depth and breadth of research was very impressive.
- Solid analyses.
- I appreciated seeing the publications at the end. This shows a serious commitment.
- Solid high quality technical and cost analysis in a well focused program.
- Good basic approach and information.
- Good identification of potential value added in storage as preprocessing (ethanol). There should be other values that can be obtained.
- Good focus on water soluble carbohydrates.

Weaknesses

- This was a robust, in-depth study. I did not see any specific weaknesses.
- Not quite as stimulating as other presentations.
- No weaknesses are evident.
- Density is a delusion. Densification can be more costly (energy and labor) than benefits. Identify practical density ranges and potential target ranges.
- Need to identify role of leaf fraction in degradation of products during storage. Leaves have highest inorganic and nutrient content and most fragile structure. Should leaves of stover etc. be separated, processed and stored separately?
- How is storage different for thermochemical platform? Still needs to be dry and consistent.
- How do storage methods compare for allowing processor to manage inventory feedstocks of different quality? Bales can be handled in dense blocks of 3 tons or more at rates of 120 tph with a squeeze. How do you shift inventory with ground material?

Technology Transfer/Collaborations

- This area was unclear.
- The high quality and comprehensive nature of this project ensures its usefulness to others.

Recommendations for Additions/Deletions to Project Scope

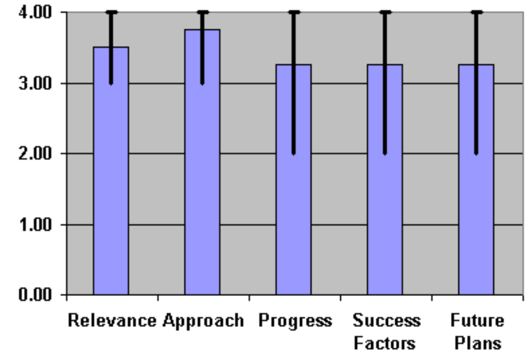
- The scope of the research is appropriate as designed and no additions or deletions are evident to me.
- Add/identify specific health impacts of moisture in storage and processing. We found some people have strong allergies or reaction to bacteria. This is well known in composting science.

- Define characteristics of stored material that are important to specific platforms – sugars, solubility, degradation, dry matter. What other preprocessing steps can be integrated with storage?
- Identify protocol for storage testing for wet or dry feedstocks.
- Provide interactive information for comment and co-development by industry.
- What process plant effluents (CO_2) can be used to offset storage risks (fire, explosion) from ground material?

Project Title: Handling & Transport

Principal Investigator: Judy Partin, Idaho National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.50	0.50	0.50
Approach	3.75	0.75	0.25
Progress	3.25	1.25	0.75
Success Factors	3.25	1.25	0.75
Future Plans	3.25	1.25	0.75
Average	**3.40**		



Question 1: Relevance to Overall Objectives

- Good problem statement. Fibrous materials are a major challenge.
- Again, there is no argument that this is a significant area in the critical path analysis of the harvesting to reactor continuum.
- Good preliminary testing of basic properties of materials.
- Because all biomass will be transported, the relevance of this work is high, which is aided by the rigor with which the project is designed and executed.

Question 2: Approach to Performing the R&D

- Good plan to obtain fundamental data needed to design handling systems. I don't expect the Johansen property measurements to provide all the information needed. They did not do much work on fibrous materials. You will need to develop your own measurements, and test apparatus size will be important.
- Use of Johansen indices and Instron are true "state of the art" measurements. You clearly did your homework.
- It's not clear where this research is headed. It appears to be pretty academic. Results need to be compared with real world experience in bin flow and hopper flow and densification.
- One outstanding element of this project is the use of the formalism of Johanson in analyzing flow properties in bins. One consequence of this is the recognition of the interaction of particle size and material flowability.
- Analysis of the rheological properties of biomass slurries will require expertise in characterizing viscosity; the object is a characterization of viscosity as a function of shear rate.

Question 3: Technical Accomplishments and Progress

- Initial tests are a good start, but this is a big project. Some data from the development of silage handling equipment might be available in the literature, particularly at the USDA Dairy Forage Research Center in Madison, WI.
- Capsule method is intriguing. Clearly, you have thought of most of the options.
- I was very impressed, again, with the breadth and depth of knowledge of the presenter…the science was dead-on as well.
- Fills basic data need.
- Results to date from the characterization of switchgrass and wheat straw are excellent.

Question 4: Success Factors and Showstoppers

- Our current approach to handling difficult materials is to increase the size of the handling machinery. That approach is too expensive. The industry will need to work smarter, not larger, to solve this one. Some experience is already available, like the Chariton Valley boiler fuel handling system, and many others, and should be brought to bear on this problem.
- Clearly, the deep extent of the testing is going to smooth many bumps in the road ahead.
- Good characterization. Needs to align with industry experience in handling these materials. They don't flow. How will INL contribution help to break the bottleneck to prevent know problems with fibers? Speculations presented about flow not convincing.
- Cost needs to be added to the analysis of pneumatic conveying, the sooner the better. Given the quality of analysis in this study, in both engineering and cost analysis, the prospects of success are high. I see no show stoppers.

Question 5: Proposed Future Research Approach and Relevance

- Good plan for future work. Need to work with companies with conveying experience.
- I was very impressed with the detailed list of work to be done.
- This was one of the best projects in totally describing what has been done vs. what is yet to be done.
- Need better definition of outcomes of this research. What is it leading to? Best possible expected outcome is improved bin hopped design for loading and unloading material. How does it compare with existing systems? Not convinced that there ahs been good communication with existing suppliers and designers of storage and handling systems.
- Good plans for research that builds on past work.

Additional Comments

Strengths

- Use of STANDARD processes and tests (INSTRON, JOHANSON INDICES, etc.) shows a clear understand of the science and engineering limits of flow theory.
- Fills basic information on properties.
- Very high quality of engineering and cost analysis in a broad search of the issues.

Weaknesses

- None identified.
- What risks does this effort address?
- Question what bottleneck breaking potential of extensive testing.
- Need to relate properties to morphology of materials. This will explain results found in lab tests.
- Results likely to be overly academic.
- Need to relate lab tests to full scale operation. There are many examples in industry.
- None evident; early cost analysis of pneumatic conveying may identify length limitations.

Technology Transfer/Collaborations

- Work will be useful to most projects.

Recommendations for Additions/Deletions to Project Scope

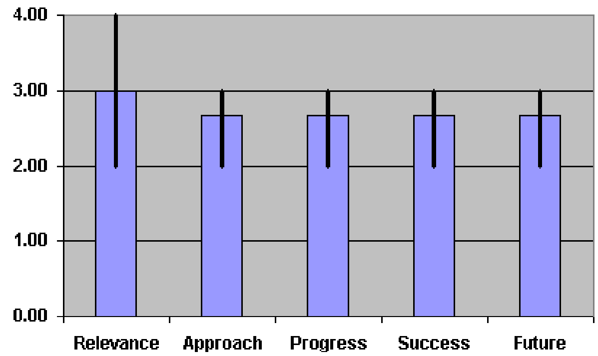
- Need more interaction with industry and to better define pioneer situation of existing industry.

Feedstock Systems Integration Projects

Project Title: Supply Systems Logistics

Principal Investigator: Shahab Sokansanj, Oak Ridge National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	1.00
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.67	0.67	0.33
Future Plans	2.67	0.67	0.33
Average	**2.73**		



Question 1: Relevance to Overall Objectives

- I have a difficult time seeing a direct positive project link for IBSAL.
- Engineering tool.
- Good presentation of engineering tool and potential uses. This relevance of the tool is the ability to model processes.
- If this work succeeds it will have a high relevance in that it can predict many factors important to biomass. Its relevance will depend critically on the accuracy of the overall model.
- Provides the opportunity to optimize logistics systems using existing equipment, as well as concepts that do not yet exist.

Question 2: Approach to Performing the R&D.

- Integrating biomass supply into corn-ethanol production? Why? Isn't the most efficient method going to be cellulosic?
- Takes into account variability in feedstocks and processes. Continuous model validation will be important.
- A good feature of this work is the recognition of the multiple options in moving biomass from field to plant, for example on farm storage, depot storage or direct transport to the plant for storage.
- Good combination of modeling supported by experimentation to supply missing data. List of risks shows good thinking. Good level of cooperation with other researchers. Expansion beyond local collection point is good. Linkage to ASPEN is under way.

Question 3: Technical Accomplishments and Progress

- Certainly, models can be an excellent way to analyze a system. However, they are much better to show what elements are the most critical and do sensitivity analyses for each variable. IBSAL may or may not be a realistic simulation scheme. We would need to see more, or have some independent scientific validation.
- Model exploration and verification.
- Basic components identified.
- What showstoppers or opportunities has IBSAL identified for high production feedstock.
- Preliminary results quantify case for biomass.
- Model use in existing plants.
- This project has led to the quantification of a number of elements of the biomass chain.
- Good work in building the model and getting the data needed to use it. Need to find or generate data to replace any assumptions that had to be made.

Question 4: Success Factors and Showstoppers

- None seen.
- Validation?
- Optimization results.
- Success at quantifying risks?
- Biggest success factor is ability to identify showstoppers in processes.
- Demonstration of shear shredding is good. That is used in our export forage industry.
- The results of any complex model need to be verified on an ongoing basis against actual data. I think that it is important in the future for reports on IBSAL to discuss ongoing verification efforts. This is a key success factor that appears to be well recognized by the principal investigator.
- Models need to be continuously validated, due to changes in crop properties from plant breeding and in agricultural practices due to increasing farm size and machine productivity.

Question 5: Proposed Future Research Approach and Relevance

- The use of IBSAL with GIS is problematic, at best.
- Focus of this particular task?? Integrated process modeling?
- Who is using model and interfacing validation etc. Can it be distributed to use it for its advantage?
- Continuous verification?
- This is a work that is underway; future planned work builds on past results.
- Future extension to the fuel distribution system will make this into a huge model. Need to balance the benefit of this extension against the cost. Should work with equipment manufacturers to validate the performance of existing machines and to encourage their participation in future model development and application.

Additional Comments

Strengths

- I did appreciate the extensive list of refereed publications.
- System approach.
- Flexible model.
- Integration of fuel distribution.
- Quantification of any process step forces a deeper understanding of that step, hence this kind of research increases insight into unit operations.
- The overall model will be very useful if verified and validated.

Weaknesses

- "To date, it has been modeler to modeler…" The next step is taking it further. THIS IS A MISTAKE. Others should have been involved, up front. Complex models need intense criticism and verification. INDEPENDENT VERIFICATION HAS NOT BEEN DONE, YET. Whoa! This is a weakness. I am not convinced that IBSAL is a robust model. (Admittedly, I would need more data than was given here.).
- Need industry interaction for densification work. There is more science and engineering in existing industry than is reflected in presentation.
- The potential weakness is that the model will mislead unless accurate. It is too early to tell.

Technology Transfer/Collaborations

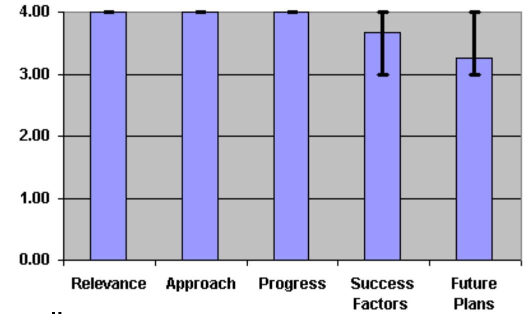
- A good job has been done in collecting other information. However, the independent verification is late, at best.
- Continuous verification.
- The model will have high use when completed: it is ASPEN for biomass.

Recommendations for Additions/Deletions to Project Scope

- Better definition of specifically who can use the model.
- Continuous verification? Dept of Defense. Validation and Verification.
- Be more explicit in future presentations on efforts to verify and validate.

<u>Project Title: Feedstock Supply System Design Report</u>
<u>Principal Investigator:</u> Richard Hess, Idaho National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	4.00	0.00	0.00
Success Factors	3.67	0.67	0.33
Future Plans	3.25	0.25	0.75
Average	**3.78**		



Question 1: Relevance to Overall Objectives

- Critical to the overall program, since it feeds them all.
- Without question, the logistics are an essential element of a successful system…end of story!
- Very well focused overall approach.
- The vision of a commodity industry supplying feedstock is highly relevant to the emergence of a viable processing industry. The high quality of this work makes it highly relevant.

Question 2: Approach to Performing the R&D.

- Well thought out, but do we know enough about processes to say that all reactor throats look alike? A uniform feedstock specification may not be optimum for all processes.
- Design and data gathering appear to be relevant and “real.” These are not ‘fudged” data – but real life examples.
- OBVIOUSLY, Richard is an effective team leader, as everyone in his group gave the very highest rated presentations. This speaks very well to both Richard’s leadership and to the capabilities of his team.
- Defined goal- two tier wet dry bulk.
- Preprocessing – good attack.
- Emphasis on “uniform format feedstock” maybe big limitation. Should allow more flexible identification of forms of feedstock.
- Systematic and well grounded in both engineering and cost analysis.

Question 3: Technical Accomplishments and Progress

- Very thoughtful analysis of system alternatives.
- “Pioneer design” is obvious realistic.
- A VERY comprehensive approach. I appreciate it when someone says: “We are counting all the costs – we are not “cheating the system” by charging zero labor for the owner, etc.
- Detail of approach, down to dust control and regulations, is amazingly thorough. Fire code, etc. could shut down an operation. THIS DETAIL OF ANALYSIS WAS VERY, VERY impressive!
- Someone really did their homework here! For example, as you push processing upstream, your efficiencies go down. You also go from electrical to diesel.
- Good preliminary investigation and successful approach.
- Should include measures of specific energy efficiency and specific conversion platform needs and specifications. Note they are different for bio and thermo conversion.
- The noteworthy components, as mentioned above, are the engineering coupled with cost analysis.

Question 4: Success Factors and Showstoppers

- Uniform concept may be in conflict with some unique requirements of some processes.
- Again, the detail of analysis was very impressive. Understandably, moving water is expensive. Any way to remove it at the source keeps the costs low. The detail here is impressive, as well.
- Analysis that shows the key is a "commodity-driven" system is an extremely critical finding.
- Recognition of factors.
- Organization of variables, challenges etc. good identification of challenges.
- The progress to date is impressive, and no showstoppers are evident.

Question 5: Proposed Future Research Approach and Relevance

- I couldn't really zero-in on what is left to do. Is it all done?
- In general very good. Caution use of uniform format feedstock as goal and expectations for it. Spend more time defining specifications of platforms and comparing with actual use of materials with similar specifications in industry. Not just 932 projects.
- Future objectives and plans to realize them are sound.

Additional Comments

Strengths

- Again, the detail of analysis was very impressive.
- This was absolutely amazing in that it looked, not only at costs and efficiencies, but "permitting," as well.
- OBVIOUSLY, Richard is a very effective TEAM LEADER, as EVERYONE in his group presented the very highest rated presentations. This speaks very well to both Richard's leadership and to the capabilities of his team.
- Good overall approach.
- Good definition of 425/ton as target on cost curve.
- Solid technical and cost analysis to achieve a vision of a commodity feedstock.

Weaknesses

- Need better definition of range of forms feedstocks can be accepted by conversion platforms. The ¼ inch "flowable" feedstock sounds like a researchers dream not a practical process engineers plan.
- Need more complete industry review to guide project.
- Define use of DGS as feedstock.
- Should emphasize or use measure of reliability of delivery as measure of process suitability. There will be tradeoffs to get reliability. These will cost money.
- Need to consider site specific aspects or localization effects.
- Need to recognize and define limits of grain analogy.
- Wood seems to be largely ignored in this approach.
- Need to better define role of potential commercial organization s in process. Harvesters and balers don't have funds for capital required.
- How do you ensure feedstock quality? That's the biggest issue in 40 million tons of forage harvesting and much more in wood fiber harvesting.
- Where is sustainability? How does overall processing system help sustainability? Identify what nutrients or other elements are lost or could be returned at stages in the system.
- None evident to me.

Technology Transfer/Collaborations

- I think it would be well to see more of the linkages. I feel that they were there, or the detailed data could not be developed, yet I didn't see it.
- The high quality of this work and the broad vision guiding the work will make it highly relevant to most/all future users of biomass.

Recommendations for Additions/Deletions to Project Scope

- Advanced pioneer processing to challenge existing suppliers.
- Building organization infrastructure through existing products and projects. This effort should be educating the engineers who will build the next generation feedstocks systems.
- Price targets are good for driving progress, but at some point need to be treated with caution: a highly efficient processing plant will be able to use more expensive feedstock. In Finland efficient users of woody biomass can outbid inefficient plants, which translate to being willing to transport biomass over a longer distance.
- Recognize that if two or three "commodity" biomass systems emerge, this may reflect economic reality. The oil industry has gravitated to two or more "commodity" crude oils: heavy crudes vs. standard crudes; this isn't a failure for the oil industry; it is an outcome that maximizes efficient processing.

APPENDIX A

Agenda

Day One – Tuesday, August 21, 2007

Evening Opening Reception (tentative)		
7:00	Wine & Cheese Reception	*All participants*
7:30	Overview of Reviewer Instructions	*Kevin Craig, Golden Field Office, Session Moderator & Reviewers Only*

Day Two – Wednesday, August 22, 2007

Introduction		
8:00	Welcome & Program Overview	*John Ferrell, OBP*
8:30	Portfolio Overview	*Sam Tagore, OBP*
9:00	Feedstock Platform Future Directions (MYPP)	*Cindy Riley, NREL*
9:30	USDA Overview	*Bob Fireovid & Bryce Stokes, USDA*
10:00	Q&A	*Introduction Presenters*
10:30	Break	
Feedstock Platform Portfolio – Feedstock Supply & Sustainability		
10:45	Area Overview	*Kevin Craig, Golden Field Office, Session Moderator*
11:30	Biomass Resource Supply Analysis - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Bob Perlack, ORNL*
12:15	GIS-based Biomass Resource Sustainability Analysis - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Tris West, ORNL*
1:00	Lunch	
2:00	Regional Biomass Energy Feedstock Partnerships - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Terry Nipp, National Sun Grant Initiative & Kevin Kephart, South Dakota State Jim Doolittle, South Dakota State*
2:45	Other Feedstock Production Projects - Mississippi State University Sustainable Energy Center (30 mins total) - The University of Tennessee Switchgrass Demonstration Project (30 mins total)	*Bill Batchelor, MSU & Burton English, University of Tennessee*
3:45	Break	
4:00	Other Feedstock Projects - Alternative Fuel Source Study (30 mins total) - Jefferson County Bio-energy Initiative (not present) - Laurentian Bio-Energy Project (not present)	*Ralph Zee, Auburn University; Wade Yates, Jefferson County; & Gary Cerkvenik, Laurentian Energy Authority*
5:30	End of Day Wrap-up & Adjourn	*John Ferrell, OBP*
6:30	Review Committee Evening Work Session	*Review Committee*

Day Three – Thursday, August 23, 2007

Time	Session	Presenter
Introduction		
8:00	Welcome & Day One Overview	*John Ferrell, OBP*
Feedstock Platform Portfolio – Feedstock Logistics Core R&D		
8:15	Area Overview	*Kevin Craig, Golden Field Office, Session Moderator*
9:35	Harvest & Collection - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Kevin Kenney, INL*
10:20	Preprocessing - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Chris Wright, INL*
11:05	Break	
11:15	Development of Engineering Data for Feedstock Supply Operations - 20 mins presentation - 10 mins Q&A/Reviewer Reflection	*Shahab Sokansanj, ORNL*
11:45	Storage & Queuing - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Corey Radtke, INL*
12:30	Lunch	
1:30	Handling & Transport - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Judy Partin, INL*
Feedstock Platform Portfolio – Feedstock Systems Integration		
2:15	Area Overview	*Kevin Craig, Golden Field Office, Session Moderator*
2:35	Supply Systems Logistics - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Shahab Sokansanj, ORNL*
3:20	Design Report - 30 mins presentation - 15 mins Q&A/Reviewer Reflection	*Richard Hess, INL*
4:05	Break & Review Committee Caucus	*Review Committee*
5:00	Review Committee Summary Report	*Lyle Stephens, Lead Reviewer*
5:45	Feedstock Review Wrap-up & Adjourn	*John Ferrell, OBP*

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Sam Tagore

Please copy Laura Neal (Laura.Neal@ee.doe.gov)

You have been invited to serve as a Reviewer for the DOE Biochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	No
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in	_____	_____

a research activity in program/project area.

Technical Area or Project on Review Agenda	Nature of conflict of interest (Leave blank if none)

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Sam Tagore (202-586-9210) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

______________________________ ______________________

Signature Date

____

Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session: [2] [3] [4] **Reviewer Name**: ______________________________

Title of Project: ______________________________

Presenter Name: ______________________________

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ______________________________

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan or the missions and objectives of USDA Programs, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach** to performing the R&D.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE or USDA goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

U.S. Department of Energy
Office of the Biomass Program
Biodiesel and Other Technologies
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Biodiesel and Other Technologies, held on August 14th and 15th in Golden, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the technology area they were investigating (i.e. fuels demonstration, combined heat and power, anaerobic digestion, or communications and outreach). The review agenda is attached to this report as Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the specific Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for comment, and any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Mark Decot
Biodiesel Technologies Manager
DOE/EERE, Office of the Biomass Program

Project Title	Relevance	Approach	Progress	Success Factors	Future Plans	Average
Missouri Biodiesel Demonstration Project (S2P5)	3.71	3.71	3.57	3.50	3.17	3.53
Regional Biomass Programs (S5P2)	3.33	3.00	3.20	2.90	3.20	3.13
National Biofuel Energy Laboratory (S2P6)	3.63	3.50	2.88	2.25	3.25	3.10
Alternative Energy Enterprise Program (S4P3)	3.29	3.00	3.14	2.93	2.75	3.02
Mississippi State University Sustainable Energy Center (S2P2)	3.25	2.94	3.00	2.94	2.75	2.98
O2 Diesel Demonstration (S2P3)	2.56	2.63	2.13	2.50	2.50	2.46
New York Biomass/Methane Gas Power Fuel Cell Project (S3P5)	2.13	2.88	2.43	2.63	2.25	2.46
Anaerobic Digestion (Ohio State University) (S3P4)	2.50	3.07	2.00	2.14	2.43	2.43
Ohio Solid Waste Authority Pyramid Resource Center(S4P1)	2.56	2.13	2.56	2.75	2.06	2.41
EERC Center for Biomass Utilization (S3P3)	2.50	2.63	2.38	2.13	2.29	2.38
E-Diesel Test and Research Project (S2P4)	2.19	2.50	2.06	2.25	1.75	2.15
Kentucky Rural Energy Supply Program (S5P1)	2.43	2.50	2.36	1.29	2.00	2.11
New Uses Information and Entrepreneur Development(S4P2)	2.21	2.00	2.21	1.43	2.43	2.06
Canola-based Automotive Oil R&D (S3P1)	2.25	2.00	1.38	2.00	1.38	1.80
Phillips Biomass Combined Heat & Power Facility (S3P2)	1.56	1.75	1.71	1.75	1.75	1.71

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Program Peer Review Platform Results

Platform Direction

Biodiesel and Other Technologies reviewers provided strong consensus on the need for renewed focus on biodiesel and similar areas within the Biomass Program's research and development (R&D) portfolio. The Program recognizes the need for an expanded biofuels scope (beyond cellulosic ethanol) in its Multi-Year Program Plan (MYPP) for 2007-2017. In this document, conversion technology platforms, infrastructure, and market transformation activities are outlined for ten years. Near-term cellulosic ethanol R&D and integrated biorefinery activities are intended to form stepping-stones to a more wide-reaching biofuels platform with industry support. Biodiesel, Bioproducts, and Other Technologies projects, while not the main thrust of the Biomass Program's efforts, continue to receive funding and staff oversight throughout the program.

Key to this approach is the Program's biomass-to-biofuels supply chain model. In line with reviewers' comments that the Program consider the end product and biomass' ability to serve as a petroleum replacement, the supply chain model aligns Program efforts along the chain of necessary events to bring biomass materials from the farmer's field to the consumer's vehicle, including any co-products of the process.

Reviewer concerns about a decrease in outreach activities will be addressed by the Program in the next few years as discussed in the MYPP section on Market Transformation, including educational and public outreach, as well as legislative communication with federal, state, and local entities. Implementation of these efforts will be facilitated by strategic stakeholder partnerships. Additional communication of Program structure to meet its goals has been undertaken in 2008 with increased participation in public expositions and trade shows and distribution of major reports at these events and via the program website.

Platform Funding (in $M):

Because Biodiesel and Other Technologies has not been a discrete Biomass Program Platform, funding for the reviewed projects is allocated across Technologies in the form of Congressionally Directed Projects. Due to the continuing resolution, there were no congressionally directed appropriations in FY 2007. None of the projects reviewed were funded in FY 2007, instead they were operating on carryover from funding in previous years. In FY 2006 these projects were awarded more than $28million.

Specific Platform Responses to Select Reviewer Comments:

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
• The need for middle distillates is known. It seems that a biodiesel or middle distillate platform is needed. • The recognition that the role of biodiesel in OBP is still very much TBD and needs to be significantly improved. • As the presentation indicates, a biodiesel platform does not exist. Much more work is		Achieving the President's Twenty in Ten goal to produce 35 billion gallons of renewable and alternative fuels by 2017 will necessarily include all types of biofuels. The Biomass Program will continue to address middle distillate barriers throughout its portfolio, while collaborating with industry to facilitate policy for increased production and distribution of commercially-

needed on this activity.		viable biofuels such as biodiesel. The Biomass Program seeks to combine its near-term focus on cellulosic ethanol with consideration of alternative biofuel approaches, including Fischer-Tropsch fuels and renewable diesel, in both the biochemical and thermochemical conversion platforms.
Biodiesel ought to be relegated to niche applications, such as mandated usage in recreational vehicles and boating where it is affordable. Biodiesel costs are prohibitive in view of other renewables. It has value to replace petro-diesel in ecologically sensitive areas.		The Biomass Program's support of biodiesel-related projects in recent years focused on infrastructure and testing issues. How biodiesel succeeds in the open market is beyond the scope of the program.
OBP should consider abandoning support for biodiesel (fatty acid esters) and instead focus on renewable diesel as supported by a strengthened thermochemical conversion platform. If the decision is to retain oil based biodiesel, the focus should be on new (as in economically viable) feedstocks.		To achieve the President's Twenty in Ten goal, the Biomass Program will combine its near-term focus on cellulosic ethanol with consideration of alternative biofuel approaches, including Fischer-Tropsch fuels and renewable diesel, in both the biochemical and thermochemical conversion platforms.

Program Peer Review Comments:

Strengths

- This is not a platform, rather a collection of mandated projects. It was a good review of the projects with many good suggestions/recommendations.
- The reviewers performed a valuable service in analyzing these "orphan" projects. Leveraging with private funding is to be commended. Pipeline testing projects may have use to the new infrastructure platform.
- The recognition that the role of biodiesel in OBP is still very much TBD and needs to be significantly improved – if that's a strength.

Weaknesses

- As the presentation indicates, a biodiesel platform does not exist. Much more work is needed on this activity.
- Didn't appear likely that many of the recommendations would be followed.
- There is no platform. Some of the projects could be moved into existing platforms for better review. However, I don't fault the Program for conducting the review in the manner they did.
- No focus.

R&D Portfolio Gaps

- Gaps are not indicated.
- The reviewers' comment that a biodiesel/renewable diesel platform is needed is interesting. I don't think that a separate program is appropriate, but should rather be integrated into existing platforms. That said we did not see much attention to biodiesel this week. As clean diesel engines have certain advantages over gasoline engines for improved fuel use, there is a need to give this some attention (at least a cost analysis). I would suggest that the Program follow up on the suggestion that the Program attempt to bring PIs from these types of projects together early and educate them on the Program goals and useful tools for project success.

- Overall, the projects presented were not focused on DOE Office of the Biomass Programs. Project timelines did not appear to be a major area of concern. As some of the projects were earmarked with a lack of coordination with more stable research programs, accomplishments were minimal. Inadequate data on cost benefits from utilizing biodiesel. Prior to demonstration projects, dollars should be spent on basic aspects of bioconversion and sourcing. Studies on engine performance and responses to regulatory requirements must be conducted. Relevant relationships with biorefineries were not apparent. Project innovations must be listed and acknowledged. Economic analyses are needed to ascertain relevancy to utilization of current and proposed materials.
- Too many to comment on.

Additional Recommendations, Comments and Observations

- Much work is required in this activity.
- The need for middle distillates is known. It seems that a biodiesel or middle distillate platform is needed.
- Biodiesel ought to be relegated to niche applications, such as mandated usage in recreational vehicles and boating where it is affordable. Biodiesel costs are prohibitive in view of other renewables. It has value to replace petro-diesel in ecologically sensitive areas.
- I agree with the ideas presented for managing earmarked projects. They can't hurt, and a few PIs might actually cooperate.
- OBP should consider abandoning support for biodiesel (fatty acid esters) and instead focus on renewable diesel as supported by a strengthened thermochemical conversion platform. If the decision is to retain oil based biodiesel, the focus should be on new (as in economically viable) feedstocks.

Platform Feedback

Specific Responses to Select Comments

Platform Peer Review		
Reviewer Comment		**Technology Manager Response**
The overall Biomass Program structure should change. • Technology Platforms could be based on petroleum replacement segment • Technology R&D should identify benefits in terms of the end product as well as process improvements. • The Biomass Program could broaden its definition of conversion, rather than using subheadings to restrict technology focus. • Congressionally-directed projects which cannot be directly aligned with a technology platform should be separately identified, with their focus technology linked to its respective match in multiple platforms. This approach could facilitate cross-fertilization.		The Biomass Program's current focus is the development of cellulosic ethanol in line with the President's Twenty in Ten Initiative. The Program structure mirrors these technology needs, funding extensive pre-commercial conversion research.

• The Biomass Program should communicate with the legislative branch that they are working hard to do good things with congressionally-directed funding. Support statements and a direct request for technology focus areas should be provided to staffers directly. • Projects could be required to undergo a review of their award and expectations prior to contract signing. Discussion with the Program would help projects to focus and plan their work.		
Project work would benefit from requirement that results be put into public domain		The Biomass Program agrees and will continue our effort to disseminate reports, studies and results on the website www.biofuels.energy.gov.
The Biomass Program should educate the public about its full range of technologies		In fiscal year 2008 the Biomass Program's plans to increase funding in the communication & outreach and has staff dedicated to the effort.
Given the needs of the 20 in 10 goal, the review panel recommended that OBP increase its support for biobased alternatives to petroleum products.		The program agrees that biobased products should continue to receive program support.
OBP should tie to HFCITP/H2A analysis of intense pressure on biomass feedstocks in medium transition years to the Hydrogen economy.		The Biomass Program will consider this recommendation in consultation with the Hydrogen Program.
DOE should pursue greater coordination of state and/or regional resources, with out-of-state review using same-level groups from other states.		The Biomass Program agrees and has included a regional/state/local effort in its new Market Transformation area.
DOE should have clear rule regarding commercial product funding, requiring at least 80 percent cost-share.		Current DOE policy states that EERE will fund process-related R&D that benefits no single company (i.e. specific product improvement). In addition, DOE does have a clear funding structure which requires increased industry cost-share as the R&D nears commercialization. The Biomass Program will continue to operate under these guidelines, while in consideration of industry preference for future solicitations.

General Platform Comments

- The overall Biomass Program structure should change.
  - Technology Platforms could be based on petroleum replacement segment?
  - Technology R&D should identify benefits in terms of the end product as well as process improvements.
  - The Biomass Program could broaden its definition of conversion, rather than using subheadings to restrict technology focus.
  - Congressionally-directed projects which cannot be directly aligned with a technology platform should be separately identified, with their focus technology linked to its respective match in multiple platforms. This approach could facilitate cross-fertilization.
  - The Biomass Program should communicate with the legislative branch that they are working hard to do good things with congressionally-directed funding. Support statements and a direct request for technology focus areas should be provided to staffers directly.

    - Projects could be required to undergo a review of their award and expectations prior to contract signing. Discussion with the Program would help projects to focus and plan their work.

- The Biomass Program should educate the public about its full range of technologies.

- Project work would benefit from requirement that results be put into public domain.

- The Biomass Program should focus on coordinating projects to avoid duplication of effort (and funding): Oxidative Stability, Lubricity, etc.

- Given the needs of the 20 in 10 goal, the review panel recommended that OBP increase its support for biobased alternatives to petroleum products.

- Sludge conversion work could be part of the processing and conversion platform's biochemical area.

- OBP should tie to HFCITP/H2A analysis of intense pressure on biomass feedstocks in medium transition years to the Hydrogen economy.

- DOE should pursue greater coordination of state and/or regional resources, with out-of-state review using same-level groups from other states.

- DOE should have clear rule regarding commercial product funding, requiring at least 80 percent cost-share.

- Encourage DOE to organize workshop with earmarks at project initiation (prior to contract development/final award) to discuss OBP goals and objectives.

- OBP should organize technical information transfer workshops after project work is begun.

- OBP platforms do not encompass broader, public, biomass vision, leading to a vacuum, creating more congressionally-directed projects.

- Potential topics for consideration:
    - Biodiesel
    - Biogas
    - Bio gasification
    - Hydrogen
    - Landfill gas
    - Chemical products
    - etc.

- DOE should establish program with strong management for outreach/regional/state efforts, including kickoff workshop involving all stakeholders. Suggest separate, targeted review for outreach projects.

<u>Comment:</u>

- Based on the projects reviewed by this panel, there appears to be a high level of interest in biodiesel and other alternative fuels that would displace or augment the use of petroleum diesel in the U.S. market. It is difficult for project PI's to address DOE goals and objectives when there is no specific platform for this area of research in the DOE portfolio.

<u>Recommendation:</u>
- Add a component to the multi-year plan that specifically covers research goals and objectives on displacement or augmentation of U.S. market demand for petroleum diesel.

<u>Comment:</u>
- Insufficient time is provided for Peer Review Panel to come to consensus on strengths and weaknesses of projects; similarly, there is insufficient time for PI's to form rebuttal comments.

<u>Comment:</u>
- Petroleum diesel is extensively used in the U.S. market for uses other than transportation fuel. These uses include electric power generation and residential heating. Displacing and augmenting these petroleum diesel uses with biodiesel and other diesel substitutes could substantially help achieve DOE's "20 in 10" goals and objective.

<u>Recommendation:</u>
- Add a component to DOE's multiyear plan to set goals and objectives, including research and development investment, to take advantage of this opportunity in the U.S. market.

- DOE should establish stronger information library, including historical results, for public use, data and information exchange, and elimination of research duplication or overlap:
  - State and university-funded information
  - Private R&D
  - National laboratory results
  - Federal agencies

- Demonstration projects should be required to present life-cycle cost and environmental analysis.

- All projects need to provide detailed statements of work for thorough background information with funding broken down by task

- Projects should be required to present expenditure summary and matching funds detail.

- Reviews can hold poster sessions for public information review, and simultaneous closed sessions to present proprietary information.

Initial Reviewer Feedback – Comment Summaries

Biodiesel and Fuels Demonstration Projects

Project Title - Mississippi State University Sustainable Energy Center
Project Investigator: Rafael Hernandez, Mississippi State University

Strengths
- Wide variety of potential fuels.
- Focused on unique feedstock niches (algae, primary and secondary sludge).
- Research program well laid-out with documented progress.
- Future funding support, meeting multiple objectives, with partners.

Suggestions and/or Weaknesses
- Could use clearer data about amount of biodiesel to be produced.
- Little incentive for ethanol producers' hydrolysate contribution.
- Some more economic analysis would strengthen project work.
- Needs stronger partners in waste industry.
- Acid esterification technology seems poorly focused.

Comments
- Needs overall focus to maximize funding and benefits.

PI Responses
- *Little incentive for ethanol producers' hydrolysate contribution.*
  MSU technology may enhance ethanol manufacturing. Transportation fuel may be maximized from an ethanol facility by utilizing recycle streams and waste streams (C5 sugars) as a source of carbon for oil accumulating microorganisms. The technology allows for economic optimization for markets, similar to how refineries shift yields between gasoline and diesel based on market conditions. MSU's technology permits economic utilization between ethanol to renewable diesel or biodiesel, thus upgrading the facility to a biorefinery.
- *Acid esterification technology seems poorly focused.*
  PI Response: This part of the project is focusing on feedstocks with a high content of free fatty acids. These feedstocks may require unique operating conditions. Most of the biodiesel producers in the U.S are not equipped to handle this type of feedstock.
- *Some more economic analysis would strengthen project work.*
  PI Response: The PIs agree with the reviewers. Funding is being requested from private and government sources to build a pilot system, demonstrate the technology, and improve the economic analysis of producing biodiesel and/or renewable diesel from sewage sludge.

<u>Project Title: O2 Diesel Demonstration</u>
Principal Investigator: Thomas Sopko, 02 Diesel, Ben Kaufman, 02 Diesel

Strengths

- Well-focused commercialization program to reduce regulatory barriers.

Suggestions and/or Weaknesses

- O2 diesel unlikely to become homogenous fuel (low volume).
- Product will have ongoing environmental and safety challenges.
- Define the incremental improvement of adding ethanol to diesel (performance enhancement?).
- Difficult to quantify improvements from adding ethanol to biodiesel blends.
- Environmental improvement data not adequate to justify fuel use.

Comments

- Recommend project achieves at least 50/50 cost-share.
- Project work does not fit biomass program objectives.

PI Responses

- It is well known that O2 Diesel, as a commercial fuel, is targeted solely for use in centrally-fueled fleets which represent at least 50% of the diesel market. Moreover, the components to blend O2 diesel, except for the additive, exist at terminals today, just like rack blending, which would support national efforts for growth in the centrally fueled fleet market. To characterize O2 Diesel as “unlikely to become homogenous fuel” is premature.
- The project has a written safety program which follows NREL guidelines with no instances of safety problems in a variety of fleets and operating environments under millions of hours of in-use testing. The use of flame arrestors in O2 Diesel capable centrally fueled fleet applications is a proven technology, which serves the same function in a number of E-85 flexible fuel-capable vehicles on the road today. Moreover, while complementary with other biomass products, the renewable and proprietary additive components of O2 Diesel provide environmental and energy security benefits beyond current biodiesel formulations.
- Aside from reducing the use of imported oil, O2 Diesel provided data showing significant emissions reduction benefits as compared to ULSD especially with respect to particulate matter and oxides of nitrogen (NOx) emissions. The positive improvements of O2 Diesel on diesel exhaust NOx emissions, as a precursor pollutant in the formation of ground-level ozone, is at a minimum directionally correct and could play an important roll in State Implementation Plans (SIPs) in compliance demonstrations should EPA decide to adopt a more stringent National Ambient Air Quality Standard (NAAQS) for ozone under its pending Notice of Proposed Rulemaking (NPRM). Further, the particulate matter benefit is synergistically improved with biodiesel blends greater than 12%. Based upon the positive data to date, we are encouraged about the potential for O2 Diesel to improve the performance of aftermarket treatment devices and new engine designs. Further research on the effect of ethanol diesel blends on the performance of after treatment devices and new engine designs would be important information.
- Finally, with regards the Comment that O2 Diesel Project work “does not fit the biomass program objectives” is puzzling. As touted on the DOE website “The Office of Energy Efficiency and Renewable Energy's Biomass Program works with industry, academia and our national laboratory partners on a balanced portfolio of research in biomass

feedstocks and conversion technologies. Through research, development, and demonstration efforts geared at the development of integrated biorefineries, the Biomass Program is helping transform the nation's renewable and abundant biomass resources into cost competitive, high performance biofuels, bioproducts, and biopower.

- In particular, our work is focused on
  - Making cellulosic ethanol cost competitive by 2012;
  - Contributing significantly to the Presidential goal of reducing gasoline consumption by 20 percent in 10 years through efficiency and alternative fuels; and,
  - Displacing 30 percent of gasoline consumption with biofuels by 2030."
  - What could be more fitting than the on-going O2 Diesel Projects?

Project Title: E-Diesel Test and Research

Principal Investigator: Nathan Fields, NCGA

Strengths

- Realistic evaluation of project data and appropriate decision to re-direct.
- Strong partnerships and OEM collaboration.

Suggestions and/or Weaknesses

- Nearly 80% of funding unspent.
- Emissions goal not addressed.
- Original durability research lacked follow-through to resolve barrier.

Comments

- Recommend tighter, phased task plans for future funding (outline go/no-go decision points).

PI Responses

- Project recognizes issue with unspent funds. Front-end issues affected the overall project timeline. The planned project re-scope should accelerate targeted fund disbursement.
- Emissions plans were addressed in the original plan of work, with results similar to those of the O2 diesel project, including documented benefits. The presentation failed to include this information.
- The original plan of work included a step to address product durability. Research did not advance past the first phase, and durability work was therefore never fully completed due to the severity of problems encountered and feasibility of 10% ethanol diesel actually reaching the market.

<u>Project Title: Missouri Biodiesel Demonstration</u>

Principal Investigator: Tom Verry, NBB

Strengths

- Well-constructed and implemented project.
- Achieved objectives in a timely manner.
- Results on BQ 9000 testing have industry-wide benefits.
- Strong partnerships with prime industry players including partnership funding.
- Strong outreach and education program.
- Addressed all three critical components: Quality/Distribution/BQ 9000.

Suggestions and/or Weaknesses

- Should have done wintertime pipeline testing.
- Pipeline test did not provide volume justification.
- Could use stronger, long-term future roadmapping.

Comments

- Bioheat is a beneficial market for pipeline use.
- Lubricity benefit comparison testing should include raw oil.

PI Responses

- *Should have done wintertime pipeline testing.*
- The pipeline runs were done at time that was convenient to the pipeline companies, and running in cold vs. warm weather was not an overall objective. The impact of 5% biodiesel on cold weather performance is small and little impacts would be expected even if run in colder weather. Pipeline runs in colder weather for confirmation purposes could be accomplished in future work. Cold weather runs will be more of a factor with higher blends like B20.
- *Pipeline test did not provide volume justification*
- The volumes needed to justify pipeline runs vary from company to company, and may be dependent somewhat on the results of pipeline testing for interface levels with biodiesel blends. At this point, our purpose is more 'proof of concept' on the technical aspects of using multi-product pipelines for biodiesel blends, rather than volume justifications.
- *Could use stronger, long-term future road mapping*
- We agree that stronger, long-term future road mapping would be useful. To a certain extent, the technical 'proof of concept' and implications of the transport of biodiesel blends at various levels are needed in order to develop good long term road mapping.
- *Lubricity benefit comparison testing should include raw oil.*
  We respectfully disagree that lubricity benefit comparison testing should include raw oil. Use of raw vegetable oils or animal fats has been demonstrated to have significant technical problems and should not be used. Please refer to Clean Cities Fact Sheet and Engine Manufacturers Position Statement on use of Raw Oils at http://www.biodiesel.org/resources/fuelfactsheets/ in the 'Engine Manufacturers' section.

Project Title: National Biofuel Energy Laboratory

Principal Investigator: Chuck Moeser

Strengths

- Very clear, targeted program to provide highly relevant information to biodiesel industry. Divided technical solutions among stakeholders well.
- Full industry coordination, including component manufacturers.
- Good technical support for B20 ASTM work.

Suggestions and/or Weaknesses

- Half the funding applied to facility enhancements/construction.
- Unclear how heterogeneous catalysts work in biodiesel production fits with overall goals.
- Did not address showstoppers/success factors.

Comments

- Recommend stronger, national data and information outreach approach.
- Project did not sample nationally to ID regional differences.
- Test should ID whether supply is BQ 9000.

PI Responses

- Project work started without an adequate laboratory. Funding used for construction was detailed as part of the original project proposal. Future plans will channel funding to testing work.
- The overall goal of heterogeneous catalyst work is to understand fuel composition for performance. Understanding of production will improve overall processing techniques, control quality, and render an efficient, competitive product.
- Success factors and showstoppers do exist, but the project acknowledges they strayed from the presentation template and did not include this information.
- The project leads regularly make presentations regarding their data at national conferences and send it to peer-reviewed publications. NextEnergy is conducting its own national event in 2008.
- The project did not address national sampling because NREL has already done similar work, though with unidentified sources.
- Bob Armantrout from NextEnergy, who was not present, would best be able to address BQ 9000 compliance.

Associated Products, Combined Heat and Power, and Other Technologies Projects

<u>Project Title: Canola-based Automotive Oil R&D</u>
Principal Investigator: Ira Pierce, Green Oil Company

Strengths

- Good group of uptake core questions.

Suggestions and/or Weaknesses

- High funding allocation disproportionate to stated project goals.
- Market analysis methodology not described clearly.
- Lacks technical plan.
- Niche market without volume displacement potential.

Comments

- Recommend task plan with research barriers, cost assessment.
- Automotive oil application not clearly defined.

PI Responses

- Technical plan in development, to use secondary sources, no laboratory analysis, use others' work.
- Volume displacement numbers not yet agreed upon, but will be large.
- Testing of the product will be a research barrier, because those developed for petroleum are not applicable to bio-oils.
- The product application will be better defined in the future. At this time hydraulic fluid and metalworking applications are the base of a hierarchy to culminate in automotive oils work.

<u>Project Title: Phillips Biomass CHP Facility</u>
Principal Investigator: Carl Nelson, The Green Institute

Strengths
- Good urban outreach for energy efficiency.
- Generated regional biomass inventory data and associated costs.

Suggestions and/or Weaknesses
- Needs biorefinery relationship.
- Needs stronger technical support/development and analysis.
- Project lacks focus, R&D improvements and value-added.

Comments
- Recommend hiring experienced subcontractor with wood power knowledge

PI Responses
- For the work completed so far, we have had subcontractors with strong experience, including some of the top engineering firms in the world with biomass experience
- Due to the second stage of work still being in early development, we still need to build further partnerships and strong subcontractors, which we expect to resolve some of the issues brought up by the panelists.

<u>Project Title: EERC for Biomass Utilization</u>
Principal Investigator: Dr. Bruce Folkedahl, U. North Dakota

Strengths

- Generating regional interest in biofuels.
- Strong education/outreach meetings.
- Many cost-share partners.

Suggestions and/or Weaknesses

- Portfolio of projects too large and unfocused.
- Poor sense of potential economic impact (individual and combined).
- Poor sense of whether projects have chance of moving out of laboratory.
- Low level of project innovation.

Comments

- Future funding route unclear.
- Need fewer, stronger projects with national potential.
- Recommend stronger programmatic control over project portfolio.

PI Responses

- *Portfolio of projects too large and unfocused.*
- In general, because of the number of projects the EERC presented, there simply was not enough time to present all of the information on each project which would have addressed some of the weaknesses cited here. Indeed the portfolio of activities was large (there were ten), but we were trying to spur innovation in high-risk applied research and development in the key areas of biopower, biofuels, and bioproducts using a million dollars and 20% industry cost share. It is very easy to do a large demonstration of one idea but, usually, that type of project is limited in the fundamental sense. We have many partners involved in our work but still stress fundamental applied research. These projects cannot be very large, like a large demonstration, because the lack of cost-share commitment. Additionally, with more activities, there are more opportunities to develop new processes and principles that can lead to large pilot-scale experiments or demonstrations.
- *Poor sense of potential economic impact (individual and combined).*
- Perhaps the reviewer meant for a specific activity, because this statement is simply unfounded. Case in point is our work to develop a 150-kW biomass gasifier for real world uses in distributed energy. The economic impact of this system is well-documented and attested to by four projects going forward for long-term demonstration and real world electricity production. The microturbine for landfill gas also has a detailed economic assessment. Other economic assessments are still being done for laboratory-and pilot-scale experiments and, quite frankly, these activities probably will not generate reliable economic forecasts with respect to markets until scale-up versions can be produced and tested for better economic numbers.
- *Poor sense of whether projects have chance of moving out of laboratory.*
- All principal investigators involved in this overall program (about 10) have clear intentions, aspirations, and partners for moving their innovations out of the laboratory. There probably simply was not time to discuss all activities in detail. For example, the biomass gasification activity discussed above has clearly demonstrated a pathway out of the lab, and a near-commercial version is installed at the Grand Forks Truss Company. A higher-risk project such as the urea fertilizer project has the North Dakota, South

Dakota, and Minnesota Corn Growers anxiously waiting to see concrete results for the innovative electrochemical process testing, to be completed this fall. I don't think this comment is justified, just miss communicated.

- *Low level of project innovation.*
- This comment is fairly subjective. I don't see any 150–300kW biomass gasifiers making electricity anywhere in the United States. I don't see any fertilizer plants in the heartland making nutrients from anything other than 100% natural gas. These two examples are indicative of projects overall.
- *Future funding route unclear.*
- *Need fewer, stronger projects with national potential.*
- *Recommend stronger programmatic control over project portfolio.*
  We agree that the EERC (University of North Dakota) project needs to be more connected to the DOE EERE Office of Biomass Program portfolio. The EERC (UND) will put more attention toward coordinating future projects in conjunction with ongoing work at the DOE EERE Office of Biomass to avoid duplication of effort. We do visit with Golden Field Office and the Washington D.C. office every year to discuss our future direction for project activities. We also agree that fewer activities under one more focused project umbrella is a good idea.

Anaerobic Digestion and Waste Processing Projects

Project Title: Ohio State University - Anaerobic Digestion
Principal Investigator: Floyd Schanbacher

Strengths
- Integrated project into numerous Biomass Program objectives.
- Design and development of advanced controls for self-healing industrial digester beneficial.
- Reactor systems, even at bench level, nicely engineered.
- Good tie between inventory, economics, and energy policy.

Suggestions and/or Weaknesses
- Should coordinate with other high strength influent work to avoid duplicative effort.
- Should identify process improvement goals. Targets, goals, benefits, cost assessments not provided.
- Progress seems slow.
- Lack of fallback position if solid-oxide fuel cell system fails. Not necessary to rest of project.
- Relies heavily on price-to-value of renewable energy without comparisons.

Comments
- Should focus on pre-fuel-cell R&D.
- Bacterial species study might be valuable, if focused on process-improvement controls.
- Using Federal dollars for state-specific resource assessment is parochial.

PI Responses
- Federal dollars were provided for state specific assessments.
- Project includes assessment of food-processing/high strength influent not seen elsewhere, applicable to other states.
- Bacterial study looking at process improvement controls. Consortia is one of the rate limiting steps.
- Composite funding affects progress.
- Appreciate need to coordinate with other high strength influent research programs.

Project Title: New York Biomass/Methane Gas Power Fuel Cell

Principal Investigator: Dr. Caine Finnerty, NanoDynamics

Strengths

- Research plan well-developed and implemented, with progress metrics.
- Project making excellent progress towards stated goals.

Suggestions and/or Weaknesses

- Better path to commercialization needed.
- Need better sense of project's larger energy impacts.
- Lack of economic information provided could be show-stopper.
- Lack of commercial partnerships and solid-oxide consortium participation.

Comments

- Project work best fits in DOE Hydrogen program-solid oxide fuel cell development.
- How does work relate to 20 in 10 goal?

PI Responses

- The project is applicable to the 20 in 10 target, as small scale Solid Oxide Fuel Cell systems in the region of 1-5kW could potentially be used as auxiliary power units (APU's) in a variety of transportation applications, for example larger tractor trailer units idle their engines during the night to provide power for electronics and environmental control, under these operating conditions the engine is operating very inefficiently, a SOFC APU could provide the necessary power whilst reducing emissions, noise and more importantly reducing fuel consumption.
- We are not currently part of consortium, the fuel cell program at ND was developed around a vertically integrated model; however, now we have reached our current phase of development and commercialization we may look into this.
- On the commercial side we are currently pursuing several contracts representing near term markets in excess of $200M, we are confident that we can successfully implement this technology in a commercial arena. Based upon the power density and manufacturing approach associated with our cell technology, we believe that the economics of the NDE solid oxide fuel cell will be very competitive. Management has experience supplying high volume, engineered ceramic components to the energy (nuclear), telecom, and automotive markets and is confident in the scalability and economics of the current approach.

Project Title: Ohio Solid Waste Authority Pyramid Resource Center
Principal Investigator: Tim Berlekamp

Strengths

- Good leverage of DOE funding.
- Good Phase I construction progress.
- Provided good information about project stages.

Suggestions and/or Weaknesses

- No life-cycle cost analysis has been done.
- Lacks commercialization plan, market analysis for CO_2;
- Recommend cost and performance analysis for gas cleanup, methanol production.

Comments

- Innovative approach to processing landfill gas.

PI Responses

- Addressing the CO_2 sales issue, the project acknowledges its commercialization plan is lagging. Due to ethanol industry supply, CO_2 availability is high, reducing the price. The project is working with the Ohio Department of Natural Resources on oil and gas well recovery efforts in Ohio.
- Cost has been an issue. The project realizes internally that additional effort is necessary.

Communications, Outreach, and Partnerships

Project Title: New Uses Information and Entrepreneur Development
Principal Investigator: Mark Williams, Growth Dimensions

Strengths
- Re-focus on bioenergy.
- Strong government and other partnerships.
- Programs like this may identify small opportunities which may otherwise be missed.
- Provide critical business development support.

Suggestions and/or Weaknesses
- Capital awards lack progress.
- Program eligibility requirements narrow, very locally focused.
- Limited success to date.
- Need better leveraging strategy based on needs and benefits.
- Seems to lack strong technical development screening capability – ensure good industrial participants.

Comments
- Future efforts should be directed statewide.

PI Responses
- Growth Dimensions is a private/public economic development agency responsible for economic development in Boone County incorporated by the City of Belvidere, the County of Boone and the
- Belvidere Area Chamber of Commerce, with funding coming from both the private and public sectors of the Boone County area, and therefore is not a statewide agency. Growth Dimensions has spearheaded a regional initiative for the commercialization of new biomass-related products and systems. The strategic goals of the imitative include increasing the value of agricultural biomass and stimulating new manufacturing opportunities.
- Understanding that geographic constraints have limited the number of award proposals, we broadened the geographic region where eligible applicants must agree to relocate to or be primarily domiciled in, from only “Boone County, Illinois” to “Boone, DeKalb, McHenry, Ogle, Stephenson, and Winnebago Counties in Illinois.” The broader region aligns more with the congressional district. Other limiting constraints were removed from the RFP solicitation, including: removing the limitation of the award of $100,000 per award, because there is no award ceiling other than what we have allocated for the Award Program with DOE. Other limiting factors including the required cost share remained the same.
- We also increased the frequency of solicitations to monthly solicitations and broadened marketing outreach to attract more proposals.
- Other barriers that we can’t change that have limited the awards program are associated with
- NEPA requirements making it cost prohibitive with past proposals.
- We have also proposed a scope of work modification to add a contract with Northern Illinois
- University for the purpose of increasing support of the Biomass Product Development

- Commercialization Services and at the same time increasing support to the Capital Awards program by providing hands-on assistance to companies interested in applying to the award program. These increased efforts will add man hours from a part-time basis to a full-time dedicated position focused on moving the project along.
- We believe the review team does include strong technical development screening capability, in addition to key business and community development support crucial for successful implementation. In retrospect, these technical competences may not have been articulated strongly enough in the presentation. The team for reviewing these proposals includes:
- **John Noel**, President Illinois Technology Development Alliance
- **Tom McDunn**, Director of Advanced Manufacturing, Rockford Area Ventures/EigerLab (Manufacturing
- Innovation Center)
- **Greg Brown**, Chairman of AgTech Initiative and President of DareCloud Development
- **Dan Cataldi**, Executive Director for Rock River Valley Entrepreneurship Center (Affiliate Office of the
- Illinois Department of Commerce and Economic Opportunity)
- **Seth Snyder, Ph.D.**, Section Leader of Chemical and Biological Technology Energy Systems Division,
- Argonne National Laboratory
- **Ann Marie Cain**, Manager of Boone County Farm Bureau
- **Mark Williams**, Executive Director of Growth Dimensions (Economic Development)
- **Jerry Zielinski,** Executive Director, Northern Illinois Technology Enterprise Center, former technology
- Commercialization executive with AT&T and Lucent Technologies

Project Title: Alternative Energy Enterprise Program
Principal Investigator: Sumesh Arora, MS Technology Alliance

Strengths

- Well-organized program with clear goals, metrics.
- Good description of impacts resulting from money allocated.
- Strong peer review process including reviewers from outside the state.
- Good alignment of state program with DOE goals.
- Good assessment of showstoppers.

Suggestions and/or Weaknesses

- Private sector involvement was very weak.
- Large amount of goal funding went to universities, did not show potential economic development.
- Did not address specific environmental regulations.
- Relatively few funded projects.

Comments

- Suggest focusing on biomass technologies which lead to significant job creation in state.

PI Responses

- A total of 24 private sector entities are involved in the various projects that are funded through the Strategic Biomass Initiative
- A portion of the project was designed for a university funding approach, but universities were asked to undertake late-stage projects. All university projects have alliances with industrial partners, with four showing strong potential for economic and commercial outcomes.
- All projects underwent a NEPA compliance review. The projects could examine environmental benefits or show-stopping aspects. Due to the project timeline, DOE is not liable if projects are not NEPA compliant when the contract comes to an end.
- A total of 16 individual projects are expected to be completed by the end of the current funding period with awards ranging from $32,000 to approximately $230,000.
- In response to the comment, MTA is an economic development organization whose performance metric is not usually job creation. MTA is a technology-oriented company, which measures commercial outcomes such as technology licensing and company start-ups. The belief is that technology diffusion and company creation lead to job growth.

Project Title: Kentucky Rural Energy Supply Program
Principal Investigator: Cam Metcalf, University of Louisville

Strengths

- Excellent consortium.
- State cash match.
- Development of university program.

Suggestions and/or Weaknesses

- Grant program should more explicitly target industry, small business.
- Poor coordination of supported projects with ongoing biomass program activities.
- Some supported projects not aligned with biomass program.
- Ensure that project redundancy does not occur.
- Needs ongoing independent (outside state) technical review program.

Comments

- Recommend relating all funding to biomass program goals.
- Program would benefit from much more focus.
- Suggest using funding as opportunity to build nationally-competitive research program.

PI Responses

- *Grant program should more explicitly target industry, small business.*
- The consortium's objective was to position Kentucky to better compete for Federal Research dollars – targeting industry and small business would not accomplish this. The funding has been used to aid and build state universities' research capabilities and collaborative efforts. The consortium represents sixty-two organizations including private sector industries and small businesses that share expertise and provide input on our research and development directions. The reviewers' comments suggested using funding as an opportunity to build a nationally-competitive research program which seems to conflict with this weakness.
- *Poor coordination of supported projects with ongoing biomass program activities.*
- All funded projects addressed a DOE roadblock, however since our original funding mandate specified biomass and energy efficiency, not all projects included biomass. The Kentucky Rural Energy Supply Program was put into the biomass program because the majority of our funding targeted biomass.
- *Some supported projects not aligned with biomass program.*
- Because our original mandate from Congress required us to look at renewable energy (including biomass) and energy efficiency projects, not all projects included biomass. Dr. Eric Berson and Dr. Sue Nokes traveled to NREL representing KREC in August 2005 and discussed the overall project and goals with DOE staff. DOE did approve all seven research projects prior to the research beginning. Ensure that project redundancy does not occur.
- The Competitive Grants Program did ensure that there was no project redundancy. The Review Panel make-up included 14 individuals from Universities (10) & Federal Labs (4) from outside of Kentucky. Three reviewers were used on each proposal. This comment does not seem to have merit.
- *Needs ongoing independent (outside state) technical review program.*
- KREC has submitted quarterly reports to DOE NREL for review as an independent and out-of-state entity. DOE should provide feedback on a continuous basis during the

project period. The KREC project ends 12/31/07, so an ongoing independent review is not feasible at this point.

- Comments:
- *Recommend relating all funding to biomass program goals.*
- Because our original mandate from Congress required us to look at renewable energy (including biomass) and energy efficiency projects, not all projects included biomass. This would violate our original mandate from Congress.
- *Program would benefit from much more focus.*
- The KREC objective was to build research collaboration and strength in the State, therefore, the project started with our strong programs to reinforce them.
- *Suggest using funding as opportunity to build nationally-competitive research program.*
- The consortium's objective was to position Kentucky researchers to better compete for Federal Research dollars and the strategy is working. The Sun Grant Initiative did fund one of the KREC supported researchers for $250,000 to progress her R&D project (biomass focus) to the next level.

Project Title: Regional Biomass Programs

Principal Investigator: Rick Handley, CONEG, Fred Kuzel, Coalition of Great Lakes Governors

Strengths

- Has potential to be powerful advocacy entity for biomass program (if program can provide role).
- Extensive involvement with broad stakeholders.
- Future plan for a legacy.

Suggestions and/or Weaknesses

- Funding R&D and demonstration through outreach program needed better coordination with biomass program.
- No defined role in biomass program.
- Poor articulation of project goals.
- Impact study has poor cause/effect relationships, could be more rigorous.
- Funding all 50 states dilutes program resources.

Comments

- Provide budget breakdown/cost-share information for future program reviews.

PI Responses

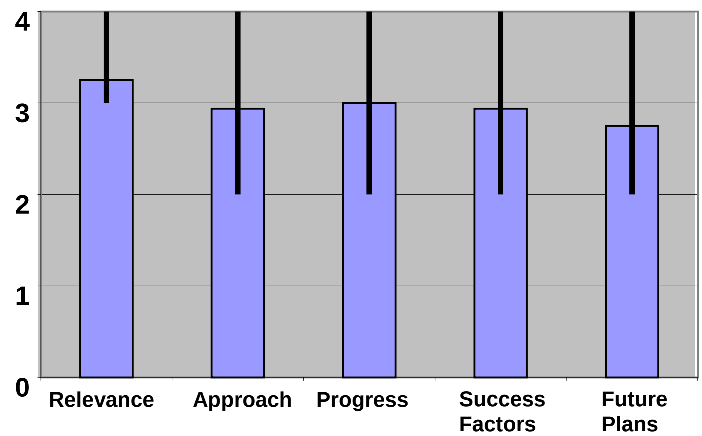
- Would have trouble selling idea to pick/choose which states to fund.
- Not having sufficient funds could be a weakness.
- Not having defined role is a weakness. Have tried communicating with DOE biomass program. A specific contact has not been provided to the regional groups. The projects are willing to coordinate, but have received no program response.
- Funding R&D/demo has not been done recently, mostly past examples. Outreach/policy/education most recent focus.
- Hope will be another program review that involves regional programs.

Full Reviewer Comments and Scores

Biodiesel and Fuels Demonstration Projects

Project Title: Mississippi State University Sustainable Energy Center
Project Investigator: Rafael Hernandez, Mississippi State University
Project Stage: Exploratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.25	0.25	0.75
Approach	2.94	0.94	1.06
Progress	3.00	1.00	1.00
Success Factors	2.94	0.94	1.06
Future Plans	2.75	0.75	1.25
Average	**2.98**		



Question 1: Relevance to Overall Objectives.

- Biodiesel is needed to meet the President's goal of 20 in 10.
- Lots of biodiesel RD& D work is underway. OBP should re-engage biodiesel.
- $.10/lb is a good target.
- New lipids work
- We strongly need new biodiesel feedstocks.
- This work is right on the mark of targeting new feedstocks.
- The use of waste water streams could be a novel source of biodiesel.
- The focus on the feedstocks is good but they have not done much to evaluate the market potential.
- Overall I rate good to fair
- Considering a range of feedstocks and the processing necessary for each. Most of the alternative feedstocks will not be high volume.
- Goal is ambitious.
- Reviewers made an effort to coordinate their projects with DOE's MYPP and Biodiesel program. Responded to the requests for goals, objectives. Provided some R&D targets
- R&D is focused specifically on biodiesel and biodiesel Feedstocks. There is a large need for biodiesel feedstock.
- The technologies under consideration are very exploratory. The market is attractive and viable. Reviewer is aware of all the potential customers, but did not have one specific one as a partner. Large, 750 MMGY, supply potential.
- Good overall program supported by defensible science.

Question 2: Approach to Performing the R&D.

- Methodical feedstock exploration and development
- Stronger economic analysis and production potential is fully developed would help.
- Nicely organized research program.
- Fair I am concerned that the project is not well focused
- They are trying to do too much

- Clear path: identify lipid sources – extract – convert to
- biodiesel – market development
- Approach is good but seems to focus on small volume sources. From an energy standpoint it does not consider alternative energy uses for the sources. Ex: Electrical power and heat energy from POTW sludges.
- Not a technically focused as typical DOE/NREL program. Project has an overarching economic target, 10 cents/lb lipids, but the technical targets are vague. A little bit of a scatter-gun approach than identifying a meaningful focus that could provide national visibility to their state. Project would benefit for more technical targets, especially on the microorganism development side. Some of the research was linked with cost assessments and value, which was good.
- More cost forecasting of envisioned processes would greatly improve the potential of this effort. Also, provides a critical
- Path development strategy for key R&D areas.

Question 3: Technical Accomplishments and Progress.

- Reasonable progress
- Tackling tough feedstocks – WWTF and tallow sources,
- How much volume in MGY analysis is needed
- Tall oil needs more progress.
- Good progress. Focus on PTOW sludges is interesting but has small yield potential.
- Insofar as there is no biodiesel program, it's hard to say what the progress looks like. However, at the strategic level, this program is making progress against DOE goals.
- Reducing the cost of biodiesel feedstocks
- They have a cost measure in cents per pound
- How will this be measured? It a good target goal but it is not clear how they measure?
- Their focus is expanding feedstock with meets DOE goals for 20-20 targets. Also trying to improve local technology for local producers, but they have not employed known technologies and are reinventing the wheel. They didn't provide enough detail on the research targets, except for feedstock cost per gallon. Local benefits were not identified. Technical barriers need to be better identified. A broader review team of highly technical experts in microorganism development and management technology would improve the project. They need to also refocus to a tighter project and get rid of the unnecessary parts, such as down stream technology which they have little expertise in.
- Good process – particularly given the basic nature of some of these tasks.

Question 4: Success Factors and Showstoppers.

- Oleaginous microorganisms growth a very positive step to improve lipid content and reduce cost at WWTFs
- Amount of biodiesel minimal; little incentive for ethanol plants to provide sugar feedstock to biodiesel plants.
- Some show stoppers have been identified such as the impact of microorganisms on water quality but they have not really looked at the business models for example would P & P industry invest in tall oil collection?
- May lead to multiple niche sources/processes.
- Economics might not be favorable.
- Well defined in presentation.
- Time frame may be too short.

- Reviewers appear to be knowledge about the key legal and EPA barriers in general, but specific barriers are vague. Their focus on non GMO for waste water is probably fine although there are ways to sterilize water before release, similar to the microalgae program issues. No recognition of issues associated with castor oil and meal, e.g., the oil is not really a biodiesel as it will have more than one alcohol on the fatty acids and they will be highly susceptible to polymerization. The meal contains ricin, which is extremely toxic. No discussion the oil or the meal barriers were presented.
- As stated earlier, more economic evaluations should be done much like the work they did with sewage sludge to biodiesel.

Question 5: Proposed Future Research Approach and Relevance.

- Specific Comments:
- Well thought through next steps.
- Keep Tall oil work going – multiple benefits.
- No particularly specific stage gate language used
- Unclear how closely cost targets depend on research success goals
- Focus on waste water lipids may be a poor choice because of the small volume potential of this source.
- Reasonable plans designed for the previous progress and current requirements
- Well thought out – suggest ensuring closer integration with DOE/USDA program objectives.

***Additional Comments*:**

Strengths

- Glad to see this work is going forward
- Very broad range of research
- Co-product nutraceuticals should help commercial economics
- WWTF feedstocks are nation wide in applicability (an important plus).
- Research looks reasonable, and results are being achieved.
- This is potentially a good feedstock market and the ability to collect the lipids or to grow more is a good idea
- I think this research needs to be done
- Broad scope/approach. Good for initial stage.
- Good professional approach to research program planning and executing.
- Progress in use of different oils for biodiesel production.
- Potential generation of more/different oils for biodiesel production.
- Integration of different research areas under one common goal.
- Focus on new feedstocks for biodiesel. Potential to expand supply. Potential to be competitive or reduce costs. Follows instruction and tries to support Program concepts.
- Well thought-out science with good academic flavor.
- Providing an educational foundation for developing more faculty active in biomass to chemicals/fuels along with the education of future biomass-savvy technologists.
- The potential of their novel feedstocks was undersold – I believe that billions of new lipids could be delivered to the market.

Weaknesses

- Need stronger economic and impact analysis – Especially alternative uses of the feedstocks.

- Response on anaerobic digestion alternative weak
- Availability and suitability of novel feedstocks could be a limiting factor.
- The team did not do enough to partner with others or review existing research
- I believe the stated volumes are too high and the potential then is much smaller than stated - this should be verified
- Nutraceuticals extraction relevance was unclear
- Doesn't seem to have a grasp on present operation of POTW's outside of the south.
- Seems to be spread thin across several different projects/programs.
- Need to consider utilizing other/additional resources/partnerships/collaborations to expedite progress with project(s).
- Some areas of research may not provide much of a volume benefit. Focus on biodiesel technology development is reinventing the wheel, has not identified good data from old technology (acid esterification). Some of the focus on the program does not identify key barriers that may either focus their research on or be used to eliminate those parts of the project. No go types of targets and milestones for technology.
- Needs a little more design development to better guide critical R&D initiatives.
- Narrow the focus toward a fewer number of projects that are hard-hitting in terms of establishing an even stronger program.

Technology Transfer/Collaborations

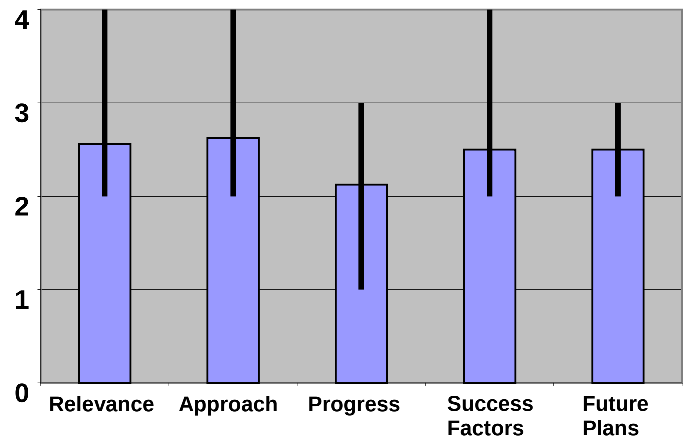
- Some presentations at national level would improve visibility and coordination with others doing similar research.
- Presentation focused almost completely on MSU activities, and there is little information given about tech transfer and collaborative activities.
- Upcoming conference.
- This does not seem to have been addressed adequately.
- Need to somehow get information out to other interested parties about the progress that is being made at MSU in feedstocks and oils.
- Good access to WWT facilities. Not much other interface with local biodiesel plants. The other relationships appear to be at arms length.
- Moderate level of effort – good improvement in program if more of this is initiated. Good to see USEPA involved.

Recommendations for Additions/Deletions to Project Scope

- None. Recommend letting MSU continue its work as planned.
- Validate the potential for biodiesel production
- Seem to be spread very thin across several different projects. May want to concentrate on one project at a time, especially biocrude generation.
- Try to focus the project into tighter focus with better detailed targets and strategies for success based on benefits.
- Determine the realistic potential for full funding in the future, then redirect their resources to the level that prediction yields.

Project Title: O2 Diesel Demonstration
Principal Investigator: Ben Kaufman and Thomas Sopko, O2 Diesel
Project Stage: Development Stage Company/Continuing R & D/Commercial Introduction

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.25	1.25	0.75
Approach	3.00	1.00	1.00
Progress	2.75	0.75	0.25
Success Factors	2.33	0.33	0.67
Future Plans	3.50	0.50	0.50
Average	**2.97**		



Question 1: Relevance to Overall Objectives.
- Another use for ethanol as blend to diesel
- Shows fuel improvement
- This technology is maturing to stage that OBP funding is no longer needed,
- What is ethanol displacement of oil additional benefit?
- Project may generate energy, but it is unclear that this is a reasonable process for new fuel development. Advantages are not well laid out.
- The original research was stopped due to problems with fuel injectors
- The plan is to redirect the project
- The proposed redirection is not well defined
- Not at all clear that this project advances cause of increased biomass-based fuel production.
- Appears to be more relevant to air quality concerns associated with petroleum diesel.
- Good relevance to program.
- Project moves DOE ethanol industry to new markets, but those markets are extremely narrow. This type of commercialization project has been industry funded in the past—see NBB EPA registration and ASTM development process. That process was 90% industry funded. Synergy with biodiesel is nice. Some ethanol will displace petro someday, if successful. This project does not lead to a homogenous fuel industry.
- Total market impact will be very limited, in the
- Millions of gal/year <25 because of the fleet limits.
- The topical area fits into the relevance category – yet, this effort does not seem to be adding any significant increase toward the body of knowledge.
- Not a compelling argument for using alcohol dilution when the market for the alcohol is so good right now.

Question 2: Approach to Performing the R&D.
- Good approach to combine demonstrations and research on fuel blend
- In its initial configuration this project did a good job at identifying technical barriers but the “phase II” is not sufficiently developed to know if technical barriers are identified
- Technical approach is sound

- Have demonstrated compliance with performance criteria.
- Strong focus on field performance
- Needs life cycle analysis for total impact of the fuel and additives. Emission reductions need to be balanced with fuel economic impacts. No specialized emission testing was performed which will be necessary to get EPA and CARB registration. Research targets were vague, what types of durability studies and are they the right studies, who is doing fuel injection studies for example. Where are the OEM peer reviewers. They only tested power and field performance. Who is doing the Tier II rat studies? Who is doing the dermal and aquatic toxicity for the additive? What are the remaining lists of environmental tests that have to be done and where is the schedule? Addresses technical barriers but all in very generic. Discussion of biodiesel blends with ethanol and additive confusing
- Unfortunately that no data were presented to justify conclusions.
- Really a product marketing effort.
- Not a lot of new information being produced.

Question 3: Technical Accomplishments and Progress.

- Solidly moving into market by resolving the various new fuel blends questions and issues.
- Lots of emissions testing and results plus lubricity, cold weather durability and handling.
- A material has been made, but its value is questionable. The PIs were not able to isolate the incremental improvements resulting from the use of B20, and the use of ethanol.
- Based on the research to date some progress on barriers has been made but overall it was good to suspend the project
- The Phase II is not well defined and it is unclear how it will benefit the goals
- This project does little to contribute to the 20 in 10 goal.
- Ethanol already has a growing market.
- Adding alcohol to diesel doesn’t contribute much to new uses of biomass-based fuels.
- This is all about selling a “proprietary additive.”
- Very good progress. Field demonstrations
- Most of this focus is commercial, the industry can afford to pay for this themselves, like the biodiesel industry did. Why should the government fund things that they should do themselves?
- No real performance metrics were provided, no analysis of the amount of ethanol that will be displaced in the petroleum diesel market? No impact on the consumer cost for the fuel? No impact on fuel efficiency. No life cycle analysis.
- Most of the metric claims (listed as goals) were not quantitatively supported.
- Good only if success is viewed as growing the company’s potential to enter the market – not that I agree with the benefits of the product.
- Need to use data that also compares B20 along with his other data points.
- Seems to lack defensible data – seems to use opinion without data supported basis.

Question 4: Success Factors and Showstoppers.

- ASTM specification and EPA registration are key next steps.
- Comparative costs will be a problem, and were poorly articulated in the presentation.
- Show stoppers were identified and the project sponsors
- Made a good decision to suspend work
- No information AT ALL concerning nature of additive.
- Cost/source/environmental impacts could all be serious show stoppers.

- U.S. is already suffering immeasurable environmental damage from fuel additives…
- Flammability can be a drawback for diesel use, (Low flash point)
- Need acceptance from OEM. Overall looks to have good potential for technical success but market acceptance not yet established
- Regulatory and legal program as superficial and does not address the complete set of analysis needed to get EPA registration or accept ASTM. Needs a outside peer review group, comprised of OEM, fuel injector manufactures, emission laboratory, and environment management. Some were identified – yet some critical issues, such as safety and water, are not well handled.

Question 5: Proposed Future Research Approach and Relevance.

- Good plan for final commercialization
- Within the context of their program goals, their research plan appears reasonable
- Future work progresses logically from previous activities.
- Not relevant to developmental goals of Biomass Program.
- The plan ahead is appropriate.
- Their future plans are not sufficient to meet EPA registration or ASTM standards. Their progress is good and there was a lot of duplicative testing, but they have not addressed key issues for success such as air toxics, injector durability, life cycle, etc.
- Seems to be moving well toward their commercialization plans. Yet, key issues of overcoming perception of safety and quality appear to be not well handled.

Strengths

- The major success – Approaching full commercialization.
- Several industrial tests ongoing.
- Helping to reduce petroleum diesel emissions – although if diesel is diluted with alcohol, we might expect reduced emissions.
- Good field testing approaches
- Evaluated safety and handling issues.
- Collaborations with multiple stakeholders
- Overcomes some perceived disadvantages of biodiesel,
- Focused commercialization program.
- They appear to be using a decent marketing strategy if E-diesel or E—BD-Diesel is the target.

Weaknesses

- Proprietary additive will be hard for state weights and measures folk to approve. How do you test for this at the pump? What is chemistry? OR situation is example.
- More education and outreach will be needed to fully introduce this new fuel blend.
- Safety
- Really difficult to see benefit of this procedure
- Improvements by adding ethanol poorly quantified, and difficult to justify process
- Relative cost
- “Proprietary additive” is a concern. What is cost of additive? What is feedstock for additive? What are the health/safety/environmental issues associated with the additive
- The actual benefit of the additive is unclear! What are properties/performance of diesel/ethanol, diesel/ethanol/biodiesel mixes without the additive or with other additives.
- Market viability/acceptability of yet another alternative fuel.
- Distribution network.

- Safety implications/issues.
- Niche market (centrally fueled fleet).
- How will weights and measures inspectors handle this?
- Will proprietary additive be a barrier to wide spread adoption?
- TOTAL MARKET IMPACT WILL be very limited, in the Millions of gal/year <25 because of the fleet limits.
- The commercialization program is weak, with little emphasis on the key technical barriers and how to achieve them, they appears to be too heavily dependent on fleet demos and criteria emission tests.
- No plans for rat studies or the other key studies needed by EPA (dermal tox, water tox, soil degradation, live rat studies).
- No data shown about the fuel economy, or other life cycle data needed.
- The safety and quality of product issue is difficult to overcome. Cannot understand the merit of this formulation over using BD blends and ethanol blends in their already established markets.

Technology Transfer/Collaborations

- A lot of education and outreach will be needed for this new fuel blends advantages. Need broad fleet only target marketing. Clean Cities will be a key audience..
- They appear to have made good industrial contacts
- Good collaborations.
- The research could carry-over into other projects.
- Working with public institutions like ASTM.
- Good linkages with industry, although the industry should be paying for this project themselves.
- Seems to be working with critical players – such as OEMs. A large fuel distributor would be a good partner.

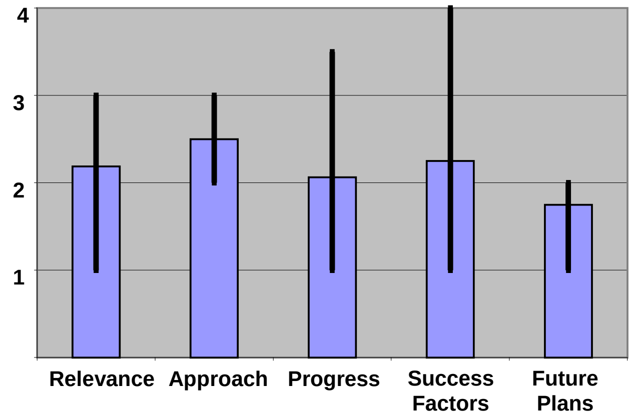
Recommendations for Additions/Deletions to Project Scope

- Role of OBP may be ending as full commercialization is achieved. Recommend strong work with state weights and measures.
- The project team made a good decision to suspend the project on ethanol blending in diesel. The proposed Phase II is not well developed and it is not clear that the project team has the necessary experience to do this
- Redefined work. I recommend that the project team submit a detailed program and justification for co-product research. This justification should include a literature search that demonstrates which areas are not being addressed. The project team should also indicate the experience of the researchers and potential teaming with other researchers
- This should not be a DOE R&D priority.
- It seems this project is a niche product and is designed around finding a use for the *proprietary* additive. While there may be some specific applications for this product, the industry is focusing on biodiesel blends (B-2, B-5, B-20) and is not going to be open to introducing another fuel to the mix. If it’s not ASTM biodiesel, and it’s not ASTM ethanol, then design- to-market deployment will be difficult. Additionally, O2 funding as a percentage of the total budget seems low.
- Sounds like need for R&D funds has ended and overcoming commercial resistance is now needed.
- NO future funding. Should be self funded. Otherwise, see above.

Project Title: E-Diesel Test and Research Project

Principal Investigator: Nathan Fields, National Corn Growers' Association

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.19	1.19	0.81
Approach	2.50	0.50	0.50
Progress	2.06	1.06	1.44
Success Factors	2.25	1.25	1.75
Future Plans	1.75	0.75	0.25
Average	**2.15**		



Question 1: Relevance to Overall Objectives.

- E-10 blend with diesel plus lubricity to replace more oil
- OEM focus for off-road - John Deere
- Rationale for E-diesel is a holdover from a desire to increase ethanol markets. However, it is not clear that this is the best way to get ethanol market increases. Moreover, explosion in ethanol markets obviates this rationale.
- Search for additional ethanol markets not really needed.
- Air quality benefits are questionable without further data.
- The little data presented could be interpreted as improvements
- coming from dilution of diesel – emissions decrease in direct proportion to dilution with alcohol.
- Support is applicable but perhaps on a very small scale
- The original research was stopped due to problems with fuel injectors
- The plan is to redirect the project
- The proposed redirection is not well defined
- The industry needs to commercial ethanol in many new markets. Funded or moved entirely into the DOE program that manages fuel and vehicle testing.
- New focus for remaining funds on biorefinery is a much better fit for the Biomass program.
- Fair because the over-arching goal to displace petro-based fuels is overlooked. The ethanol could go to gasoline displacement – in essence – it has a use already.
- New phase development approach is moving in better direction. Need to ensure that solid data are generated and realistically evaluated.

Question 2: Approach to Performing the R&D.

- Did not use biodiesel for lubricity and then ran into lubricity issues. Probably should have had a biodiesel blend as part of study.
- Project stopped for re-scoping and rethinking.
- Original project well done, and made some significant discoveries, even though the results were the opposite of what they wanted to see. Potential re-direct, which is almost 80% of remaining funding, is yet to be determined.
- Did not identify causes of failures. Essentially abandoned research.
- Lubricity approached using commercial additives.
- Research needed to address problems discovered, especially injector plugging.
- May need to rethink if this is better than the alternative.

- In its initial configuration this project did a good job at identifying technical barriers but the “phase II” is not sufficiently
- Developed to know if technical barriers are identified
- Very limited focus of research.
- Technical targets were clearly defined, well designed.
- The approach is problematic so far. Needed a better technical review team to help identify the barriers and fine tune the approach to testing those strategies. Gave up on the durability product too easily. Project planning appeared weak, the project took too long to conduct very little research.
- Not sure that team has the technology experience with new program direction which is biorefineries.
- The methods used seem valid and reasonable.
- New to ensure that good science/research methodology are incorporated into Phase 2.

Question 3: Technical Accomplishments and Progress.

- Ethanol helps viscosity so less loss of power than expected
- Injector issue as lubricity broke down.
- Engines struggling at E-10
- A rethinking work is in progress
- The engine test appears to be a good, well designed project with a qualified outside subcontractor, leading to some important E-diesel discoveries.
- Demonstrated unexplained failures of diesel engines using ethanol/diesel blends. Did not address objective re emissions.
- Did not address fleet testing objectives.
- Program stopped for good reason.
- Based on the research to date some progress on barriers
- Has been made but overall it was good to suspend the project
- The Phase II is not well defined and it is unclear how it will benefit the goals
- The effectives, efficiency, cost and benefits of this project were not well define or in some cases defined at all. Barriers were vague and did not appear to take previous R&D into account in a full manner.
- Some good data evaluating the potential of this product.

Question 4: Success Factors and Showstoppers.

- Original plan did not work
- Reasonable evaluation of engine issues w/E-diesel
- They punted.
- Injector plugging and other fuel delivery problems is a problem. Rebuilding engines are an impractical solution.
- Show stoppers were identified and the project sponsors made a good decision to suspend work
- No legal or regulatory issues.
- Focus was limited on technical engine performance and durability barriers. The other showstoppers appear to be poorly defined and the approach to overcome the show stoppers was weak.
- The R&D focus on E-Diesel as a homogenous fuel was good, as it would have achieved a larger impact of oil displacement.
- I sense that the project looked at the data using a realistic viewpoint. I do like the new direction, but showstoppers for Phase 2 must be defined.

Question 5: Proposed Future Research Approach and Relevance.

- Questionable
- Unclear…project is being redirected, and very few details were given. Project could be seen to be fairly diffuse. However, good partners have been chosen.
- Difficult to rate due to radical redirection.
- Future R&D is good start but just a start. No targets, no Research team, no discussion of future plans in detail except list of project areas which are too broad and too aggressive. They need a better step by step program with go no-go types of decision points and a strong independent technical review team.
- Will contract to Michigan State University Chemical Engineering group
- The project appears to be searching in some regard for what to do with the funding – does not some potential.
- Once their new research plans are matured, a better sense of worth can be derived. At least a good R&D team has been selected.

Additional Comments:

Strengths

- Learned what the problems were. Stopped progress and saved the money.
- Good job on E-diesel portion of effort
- Good testing of ethanol/diesel mixes on major OEM engines of varying sizes. Demonstrated problems with fuel delivery in all engines.
- Strong partnerships
- OEM Collaboration
- Tightly focused program on engine durability for E-D. Focus on the homogenous fuel provides larger potential market than O2.
- An honest evaluation was performed and the negative results well handled. I also like the new direction – highly encourage that solid data are generated to support potential new products and good process costing performed to support concepts and drive critical path developmental initiatives that will arise.

Weaknesses

- Future direction unclear but being thought through.
- Missed opportunity to do biodiesel blend.
- Somewhat unclear on redirect, although the program appears to be using reasonable partners.
- Did not address emissions. Did not address fleet studies.
- Barriers may be insurmountable.
- Suggested new program looking at very low volume markets.
- Incorporating yet another alternative fuel into a market that has not yet fully embraced alternative fuel.
- Development of yet another transportation/delivery system for E-10 diesel blend.
- Problems with engine performance/power loss/engine wear.
- Use of additives.
- Off-road focus of project.
- Needs to address emissions

- Not enough planning in avoiding some of the problems in durability with ethanol diesel blends that were known to occur. Project concluded that the original approach is a no go.
- No real ones at this time. Phase 2 will be interesting.

Technology Transfer/Collaborations

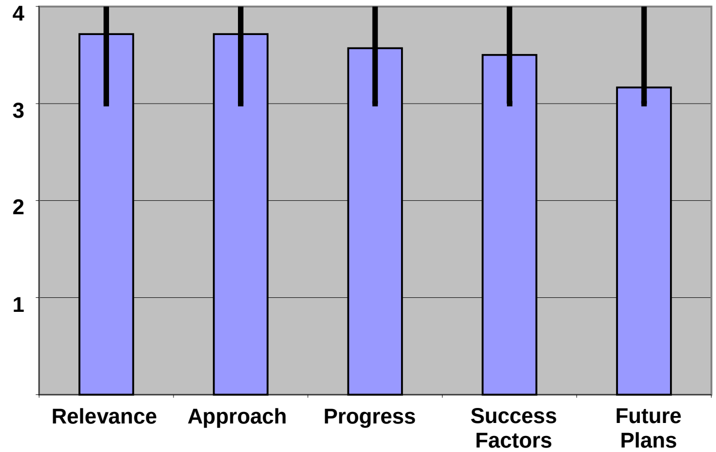
- Not ready for major tech transfer other than lessons learned.
- Not yet applicable.
- Project certainly adds value to the Program if for no other reason but to enforce this is not a good direction to pursue. Good information and research.
- Strong partners but we have to ask why there wasn't a better plan with these partners before the testing began.
- Fairly strong.

Recommendations for Additions/Deletions to Project Scope

- Engines not designed for E-10 diesel fuel. Would take a determined OEM engine compatibility effort to proceed or other fuel blends to resolve
- New proposed research directions are so different from original, and since original work failed to try and overcome barriers, I would not support DOE money funding this group.
- Delete the project.
- This project seems to not fit well with DOE goals and objectives for the Biofuels Platform.
- The project team made a good decision to suspend the project on ethanol blending in diesel. The proposed Phase II is not well developed and it is not clear that the project team has the necessary experience to do this
- Redefined work. I recommend that the project team submit a detailed program and justification for co-product research. This justification should include a literature search that demonstrates which areas are not being addressed. The project team should also indicate the experience of the researchers and potential teaming with other researchers
- Future R&D is refocused on biorefinery and specifically on coproduct development with MSU. This project will be better focused for the Biomass Program and may add value.

Project Title: Missouri Biodiesel Demonstration Project
Principal Investigator: Tom Verry and Jill Hamilton, National Biodiesel Board
Project Stage: Research completed

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.71	0.71	0.29
Approach	3.71	0.71	0.29
Progress	3.57	0.57	0.43
Success Factors	3.50	0.50	0.50
Future Plans	3.17	0.17	0.83
Average	**3.53**		



Question 1: Relevance to Overall Objectives.
- Targeting key biodiesel issues.
- Pipeline use, economics, re-prove lubricity of ULSD, terminal blending capability and fuel quality
- Context – 20 in 10 needs biodiesel
- Critically needed for biodiesel market challenges
- Within context, this program is measuring important criteria of importance to the biodiesel industry. This will result in standards allowing BD to contribute to higher level OBP goals in renewable fuels. DOE link is nice, in that they don't support biodiesel production work, but has a strong interest in qualification of a growing fuel stream.
- Increasing usage requires demonstration and education.
- This project directly addressed these needs.
- This project is very relevant and will help to improve the distribution of biodiesel.
- Large scale development for biofuels will depend on pipelines
- Colonial pipeline was an excellent partner for moving the data
- Into other pipeline firms.
- Project appears premature for the size of the US biodiesel industry. Clear economic benefits from reducing transportation costs.
- Good applied market-driven project that addresses real issues.

Question 2: Approach to Performing the R&D.
- Well thought out set of goals
- BQ-9000 for quality
- Within context, the program appears to be highly focused and directed toward important goals.
- Very careful/deliberate approach covering many limitations.
- Good comprehensive approach to pipeline testing and lubricity evaluation.
- Outreach work well planned and executed.
- The basic Technical barriers were well defined except for cold flow. The detailed technical barriers of pipeline logistics were not included in this study and may appear later as a barrier in the future.
- They should have done the pipeline test in the winter.
- The BQ-9000 education was well defined and met the objectives.
- The lubricity testing was duplicates older data with no new value..
- The petroleum education goals was well conceived but

- The industry should carry it forward.
- For their stated goals, the approach appears good.

Question 3: Technical Accomplishments and Progress.

- Pipeline test successful
- BQ-9000 now self funded
- Tackled MN quality problem head-on.
- Major milestones met, and good data regarding use of BD has been generated.
- Accomplishments well-documented in presentation.
- All testing was completed and satisfactory.
- Outreach activities well received
- The impact on the performance factors was not quantified and there is a real issue with respect to the future volume of fuel produced. We may not ever need a biodiesel pipeline.
- The program in general was well defined with specific goals.
- They appear to have completed what was promised and at the same time appeared to have generated reasonable data of value.

Question 4: Success Factors and Showstoppers.

- All goals are well along
- Reasonable evaluation of showstoppers.
- No show stoppers exist.
- The project moved with clockwork precision and achieved most of their objectives. Legal and regulatory barriers, such as the ASTM standard and fuel quality, were addressed to the benefit of the entire industry.
- This project essentially addresses showstoppers for the industry.

Question 5: Proposed Future Research Approach and Relevance.

- Finishing efforts already underway - jet fuel and pipeline
- Could use more next steps thinking
- Future work is reasonable and continues a nice focused effort on useful questions,.
- No additional research is needed.
- Not enough information was provided, but any issues were obviously resolved in a timely way without impacting the quality of the project.
- No future work is anticipated. The program is ending.
- Really not applicable since the project is almost over.

***Additional Comments*:**

Strengths

- This project has very strong performance in a very challenging time for biodiesel industry growth
- Tightly focused, pertinent questions being addressed on getting biodiesel infrastructure and awareness improved. Testing of key operational and commercialization issues.
- Very practical approaches to overcoming real and perceived limitations to biodiesel usage, including public education and developing new markets, i.e. bioheating oil.

- Clearly one of the best projects reviewed by this panel.
- A very good program that succeeded.

- Strong partnerships with prime industry players, including partnership funding.
- Strong outreach and education program.
- Addressing all three critical components – fuel quality, distribution and BQ-9000
- A well constructed and implemented project. Achieved the objectives in a timely manner. Results generated industry wide benefits (BQ-9000). Colonial pipeline was a strong partner for the project.
- Good practical project that answers some questions for the industry.

Weaknesses

- Stronger roadmapping would help future needs.
- Few
- Pipeline test should have been done in cold winter weather
- Should have run the pipeline test in the winter. May have to be redone now.
- Need to include raw soya oil mixing as a lubricity enhancers in your tests. This will provide some critical data for many folks who are thinking this option.

Technology Transfer/Collaborations

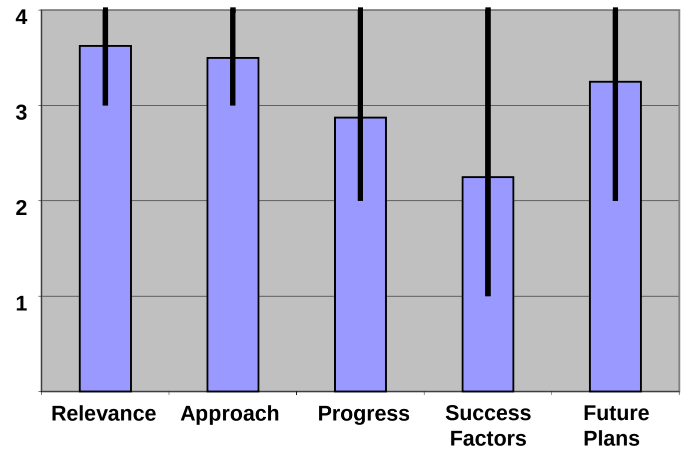
- BQ-9000 workshops and other outreach with MN are real successes.
- Excellent tech transfer and education efforts.
- Outreach activities generated a lot of interest.
- Good dissemination of information to stakeholders.
- Excellent TT partners.
- Very strong given the nature of the organization.

Recommendations for Additions/Deletions to Project Scope

- Recommend continued funding
- **Keep this group funded and applying themselves to other barriers/limitations!**
- Explore the use of untransesterified soy oil on lubricity
- I do appreciate the funding of organizations such as this because they appear to be addressing key market issues – as long as they are true to the data and et conclusions favorable or not become public.

Project Title: National Biofuel Energy Laboratory
Principal Investigator: Chuck Moeser
Project Stage: Various

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.63	0.63	0.38
Approach	3.50	0.50	0.50
Progress	2.88	0.88	1.13
Success Factors	2.25	1.25	1.75
Future Plans	3.25	1.25	0.75
Average	**3.10**		



Question 1: Relevance to Overall Objectives.

- Targets feedstock supply issue
- Goal - Feedstock neutral biodiesel with database
- Within the context of high level OBP strategic goals, then this program will provide important information. The lack of a separate biodiesel program makes it harder to place given the current single minded interest in ethanol.
- Good basic data collection re characteristics that are critical to increased use.
- Relevance is pertinent and will provide guidelines for fuel development.
- Given that fuel demand is key to the development of biodiesel production and that fuel and engine compatibility are important for demand – this project is well defined and will help to build market demand for biodiesel.
- These barriers can ultimately derail the biodiesel industry and this testing will provide critical data. The research will benefit the customers directly. May lead to improved engine design and durability. May also be moved into the Advanced vehicle engine program.
- Good experimental effort that is somewhat redundant to other works, but still of value to the Fed mission.

Question 2: Approach to Performing the R&D.

- Sorting out the characteristics of the biodiesel feedstocks is important work and will broaden the feedstock supply
- Strong engine testing and emissions
- The lab appears to have all of the correct components to do extremely relevant data generation for B20.
- Technical approach very clear, very sound, very focused.
- Excellent scientific qualifications and efforts.
- Framework for setting goals and identifying critical factors is sound.
- This is one of the best-designed research projects for biodiesel for on-road applications. It addresses nearly all the key manufactures questions about biodiesel use in diesel engines and for tailpipe emissions, and effects on after treatment equipment
- One of the best defined projects I've seen in a while. The technical design with objectives, targets, partners, and the quality of date and the uniqueness of the data is outstanding.
- Well organized project for the listed goals. Appears to have used sound methods and data handling techniques.

- A significant amount of the project was spent on facilities enhancement and not research.

Question 3: Technical Accomplishments and Progress.

- Precipitates above cloud point by feedstock plus other characteristics is important progress.
- A number of key findings – transition metals, engine testing, SCM
- Project has defined goals and is addressing important questions. However, the catalysis work is a distraction because it's biodiesel production which is not of interest to the program.
- Good basic research to date. Not so much progress re overcoming barriers
- This seemed to be more an identification and, to some extent, quantification of problems, barriers, etc. Some of this was very interesting research but did not support the program. It can lead to additional research that will be supportive of the DOE program.
- It is not clear what the performance metric are for this project and the project has not made significant progress in its research to date with most of the effort focused on establishment of the testing facilities. However this pace does not should not take away from the overall value of the effort
- The goals defined are critical
- Very specific performance targets are being used, with their selection generated by EMA, ASTM, NBB, USDA, and biodiesel producers. The project is focused on discovery at this level.
- I would expect that the next steps are cost effective solution.
- Improving biodiesel use for fuel transportation and its changing EMA technology is critical.
- Generated a significant amount of data – would help if a summary of what the data means for the involved industries.

Question 4: Success Factors and Showstoppers.

- Strong technical basis for ASTM B-20
- Missing
- Success factors and showstoppers not clearly pointed out.
- Little was done to address show stoppers or success factors.
- This project could do a better job at articulating the showstoppers and success factors. One of the difficulties is to separate the success factors of the research project with the success factors of biodiesel use
- The researchers clearly know what the show stoppers are in engine components, emissions, and durability.
- This area could be better presented and potentially better thought-out. Does appear to may be slightly reinventing the wheel so to speak.
- Need to start producing peer-reviewed papers.

Question 5: Proposed Future Research Approach and Relevance.

- Looking forward to future progress and next steps
- Annex to ASTM is needed.
- The lab appears to have established a center that will be a credible clearinghouse for information related to biodiesel properties and impact on engines, performance and markets.

- Limited information presented. Will continue with current approach.
- The future research is well founded. It appears to be more results oriented.
- Very methodical plans with go and no-go decisions and a research plan that produces unique, high value research data that will be critical for biodiesel users across the world.
- Not a lot was presented. The lab has plans to grow their program it appears, but future work via this funding is not well stated.

***Additional Comments*:**

Strengths

- Very clear program to develop vital information of use to the biodiesel industry. Appears to be a good investment of DOE funds related to biodiesel qualification.
- Very good research and progress – Well done in a needed area.
- ASTM spec focus technical support is crucial.
- Industrial partners
- Sound scientific approach to basic data collection on characteristics of biodiesel before, during, and after combustion in engine.
- This data is absolutely necessary for acceptance of fuels by OEMs.
- This will support the ASTM specification work.
- Outstanding partnerships.
- Have divided technical challenges among different stakeholders for solution.
- Good assimilation of information.
- The research proposed under this project is well positioned to help build demand for biodiesel in on-road use. This is important in building national demand for biodiesel and displacing petroleum. The project has assembled a strong project team with good technical capability respect and reputation with the original equipment manufactures.
- Addressing key R&D needs for biodiesel use in engine oils to prevent future barriers that may derail the biodiesel industry. Project plans are focused, based on previous experience in OEM component testing, developed stakeholders to develop the objectives and goals and develop the research agenda and the type of information needed by the customers.
- Solid R&D methods appeared to have been used.

Weaknesses

- What is on the horizon?
- Better public information needed.
- Basic data collection so far. Not much progress to overcoming barriers.
- This project seems to stress process or activity rather than results that support the DOE program.
- Need additional samples from around the country to see if there are regional differences.
- Test does not identify if supply was BQ-9000 or not.
- Limited NOx reduction scope.
- Slow progress to date. Failure to leverage its resources with others such as establishing research facilities
- Defining metrics directly tied to the research project. It would also be good to see a plan to fund the NBFL beyond the initial federal funding.
- Heterogeneous catalyst work does not fit. Need broader samples of existing biodiesel blends or coordinated with the BQ-9000 or not. Not enough address the showstoppers.

- A lot of funds went to facilities enhancement and not developmental activities. Granted, establishing new capability is good for the region – that is appreciated.

Technology Transfer/Collaborations

- B-20 summits are great. This research needs much greater publication of results and outreach. A trove of information broader than just B-20. Some reports and public domain publications are needed
- Excellent industrial partners. Including manufacturers whose products will need to operate successfully with new fuel types.
- Many presentations have been given.
- Outstanding technology transfer to industry.
- Good assortment of industrial partners along with a university.

Recommendations for Additions/Deletions to Project Scope

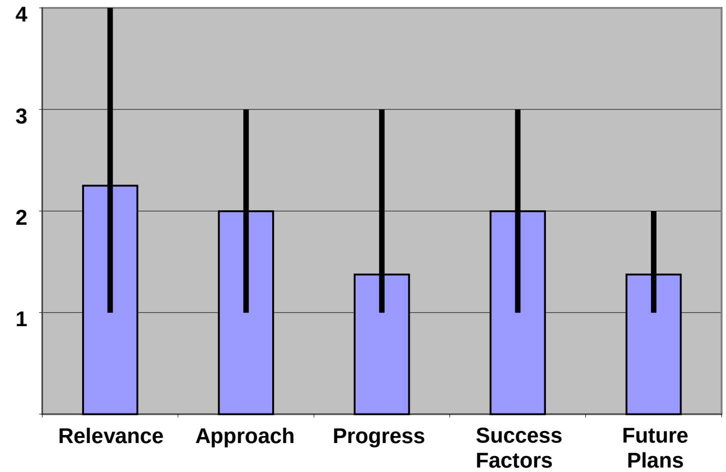
- Recommended for further funding.
- Expand scope across US. Stratify BQ-9000 fuel against other supplies. Look at other technologies for NOx reduction such as lean-burn, catalytic, etc. Even though original cost of non-SCR NOx reduction technology is higher, may need to perform a lifetime cost analysis to ensure SCR is still the best fit – show analysis in presentation. Work closer with NBB to get information out to public. Need to address emission concerns for using urea SCR (urea slip).
- Plan to continue and or expand the effort beyond federal funding. Metric for the research.
- Needs broader data outreach, SAE, etc.
- Invest more funding on experiments and seek out partnerships with other groups active in the same exact areas.

Project Title: Canola-based Automotive Oil R&D

Principal Investigator: Ira Pierce, Green Oil Company

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.25	1.25	1.75
Approach	2.00	1.00	1.00
Progress	1.38	0.38	1.63
Success Factors	2.00	1.00	1.00
Future Plans	1.38	0.38	0.63
Average	**1.80**		



Question 1: Relevance to Overall Objectives.

- Biolubricants – Green Oil company
- Canola
- More lubricity offsets oxidation
- Co-product/petroproduct offset
- Fit to 9002 USDA
- This is a huge expenditure of money without a clear reason why. The PI could gather a lot of the desired information with much less money.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Bio-oil is supportive of the DOE goals and programs.
- This project is not well defined with regard to the DOE USDA mission. It did not detail the energy saving potential of its products.
- Did not say what the goals of the program are except "reliable metrics for canola based automotive"
- Type of crop research very vague and no real coordination with USDA and other key stakeholders.
- A lot of money for absolutely not focus or plan
- No estimates of volume production of feedstock
- Only good thing appears as a focus on canola oil
- Does support conversion of petro to biomass-based goals.
- However, the effort does not appear to add any new knowledge to program goals.

Question 2: Approach to Performing the R&D.

- Proved product works and viable but not a market
- Need to get out of batch process so cost competitive and readily available.
- Need 9002 preferable procurement
- Market research – Triad sessions
- For 1.3 million, there should be a much more detailed and integrated approach to analysis. Much more information for the dollar should result.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Big issue is cost but process is batch, not continuous.
- No detailed technical plan was presented.

- The focus group approach to markets and customers is sound.
- The presentation was a rambling story rather than a focused discussion on the project. Following the presentation it was not at all clear what the approach would be or why it would be better than alternatives
- Need a more detailed feasibility analysis
- No focus on specific crop R&D goals or objectives, no
- Quantitative targets
- Not sure what the benefits of the survey will be, or how to estimate the value of the survey for the crop project.
- Not much information presented on the exact methods.
- What was presented – a reasonable marketing plan is proposed.

Question 3: Technical Accomplishments and Progress.

- None to date
- The evaluation is very narrow, and applies only to the PIs product and potential impacts.
- No specific objectives.
- Nothing, apparently, has yet been done.
- This reviewer could not determine what if any progress has been made
- No discussion on existing data from USDA and other canola producer --current yields, current pesticides, current cropping programs, current costs and barriers. No discussion of which barriers they are looked at.
- No estimates of benefit of this interest in canola oil.
- Just started.

Question 4: Success Factors and Showstoppers.

- Needs more progress
- Shelf life concerns
- Realistically, economic and market evaluations have few show-stoppers associated with them. One gathers data and presents a conclusion with a short shelf-life. Thus, in that context, the success factors et al appear to have been evaluated.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Price is the big show stopper. Other success factors and show stoppers will be identified as the project progresses.
- This project needs to identify the technical and business factors limiting this fuel and feedstock area, including showstoppers, research strategies, and everything else.
- Seems to have identified most – suggest no ignoring the meal issue.

Question 5: Proposed Future Research Approach and Relevance.

- The plan to proceed and the methodology are quite limited. This could be much more effective if one would look at a much broader cross section of biobased products.
- All about marketing one company's product.
- Minimal relationship to 20 in 10 goals.
- This is primarily about increased biobased product use – not about biofuels.
- Marketing study not relevant to Biomass Program goals.
- It is premature to consider future research.
- Need a more detailed planning structure. Not sure how the survey will be translated into future planning.
- Hard to gauge that is was recently initiated.

***Additional Comments*:**

Strengths

- Market analysis was needed
- Good application of biobased products as offset to petroleum-based.
- Improved lubricity is a major strength.
- Strong group of stakeholders/partners.
- Good group of uptake core questions if these questions are not available other places.
- Behavioral Insights subcontractor may be solid, I've heard of them before.
- Will further develop a relatively new market for bio-based lipids.

Weaknesses

- Progress has been slow
- No technical plan
- The amount of funding for a market evaluation study is exorbitant. This could have been done for a tenth of the level of the earmark. Frankly, the amount of money allocated to this activity is outrageous.
- The methodology for the market analysis is very poorly defined. Much clearer description of process is required.
- No details on budget, specific quantitative objectives. What processing is necessary to produce the various lubricants? What are energy inputs, environmental impacts?
- Price is a major weakness.
- Explanation of why Government (DOE) money should be used for Green Oil Company to meet the Preferable Procurement requirements of the 2002 Farm Bill.
- This project appears to be an investigation into and the establishment of metrics to test canola based lubricants
- However there was no discussion of why this metric is need other than to say the consumers would not buy
- This product unless they know it was reliable – despite the fact that the company has been selling the product for 17 years. The discussion alternated between the need for test metrics to encouraging farmers to grow canola, to a marketing survey for biobased lubricants.
- Denigrates DOE and its processes while they expect to take their money. "They don't do feasibility studies correctly. They don't know anything about it."
- Did not follow power point format, so we have a large number of unanswered questions.
- Used too may "buzz" words to confuse the purpose of the study, it took the entire presentation on "off-takes" to understand they want to do a product marketing study.
- The engine oil market is small, very fragmented, highly technical and requires close coordination with the engine manufacturing for large scale production. This project appears to be self serving.
- The project offered nothing of value.
- Not a lot of information presented on methods – get the impression that the method proposed is neither well-defined nor thought-out.
- Not considering the meal nor extraction issues.
- Not offering up a plan to initiate significant testing.
- A niche market – not a lot of volume displacement potential.

Technology Transfer/Collaborations

- Has large industrial clientele
- Nothing was said.
- None I could tell.
- Very minimal - based on the presentation.

Recommendations for Additions/Deletions to Project Scope

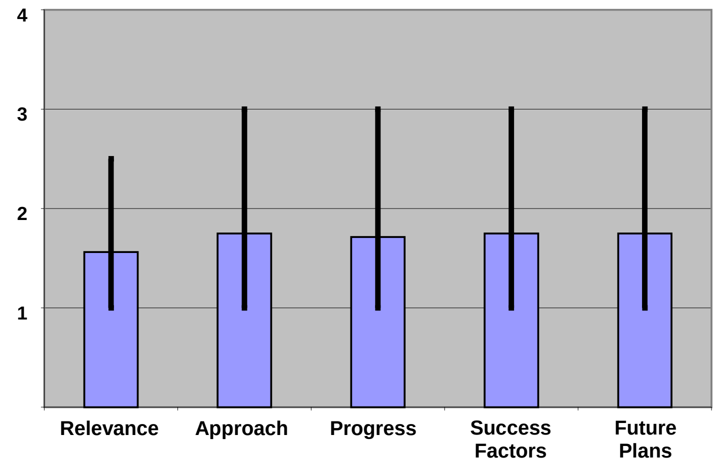
- Large potential market but very fragmented
- This project is not appropriate in this program. It has nothing to do with Biobased fuels or meeting the 20 in 10 goals.
- This project does not seem to fit with DOE's goals and objectives for the Biofuels Program.
- Require a focused test program for canola based lubricants what are the parameters, why are they important, how will they be tested, who are the partners, what are the results.
- Provide a detailed task plan with research barriers, targets for improvements, methodologies for conducting the studies, estimates of benefits if some or all successes occur. I
- Need to really focus on user machinery testing using a well-respected testing service along with considering turn-key issues pertaining to oil production.

Project Title: Phillips Biomass Combined Heat & Power Facility

Principal Investigator: Carl Nelson, The Green Institute

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	1.56	0.56	0.94
Approach	1.75	0.75	1.25
Progress	1.71	0.71	1.29
Success Factors	1.75	0.75	1.25
Future Plans	1.75	0.75	1.25
Average	**1.71**		



Question 1: Relevance to Overall Objectives.

- Two projects – CHP & then new work plan
- Not good fit to OBP
- Minimal relationship to 20 in 10 goals.
- The project is relevant but is not new. You can go out and buy commercial CHP for this use. There is no R&D involved
- The biomass actions are very fringe to the goals of DOE
- Although a good idea the efficiency work is out of scope
- No justification for government support where a feedstock that receives a tipping fee and a green power rate that averages 25 cents/kwh should be great but major barriers are present (bad site, limited MSW supply, etc.) . No need to commercial a old and well established industry unless they can identify what new development will be included in the technology , such as NOx reduction, or more efficiency, or cheaper drying.
- No integration into liquid biofuels, chemicals, or other coproducts.
- No real technological developed appears to be happening.

Question 2: Approach to Performing the R&D.

- 20 MW CHP for local community with district heating and energy efficiency program through energy coop
- So, shift to anaerobic digestion CHP and pellet wood stove study.
- Upfront analysis missing when originally targeted.
- Clear definition of the project, both the original Phillips activity and the subsequent redirection.
- No R&D at all to date. Some nice community energy-conservation outreach.
- There seem to be no technical barriers. There are other alternatives to the identified biomass boiler. Approach is simple and commercially available.
- Technical barriers -contracts for wood were not addressed
- In fact they are doing the same thing with Rock-Tenn
- No technical barriers were identified, all of their barriers are lack of planning or lack of reality, they want to make it work so they believe it will work. They were really wallowing around looking for answers. Their feasibility study has not well defined, comprehensive or complete. No novel technical barriers are being explored. Their biomass waste wood inventory database is good.
- Very scattered list of activities and little directed focus on an achievable value-added product.
- The inventory of available biomass will provide usable info.

Question 3: Technical Accomplishments and Progress.

- Plan B appears to be better for CHP. No lasting OBP accomplishments to date.
- Original project didn't work out, however, the research team recognized shortcomings and have redirected in a reasonable effort.
- Virtually no accomplishments relative to DOE R&D
- Nice urban energy efficiency outreach
- Just getting started with resource survey.
- No metrics included
- The project need to have a much better fined set of barriers and would benefit for a professional, experienced feasibility development firm.
- Not a lot of substance presented in terms of accomplishments. However, there has been completion of some activities that appeared to have been part of their scope.

Question 4: Success Factors and Showstoppers.

- Spring/Fall district heating and cooling load not there
- MN lowered biopower mandate
- Long term wood waste supply contracts missing
- Evaluation for original and redirected projects seems to spend an appropriate amount of time defining barriers and opportunities.
- Progress based on the possibility of cooperating with ONE commercial entity. No solid technical plans for achieving goals.
- Funded investigators looking for something to do with the money
- A poorly done plan. Not related to DOE goals and objectives in this program.
- This project should have done a sensitivity to the electric
- Revenue and would have realized early on that it was not feasible or at least linked to electric contract
- They have identified some of the key show stoppers but only through trial and error.
- No a significant effort in this critical aspect was presented – quite frankly, it appears that they have funds and looking how to spend it.

Question 5: Proposed Future Research Approach and Relevance.

- CHP biomass supply is uneasy.
- 20 yr financing is uncertain.
- An apparently comprehensive evaluation of inventory, impact, cost, etc. has been carried out to justify the redirection of DOE funds.
- No significant R&D identified.
- Unlikely to contribute ANYTHING to 20 in 10 goals.
- No plan.
- Their plans to continue are poorly defined at this time.
- Minimal value is expected to be gained from more effort other than stimulate regional interest.

***Additional Comments*:**

Strengths

- Stopped original plan when project proved unfeasible.
- Good use of DOE funds for societal impact
- Homework has been done on paper to provide case for redirection of funds

- None. Three+ years into project they don't have a plan.
- The concept is good (although not part of DOE biorefinery platform) the use of biomass for combined heat and power is practical the waste wood inventory was well done
- Generated inventory data. Good community relationships.
- Growing regional interest in alternative E and energy conservation.
- Generated some regional biomass inventory data and associated costs.

Weaknesses
- Needed stronger upfront analysis
- St. Paul district heating competes for urban biomass availability.
- Uncertainties in the infrastructure for collection and delivery of fuel
- Has their project evaluation document been carefully peer reviewed by experts for accuracy?
- Very limited technical progress.
- Planning is not well advanced.
- Infrastructure is not developed.
- Weak, weak overall plan.
- Does not know what type of CHP going to be utilized – if you don't know what generation source you are using then how can you plan for fuel needs.
- No emissions plan.
- No long range fuel plan.
- The project should not have been so large to start with a smaller co-gen project may have been easier to work with. If the wood availability proved to be problematic for the co-gen then it will be for Rock-Tenn too and this project was not a good refocus of this effort
- Everything. No benefits offered to DOE research or even commercialization as R&D barriers were identified. No focus on technology optimization—gasification for liquids and power for example.
- Need technical support.
- Little focus with no real technology development nor advancement expected to occur.

Technology Transfer/Collaborations
- Local energy coop model is a good base to build from in local community.
- Minimal
- Technology transfer was not addressed.
- Questionable
- Minimal – no real collaborations were illustrated.

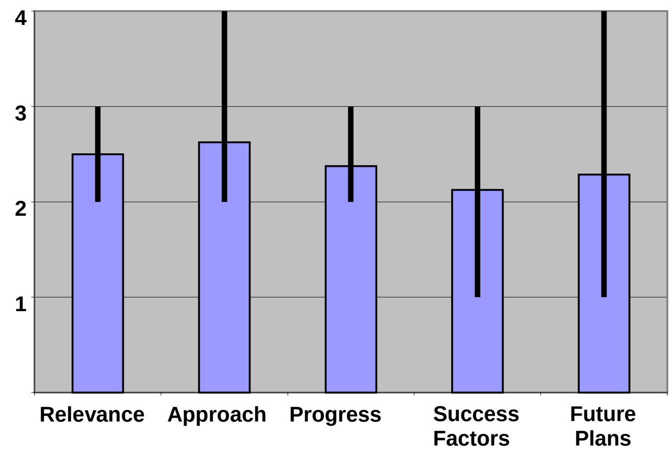
Recommendations for Additions/Deletions to Project Scope
- Strong caution for future funding from OBP.
- Very weak component of this DOE Program…
- Possibly a good example of community outreach/energy efficiency programs.
- Not relevant/does not fit well with DOE goals for the Biofuels and other Technology platform.
- Consider smaller dispersed biomass co-gen projects
- Recommend closing program and returning funding to either US Treasury or other Biomass Program projects.
- Find an area that capitalizes on regional assets and dive into technological development.

<u>Project Title: EERC Center for Biomass Utilization</u>

<u>Principal Investigator:</u> Christopher Zygarlicke and Dr. Bruce Folkedahl, University of North Dakota

<u>Project Stage</u>: Various

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.50	0.50	0.50
Approach	2.63	0.63	1.38
Progress	2.38	0.38	0.63
Success Factors	2.13	1.13	0.88
Future Plans	2.29	1.29	1.71
Average	**2.38**		



Question 1: Relevance to Overall Objectives.

- Biofuels, biopower & bioproducts for biorefinery of future
- Many activities-& Cross-cutting
- Cuphia feedstock
- H2 from ethanol plant
- Biojet fuel
- Urea fertilizer as ethanol plant co-product
- Pyrolysis oils
- Hard to see how this eclectic collection of projects combines to make an impact relating to OBP goals.
- Supports a wide variety of approaches to meeting program objectives
- Plan support is not entirely clear and markets not identified in some cases.
- The shotgun approach was bound to hit something.
- The project meets the DOE objectives in the broadest sense
- The customer potential is identified – EERC says they
- Identify projects based on customer need
- The market potential from these project / technologies Is not explored
- Little real focus on specific areas with major impacts.
- Does not try to coordinate with DOE. They show a stage gate but it's not clear that this concept is used in their myriad research programs.
- Not particularly novel developmental effort.

Question 2: Approach to Performing the R&D.

- Multiple pathways
- Issue identification and resolution
- Good list of challenges
- Too many
- Landfill Microturbine CHP is more common than acknowledged
- Barriers seem to be addressed
- Excellent – addressing multiple goals, objectives, and approaches.
- Outstanding number and variety of partners.
- Very scattered number of topics and unrelated. But, everything is moving along well. Biojet fuel is a good goal with a large potential market.

- The approach is “shotgun” at best with little focus
- The barriers are too broadly defined
- There could be more integration with other research
- Technical R&D targets are poorly defined with respect to benefits that may be justified. Appears to be a scatter gun with no focus. NO integration evident. The key barriers and targets are not identified in detail, primarily as they have too many projects involved. Would benefit for a tighter focus on a few number of projects that might achieve something substantial. Some of the testing work does not have any specific targets, but just appear to be demonstrations for additional data. In many cases they are reinventing the wheel, such as steam reforming wet ethanol, demonstrating commercial microturbine applications, etc.
- Very broad scope of activities. Suggest investing more defined focus to gain expertise and a sufficient tech base to contribute to DOE mission and the lab’s growth as well.

Question 3: Technical Accomplishments and Progress.

- Lots of work in progress
- Results forthcoming
- Too many undone activities
- Cuphia – No go
- Generally low level of innovation.
- Good progress on most projects. Landfill methane project is based on fallacy.
- I saw little evidence of metrics in the in the review
- It seem to be almost exclusively based on technical
- Evaluation no cost and benefits
- The project researchers tend to have a cursory evaluation
- Process for efficiency, benefits, risks, etc. but they don’t
- Tend to use the results in a better focused strategy.
- Some benefits may occur but real benefits not clear.
- Good for their planned scope.

Question 4: Success Factors and Showstoppers.

- Hard to name successes
- No indication that this work will offer any new insight into solving barriers in gasification, new products, biodiesel production, etc
- Good Cooperation, commercialization progress.
- Using landfill gas in a microturbine has been proved impractical.
- This project has not looked at regulatory or business showstopper in depth
- This is the key weakness for this project area.
- In some cases, their effort is not very novel therefore does not address showstoppers.

Question 5: Proposed Future Research Approach and Relevance.

- Activity specific completions only
- Unless innovation improves, it’s hard to believe that OS will be supporting this work.
- Clarification on where funding will come from would be useful
- Future plans not clearly delineated.
- This work is mostly preliminary little future work is defined
- The program would benefit for future planning, a future focus and a goal to achieve from the program rather than a random group of projects.

***Additional Comments*:**

Strengths
- Great list of ideas and challenges
- Very nice education and outreach meetings
- Lots of cost share partners
- Diversity
- Good matching of needs and Federal funds with cooperators
- Strong group of both cash cost-share funding partners and in-kind partners.
- Good education program.
- Industry partners good resource capability
- Good partnership and cost share.
- Good educational outreach.
- Building capabilities of the group and expanding regional interest/expertise in biofuels.
- Providing an educational foundation for developing more faculty active in biomass to chemicals/fuels along with the education of future biomass-savvy technologists.

Weaknesses
- Too broad for dollars available – spread too thin
- Too many works in progress – no results
- Way too many projects
- No good sense of economic impact
- Poor sense of whether projects have a realistic chance of moving out of the laboratory
- Very low level of innovation…lots of this has been done again and again
- Diversity
- Too many subprojects.
- Some projects already proved impractical.
- No mention of an emission component to gasifier.
- Too many projects going on at one time – focus.
- Presenter did not address the corrosive effect of landfill gas on microturbines.
- Regional focus
- There is little focus to this project it appears that the Center will do whatever the research dollars will cover
- Portfolio too broad and no sense of benefits or economic value. Some of the projects have been done before.
- Needs to coordinate with DOE Biomass Program to get better value of the project.
- Way too broad – lacks focus. Should spend effort in focused area that fits well with ND region and the DOE interest areas. Also, their work lacks economic analyses.

Technology Transfer/Collaborations
- Annual workshop – Attendance growing,
- Strong panel of partners.
- Excellent
- This project could do a lot more with working with other groups to coordinate it projects. The laboratory and its many partners have substantial intellectual and outreach resources that should be more focused.
- Needs a single big project.
- If needs several projects, then need a gate keeper.

- Appears to have limited direct industrial involvement with research – need to enhance this area.

Recommendations for Additions/Deletions to Project Scope

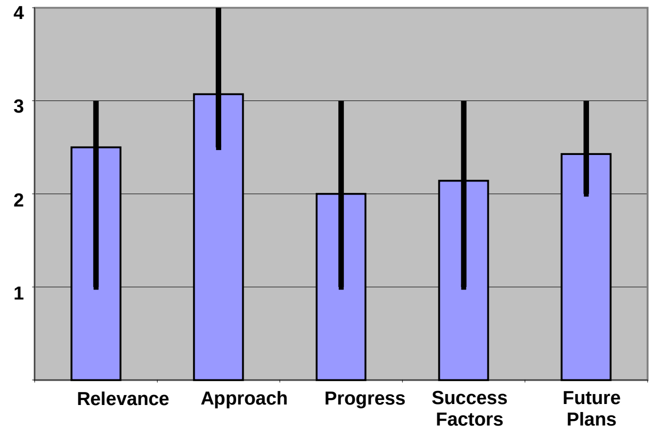
- Need strong focus, Caution on any future funding unless stronger filtering.
- Reduce the number of activities and focus the money on very few promising and high market potential possibilities.
- Narrow focus. Work toward building capabilities that have a future for competitive funding – need to fit DOE and USDA future R&D goals. I also believe that you are missing an opportunity to utilize regional feedstocks and other associated regional assets. Build capability around technologies with a funding future coupled with a strong component of using feedstocks from your region.

Anaerobic Digestion and Waste Processing Projects

Project Title: Anaerobic Digestion (Ohio State University)

Principal Investigator: Floyd Schanbacher
Project Stage: 2 – Detailed Investigation

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.50	1.50	0.50
Approach	3.07	0.57	0.93
Progress	2.00	1.00	1.00
Success Factors	2.14	1.14	0.86
Future Plans	2.43	0.43	0.57
Average	**2.43**		



Question 1: Relevance to Overall Objectives.

- The project will generate energy in the larger context of biomass platforms, but the innovation is not particularly high.
- Has integrated project into numerous DOE objectives.
- Excellent partnerships
- Comprehensive
- Relevance is pertinent. Market potential is highly questionable.
- The market potential was not well defined this technology
- Is not farm scale but industrial There is not much outreach and there should be more coordination with other states
- Oil displacement benefits not identified. The market is biopower with novel fuel cell end technology that appears to have good technical justification. Conversion technology appears to benefit a waste stream issue and low cost feedstock.
- No new information being generated. Very redundant effort too many projects already done.

Question 2: Approach to Performing the R&D.

- Performance is reasonable, but innovation is low.
- Well-conceived and integrated project.
- Cost may be the primary barrier.
- Feasibility of fuel cells for processing biogas was proved earlier in other locations.
- I like the research on microbes and the controls
- A self-controlling digester is a good outcome
- more focus should be put in this area and less on the
- resource assessment
- The technical barriers were address only once we dragged that info out of the reviewer with questions. They did not offer key targets at all saying it was premature, while in discussion they clearly had some type of go no-go types of strategies. The self-healing, self diagnostics, self operating digester looked unique but potentially expensive.
- Their approach is good for their stated objectives. The engineering and project plan is well thought out.

Question 3: Technical Accomplishments and Progress.

- Project appears to be moving slowly
- Most effort to date has been planning and facility construction. High potential for valuable contributions in several areas.
- Some progress on bacterial characterization. Optimizing organisms for anaerobic digestion is very important with potential to increase gas yield and improve overall efficiency by possibly reducing energy input requirements.
- Progress is adequate but has not reached the stage of generating data.
- Bacterial species studies may be the most valuable part of this work.
- Why was fish processing waste not included?
- There are no performance indicators it is very difficult to
- Measure any success or progress
- The reviewer did not provide any discussion as to how the project will benefit the 2020 goal, or DOE's program direction, nor did he provide any cost benefit estimates or cost targets, or efficiency targets. Need some economic analysis. The focus on the project is higher efficiency of biogas production and the approve is fairly innovative but needed more specific microbiology R&D.
- Very limited new information will be generated from this effort as planned.

Question 4: Success Factors and Showstoppers.

- Project tried to identify show stoppers, but at a pretty high level. Did not address details.
- Excellent analysis of showstoppers. Honest assessment of success factors.
- Fuel cell component is important, but is not necessary for project to be successful.
- Identified show stoppers are true and good. Did not address alternative energy conversion technologies for biomass.
- The success factors And showstoppers seem to rely on
- Policy and Renewable incentives
- The reviewer provided some justifications for their research direction that looked legitimate. The project has not processed to the point where regulatory barriers or environment barriers are integrated into the project.
- Minimal true show-stoppers have been identified.

Question 5: Proposed Future Research Approach and Relevance.

- Plan forward is reasonable, but is treading well worn ground.
- Good plans.
- The future plan looks good.
- The future plans are a little vague and tended to focus on more operational data and adding another digester to their infrastructure. Neither research target dates nor any research or economic targets were provided.

***Additional Comments*:**

Strengths

- Reasonable coordination between engineering and development of efficient new anaerobes
- Addresses an issue in OH with an available waste stream.
- Reasonable leverage of DOE funds
- Good research plan.
- Results could be very useful but positive result highly unlikely.
- Strong partnership between industry and academia

- Comprehensive focused approach
- Commercial potential with broad appeal to municipals
- Good engineering
- I like the research on microbes this will lead to better understanding and potentially improved efficiency
- I like the controls research and development of better self operated systems
- Novel approaches to better microorganisms and better instrumentation feedback systems to better reliability and higher operability targets.
- Appears to be well engineered systems.
- Well laid out experimental plan for their stated objectives.
- Good outreach initiative with industries who may not seriously consider biogas utilization.
- Building new expertise within their state along with additional R&D capability that could grow their program.
- Providing an education to students who will be biotechnologists of the future.

Weaknesses

- Larger national impact is not clear, as the project is quite OH-centric
- Low innovation – anaerobic digestion is well studied and employed
- Project appears to be moving somewhat slowly. Only at batch scale so far. Two large scale ups still necessary before completion.
- Need not demonstrated
- No fallback position if SOFC fails because of biogas contaminants
- Relies heavily on price/value of renewable energy
- Did not address SOFC generation price/kW
- Did not address kW/gal of digestion or btu/gal of digestion
- Lack of coordination with other researchers
- No assessment of the market potential
- Too much federal dollars for resource assessment
- No R&D targets, no milestones, no quantitative benefits, no feedback loop to DOE, no integration into other researchers in the field.
- Project has been slow.
- Don't see any significant technology advancement presented thus far.
- Efforts on the dairy wastes are not considered of significant value – already been done by many groups.
- The waste inventory assessment seems of little value.
- The connection of microbial population identification efforts to improved process control/production was not clearly made.
- Lacks process economic analysis and the supporting economic benefits.

Technology Transfer/Collaborations

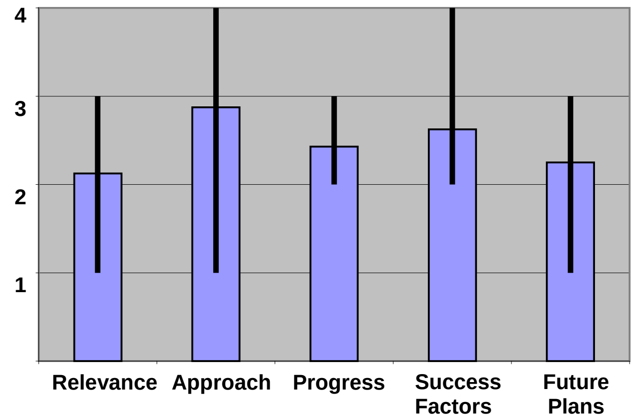
- Excellent
- Good collaboration with commercial sector.
- Poor
- Reasonably good – like the mix of feedstock producers along with process equipment vendors.

Recommendations for Additions/Deletions to Project Scope

- Fuel cell work does not contribute much to this project. Focus instead on biogas production research.
- Emphasize development of new bacteria.
- Project needs to identify other types of power generation if SOFC fails. Show comparison of cost/kW of other types of power generation. Identify emissions profile of different types of generation.
- Reduce work on resource assessment more focus on controls and interface with fuel cells
- Fine tune the project and provide good quality management processes such as Microsoft project and better technical targets and milestones. How do you know when you succeed or making progress?
- Recommend focusing exclusively on industrial wastes and oriented process automation toward industrial plant operators where their training level is much higher than farmers for process controls, plus their comfort zone for process controls/operations are much more established.
- The project has potential good merit if it strives to break new ground or attempts to bring industries on board that have been hesitant to give this technology a realistic look.
- Ensure that a plan is in place to manage digester residuals – look toward possibly marketing the residuals, i.e. digester tea or fertilizer value – keep in mind that the industry may be concerned about their materials going out into the market.

<u>Project Title: New York Biomass/Methane Gas Power Fuel Cell Project</u>
<u>Principal Investigator:</u> Dr. Caine Finnerty and Praveen Cheekatamarla, NanoDynamics, Inc.
<u>Project Stage</u>: Stage 4: Technology Development

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.13	1.13	0.88
Approach	2.88	1.88	1.13
Progress	2.43	0.43	0.57
Success Factors	2.63	0.63	1.38
Future Plans	2.25	1.25	0.75
Average	**2.46**		



Question 1: Relevance to Overall Objectives.

- Belongs in HFCITP portfolio
- SOFC distributed size
- Provides a user of the biogas or even syngas that will be produced from biomass.
- Falls within the hydrogen project
- Relevance is pertinent
- Not closely related to Program objectives.
- Fuel cells have their own program.
- Not biomass related.
- Operation with biogas/syngas is important goal for future fuel cell adoption/use.
- The use of renewable fuel for the fuel cell is a good
- Approach but the focus on biogas and the research is really focused on improving the fuel cell which makes this a better fit in Hydrogen
- PIs gave poor indication of how the project will affect DOE program goals. Difficult to evaluate and PIs need to be more integrated with OBP programming goals.

Question 2: Approach to Performing the R&D.

- Small scale – lab level
- Gel casting is good approach – problem to tackle
- Their experimental approach appears solid for their stated objectives:
- Clear R&D targets, focused strategies for achieving the targets, innovative R&D on materials formulation and practical construction, focus on efficiency conversion, and verbal discussion on capital and operating cost targets. Barriers were fairly well defined but not linked for specific market end application issues.
- Very small scale. One can already buy a bigger one.
- Not clear what the goal is
- Good research plan
- For a fuel cell project this is very well organized and designed
- The performance measures are clear and are being met
- I would have scored higher if the project had been more in line with the OBP program
- Project is highly focused on one thing: making a cell that generates 20W. Activity is at the expense of placing work in larger energy context. However, highly focused research appears to be progressing along a defined path.

Question 3: Technical Accomplishments and Progress.

- Making steady progress from fuel cell development perspective

- Fit issue with OBP
- If this were a HFCITP project would grade higher
- Significant work appears to have been performed and considerable amounts of data were presented.
- No performance target indicators were provided specific to the DOE program and its goals, but the project did have well defined efficiency and cost targets.
- Had good focus on robustness and durability.
- Good progress has been made but it is not clear that this is worthwhile. They seem to be behind other industrial players.
- The reformer catalyst studies and development seem worthwhile.
- Some good progress, but unrelated to needs of this Program.
- Fuel cell development should focus on direct utilization of biogas without reforming step.
- This project has mead very good progress The only thing
- That brings it down from outstanding is that it is more of a
- Fuel cell development than biomass
- Great proportion of effort is on cell design and making one that meets certain parameters with little apparent understanding of what targets should be met on a national scale, and how this technology might address those targets.

Question 4: Success Factors and Showstoppers.

- Planar cells success is important for cost cutting
- I believe this project is well run and moving in a reasonably positive direction.
- Business and regulatory issues were not addressed in detail. Commercialization targets were verbally addressed in feedback (Japanese market).
- Commercial scale up of electrode manufacture not clear.
- Reliability.
- Tolerances may too wide.
- Discussion of biogas neglected to address effects/removal of SO2
- The market for this package appears to be a real showstopper
- That is not addressed. The small fuel cell works well but the
- Biogas fuel to supply the fuel cell in a home is not practical
- By focusing so strongly on cell design, the larger impacts appear to have been ignored. Vague description of eventual deployment and application.

Question 5: Proposed Future Research Approach and Relevance.

- Concept C success is important capstone of work
- Their appeared to have demonstrated a vision for how they will fully meet project goals.
- Not a clear idea of how it is going to commercialize the technology. May need partner, such as GE, to commercialize larger systems (2-5 MW).
- Future plan looked to be somewhat repetitive of what has been done.
- Future work not expecting new innovations – incremental improvements.
- In my opinion the only way to make this be a biomass project is to look at biodiesel as a fuel
- In short term, project needs a much better sense of how their project fits into the larger national energy strategy, quantifying potential opportunities and impacts.

***Additional Comments*:**

Strengths

- Making good progress
- Good SOFC R&D targeting
- Appears to be a well thought-out and implemented project.
- Advances the potential for using biogas for use in fuel cells.
- Also, provides more development work on fuel cells.
- Strong R&D plan has clear goals and objectives, clear plan to achieved, achieved their research in a step by step manner, and reported results that nearly achieved target.
- Good research program
- Uses a wide variety of fuels
- Well-designed project from the fuel cell research side and if the plan was to build bigger fuel cells for stationary power generation then it would be OK
- In depth investigation of cell construction and performance

Weaknesses

- Not partnered with the SOFC development consortium
- Poor fit to OBP
- No economic information was provided – with these technologies – could be your ultimate show-stopper.
- Didn't address sulfur issues.
- The stated technology economics don't match up to the volume of biogas that is produced nor do the costs/scale match up.
- Weak commercialization plan
- Not clear where it is positioned for cost effectiveness or compared with other technologies.
- The way forward (commercialization) was not described.
- Lots of data but few conclusions.
- Questionable scalability to residential application
- No partnerships
- Does not address cost/kW
- Addresses Japan market and not U.S. market
- Too expensive for American market
- Not relevant to this DOE Program
- The potential market is weakness To focus on a small package for homes or apartments makes this project problematic because the biogas can't be generated cost effectively at that scale
- Poor sense of larger impact of work; needs to have a much better idea of path to commercialization, and for DOE, a much better indication of broad energy impact.

Technology Transfer/Collaborations

- No partners
- It appears that they have minimal interaction with other groups.
- Looks like no activity in this area. No clue about target market.
- Fair
- Very poor. Presentation specifically noted no industrial partners, although the Q/A period revealed that some industrial partnerships may be developing.

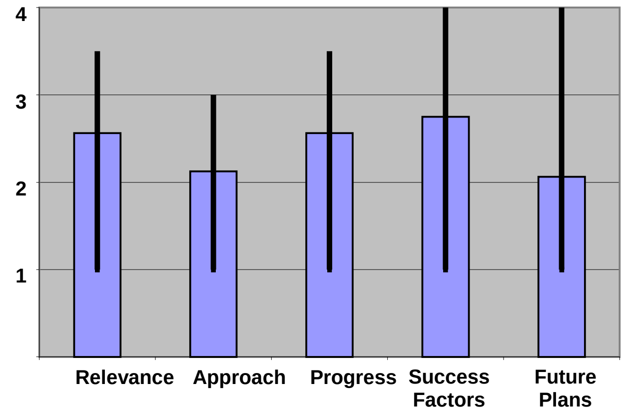
Recommendations for Additions/Deletions to Project Scope

- Move this project out of OBP to the SOFC effort

- Need to spent significant time on scale-up and the derived economic benefits.
- Need to address scale-up to match with the biogas sources – a lot of biogas is produced at production facilities with very limited storage capacity – need to ensure that these match up.
- This belongs in the Hydrogen Program.
- Misplaced project – belongs in hydrogen program
- Belongs in another DOE program.

Project Title: Ohio Solid Waste Authority Pyramid Resource Center
Principal Investigator: Tim Berlekamp, Solid Waste Authority Pyramid Resource Center
Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.56	1.56	0.94
Approach	2.13	1.13	0.88
Progress	2.56	1.56	0.94
Success Factors	2.75	1.75	1.25
Future Plans	2.06	1.06	1.94
Average	**2.41**		



Question 1: Relevance to Overall Objectives.

- Biopower is not currently in OBP target zone but is in the new Vision document
- The project is successfully tapping an existing but unused fuel source. The project, although of somewhat low innovation, is still doing an excellent job of moving from opportunity toward commercial production of renewable energy.
- The project is a demonstration project not research
- It should have an outreach component
- Good plan and relevance to DOE Biomass programs and
- existing commercial MSW landfills
- Relevance is pertinent.
- Good project but not real linkages to Biomass Program except for expand distribution of green CNG for fueling and possibly for facilitating B20 distribution.
- First commercial scale application of CO2 wash which may be one of the solutions for gasification clean up.
- Provides a developmental program that will demonstrate renewable fuel production technology.

Question 2: Approach to Performing the R&D.

- Good commercialization of biogas scrubbing – CO2 Wash
- Uses refrigeration to separate CO2 from methane
- Closed loop energy system
- Methane to methanol as feed to biodiesel
- Very integrated including CNG fueling for garbage trucks
- Scaling for small landfills and large
- Project is well designed, focused, and is on a path to convert a generally untapped fuel source. Variability of landfill gas pressure could be a problem.
- The technical barriers – small landfills don't have the technology At a scale to develop
- It is not clear no comparison of # of landfills and comparison to more typical LFG generation projects
- Reduction of NOx
- Very thorough.
- Everything seems to depend on trademarked "CO2 wash."
- Landfill gas clean up to methane is existing technology.
- This approach may be a little different but the result is the same.

- Rated poor because the project is not needed to reach the goal.
- Technical targets were not provided, nor does the implementation plan show any coordination with the DOE program. The team has very experienced technical people involved and the project is well designed and appears to be technically feasible. For a demonstration project, we don't know how to measure it to see if it's successful. No real economic research targets either.
- Their Phase II program with methane to methanol conversion production and their biodiesel production facility needs to be better justified economically.
- Limited actual approach was presented – appears to be reasonable – however, little justification of scrubber choice was presented.

Question 3: Technical Accomplishments and Progress.

- Almost complete as first generation commercialization
- Project is well described and quantifiable, and presentation is able to deal with key questions.
- This is not a biorefinery it is more of a waste reduction recycling project
- The fuel / petroleum reduction will be small
- The environmental benefits could be a positive factor
- Planning, design, and installation for Phase I nearly complete. Not yet operational.
- Good progress being made
- Some performance metrics were discussed such as natural gas and kWh green production. The methanol production would reduce fossil fuel imports. Cost appears to be effective at really low Btu cost from landfill gas production. No discussion about how this technology can role out nationally and what that benefit might be.
- Appears reasonable for stated goals.

Question 4: Success Factors and Showstoppers.

- Good sense of economic impact and potential problems in dealing with this source of energy.
- It seems that the only success factor was if the project sponsors could make this a commercial technology
- Everything seems to depend on trademarked "CO2 wash."
- Market for CO2 critical for success?
- Applicability to lesser-managed landfills?
- Operator skills, time requirements?
- Most listed showstoppers were overcome 10 years ago in California. The other showstoppers are unique to Ohio.
- Some success factors and show stoppers were identified but without any quantitative numbers. Regulatory and legal issues are high with this project but the team appears to be experienced to overcome these.
- I believe that they have not adequately addressed project cost benefit for this project.

Question 5: Proposed Future Research Approach and Relevance.

- Very good plan to make green methanol for biodiesel plant
- Plan for additional activities are focused on commercialization, and construction is proceeding to develop a fuel production and distribution facility.
- The CO2 sales was not well addressed – what happens to the commercial value if the CO2 market is lost
- Still waiting for demonstration of concept for Phase I. Ambitious plans for phase II, scaling and marketing to various-sized landfills

- Phase II can also be achieved with existing technology.
- The project is overly complex and does not have any go/no-go decision points. Needs a better planning process for why some of the down stream sections are included. Their progress on construction to date is good, but plans for going forward were generic.
- Not many real future activities were presented.

***Additional Comments*:**

Strengths

- Commercialization of potentially needed product in biogas scrubbing – CO_2 wash
- The small scale is especially appreciated for smaller landfills – new market
- Renewable methanol
- Very good leverage of DOE funding: 40% federal/60% private
- Excellent progress toward commercialization.
- Team is highly informed regarding all technical, regulatory and production issues surrounding their process.
- Nice demonstration of moving from concept to commercial reality
- Good cost sharing
- Good plan to produce CLEAN, multi-use fuels from landfill gas. Possibility of CO_2 capture is worth exploiting – though not part of DOE program. Decrease in greenhouse gas emissions also important.
- Strong partnerships
- Good environmental benefits of this technology
- Variability of CO_2 Wash btu output
- Strong team with good commercial technology.
- Good project with little benefit to the nation over all, but maybe good benefit to Ohio.
- Using an energetic resource that is currently wasted.
- Expanding utility of landfill gases.
- Demonstration of new technologies.

Weaknesses

- Stronger economic analysis needed for easier commercialization
- The ideas are not new, except for the CO_2 wash, but the progress and potential impact mediates this issue.
- This is an expensive project Given the barriers that the sponsors say they will be addressing why did they need to build such a large installation? Most of these issues have or are being addressed – this is more of a commercial project designed to sell additional units.
- Everything seems to depend on trademarked “CO_2 wash.” Unclear why they are specifically tied to this technology.
- Verbally expressed energy recovery efficiencies seem wildly optimistic considering the compression, refrigeration, etc. steps in processing.
- Market/use for “purified CO_2”?
- Little discussion of byproduct CO_2 that is heavily contaminated with LFG components.
- Need to address cost/kW of micro turbine vs. other types of generation
- Acceptance of these synthetic fuels, both Biodiesel and CNG
- Presented not cost/benefit projection or performance analysis
- Nothing new in this project
- Market may be very limited.

- Land fill gas only lasts so long, and no real consideration to adding a gasifier in the future has been considered.
- Minimal new technology development is being accomplished.
- No life-cycle cost analysis has been done.
- A mass balance analysis of carbon particularly considering methanol and methane volume calculations should be presented.

Technology Transfer/Collaborations

- Good partnership team
- Appropriate team to carry out the research and development activities.
- Although they have a number of partners they don't have outreach partners Where is the EPA LMOP program?
- Good partnerships/collaboration.
- Fair/poor
- There appears to be a good interface for technology, but no activity was proposed.
- Seems to have significant collaborations. Strong vision toward future partnering.

Recommendations for Additions/Deletions to Project Scope

- Add economic analysis component
- It would be best if DOE could get some benefit from its investment
- What are the "problematic" CNG fuel specs?
- What LFG Vehicle Fuel commercial issues need to be explored?
- What is the market potential?
- Not sure this project belongs under this platform
- Badly need to perform an IRR analysis of project life cycle.
- Consider other types of carbon dioxide scrubbing units.
- NOTE: The CO2-laden stream derived from your process cannot be considered an equal stream, chemically composition-wise/quality, as those generated from ethanol plants – significant health issues if the stream is intended for human consumption/application markets – will have to prove your stream safe (likely via FDA)

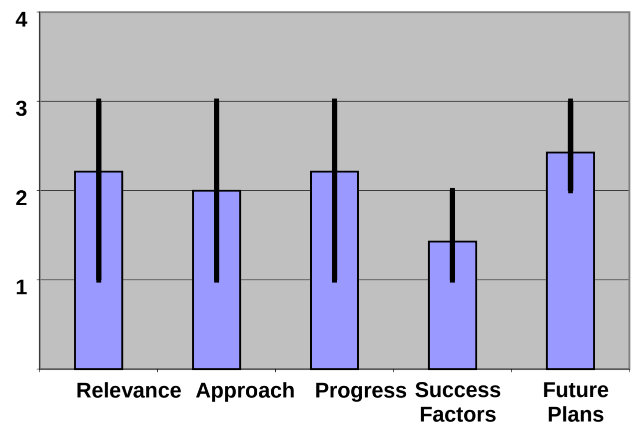
Communications, Outreach, and Partnerships

Project Title: New Uses Information and Entrepreneur Development

Principal Investigator: Mark Williams

Project Stage: Project Management of Biomass Commercialization Awards and Full-time focus on commercialization support services

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.21	1.21	0.79
Approach	2.00	1.00	1.00
Progress	2.21	1.21	0.79
Success Factors	1.43	0.43	0.57
Future Plans	2.43	0.43	0.57
Average	**2.06**		



Question 1: Relevance to Overall Objectives.

- Bioenergy business development cross-cutting fit
- Working in bioproducts area improves fit
- Program may be duplicating existing funding efforts that are part of the normal DOE funding opportunities. However, the program may also be able to identify groups that are inexperienced in finding federal funding to support new commercial opportunities.
- Need to develop markets for biobased fuels.
- This project is more focused on biobased products.
- Will not contribute much to 20 in 10 goals.
- Relevance OK.
- Limited program eligibility requirements
- The project is too narrow—one county—to have a significant impact on a national program. They need to broaden out their focus on bio-based products to a support biorefinery development. They need to develop some way to measure the attractiveness of their market projects and a better way to identify customers.
- Some of their projects were counter productive, for example, the Biodiesel symposium was a forum for the NBB to develop stakeholders to reduce incentives on the Renewable diesel industry.
- Addressing commercialization within a region – which is good, but not really part of the focus or the DOE Biomass Program.
- Information provide makes it difficult to asses further.

Question 2: Approach to Performing the R&D.

- Economic development award program targeted to biomass
- Looking for existing IP for commercialization
- A bit scattered
- The barriers were not particularly well defined, nor were the approaches to their solution. The programs were described, but the actual process for allocating funding could have had a clearer explanation.
- This project seems to duplicate services/programs already offered by many universities/small business development programs.

- The approach is pertinent to the goals. Education of inventors in these areas is very worthwhile.
- Capital Awards element may need more attention and rework
- They are integrating into a broad group of similar or related organizations (universities, economic dev., private industry, manufacturing association) to broaden out their expertise. Their use of angel investment groups and other support agencies are good. Once they get a project though, they are weak on the identification of barriers, research targets, economic analysis to achieve those targets, etc.
- Difficult to assess with information presented.

Question 3: Technical Accomplishments and Progress.
- Not a lot of businesses up and running due to this effort
- Work in progress
- Re-tooling awards program
- It may be important to provide an opportunity for groups that might get overlooked to have access to funding, however, this group should focus strictly on the small entrepreneur, rather than providing funding to large, existing companies well versed in finding their own funding, or supporting the work internally. None of the projects described appeared to be high risk.
- Excellent progress in forming partnerships, increasing public awareness, and specific product/industry projects.
- However most of these are not relevant to Biomass Program
- Will not contribute to 20 in 10 goals.
- Local outreach effective with media and targeted partners.
- They have not developed key metrics for their program. They have not developed any way to measure their benefit.
- Addresses outreach.

Question 4: Success Factors and Showstoppers.
- Not a good set of success factors
- Not part of presentation
- Hard to tell. The program is quite straightforward: provide support and funding to new biomass opportunities, thus, there aren't many showstoppers to be identified.
- Not well-defined.
- Presenter did not address these factors.
- Capital Award element needs attention to avoid becoming a show stopper.
- The identification of key barriers and their relationships to the bioproducts and DOE goals is weak.
- Project tea, appears to be working with their companies in terms of helping them ID stoppers along with providing services to address them.

Question 5: Proposed Future Research Approach and Relevance.
- Given the stated goals of the project, the team has defined a reasonable path forward.
- Future planned work is a logical extension of past work and will strengthen the program.
- Continuing what they have already started.
- More fully integrate partners with entrepreneurs.
- They take what is a general business outreach and entrepreneurial organization and refocus it on biomass energy commercialization. However, Not much planning is shown, it seems to be very serendipity. They do have plans for a symposium for biobased

products in Chicago that has the potential to develop projects, but good projects will depend on who speaks at the symposium and who attends.
- Reasonable for the type of program this is.

***Additional Comments*:**

Strengths
- Has an awards program with $$ for business development
- Biobased products is good area
- May identify small opportunities that may not have experience in finding support for promising programs.
- Local focus increases effectiveness.
- Strong partnerships with government and others
- Might help some opportunities which could drop between the cracks
- Focusing in regional economic development using biomass.
- Program design does provide critical business development support.

Weaknesses
- Need to focus more
- It is unclear how this group's role differs from existing funding opportunities for potential commercial opportunities.
- Their "clients" also include very large companies (Chemtool). Did Chemtool try the traditional routes and fail?
- Does not contribute to 20 in 10 goals.
- VERY locally-focused.
- Some funding supports efforts of LARGE company…
- Duplicative of other resources already available to entrepreneurs.
- Staffing may a bit under funded.
- Very narrow program eligibility requirements
- Local focus
- Limited success to date (only one joint venture accomplished)
- Duplication of effort with other state/national funding opportunities (SBA, USDA, etc.)
- Relatively weak project, with only a fuzzy idea of what to do with it. No metrics to speak of, little focused planning is occurring, no barriers (regulatory, economic, technical) are being identified with any consistency.
- Focus on one county too small, and limits their potential impact for the program for DOE.
- Seems to lack strong technology development screening capability to ensure good industrial participants are involved.
- Have not presented any info on IP.

Technology Transfer/Collaborations
- Partnerships are solid – Argonne, USDA, universities, local government
- This is a strength of the program.
- Poor
- Very strong given the nature of this project.

Recommendations for Additions/Deletions to Project Scope
- Future funding should be state and local
- Not relevant to DOE Biomass Program.

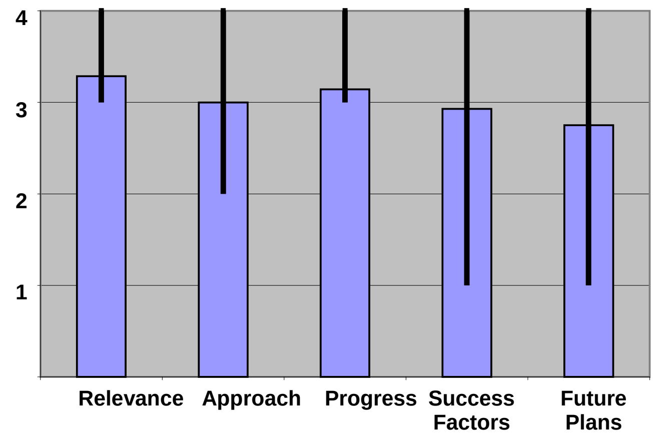
- My opinion is this is questionable/poor use of federal funds. This project should be funded at the State or even local level and not with federal tax dollars.
- Increase access of industrial participants to university expertise – ensure the university side is properly supported to ensure critical investment interest from the faculty/staff.

Project Title: Alternative Energy Enterprise Program

Principal Investigator: Sumesh Arora,
Mississippi Enterprise Institute

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.29	0.29	0.71
Approach	3.00	1.00	1.00
Progress	3.14	0.14	0.86
Success Factors	2.93	1.93	1.07
Future Plans	2.75	1.75	1.25
Average	**3.02**		



Question 1: Relevance to Overall Objectives.

- Cross cutting
- Biofuels focus – Cellulosic and biodiesel
- This project is an excellent example of how to set up a state program lined up with DOE goals.
- Addresses overcoming limits to commercialization of biomass-energy projects and economic development.
- Relevance OK
- Tightly coordinated with DOE Biomass Program goals, 2525 initiative, becoming self funded, estimating benefits, using quantitative metrics, etc.
- Supporting 10 (5 Ethanol, 5 Biodiesel) projects.
- Biorefinery focus.
- Project could be a template for other state outreach programs. The project is focused biomass and biodiesel feedstock, conversion technology, and commercialization.
- Somewhat Advancing biomass-based industrial development.
- Not an outreach program.
- Does focus on projects that are within program goals.

Question 2: Approach to Performing the R&D.

- Good understanding of Mississippi feedstocks
- Region appropriate
- Advisory board
- Funding to get things done – both R&D and business start-up
- Scaled for region
- The project has done a good job of picking projects that are aligned with DOE/OBP goals, and also has a nice management system in place to make sure that those research paths are maintained.
- Organization is appropriate to the goals and operations.
- University partners are appropriate but private sector
- Involvement is weak
- Very well designed program, clear metrics and very strong project portfolio management. Their approach is very well integrated into DOE research and how to take those needs and screen the various projects to select only the projects that also meets DOE. The barriers that would have been addressed will be reduced through this project.
- Presented a reasonable path to implement their program.

- Good business development presence.
- Not comfortable with the level of oversight for the individual projects.

Question 3: Technical Accomplishments and Progress.
- 14 projects selected
- Glycerin – commercially saleable product
- Slash bundler - John Deere
- Just getting started
- The project is well organized and appears to be aligned with the goals of the DOE/OBP programs.
- Good start forming partnerships and a few funded projects
- 12 projects thus far.
- Good outreach effort.
- Providing access to capital
- Program measures metrics, measures benefits, identifies goals and objectives and how they were identified, quantified and achieved. There is a clearly defined, documented progress in this project. It has great integration with business partners, cost share funding, audit trails. Etc.
- Reasonable program development has been accomplished.

Question 4: Success Factors and Showstoppers.
- Effective Communications
- Low price of fossil fuel alternatives. Analytical list
- Very clear articulation of the showstoppers, which are harder to define for a research support function, rather than an actual hands on research investigation.
- Most identified.
- Doesn't mention environmental regulations, which, if not
- explicitly considered, might inadvertently inhibit progress.
- Appeared to be aware of legal and regulatory barriers, although more specific types of contingency planning might improve the project.
- Not well defined - appears to need work in this area.

Question 5: Proposed Future Research Approach and Relevance.
- Late start impacts future work
- At beginning stage
- The plan forward is reasonable based on the activities that are currently supported.
- Continue what they are doing.
- Not so crazy about funding universities with these $$$. Universities have many funding sources. Should go to assist small private entities.
- Fund universities only as partners with commercial entities.
- This topic was not addressed.
- Plans to become self-sufficient are excellent. Has a clear view for future planning and succession. I did not get enough input about how the resources are allocated or whether the schedule is on time, etc.
- Reasonable plan to advance the project.

***Additional Comments*:**

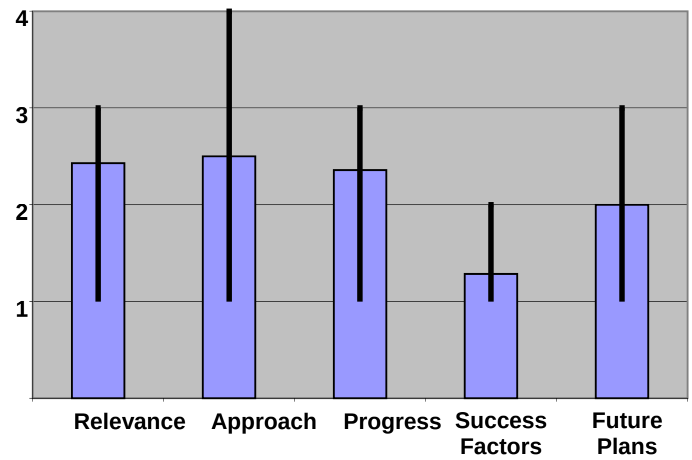
Strengths
- Has funding for university R&D and for business development
- Partnerships and advisory board
- Well organized program with clear goals, and a good description of impacts resulting from money allocated.
- Broad state based activity, with attempts to move more widely into SE region.
- Good alignment of state program with DOE goals
- Best of the various state projects evaluated.
- Well balanced program.
- Strong list of partners including universities and private-sector
- Use of an outside-the-state advisory board
- Broad commercialization opportunities
- Regional approach is national and not local (southeastern U.S. vs. local counties)
- Tracking/auditing funds after awards are given
- 501 (c)(3) status
- Strong outreach network with many partners, great metrics, tight integration into Biomass Program goals and objectives. Shows budget allocation and cost shares. Does an enormous amount of work for a short period of time. Covers both ethanol and biodiesel projects and avoids investment in too much power, gasification, etc. Has a very nice set of out-of-state technical reviewers that reduce domestic policy influences that might dilute the program goals.
- Good mix of technology development stakeholders.
- Outside review.
- Competitive program.

Weaknesses
- Need to focus on results of 14 funded projects – What happens? Not just financial audit
- Local focus without local funding
- Private sector funding is lacking, very few non-university projects funded
- Too much money to universities.
- Seems to significant private sector funded projects – the stated goal.
- Not showing a strong model of how the universities are dramatically impacting economic development.

Technology Transfer/Collaborations
- Good outreach efforts noted
- This is a strength of the program.
- Excellent
- Seems to be good – but needs more industry involvement

Recommendations for Additions/Deletions to Project Scope
- Future funding should be state and local
- I'm not completely comfortable with federal tax dollars/funding going toward a local initiative program. This should be funded with State and local funds.
- Carry on.
- Try to encourage more technology development that will result in a larger job creation potential – seem to have a lot of little companies with minimal experience with business development.

<u>Project Title: Kentucky Rural Energy Supply Program</u>
<u>Principal Investigator:</u> Cameron Metcalf, Kentucky Pollution Control
<u>Project Stage</u>: Exploratory Research



Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.43	1.43	0.57
Approach	2.50	1.50	1.50
Progress	2.36	1.36	0.64
Success Factors	1.29	0.29	0.71
Future Plans	2.00	1.00	1.00
Average	**2.11**		

Question 1: Relevance to Overall Objectives.
- Energy efficiency and biobased products
- Beyond OBP for some of work
- Used OBP platform for review and selection
- Several of projects funded with OBP money are used to support KY projects that would be placed in other non-biomass parts of DOE
- Good advisory board membership.
- Education and support of biobased energy and product development
- Relevance is pertinent.
- No industry participate just university funding and the governor's office. No focus on providing projects that might benefit DOE, too much money to solar, and energy efficiency, and other non-biomass program. Obviously not strong enough to direct the project to meet DOE goals and objectives and does not appear to know what those are or how to achieve it. Showed a stage gate picture, but they clearly do not know how to use the process to help improve their projects.
- A portion of the work fits within the program.
- However, some projects did not fit within the mission.

Question 2: Approach to Performing the R&D.
- Lots of organization structure and coordination
- Tech assistance and clearinghouse
- External review of funds
- IAC
- Project seems to be a reasonable attempt to seed and develop additional biomass programs for the state, but there is poor technical control over the programs WRT alignment with OBP goals and program directions.
- Need more focused program.
- Need better technical oversight/review of funded projects.
- Too much funding to universities. In just the few cases shown during presentation, the same investigator appears in several projects – implies that either few Kentucky universities have interested/qualified researchers, or good review - effort to incorporate other approaches is lacking.
- Program plan is reasonable.
- Communications with private sector is good.
- Strongly based on university research projects.
- Better technical reviewer would improve technology, also tighter management for selection in better focus projects on projects to support DOE's program. Too many

projects that don't do anything for biomass, and too much charlatans, such as the Bio-oil people, which many people have tested and found that the product is unreacted soy oil despite their claims. Has no technical goals for the projects and little understanding of the technologies and cannot develop a strategy to achieve those goals. Project director does not bring enough technical support and does not have any.

- Scattered program with little in common, does not appear to be much oversight for university researchers.
- Lacks program oversight of R&D activities.

Question 3: Technical Accomplishments and Progress.

- 7 funded projects
- Microbes at higher concentrations of ethanol – One of two in the world
- Catalytic upgrade of BioOil – Found catalyst for deoxygenation
- And now moving to commercialization
- Corn stover pre-treatment
- Biomass briquettes
- Developed soy based transformer oil
- Several projects seem duplicative of work that OBP is already paying for. Better coordination needed at the project level with ongoing DOE projects.
- Good partnerships
- Some projects beginning to show results.
- Progress on specific projects is good.
- No benefit analysis, no efficiency improvement or any other metrics to show that the projects invested will make any R&D progress.
- Little information was presented to make this decision.

Question 4: Success Factors and Showstoppers.

- No presentation on this topic
- Showstoppers and success factor assessment pretty weak
- Not addressed in presentation.
- None were addressed.
- Legal and regulatory issues were not address even though potential lawsuits over the Bio-oil claims might have resulted from this investment. No milestones are provided, no show stopper provided.
- Program does not address these issues based on the presentation.

Question 5: Proposed Future Research Approach and Relevance.

- 25 X '25 roadmap coming – state funding
- Project appears complete, in that all the allocated money appears to have been sent out, but project choice needed better control and oversight.
- Plan to continue what they have been doing.
- Need to focus on biomass-based fuels. Not solar, etc.
- Future plan is to continue on same path.
- Project is poorly planned, funded non biomass R&D and does not a strategy or a focus to try to build a biomass-based capability in KY.
- Not much information presented addressing this factor.

***Additional Comments*:**

Strengths

- Competitive grants R&D program with cash cost share from state
- Biobased products
- Economics and net energy balance
- Good project targeting and economic impact analysis
- Good research team chosen as a result of grant program
- Good oversight activities, meetings, reporting program, energy impact assessment program…not frequently seen in other projects evaluated
- Implementation is generally good.
- University and government partnership in addition to consortium members
- Must apply through State for funding
- Consortium Advisory Board
- Developed a vision statement - focus
- Developing capability within KY universities.

Weaknesses

- Too broad – All of EE plus OBP
- Build capability
- Future planning needed
- Grant program should have more explicitly targeted industry and small business
- Supported projects duplicate ongoing DOE research
- Poor coordination of supported projects with ongoing DOE activities
- Some funded projects do not fit within OBP goals, and align much more closely with other programs within DOE
- Bio-transformer oil is already a commercial product
- Use of federal dollars to fund State projects – this project should be a State funded.
- Should target small business concerns
- Way too broad – needs to focus
- Needs independent, outside review of projects (too much opportunity for a breach of integrity)
- No planning, funding way too much non-biomass money spend to useless projects. No multiple or focused biomass solicitations after the first solicitation failed to generate much interest. No real focus on the DOE program even though he did intend to focus, there wasn't any follow through. Too much money to universities and not enough money to private partners. No research targets, identification of barriers, or strategies to achieve the barriers or research goals.
- Lacks close integration with industries.
- Lacks focus.
- Basically, another university R&D funding mechanism with minimal commercialization potential presented.
- Lacks strong and knowledgeable technical oversight.

Technology Transfer/Collaborations

- KY consortium and advisory board website
- Good if information is widely disseminated
- A lot of government entities, however – needs more industry partners.

Recommendations for Additions/Deletions to Project Scope

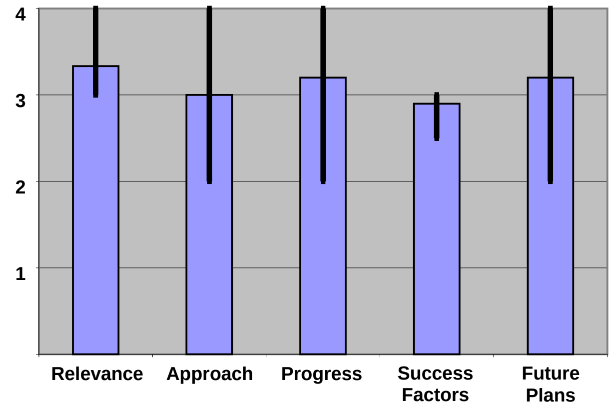
- Need to have some type of federal oversight with these federally funded, state run programs
- Need to recommend to OMB for elimination. If you have to keep it, then: see above for all.
- Attempt to position each university with a large focused group that can position themselves to be more competitive on a national basis.
- Suggest significant tightening up program focus.
- Badly need to have industries directly involved.

Project Title: Regional Biomass Programs

Principal Investigator: Rick Handley, Coalition of Northeastern Governors, Frederick Kuzel, Coalition of Great Lakes Governors

Project Stage:

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.00	1.00	1.00
Progress	3.20	1.20	0.80
Success Factors	2.90	0.40	0.10
Future Plans	3.20	1.20	0.80
Average	**3.13**		



Question 1: Relevance to Overall Objectives.

- It is a reasonable investment of money to find a way to connect biomass opportunities within a region with policy makers needing information.
- Critical need for this level of coordination, education, outreach, policy, and economic development.
- Very supportive. Funded by DOE.
- Good focus on issues
- At this time, the RBEP is tightly linked with the Biomass Program and has tried to "direct" local and state towards ethanol and lignocellulosic R&D, but the way the "each state gets a piece of the pie" approach was used, directed solicitation did not occur. The funding provided by the Program and each Region was insufficient.
- The change from R&D and demo was good but too slow. The program did not have 2-3 key objectives and goals that were tightly linked to the success of the outreach effort. Part of this problem is the inability for DOE to identify these goals that could be developed in a 1-5 year timeframe that will support the introduction of a technology towards the end of that timeframe. Obviously the highly technical side of the DOE program has a disconnect to the marketing and outreach side, but DOE failed to consider a broader vision and balance for the whole and how to benefit from the RBEP infrastructure.
- Provides effective coordinator among governmental entities and industry interest groups.

Question 2: Approach to Performing the R&D.

- Program very diffuse and needs better focus in order to address barriers effectively.
- Good "high-level" barriers assessment.
- Good national-level partners
- Communications with many state and NGO organizations.
- Prepare technical reports.
- Collect and analyze data. Outreach and analysis.
- Regional networking groups and direct technical assistance to states.
- These results are a mix, some of the projects were well tightly selected, targets, goals, metrics, results, and approaches were well designed. And some of the projects were scattergun approaches which resulted by the "state pieces of the pies" approach. The Regional programs has been very successful, and would be improved by developing a broad pool of experts, good experts, selected by DOE, NREL, ORNL, PNL, etc., (such

as 150 to 200 researchers) to bring in technical support and program review. This approach would also provide better value to DOE.

- Appears to be a good effort toward meeting goals of the project along with assisting DOE with key coordination of efforts.
- Really need to show the breakdown of just how the funds are allocated.

Question 3: Technical Accomplishments and Progress.

- The metrics evaluation and its cause/effect conclusions are poorly justified. The PIs were unable to address this issue as they felt that Antares and their method was imposed upon them.
- The impact evaluation needs to be compared to other groups that are well established in market analysis.
- Partnerships led to inclusion of biomass in state policies
- The RBEP's projects begin adding metrics in 2000 and were integrated into the state proposal or project proposals slowly and the quality of those numbers were weak. Over time these metrics improved, but a better technical group of reviewers could improve the quality of the results of the projects as well as the metrics produced. RBEP should have developed a better set of metrics for the 2-3 key directions used in their program.
- RBEP has an excellent idea of commercialization barriers, the understanding of the technical barriers is weak, but once again, a broad group of technical reviewers would be improved. Many of the RBEP projects were slow to finish. Better project management skills may be needed through training or an expert consultant.
- Appears to have accomplished goals and advanced communication among involved parties.

Question 4: Success Factors and Showstoppers.

- Critical success factors and showstoppers are not well defined. The Antares evaluation does not appear to be a valid method of evaluation, based on the information presented.
- Good, realistic assessment
- Policy can be a show stopper. As can consumer awareness.
- Few show stoppers for a very complex program
- RBEP has an excellent network of regulatory and environmental agencies, NFP organizations, and legal network. Many of these issues were employed in commercial development, demonstrations, etc.
- Good leverage of federal funding but the quantification of the leverage was not always fully quantified.
- There wasn't enough funding to be successful, and internal struggles for funding between R&D and outreach were poorly managed by DOE and damaged the program. At least $5 million for the five regions are required.
- Eliminating the program will cause 50 states to begin contacting DOE directly for anything they need.
- Work with key trade organizations for biodiesel and RBEP accelerated the progress of the industry and the favorable development of local policies for biodiesel can be directly linked to the state in with RBEP and NREL worked together with the State soybean boards and NBB. A similar focus on ethanol distribution can be shown where RBEP partnerships with Clean Cities broaden out the Clean Cities programs into biofuels and predictable expansion in biofuel sales. Program did not have specific research target goals or barriers to eliminate because their focus was too broad. Needed to refocus program into 2-3 key barriers to succeed.
- Works well with constituency to ensure barriers are addressed and identified.

Question 5: Proposed Future Research Approach and Relevance.

- The value of the program so far is unclear, but diffuse and unfocused nature of program indicates a need for more targeted future programming.
- The RBEP has planned its final funding very carefully, and they are currently trying to transition their dying program into NSEO and governor coalition groups. Details about the transition were vague.
- I like the “creating legacy” view to the future
- With some redefining, this program could be an asset to overall program goals.

***Additional Comments*:**

Strengths

- Reasonable to have activities coordinating government interest with information providers in various regions
- Proven track record of accomplishments
- Regional approach
- Independent review of program
- Good effort to try and bring in all biomass stakeholders
- Strong partnerships with different states and federal governments including universities, farmers, petroleum
- industry and consumers
- Principals hold meetings on a consistent basis
- Excellent approach to project (forums, workshops, conferences, technical reports, etc.)
- RBEP has the potential to be a powerful advocate program for the Biomass Program if the Biomass Program can direct what is needed.
- Properly directed, REBP could reduce the earmarks and the confusion of having 50 individual and uncoordinated states doing their own thing, particularly where some of these earmarks are duplicative of the outreach program.
- Has a tremendous network of contacts and stakeholders.
- Has the potential to be a leader and a catalyst for state policy makers, regulatory agencies, and economic development groups.
- Has the potential to bridge the Vision of Biomass Program (e.g., just ethanol) and convey that message to the public which has a different and much broader vision (power, gasification, biogas, biodiesel, etc.).
- Provides critical interchange of information between involved parties.
- Long history of involvement and contacts which allows a potential high level of success.

Weaknesses

- Poor articulation of project goals, and unreasonable time overrun in presentation. Unfair to other speakers.
- Low innovation in chosen activities
- Impact of chosen activities unclear despite the metrics. They’ve been involved with several projects, but the cause/effect relationship is not there. What evidence is there in the Antares report that can credibly allow credit to be given to the partnership that cannot be attributed to other factors or advocacy groups? Especially in the period described, when biomass was growing? Cause and effect is hard to justify.
- No link to OBP.
- No defined role from DOE

- No breakdown on where money was spent including cost-share information
- Not enough technical support to help manage the R&D part of the projects.
- Too much diffusion of funding to make each state happy.
- Should provide better quality metrics, differentiate short term impacts (1 year) vs longer term (5 yr)
- Did not become a leader in the regions in all cases. DOE needed stronger oversight on personnel selection.
- Should have shown budget distribution.
- Hard to determine goals.
- Mission is somewhat weak – very broad and not easy to clearly define from a reviewer perspective

Technology Transfer/Collaborations

- This is a major strength of the program.
- Excellent
- A lot of partnerships – which is good.

Recommendations for Additions/Deletions to Project Scope

- Expand the partnership by incorporating new stakeholders into program
- Need to review information on PowerPoint slides to make sure it is correct, current and easily explainable
- Need cost-share requirement from DOE and report cost-share requirements from states
- DOE has squandered its opportunity to make and deploy a powerful outreach tool for biomass feedstock, production, and distribution that could have grown federal funding for the Biomass Program.
- DOE needed to identify a HQ leader that could direct the program is a tightly integrated manner with a clear purpose, 2-3 key targets, strategies for achievement, and quantifiable measurement of metrics.
- A powerful program would have prevented the growing earmarks for similar, discrete programs for each state, or even within each state. For example, the earmark money for the IL, KY, and MS outreach funding would have been sufficient.
- Recommend placing a DOE HQ rep and a DOE lab rep – a USDA one would be good as well.

APPENDIX A

Agenda

Denver West Marriott
1717 Denver West Blvd.
Golden, CO 80401 USA
303-279-9100

Day 1 – Wednesday, August 15th

Welcome and Platform Overview		
8:30 – 8:40	Welcome	*Mark Decot, Biodiesel Technologies, Office of the Biomass Program*
8:40 – 8:50	Program Biodiesel Overview	*Bob McCormick, National Renewable Energy Laboratory*
8:50 – 9:00	Process Overview	*Leslie Pezzullo, BCS, Incorporated*

Biodiesel and Fuels Demonstration		
9:00 – 9:20	Session Overview	*Roxanne Dempsey, Golden Field Office*
9:20 – 12:00 (10:20 – 10:30 Break)	Presentations* on Biodiesel and Fuels Demonstration Projects	
	➢ Mississippi State University Sustainable Energy Center (MS)	*William D. Batchelor, Mississippi State University*
	➢ Oxydiesel Demonstration in California and Nevada	*Thomas Sopko, O2 Diesel*
	➢ E-Diesel Test and Research Project	*Nathan Fields, National Corn Growers' Association*
	➢ Missouri Biodiesel Demonstration Project (MO)	*Tom Verry and Jill Hamilton, National Biodiesel Board*
	➢ National Biofuel Energy Laboratory	*Chuck Moeser, NextEnergy*
12:00 – 1:00 Lunch		

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Associated Products, Combined Heat and Power, and Other Technologies		
1:00 – 1:20	Session Overview	*Golden Field Office*
1:20 – 1:50	Presentation* on Products ➢ Canola-based Automotive Oil R&D (PA)	*Ira Pierce, The Green Oil Company*
1:50 – 2:20	Presentation* on Combined Heat and Power Projects ➢ Phillips Biomass CHP Facility	*Carl Nelson, The Green Institute*
	2:20 – 2:30 Break	
2:30 – 3:00	Presentation* on Other Technologies ➢ EERC Center for Biomass Utilization 2005	*Dr. Bruce Folkedahl, University of North Dakota, Energy & Environmental Research Center (EERC)*
	3:00 – 4:00 Break	

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Plenary Session		
4:00 – 5:00	Day 1: Review Chair Report-out and Project Investigator Rebuttals	*Shaine Tyson, Review Chair*
5:00	Adjourn	

Day 2 – Thursday, August 16th

Anaerobic Digestion		
8:30 – 8:50	Session Overview	*Golden Field Office*
8:50 – 10:20	Presentations* of Anaerobic Digestion Projects	
	➢ Research on Anaerobic Digestion: Optimization and Scalability of Anaerobic Digestion of Mixed High Strength Food Processing Wastes for Renewable Biogas Energy	*Floyd L. Schanbacher, The Ohio State University Research Foundation*
	➢ New York Biomass/Methane Gas Power Fuel Cell Project	*Dr. Caine Finnerty, Nanodynamics, Inc.*
	➢ Ohio Solid Waste Authority Pyramid Resource Center	*Tim Berlekamp, Solid Waste Authority of Central Ohio (SWACO)*
	10:20 – 10:30 Break	

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Communications, Outreach, and Partnerships		
10:30 – 10:50	Session Overview	*Golden Field Office*
10:50 – 1:50 (11:50 – 12:50 Lunch)	Presentations* of Communications, Outreach, and Partnerships Projects	
	➢ New Uses Information and Entrepreneur Development	*C. Mark Williams, Growth Dimensions, Inc.*
	➢ Alternative Energy Enterprise Program	*Sumesh Arora, Mississippi Technology Alliance*
	➢ Kentucky Rural Energy Supply Program	*Cameron Metcalf, University of Louisville Research Foundation, Inc.*
	➢ Regional Biomass Programs: ▪ Coalition of Northeastern Governors ▪ Council of Great Lakes Governors ▪ Southeastern Biomass State & Regional Partnerships ▪ Western Governors' Association	*Rick Handley, CONEG Policy Research Center, Inc. and Frederic Kuzel, Council of Great Lakes Governors*
	2:20 – 3:15 Break	

*Each Presentation – ca. 20 minutes; Reviewer Q&A – 5 minutes; Quiet Time for Reviewer Note keeping – 5 minutes

Plenary Session		
3:15 – 4:15	Day 2: Review Chair Report-out and Project Investigator Rebuttals	*Shaine Tyson, Review Chair*
4:15	Adjourn	

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Mark Decot)
Please copy Harriet Foster (harriet.foster@ee.doe.gov)

You have been invited to serve as a Reviewer for the DOE Thermochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	**No**
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Technical Area or Project on Review Agenda	Nature of conflict of interest (Leave blank if none)

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Mark Decot (202-586-6501) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

______________________________ ______________________
Signature Date

____
Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session: 2 3 4 **Reviewer Name**: ______________________________

Title of Project: ______________________________

Presenter Name: ______________________________

Reviewer Self Assessment of Subject Knowledge (Circle One)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ______________________________

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan or the missions and objectives of USDA Programs, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments:
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach to Performing the R&D.**

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments:
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. **Technical Accomplishments and Progress**

Toward overall project and DOE or USDA goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments:
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. **Success Factors and Showstoppers**

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments:
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research Approach and Relevance** (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments:
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

U.S. Department of Energy
Office of the Biomass Program
Biochemical and Products Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Biochemical and Products Platform Review held on August 7-9, 2007 in Denver, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the biochemical and products area they were investigating (i.e. preprocessing and storage, processing and process integration). The platform review agenda is attached to this report in Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for response. Any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Amy Miranda
Biochemical Platform Technology Manager
DOE/EERE, Office of the Biomass Program

Project Title	Relevance	Approach	Progress	Success Factors	Future Plans	Average
Pretreatment and Enzymatic Hydrolysis	4.00	3.67	3.67	3.67	4.00	3.80
Biochemical Process Integration Task	4.00	3.50	3.50	4.00	4.00	3.80
Targeted Conversion Research	4.00	3.67	3.67	3.33	4.00	3.73
Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis	3.00	4.00	4.00	3.50	4.00	3.70
Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products	3.67	4.00	3.33	3.33	3.50	3.57
Biochemical Platform Analysis	3.67	3.67	3.33	3.33	3.67	3.53
Integrated Biorefinery - Separations/Separative Bioreactor - Continuous Bioconversion and Separations in Single Step	3.00	3.67	3.67	3.00	4.00	3.47
Advanced Catalyst Development for Polyols Production	3.33	3.67	3.67	3.67	3.00	3.47
Fungal Genomics	3.33	3.67	3.33	2.67	3.67	3.33
Development of Sustainable Bio-Based Products and Bioenergy in Cooperation with Midwest Consortium for Sustainable Bio-Based Products and Energy	3.00	3.50	3.00	3.00	4.00	3.30
Lab Validation for Organism Development Solicitation Recipients	3.67	3.00	3.33	2.67	3.00	3.13
Succinc Acid as a Byproduct in Corn-Based Ethanol Biorefineries	3.00	3.50	3.00	3.00	3.00	3.10
Preprocessing and Storage Systems Development/Qualification	3.67	2.67	3.00	2.33	2.67	2.87
Energy Corn Consortium	3.00	3.00	2.67	2.33	3.00	2.80
Development of Applied Membrane Technology for Processing Ethanol from Biomass	3.00	2.67	2.67	2.67	3.00	2.80
Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol	2.00	2.00	2.33	1.67	1.67	1.93
Iowa State University Biomass Energy Conversion Project	1.50	2.00	1.00	1.50	2.00	1.60

Table of Contents

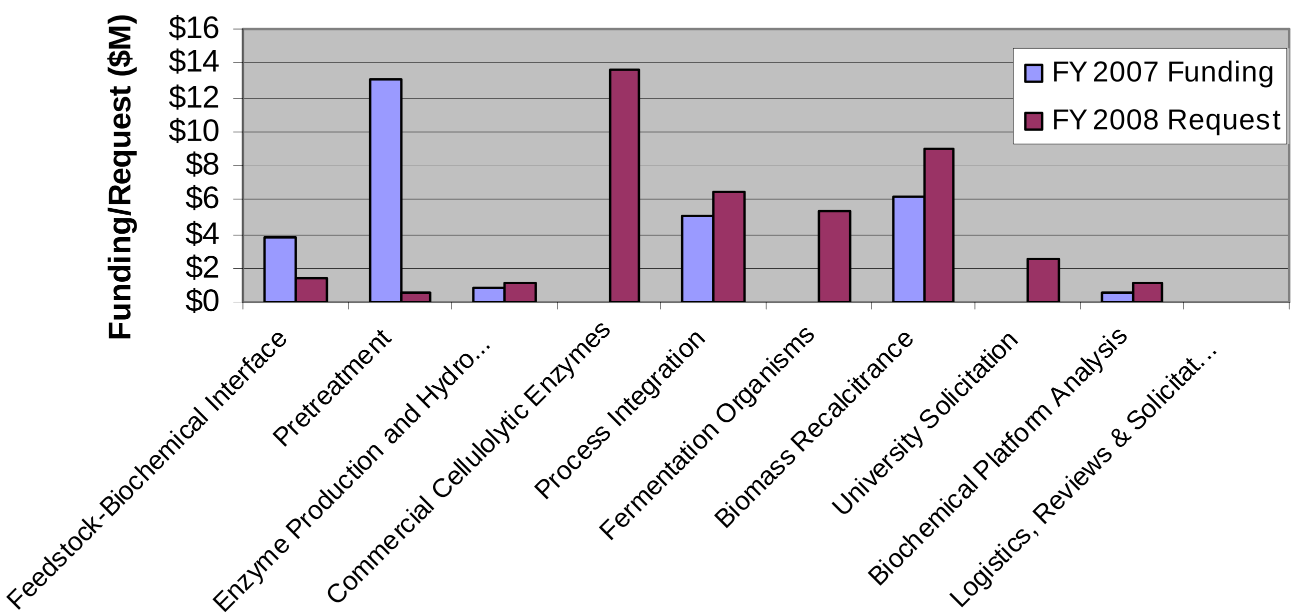
Program Peer Review Platform Results

Platform Direction

In 2008, the Biochemical Platform will continue to work with a diverse group of partners including the National Laboratories, academia and industry to achieve the progress necessary to support the Program 2012 goal. The Biochemical Platform is focusing R&D on tasks related to enzyme development and fermentation processes as well as process integration in order to reduce sugar costs. In FY2008, solicitations on fermentation organisms (ethanologens) and commercial enzyme systems will be awarded. This research is focused on ethanol as the end-product but these economically viable technologies will act as the springboard to the next generation technologies which will produce ethanol, other alternative biofuels and products from a wide range of cellulosic feedstocks.

Additionally, the Biochemical Platform is expanding its focus to consider research on a wider potential alternative feedstocks and biofuels. An additional solicitation will be released in FY2008 to increase university participation in the Biochemical Platform.

Platform Funding (in $M)[1]



[1] Please note that FY 2007 Pretreatment funding included forward funding for FY 2008 activities.

Specific Responses to Select Comments

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
While I agree that woody biomass be included in the platform's goals, such work must be limited to those feedstocks that are in sufficient abundance and logistic availability to justify their incorporation into this platform. I suspect that the thermochemical platform can more readily handle a temporally varying mix of heterogeneous woody materials.		The Biomass Program is utilizing a strategically balance portfolio of feedstocks, evaluating the promise and risk associate with various feedstocks and investing appropriately by platform. The Biochemical Platform is looking to extend its focus to additional feedstocks but plans to continue work on agricultural residues.
I have to express some disappointment that we have to revisit the enzyme development process. We have been given misleading information about the cost of enzymes in the past, and I have no reason to be any more confident in the future. The enzyme cost goals shown in the MYPP seem to be drawn from thin air.		While the Program recognizes that there is no market for the enzymes developed within our portfolio and that costs of these enzyme cocktails will be higher than our projected costs, the advances in the enzyme characteristics were sufficient to encourage ongoing research in this area and further improvements are needed to reduce enzyme production cost even further. The cost goals in the MYPP were developing using modeled data from the 2002 enzyme advancements on pure sugar streams, current work is focused on meeting that target with a more realistic hydrolyzate stream.
Focusing on switchgrass and hybrid poplar is a logical development, but a small amount of research of other feedstock species may be valuable. For example, woody biomass was mentioned by the platform review.		The Biomass Program is utilizing a strategically balance portfolio of feedstocks, evaluating the promise and risk associate with various feedstocks and investing appropriately by platform. The Biochemical Platform is looking to extend its focus to additional feedstocks but plans to continue work on agricultural residues.

Program Review Comments

Strengths

- This platform is noted for its strong progress and focus on critically important topics. The quality of much of the science and engineering is internationally recognized for its excellence.
- Integration and singularity of focus are good. The program really seems to be abiding by guiding principals.
- I appreciate this platform's understanding of its role as a government program and how it has utilized its resource to focus on technical barriers. This platform appears to be well funded. Utilization of university consortium taps a wider intellectual resource base. I am pleased to note increased interaction with USDA. I hope that a coordination relationship can be developed as well. I would recommend an early request for an audience with the new Ag Secretary (once confirmed).
- Good liaison with industry. Work on process integration. Correct focus on work required to meet platform and Program goals.

Weaknesses

- Several programs were mentioned in a negative light, indicating that better management could be warranted.

- Focusing on switchgrass and hybrid poplar is a logical development, but a small amount of research of other feedstock species may be valuable. For example, woody biomass was mentioned by the platform review.
- No major weaknesses; however, decreased emphasis on C5 fermentation to ethanol should be considered.

R&D Portfolio Gaps

- Review was of summer proceedings. It was needed to close he loop of what will be done with the assessments and if comments are taken seriously.
- I find the list of critical gaps (challenges and barriers) discussed in MYPP 3.2.1.3 to be fairly comprehensive, if not daunting.
- The platform review recommended use of pilot runs as soon as is practical. This seems to be a theme of the week and therefore deserves attention.
- No significant gaps were identified.

Additional Recommendations, Comments and Observations

- I agree with the peer review team's recommendations, in general. However, while I agree that woody biomass be included in the platform's goals, such work must be limited to those feedstocks that are in sufficient abundance and logistic availability to justify their incorporation into this platform. I suspect that the thermochemical platform can more readily handle a temporally varying mix of heterogeneous woody materials.
- I have to express some disappointment that we have to revisit the enzyme development process. We have been given misleading information about the cost of enzymes in the past, and I have no reason to be any more confident in the future. The enzyme cost goals shown in the MYPP seem to be drawn from thin air.
- A) Pretreatment and enzymatic hydrolysis program at NREL is focused to the overall objectives. A project which encompasses both esoteric and applied research aspects; therefore, finding should be of benefit to the industry while utilizing background information. As scientists and engineers within the NREL program continue to relate with those individuals with knowledge about needed outcomes, this program will flourish. B) Biochemical Process Integration Task has been designed to provide samples and relevant findings to other NREL programs as well as extramural researchers. Perhaps a bit more coordination with feedstock needs would be helpful. A critical portion of this program will be to provide state of the art instrumentation as well as data generated from the analytical objectives. C) As work continues towards converting cellulose to ethanol, the fundamental drivers in this project will be critical to future investigations. Well designed studies to assess relevance of providing clean cellulose from samples containing hemicellulose and/or lignin will be imperative to advancing cellulose conversion science. Continued extra and intra-agency discussions and joint projects will be relevant to future success.
- A higher sense of urgency on planning and operation. Ongoing evaluation of the value of CAFI work to achieving platform goals. The work is very academic and several of the pretreatment processes CAFI is studying are unlikely to ever be implemented at commercial scale.

Specific Responses to Select Comments

Platform Peer Review		
Reviewer Comment		**Technology Manager Response**
Project work would benefit from requirement that results be put into public domain		We agree. The platform will continue to publish any non-proprietary advancement and work with the project performers to facilitate communication of progress.
The Biomass Program should educate the public about its full range of technologies		The Program is in the process of updating the Program website and reinvigorating our communications plan, which will hopefully increase public awareness of the Program's focus. Additionally, the Program is expanding out outreach activities to organizations at the state, local and international level.
The economic goals and targets (example: the feedstock economic value added or subtracted to the economic goals of the biochemical platform) for the two platforms should be the same.		The Program Platforms work closely to ensure that all targets consistent and are appropriately documented and disseminated. The differences in feedstock economic value are related to the feedstock needs for both biochemical and thermochemical conversion processes.
Strengthening the interface between the platforms integrates the goals overall.		We agree. Thank you for your comment.
Biochemical platform is exclusively tied to a subset of feedstocks and isn't tied to others or all. For example, the forest products industry isn't addressed within this platform. Attention is focused on corn stover and moving toward switchgrass and completely negates any focus on woody feedstocks. There is value in looking at woody feedstocks within this platform.		Biomass Program is utilizing a strategically balance portfolio of feedstocks, evaluating the promise and risk associate with various feedstocks and investing appropriately by platform. The Biochemical Platform is looking to extend its focus to additional feedstocks but plans to continue work on agricultural residues.

General Platform Comments

- For future reviews, if you want the public to be invited, but you need the technical information, then ask all attendees to sign confidentiality forms so that technical data can be given. If not, consider a closed session so that detailed technical information can be presented allowing full utilization of evaluation by the Reviewers.
- Evaluation form contains reference to USDA goals. This is confusing to the Reviewers and it's not clear why it's on the form.
- Feedstocks present important economic factors relevant to this platform as well and the interface between the two platforms is very important. The projects in both platforms should take this into consideration – feedstock projects should include economic impacts to biochem and vice versa. Consistency in the values assigned is important.
- The economic goals and targets (example: the feedstock economic value added or subtracted to the economic goals of the biochemical platform) for the two platforms should be the same. What is encompassed in that value should be better defined as well (delivered, processed, handling, etc.). Although it's noted that the feedstock value is approached from the same economic viewpoint for both biochem platform and thermochem platform, the feedstock 'value' is different. Processing, handling, etc. can be

significantly different for biochem vs. thermochem. Set value is based on corn stover – however, this is not necessarily applicable to other feedstocks. Definition of this value is very important and can address the concerns noted. Consider looking at other industries to see how they allocate a ‘value’ to issues like this.
- Strengthening the interface between the platforms integrates the goals overall.
- Biochemical platform is exclusively tied to a subset of feedstocks and isn’t tied to others or all. For example, the forest products industry isn’t addressed within this platform. Attention is focused on corn stover and moving toward switchgrass and completely negates any focus on woody feedstocks. There is value in looking at woody feedstocks within this platform.
- The platform should align with the growth, sensitivities and issues associated with the major corn to ethanol industry, the petroleum industry and the interactions thereof.

General Comments (applicable to all presentations)

- Overall the presenters did a good job of answering review panel questions and sticking to the presentation template provided.
- Presentations needed to provide more detailed quantitative information on their goals and achievements.
- Better Performance Metrics are needed
- In many of the presentations, the titles to the presentations don’t necessarily represent what they are going to discuss. It would be so much more useful to the Reviewers if the content supported the title and vice versa. The titles can lead to expectations by the Reviewers that don’t necessarily get met within the actual presentation.

Initial Reviewer Project Feedback – Comment Summaries

Biochemical Platform Support

Project Title: Biochemical Platform Analysis
Project Investigator: Andy Aden, National Renewable Energy Laboratory

Strengths
- This is the benchmark of the expertise in the industry
- The work is the "guidepost" for the Platform R&D
  - Identifies barriers and identifies future work and tasks
- Dynamic essential tool that evaluates the state of technology
- Includes limited private advancements, excellent starting place for a model that can be customized for each individual case.
- Continue to communicate a snapshot of "where you are" towards the goals

Weaknesses
- Some of the existing and future technology advancements do not fit well in the model
- Need to develop additional complexity based on new variables
- Difficult to maintain the high quality effort with the expected turnover in industry today.

Comments
- Recognized (as it was stated) that the work should be continually evaluated for the assumptions going into the model
- Tendency for the public to misinterpretation of the goals in pilot/bench scale test will be applicable (or seen) in a full-scale plant
- Continue to incorporate environmental, socio-political factors into the model
- Continue to link with other DOE and industry working groups

PI Response
- Model is a tool – we do plan/strive to capture the future state of the art technologies

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Feedstock Interface

Project Title: Feedstock Interface
Principal Investigator: Corey Radtke, Idaho National Laboratory

Strengths
- Feedstock (type, composition and quality) and infrastructure development is vital to this industry
- Feedstock interface effort is needed to bring feedstock supplier issues into this platform
- Effort on harvesting technique vs. quality (composition, treatment, yield, etc) of feedstock is extremely valuable

Weaknesses

- This is a new project, that would benefit from more interaction with other projects in the platform
- This task should be integrated with an overall picture at the impact to the farmer (cost/acre), the environmental effort and overall availability

Comments
- The role of a cross platform integration task could be better defined.

PI Response
- The team is working with the feedstock analysis group and integrated across all of the laboratories. Some of that funding is going into sustainability efforts too.
- There is also extended interaction with USDA as well.

Biochemical Processing Core R&D

Project Title: Pretreatment and Enzymatic Hydrolysis
Principal Investigator: Rick Elander, National Renewable Energy Laboratory

Strengths
- Outstanding degree of integration with other platform projects and outside industry groups
- Good job of incorporating all the latest ideas and technologies
- Achieved goals with a high degree of relevance to industry needs
- Long-term vision - on track to achieve 2017 goals
- Been able to utilize sophisticated tools to improve understanding of the chemical processes

Weaknesses
- Lacks ability to disseminate results for use of advanced enzymes and studies
- Lack of transparency in team process

Comments
- Urge continued pressure to be able to communicate results of latest technological /enzymatic advances
- Recognize the tremendous range of activities addressed by this task

PI Response
- Stakeholders have shown interest in how well advanced enzymes operate under more rigorous conditions
- Review Team: Recognizes that and would like to see that happens

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Project Title: Novel Enzyme Products
Principal Investigator: Larry Allen, Lucigen

Strengths
- Made progress towards very specific technical goals
- Fundamental research preformed well

Weaknesses
- Not clear how success in this project would impact ethanol cost/production
- Lack of understanding of the processing area
- Technical issues with enzyme selection

Comments
- Soy isolates have not been competitive industrially and industry has been unwilling partner or showing interest.
- “Solution looking for a problem”

PI Response
- That work has been done – interest from different industry and capital groups
- Several alcohol companies are interested in the work, ethanol
- In response to the question on enzymes – we didn’t use cellulose for the testing, we used MEC for the exo substrate and AZCl-He – Cellulose (Megazyme Corporation) for the endo acting cellulases

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Project Title: Energy Corn Consortium
Principal Investigator: Michael Blaylock, Edenspace

Strengths
- Excellent group of partners
- Showing good progress
- Good strategic plan (concept to commercial application)
- Good understanding of the significant barriers

Weaknesses
- There may be a mismatch between the enzyme and the process (what value will the enzyme have after processing)
- Project would be strengthened by targeting the timing of enzyme expression during plant development to carryout plant cell wall deconstruction
- Didn’t present clear technical plan to address all the barriers identified

Comments
- More attention to the technical aspects of the screening with appropriate substrates (e.g. CBH is not active on CMC)
- Incorporating cellulases in cell wall plants ***may be*** extremely valuable

PI Response
- There are a lot of barriers that we have people working on (both within and outside of the funded effort)

Project Title: Lab Validation for Ethanologens
Principal Investigator: Kent Evans, National Renewable Energy Laboratory

Strengths
- Good oversight and credible strain validation provided by DOE

- Developing a needed benchmarking method that compares and verifies ethanologens for simultaneous conversion of C5/C6 sugars (includes stresses and inhibitors)
- Strong QA/QC plan, to incorporate lessons learned as the project matures
- Evaluation is thorough, through cap investment and operating/production costs
- Open to future developments/organisms – Not a constrained task

Weaknesses

- Inclusion on scalability testing would help assess the commercial viability of an organism
- There were no clear guidelines from DOE concerning the disclosure of results
- Validation screen method may not particularly simulate realistic proportions of sugars in hydrolyzate stream or operating conditions in a commercial facility (inclusion of acetic acid may also bias results)
- Significant challenges in comparing results in customized conditions and substrates.

Comments

- Second validation time period is too long. Twelve to fifteen months would be sufficient.
- Should be required to publish standard protocols
- Very appropriate use of national lab expertise
- Not enough attention to cost estimating for use in commercial process

PI Response

- No response given.

Project Title: Development of Applied Membrane Technology for Processing Ethanol from Biomass

Principal Investigator: Don Stookey, Compact Membrane Systems

Strengths

- Development of novel membranes to address important industry requirement for FGE (i.e., elimination of water)
- Two candidates identified with excellent characteristics (laboratory testing)
- Extensive experience with membranes, albeit not in fuel ethanol

Weaknesses

- Only lab scale so far, need flux and durability with industrial feeds
    - Realistic process streams should be incorporated, as early as possible
- May not be appreciating the complexity of the process stream
- Realistic process streams should be incorporated, as early as possible
- Incremental value to the Biomass Program

Comments

- Work plans may overlap with other projects, clarify who is paying for what work
- There are similar technologies that are commercially available today

PI Response

- CMS plans to have membrane devices in field streams during the 1st Q ’08 in collaboration with an industry player.
- CARB certification and ramp-up of our VOC product line will lead to early commercialization of a Fuel Ethanol dehydration product.

Process Integration

Project Title: Process Integration
Principal Investigator: Dan Schell, National Renewable Energy Laboratory

Strengths
- Vital importance to achieving program goals
- Works well with other platform projects to validate data from processes that are optimized in isolation
- Good interface with larger community providing feedstocks and process intermediates
- Have done very good and timely job of disseminating latest analytical methods
- Planned expansion of pilot facilities is important

Weaknesses
- Have not run a process from start to finish for any length of time
- Pilot plant and system are not flexible
- Unclear transition of activities from this project into feedstock interface
- No clear work plan presented to evaluate impact of feedstock improvements and feedstock variability

Comments
- NIR method of raw material may be a problem. Could expand efforts to make NIR method available to and validated by the community.
- More detailed information on ammonia conditioning system would have been good.

PI Response
- No response given.

Fundamentals and New Concepts

Project Title: Targeted Conversion
Principal Investigator: Mike Himmel, National Renewable Energy Laboratory

Strengths
- Strong credible fundamental program with excellent collaborations
- Established a program that is internationally recognized and therefore experts are coming to DOE as a point of contact
- Novel work that ensures new discoveries are incorporated into projects, essential for achieving long term Program goals.
- This project is developing a novel capability to explore the fundamentals of plant chemistry

Weaknesses
- Encourage to continue the fundamental work to the point that it can be handed off to the applied projects

- Focus needs to be expanded to include feedstock variability

Comments
- Impressive team that furthers understanding of underlying principles of enzyme structure function towards achieving cost effective enzyme for use in commercial applications
- Impressive animation and graphics as communication vehicles

PI Response
- We are aware of the challenge to increase integration
- The trouble is where (or what point) to take the fundamental work – how far do you push?
- Genencor package does in fact include an enzyme developed by NREL
- LOTS of interaction within the NREL groups

Project Title: Engineering Thermotolerant Biocatalysts
Principal Investigator: K.T. Shanmugam, University of Florida

Strengths
- Solid fundamental approach with promising results
- Great team, commercialization partners in place
- Successful results will optimize process integration (aligns temperatures for saccharification and fermentation steps)

Weaknesses
- Dilute ethanol solution

Comments
- Worthy of the no-cost extension
- There may be outstanding issues with public acceptance (or perception) of use of a GMO

PI Response
- No response given.

Project Title: Fungal Genomics
Principal Investigator: Scott Baker, PNNL

Strengths
- Great focus on tool kit development
- Fundamental research with a keen awareness of the final application and potential for advancement with new organisms
- Addressing important area of study (fungal morphology as it relates to productivity)
- Impressive group of partners

Weaknesses
- Too early in the R&D project to evaluate the role of filamentous fungi as ethanologens

- The fermentation strategy maybe have some serious showstoppers that we are not yet aware
    - Fungal may need aeration, which is a challenge because it can produce acetic acid bacteria – so competitive issues

Comments

- Would like to see project screen for organisms with both ethnologic and enzyme relevant activities incorporated
- Project team needs to do conceptual engineering early on (what is this organism going to need), in light of the unique metabolic requirements

PI Response

- PNNL has restructured the program and plans to do the conceptual engineering
- Aeration has been discussed within the team and we plan to determine the need for aeration in the coming months

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Chemicals and Products

Project Title: Separation/Separative Bioreactor

Principal Investigator: Seth Snyder, ANL

Strengths

- Strong committed partners
- Excellent leverage of National Laboratory strengths
- Excellent attention to process economics
- Challenging goals, to which the outcomes look promising
- Novel and relevant to chemical products with potential application in another areas
- 12 weeks of continued operation in pilot is significant

Weaknesses

- Data was not presented on relevant testing processes
- Scale-up information presented was anecdotal
- If this is going to make a large impact on the industry, then what are they going to do with the material? Do they have a market for this? Market potential was clearly presented.
- The raw material used for the pilot runs is not well defined.

Comments

- Technology has strong potential for wide application to other areas

PI Response

- No response given

Project Title: Advanced Catalyst Development for Polyols Production
Principal Investigator: John Holladay, PNNL

Strengths
- Strong collaboration with catalyst leader UOP, with extensive petroleum and wet milling processing experience
- Working with realistic bioenergy feedstocks
- Commercialization potential is high due to IP and industrial partners
- Excellent internal communication exchange and well-managed work plan

Weaknesses
- Vulnerability around carbon support

Comments
- Integrity and stability of feedstock needs to be evaluated

PI Response
- No response given.

Project Title: Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis
Principal Investigator: Rodney Williamson, Iowa Corn Promotion Board

Strengths
- Met goals and projects succeeded
- Generating valuable IP with licensing strategy in place
- Selected partners with needs in mind

Weaknesses
- Tied to corn price and production
- Economics are not proven or modeled

Comments
- Interesting slate of new polymers and materials considered
- Strong team and a lot of upside opportunity for future applications

PI Response
- No response given.

Project Title: Succinic Acid as a Byproduct in Corn-Based Ethanol Biorefineries
Principal Investigator: Susanne Kleff, Michigan Biotechnology Institute

Strengths
- On track with plan with a commercialization partner in place
- Generating potentially valuable IP with potential licensing in place
- Have demonstrated C5/C6 utilization and conversion

Weaknesses

- No end user on board yet
- Not economic for large scale use
  - $0.50/lb your target, or would it need to be even lower

Comments

- Significant additional work required for isolation of new strain

PI Response

- Have some end use testers lined up, but cannot disclose the company names
- $0.50 is based on suggestions from our initial “early adapters”

Project Title: Development of Sustainable Bio-Based Products and Bioenergy
Principal Investigator: Mike Ladisch, Purdue University

Strengths

- Strong analytical foundation within the consortium
- Valuable exploration of different enzyme systems
- Public dissemination of results
- Strong industrial ties

Weaknesses

- Unknown feed value of eDDGS
- Not exploring DDG diversity

Comments

- Results of economic modeling not shown
- DDGS – The corn leaving the market might actually lower the available grain – which would have impact on cost of DDG

PI Response

- We do have economic modeling results in a version of the presentation (was distributed for reviewer consideration)
- Projecting DDG supply/demand is a big issue that we acknowledge and are pursuing
- The team has looked into some DDG diversity and plans to have more results by the end of project in March 08.

Project Title: Biomass Energy Conversion Project
Principal Investigator: Norman K. Olson, Iowa State University

Strengths

- Interesting preliminary approach based on lab scale evidence
- Team appears to be adequate
- Process may interface well with ensiled biomass

Weaknesses

- Team does not appear to understand challenges and complexity of the objective

- Shot-gun approach may be too scattered
- No pre-assessment of economic potential

Comments
- This project is at a very early stage of R&D and it is too early to evaluate
- Similar approaches being investigated by others, this effort may be duplicative

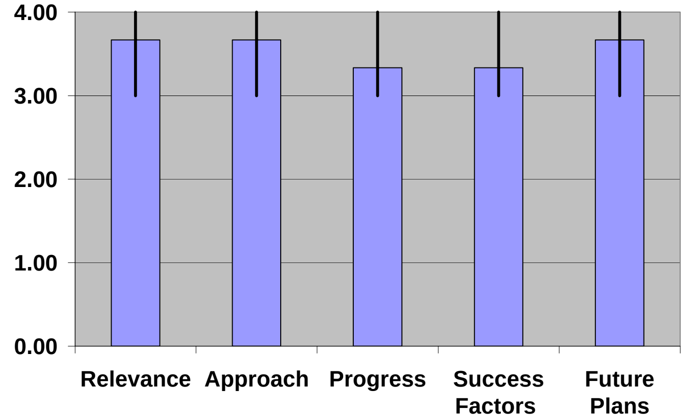
PI Response
- It is tricky, and we think there is a good shot to move forward and will serve us well in moving forward.

Full Reviewer Comments and Scores

Biochemical Platform Support

Project Title: Biochemical Platform Analysis
Principal Investigator: Andy Aden, National Renewable Energy Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	3.67	0.67	0.33
Progress	3.33	0.33	0.67
Success Factors	3.33	0.33	0.67
Future Plans	3.67	0.67	0.33
Average	**3.53**		



Question 1: Relevance to Overall Objectives.
- This project is critical for assessing progress and identifying major hurdles, prioritizing project work and integrating results across all project areas.
- This is the "mission control center" for internal and external R&D projects, tracking, synthesizing and incorporating results.
- Good overview of the ongoing biochemical platform technical program. Highly relevant but needs to be focused in light of what private sector researchers or doing as well.
- Excellent, high standard interface with all aspects of new industry benchmark expertise. One place to go for excellent data on many aspects of biomass conversion.
- Essential tool when facing so much change in so many aspects of this industry.

Question 2: Approach to Performing the R&D.
- This project focuses the work of the mission, identifies barriers and is the critical component to prioritize the tasks.
- Good approach but be careful with cost estimates of this level. Need some detailed estimating on large scale unit operations just to calibrate the factored cost estimates to real world numbers.
- Outstanding work being done in support of a diverse set of new technologies
- Feedstock effects should be evaluated at a higher level.

Question 3: Technical Accomplishments and Progress
- This is the tool to do all of the above! Progress on the overall program depends upon progress by task units. This task tracks it and insures priorities are updated.
- Obviously on track with DOE and USDA goals.
- This project is recognized world-wide as the place to go for techno-economic data in biomass conversion.

Question 4: Success Factors and Showstoppers
- Does the identifying, may not emphasize regulatory issues as well as it could.
- The effort is closely aligned with and dependant upon numerous other programs.
- Identifying key technical an business barriers for many

- Projects within the biochemical platform. Work should now extend to waste-water discharge and emissions on the downstream end and to identifying key issues / opportunities on the feedstock end.

Question 5: Proposed Future Research Approach and Relevance.

- This is the tool which signals when other tasks or the overall project can proceed to the next stage, though it may not have all the components (financial, social, and political) that may impact next stage.
- Good future plan.
- DOE should fund this project adequately to allow NREL to attract and retain quality process engineers knowing that employee turnover is likely to be high over the next 5-10 years.
- Would like to see additional complexity added to the design case to evaluate the potential impacts of feedstock variability for processes using short rotation woody crops, agricultural residues and dedicated energy crops.

Additional Comments

Strengths

- Necessary, critical to program.
- The Charrette study is especially useful in attacking barriers
- Good to keep R&D focused on capital and production cost as compared to grain and oil. May want to include the Brazilian benchmark as well since it is the low cost global producer.
- Excellent, high standard interface with all aspects of new industry benchmark expertise. One place to go for excellent data on many aspects of biomass conversion.
- Essential tool when facing so much change in so many aspects of this industry.

Weaknesses

- Hard to find any weakness.
- Pro activity not apparent in presentation. Needs to anticipate hurdles as barriers are deal with by task units.
- Need some private participation from industrial partners/ engineering groups.
- May not get critical feedback from industry due to concerns with proprietary technology protection. Be careful with using the RMI charrette type programs. They can be useful but some ideas can be very distracting if not properly filtered.
- Capital cost comparison with corn plants can be dangerous since these numbers of highly variable and may not include the full project scope. Also, recent escalation in steel pricing results in high maintenance effort to keep cost information current.
- There is a lot of work ahead. Is this project adequately staffed and funded to attract and retain the expertise required to maintain the high DOE/NREL standards?
- Model needs additional complexity in some areas e.g. assessing the potential impact of feedstock choices and feedstock variability.

Technology Transfer/Collaborations

- Part of the input is from external sources as relevant.
- Outstanding web-based information
- Essential support for 10% scale up projects.

Recommendations for Additions/Deletions to Project Scope

- Can socio-political issues be incorporated into such a model?
- May want to provide a high level view of the potential impact of implementing technologies not included in the model. Such as, other hemicellulose hydrolysis options, other cellulose hydrolysis and fermentation strategies. This may allow commercial technology developers to better assess the economics of their research. Benchmark against other technologies options, including some EU groups.
- Make sure that this project has adequate resources for required scope changes as industry requests quality data on new and complex processes not addressed in the design case.

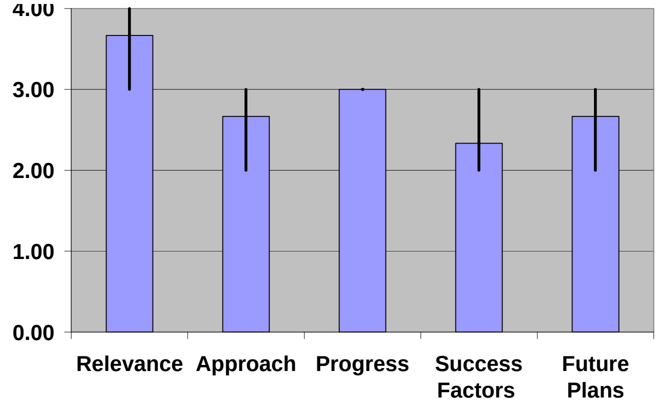
PI Response to Reviewer Comments

No comments were provided by the PI

Feedstock-Biochemical Conversion Interface

Project Title: Preprocessing and Storage Systems Development/Qualification
Principal Investigator: Corey Radtke, Idaho National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	2.67	0.67	0.33
Progress	3.00	0.00	0.00
Success Factors	2.33	0.33	0.67
Future Plans	2.67	0.67	0.33
Average	**2.87**		



Question 1: Relevance to Overall Objectives.
- Important information which may have a profound effect on our view of biomass availability
- Valuable information for private sector researchers.
- Highly relevant interface with feedstock platform. This connection must be made for successful biorefineries. Working in isolation without communication is never good.

Question 2: Approach to Performing the R&D.
- Strongly interrelated with the ability to pretreat biomass, and will certainly affect the economics of pretreatment-raw material cost.
- They don't indicate partnering or counseling with John Deere or other equipment manufacturer, but they should draw them in early to so that results can be used to design collection.
- The work is mostly qualitative. The research is well planned providing solid information of future commercial value.
- The project plan looks too much like a feedstock project within the biochemical platform. This project should focus on integration activities, e.g. ensuring that the biochemical projects are working with the best feedstocks produced by the feedstock platform, ensuring that the feedstock platform projects have access to the latest analytical methods, continuing the feedstock variability studies and providing data and samples to the biochemical platform for assessment of the impact of variability on downstream biochemical processes

Question 3: Technical Accomplishments and Progress
- Significant progress made since project inception. Need more progress and even more rapidly to incorporate into model.
- The results of this effort will be measured by performance improvements in others research areas.
- New project, but the stover cut height study was very valuable and interesting. Samples now need to be provided and processed by the BC platform

Question 4: Success Factors and Showstoppers
- Should include equipment manufacturer in program early.

- Likely need more ag economic content. Feedback from farming community could contain showstoppers.
- New project. There is a lot of work to do here in identifying integration barriers and addressing them in a clear workplan

Question 5: Proposed Future Research Approach and Relevance.

- They have a good plan, and progress has been made, but they need to integrate their findings with equipment development and environmental (and regional availability) studies.
- Need more specifics on future data.
- Workplan needs to focus more on integration tasks. It should not be the feedstock research in the BC platform.

Additional Comments

Strengths

- Good plan well integrated with pretreatment area.
- Uncovering new critical issues, may profoundly change thinking on harvesting, storing and transporting residue.
- Cooperative effort among labs
- Information on harvest techniques and plant morphology versus processing ease and yield is very good information
- Need more of this type of data on other feedstocks
- Well aware of feedstock platform and issues for feedstock suppliers
- Interesting and valuable results reported

Weaknesses

- Need to include equipment manufacturer early
- Need to compress time table for this critical issue
- Need more input on the farmer perspective. Should include overall crop economics in the case of cereal grain/straw and corn/ stover applications. i.e., what is the impact on the farmer's gross and net income per acre? The SE US needs to be included.
- New project. Integration with biochemical platform could improve. The role of this project should be better defined.
- Project activities should align more closely with program goals and more specifically address barriers.

Technology Transfer/Collaborations

- Close coordination with pretreatment and availability studies indicated, which is good. This is extremely important to program.
- Needs more ASDA and regional state AG participation.
- Could improve – the role of this project as an integration tasks should be better defined.

Recommendations for Additions/Deletions to Project Scope

- Recommend that they ramp-up the program and condense the timetable. These data are too important to the program stretch out the program as indicated.
- Expand harvest techniques & plant morphology vs. processing ease and yield is very good information. More focus should be placed on this but with consideration of other treatment techniques.

- This project should compliment, not replicate work being done in the feedstock platform. Workplan should focus on ensuring that the latest information, materials and techno-economics are available to both platforms.

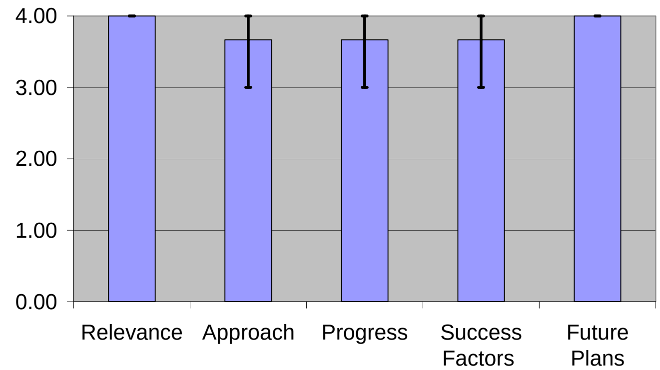
PI Response to Reviewer Comments

No comments were provided by the PI

Project Title: Pretreatment and Enzymatic Hydrolysis

Principal Investigator: Rick Elander, National Renewable Energy Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.67	0.67	0.33
Future Plans	4.00	0.00	0.00
Average	**3.80**		



Question 1: Relevance to Overall Objectives.

- Project is core to the overall program
- Extremely valuable work especially the analytical side.
- This project deserves the highest rating. It is right on track in its research portfolio. It is serving industry needs with an outstanding combination of fundamental and applied tasks. Impressive list of partnerships
- The project is clearly aligned with both short and long-term program goals and is ahead of the game in its preparation for long term goals and the future needs of this industry. Already working to meet 2017 goals.
- Also outstanding is the degree to which this project is integrated with other aspects of the Biomass Program.
- CAFI support was downplayed, but deserves much credit. The coordinating efforts provided to CAFI by this project are essential for its success.

Question 2: Approach to Performing the R&D.

- Good job of identifying barriers. One barrier not stated is inability to disclose certain data from enzyme companies
- May need to look into possibility of scaling down pilot and commercial unit operations to bench scale. In some areas the correlation between batch and continuous process may be problematic.
- Excellent focus on integration with other platform tasks.
  - Using the unique tolls available at NREL
  - Using BSC facility tools to guide research
  - Using analytical pyrolysis tools as a screening tool and to investigate the chemistry of recalcitrance
- This task is clearly up to date and flexible. The newest ideas and techniques are incorporated into the research plans.
  - Screening with advanced enzymes
  - Screening with cellulases and hemicellulases.
  - High solids pretreatment
  - Low severity pretreatment
  - High solids saccharification /rheology

Question 3: Technical Accomplishments and Progress

- Very good progress toward DOE goals, and good communication of results, except as noted above.
- Good yardsticks for determining progress.
- Impressive accomplishments covering many, diverse aspects of pretreatment in the Biorefinery.
- Multiclave screening at low solids loading to screen for feedstock variability.
- High solids pretreatment optimization.
- High solids saccharification work planned.
- Testing advanced enzyme systems.
- Excellent integration at all levels.
- Positioning project well for feed forward and feed backwards integration.
- Working closely with fundamental science projects to ID structure of oligomers and to verify nature of recalcitrance.

Question 4: Success Factors and Showstoppers

- Need more interface with structural and fermentation researchers.
- On track to meet goals. Providing innovative solutions. Addressing industry needs.

Question 5: Proposed Future Research Approach and Relevance.

- Progress is good and they have made it transparent, except for position of enzyme suppliers, which may be beyond their control
- Ambitious but comprehensive plan to meet short and long-range goals.

Additional Comments

Strengths

- Good plan, critical component of overall program
- Good interaction with other projects and external developments
- Barriers well identified and targets to overcome are spelled out.
- Sound research on fundamental problems.
- Outstanding degree of integration with other aspects of the platform
- Incorporating all of the newest ideas and technologies.
    - High solids PT and saccharification
    - Advanced enzymes
- Keeping relevant and aware of industry needs.
- Interacting well with community as evidenced by numerous partnerships and subcontracts. Providing essential support to the CAFI efforts.
- Clear vision and long-term plan for meeting industry needs.
- Well aligned with program, both short-term and long-term program goals
- Excellent balance of fundamental research and applied science.
- Leveraging unique capabilities at NREL, many types of PT reactors, BSCL and MBMS

Weaknesses

- Would like to see their timetable compressed more sense of urgency.
- An effort needs to be made to develop bench scale systems that better mimic larger scale continuous commercial processes.

- Need some work on non-acid hydrolysis pretreatment strategies to keep alternate options open.

- Extremely diverse set of tasks and activities. May need additional resources

Technology Transfer/Collaborations

- Must cut across all boundaries to be successful, they appear to be striving to do that.
- Could use more private sector participation.
- Keeping relevant and aware of industry needs.
- Interacting well with community as evidenced by numerous partnerships and subcontracts.
- Providing essential support to the CAFI efforts.

Recommendations for Additions/Deletions to Project Scope

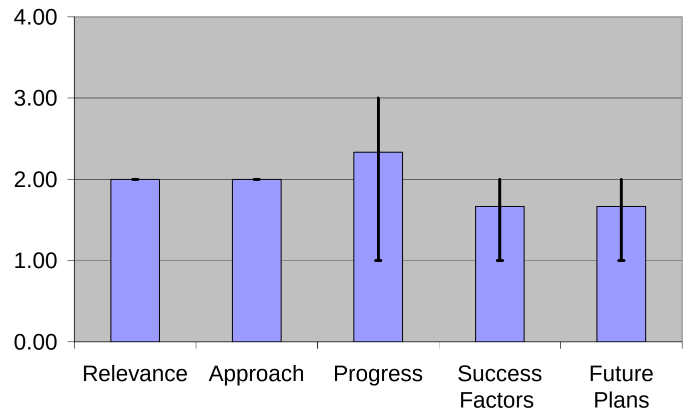
- There seems to be too broad a subject for presentation to reviewers. The section needs to be broken into multiple sections with more detail.

PI Response to Reviewer Comments

No comments were provided by the PI

Project Title: Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol
Principal Investigator: Larry Allen, Lucigen Corporation

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.00	0.00	0.00
Approach	2.00	0.00	0.00
Progress	2.33	1.33	0.67
Success Factors	1.67	0.67	0.33
Future Plans	1.67	0.67	0.33
Average	**1.93**		



Question 1: Relevance to Overall Objectives.
- This is generous rating. Perhaps developing enzymes to hydrolyze stachyose has a place in the program , but it appears to aimed at producing a soy isolate, and by the way, a small amount of ethanol
- Have not done a thorough job of assessing market potential or private sector interest. More details on the economic claims need to be provided.
- Not clear how this work could have a significant impact on
- Renewable fuels production.
- No commercial partners

Question 2: Approach to Performing the R&D.
- Should be funded by NSF as it is fundamental research with no clear relevance.
- Minimal data beyond genetic engineering was provided.   Too early in the development effort to determine.
- Technical weaknesses in enzyme selection, e.g. Why focus on xylanases when hemicellulose is galactan?

Question 3: Technical Accomplishments and Progress
- They have accomplished their first steps. Haven't shown how this can be relevant to program however, the reviewer was not qualified to judge the significant of the enzyme development effort but it appears that this is an isolated organism/ enzyme in search of a process instead of the opposite more conventional strategy.
- No data on economics.
- Compositional information on the feedstock (soybean meal) seems to be poorly understood.
- Progressing with workplan

Question 4: Success Factors and Showstoppers
- Too early to comment
- Very limited reference to success factors and showstoppers
- No plan presented to connect this project to liquid fuels production. Technical barriers not clearly defined.

Question 5: Proposed Future Research Approach and Relevance.

- They seem to have done some good research, but need to show relevance, more than the vague assertions so far
- There doesn't appear to be a strong plan towards future process/ technology development and commercialization.
- Workplan should be revised to connect this project to liquid fuels production. Technical barriers to this goal should be clearly defined and addressed.

Additional Comments

Strengths

- Good team to perform the genetic engineering planned.
- Isolation of new, potential valuable enzymes.
- Progress being made toward specific technical goals.

Weaknesses

- A conceptually engineered process estimating cost of process and overall economics within identified assumptions would guide this project to determine whether it is worthwhile.
- An industrial partner who has some interest would be helpful. (Presenter later, in later conversation indicated that they did have such interest, but is only anecdotal.)
- A more critical look at "what if successful" with an industrial partner would be very helpful (with a definition of "success.")
- Soy isolates have been around for a long time, and the small amount of alcohol produced in conjunction is interesting but not very exciting.
- There appears to be a poor understanding of the soy industry and potential impact of this concept. Significant work will be needed on pretreatment strategies, etc.
- Very long shot of commercial success.
- Not clear how success can be measured in terms of ethanol production
- Technical weaknesses in enzyme selections
- Could improve on understanding of the role of this project in OBP goals.

Technology Transfer/Collaborations

- Minimal beyond the molecular biology. Should have had a soy processor on board.

Recommendations for Additions/Deletions to Project Scope

- Recommend that project funding be very closely controlled and that other activities be limited until enzymology has been thoroughly demonstrated.
- Start working with a more relevant slate of enzymes.

PI Response to Reviewer Comments

A major problem with the reviews appears to be the mistaken assumption that this project is on the Commercialization, rather than the Exploratory & Development Research track. The presentation and documents supplied to the reviewers explained that the work was to determine the feasibility of converting soy carbohydrates into a feedstock for producing ethanol and, if feasible, developing an enzyme product capable of this conversion. There are currently no commercial industrial enzyme products for converting soy carbohydrate to fermentable sugars, so it is not just a matter of optimizing current products to determine the economic viability. Soy contains no starch or xylose based hemicellulose, making all current industrial enzyme products useless for the conversion. The galactose-based polymers of soy will require the discovery, cloning and expression of new enzymes to convert the soy carbohydrate to fermentable sugars.

Once the enzymes are in hand, fermentation of sugars to ethanol will be performed and the compositional quality of the residual protein will be determined.

Responses in order of the Weakness given on the previous page:

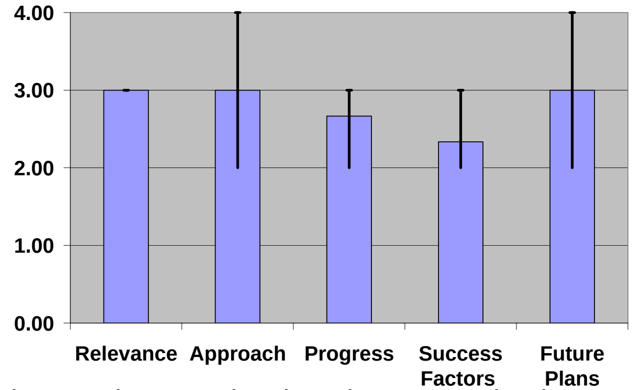
- An economic analysis was performed using the base case of a dry mill ethanol plant, no pretreatment of the soybean meal, 5% to 7% final ethanol, and $0.25 to $0.30/lb of soy protein. This resulted in ethanol production costs of <$1.00/gallon. Depending on the quality of the soy protein produced, values of and $0.65 to $1.00/lb of soy protein can be obtained; this would effectively make the production cost of the ethanol <$0.50/gallon. These costs make ethanol from soy the lowest cost source of bioethanol.
- Confidential discussions are continuing with two major soy crushers; both are extremely interested in the technology if feasibility is demonstrated. Because of the confidential nature of the discussion, we were not then, and still are not, at liberty to comment further.
- The reviewers appear to have little understanding of the soy industry. The processes for preparation of soy isolates are both capital and energy intensive processes resulting in products that sell for >$1.00/lb. An outline of the research and goals of the project were presented at The First Soy Protein Technical Advisory Panel of the United Soybean Board on Feb, 12, 2007 to major soy crushers, soy isolate producers, and isolate users. The talk was well received, and all attendees felt the work was very exciting and, if successful, this work would have a major influence on the future of the soy protein business. This presentation resulted in initiation of discussions with one of our two potential industrial partners.
- The lack of lignin and altered hemicellulose structure in the soybean meal suggest that traditional pretreatment, a major cost center for most cellulosic ethanol processes, would be unnecessary and useless. Preliminary results with thermostable cellulase confirm that pretreatment may be unnecessary.
- C5-6, with support from the state of Wisconsin commissioned a study on the current and potential markets for high protein soy isolates by Dr. R. Fortenberry, a noted agricultural economist at the U. of Wisconsin; the study was underway at the time of the presentation. Dr. R. Fortenberry has completed the study and identified a number of current and potential large markets for the highly concentrated soy isolates produced as a byproduct of ethanol production.
- Based on discussions with venture capital and angel investors, soy crushers and biodiesel producers, the soy conversion to ethanol has a much stronger shot at commercial success than most cellulosic processes due to the predictable cost and availability of feedstock and the strong byproduct value for the protein, both lacking in proposed cellulosic processes.
- Ethanol fermentations will be conducted using enzyme-treated and untreated soybean meal to determine the fermentability of carbohydrates. The goal of this work is to develop a mixture of enzymes capable of converting >80% of the soy carbohydrate into sugars fermentable by yeast.
- The reviewers appear to have not been paying attention. The presentation clearly stated that the xylanase cloning was done to validate the host-vector system for the cloning and expression of the enzymes, a milestone agreed to by the DOE. Never was it stated that the cloned and expressed xylanase was for use in soy hydrolysis. Enzymes to degrade soy carbohydrates are not commercially available, and must be individually discovered, identified, cloned and expressed. The presentation showed clear progress in identification and capture of thermostable bacterial cellulases, beta-glucosidases, and alpha-galactosidases, all enzymes absolutely required for soy hydrolysis.

- This work clearly falls within the goals of the OBP. In 2000, 2.5 billion bushels of soybeans were produced in the U.S., of which 1.6 billion were crushed for oil. This 1.6 billion bushels of crushed soybeans yielded 70.4 billion lb of soybean meal, containing approximately 30 billion lb of carbohydrate. Currently, soybean meal is sold as a protein source for animal feed; the carbohydrate portion of the meal has no commercial value. Assuming 90% efficiency in conversion to alcohol, the soluble and insoluble carbohydrates could yield as much as 2 billion gallons of additional ethanol. Besides creating a new source of bioethanol, the enzymes discovered here will have significant value in improving the economics of conversion of cellulosic biomass to ethanol.

Project Title: Energy Corn Consortium

Principal Investigator: Michael Blaylock, Edenspace Systems Corporation

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	0.00	0.00
Approach	3.00	1.00	1.00
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	3.00	1.00	1.00
Average	**2.80**		



Question 1: Relevance to Overall Objectives.

- Interesting approach, in early stage of research. May be more barriers than recognized. Results may be important to overall program, but in different way than planned!
- Concept could be making a strong contribution to the biofuels effort.
- Potential improvement to biomass conversion processes, but not essential to their success
- Good partnerships in place.

Question 2: Approach to Performing the R&D.

- Good experienced folks working on project and the program is well designed to address issues.
- Have a good strategy for developing and testing the technology.
- Some technical questions about the screening of enzymes with relevant substrates.
- It is important that this project address the timing of enzyme production in the plant lifecycle.
- These enzymes must survive senescence as well as pretreatment.
- Assumptions are being made that viable , low severity pretreatment technologies will be developed

Question 3: Technical Accomplishments and Progress

- Project has an impressive milestone chart with time tables.
- Good progress was reported
- This will be difficult to accomplish until significant progress has been made.
- Progress shown in tobacco

Question 4: Success Factors and Showstoppers

- They appear to have a good handle on issues and how to deal with them
- No technical show stoppers were provided.
- Assumptions are being made that viable , low severity pretreatment technologies will be developed
- Other significant regulatory barriers lie ahead without clear plans presented to address them.

Question 5: Proposed Future Research Approach and Relevance.

- Aggressive timetable and good work plan
- Workplan should show clear plan to address known barriers

Additional Comments

Strengths

- Novel approach, may have ramifications on Himmel's project even if not successful
- Fits well with overall program approach.
- Good solid team which includes commercialization experience
- Raised venture capital for the approach
- Sound research plan.
- Understands significance and challenges of this work.
- Excellent group of partners

Weaknesses

- May have more issues to deal with than they let on.
- Need to develop protocols for measuring the benefits of the technology.
- Significant barriers to overcome
- Not clear how all barriers will be approached.

Technology Transfer/Collaborations

- If they are successful, the results may be more significant than just having enzymes in the raw material. It may verify of augment Himmel's theory on cellulose recalcitrance by imbedding enzyme in cell wall regions which are difficult to reach with external cellulases
- Could use stronger partners. Current group has limited biomass experience.
- Impressive group of partners in place

Recommendations for Additions/Deletions to Project Scope

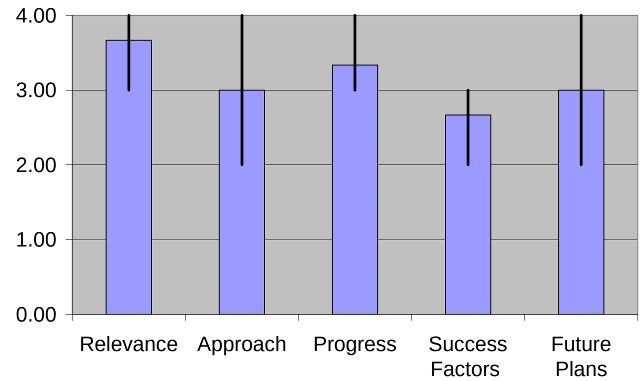
- Mike Himmel should work closely with them to have early access to cellular material with embedded enzyme
- Need to look at application into faster growing plants to test the impact of imbedded enzymes.

PI Response to Reviewer Comments

No comments were provided by the PI

Project Title: Lab Validation for Organism Development Solicitation Recipients
Principal Investigator: Kent Evans, National Renewable Energy Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	3.00	1.00	1.00
Progress	3.33	0.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**3.13**		



Question 1: Relevance to Overall Objectives.
- This could be the singularly most important project in the platform program for the present stage of development. A robust ethanologen could spell the success or failure of the upcoming demo plants.
- Good applicability. Will help with the development and benchmarking of new and existing organisms.
- Impartial comparison of available strains is clearly useful information, needed to guide feedstock selection in pilot scale facilities and beyond.
- Appropriate use of National lab expertise

Question 2: Approach to Performing the R&D.
- The validation and oversight, which is the focus of this program, is critical.
- Sound approach. More attention needs to be placed on costing. Budget seems too low for a though job on later phases of the task.
- Well thought out QA/QC plan with flexibility for as-needed improvements
- Project should be required to publish standard protocols
- The concept of an over-site / validation projects is new and may offer many lessons-learned for efforts of this type in the future.
- Adequate access to process engineering to guide these complex evaluations.

Question 3: Technical Accomplishments and Progress
- Doesn't fit this evaluation. Team is overseeing the development of organisms, mostly by industrial entities.
- Accomplishments are out of program manager's control, except to ensure that contractors are doing what they said they'd do.
- n\a program just starting. Good planning effort.
- Slow start, but acceptable early progress. Good plan

Question 4: Success Factors and Showstoppers
- Overcoming big technical hurdle.
- Researchers have to deliver
- Presented success factors not realistic. This program will not confirm commercial readiness of this industry or significantly reduce risk.
- Significant challenges lie ahead in comparing results in their chosen conditions with their substrates. This may be a highly controversial effort.

Question 5: Proposed Future Research Approach and Relevance.

- Program is ready to go
- Limited contingency planning.
- Good initial plan, but flexibility will be essential to incorporate
- Lessons learned and offer fair and equivalent comparisons

Additional Comments

Strengths
- On sight validations well thought out.
- Oversight plan good, retains good control over purse strings.
- Good standardization of review.
- Needed effort.
- Strong QA/QC plan for objective analysis of all strains, with flexibility to include lessons-learned.
- Access to process engineering task, essential for economic evaluations
- Willingness to take "poison pill"
- Relevant and needed by industry to guide process selections.
- Strong QA/QC plan with flexibility to include lessons learned.
- Goes all of the way through to evaluate impact on capital and investment impacts

Weaknesses
- Robustness criteria may be somewhat lacking, but four of the five recipients are industrial entities that have experience with commercializing such processes and should know what they need.
- 18-22 months to second validation is too long. Recommend 12-15 months
- More focus on the costing strategy. There is a sound strategy for benchmarking the organism but not the capital or operating cost efforts.
- No clear guidelines from DOE concerning disclosure of results
- Significant challenges in comparing results in their chosen conditions with their substrates.

Technology Transfer/Collaborations
- Goes without saying, ethanologens are critical to program.
- Information like that which will be generated in these projects is needed to guide feedstock selection in pilot scale facilities and beyond.
- Standard methods for strain evaluation should be published a kept available for the inclusion of new strains and organisms.

Recommendations for Additions/Deletions to Project Scope
- Spend more time on costing effort to ensure that cost comparisons are valid.
- Public disclosure of methods used for evaluation. Publication through ASTM as industry standard.

PI Response to Reviewer Comments

1. Robustness criteria may be somewhat lacking, but four of the five recipients are industrial entities that have experience with commercializing such processes and should know what they need.

Response: It is true that we are unable to broaden the robustness beyond the inhibitory compounds generally identified in pretreated biomass. Robustness could certainly expand to areas of scale-up, process variations, substrate variations, etc... DOE established this funding opportunity to address the development of ethanologens that meet the basic characteristics.

1. High yield and full sugar utilization with minimal byproduct formation
2. High final ethanol titer
3. High overall volumetric productivity
4. Tolerance to inhibitors present in hydrolyzates
5. Low cost fermentation process

This solicitation was directed to groups that have organisms under development and are near pilot demonstration (Topic 2) or groups that have identified organisms that could meet the above criteria with further development (Topic 1). Topic 2 projects require the organism to be tested in actual biomass developed by the Recipient's process, while Topic 1 projects are not required to ferment hydrolysate but need to demonstrate that the organism can tolerate inhibitory compounds generally found in pretreated biomass. We determined that acetic acid is one compound that is found in many types of pretreatment processes and severity conditions. The inclusion of furans and phenolics are less defined due to the variability of the chosen feedstock and the individual processes to create a fermentable sugar stream.

The topic 2 projects will need to demonstrate the robustness of their organism in fermentations of specified biomass as it applies to the specific process proposed by the contractor. This process will need to be commercially relevant confirmed by the validation of supporting process economic data.

2. 18 – 22 months to second validation is too long. Recommend 12 – 15 months.

Response: DOE/GO established a 6 – 8 month go/no go decision in the validation plan that does not require a site visit but it does require each project to set performance targets by which DOE will determine whether the research is following the established schedules and objectives. Since the performance targets are based solely on fermentation improvements, we felt it was necessary to provide adequate time to perform genetic research which can be a time intensive process (gene identification, construction, transformation, selecting isolates, testing expression, etc.). Twelve months did not seem adequate to allow the projects to select an isolate and perform preliminary testing in fermentations prior to conducting the pre-Stage Gate validation and successfully meeting the proposed target performance. Additionally, each project is required to establish and follow very specific milestones throughout the project and each milestone has performance metrics that are as quantifiable and specific as possible. The progress against the milestones is reported on each quarter by the PI, so any issues with validation should be flagged early by the PI allowing for mid-course corrections.

3. More focus on costing strategy. There is a sound strategy for benchmarking the organism but not the capital or operating cost efforts.

Response: "Perhaps it did not come across as clearly as desired, but there is a sound strategy for benchmarking both the organism and the process economics, ensuring consistency between the two. From the very start, DOE made it clear that these organisms were to be commercially viable, which meant demonstrating positive economics. A very important part of each proposal was filling out all benchmarking data, both for the organism (Table A) as well as the economics for the process that would use the organism (Table C). Capital and operating costs are broken out into significant detail as part of this table.

The primary purpose for engineers on the Validation Team during each benchmarking auditing visit is to understand a clear basis for where those economics come from. If they were derived from the Aden, et. al 2002 report, awardees are required to describe in detail how their process differs from the Aden, et. al. process. If their process is a large departure from Aden, et. al. or is a much different process, awardees are required to show material and energy balance data that provides the basis for their costs. A second key part of the economics strategy and auditing visit is to understand exactly how the strain improvements over the 36 month period translate into economic improvements. If there are discrepancies, NREL engineers will catch these during the auditing process.

4. No clear guidelines from DOE concerning disclosure of results.

Response: We fully agree that there was no specific language in the FOA that required the groups to provide information for public dissemination. Due to the commercialization requirements and IP and confidentiality related issues, DOE chose not to require disclosure information in addition to those already in place. The applicants are required to prepare a final technical report that contains meaningful, but non-proprietary information. DOE will on a case-by-case basis, continue to make determinations regarding requiring additional disclosure of results. An example of additional disclosure requirements in a recent Funding Opportunity Announcements may be found in the FOA entitled “Development of Saccharifying Enzymes for Commercial Use” which was announced in August 2007. The document includes the following section;

Dissemination of Research Results on Model Systems

Following selection and at the first audit, each successful and awarded applicant will be required to evaluate their enzyme system on a benchmark lignocellulosic feedstock prepared by NREL. Standard conditions will be established in an audit and validation plan that will be made available to any selected applicant prior to finalizing the award. The evaluation will be done either at the applicant’s site by personnel from NREL or at NREL. The determination of site will be made during negotiation of award. The data from these specific evaluations will be reproduced without attribution of applicant in an NREL Technical Report that will be available to the public.

No reference to enzyme type, source, or system description will be published, but comparative data regarding the performance of the enzyme or enzyme systems on the benchmark feedstock will be documented in the Technical Report.

5. Significant challenges in comparing results in their chosen conditions with their substrates.

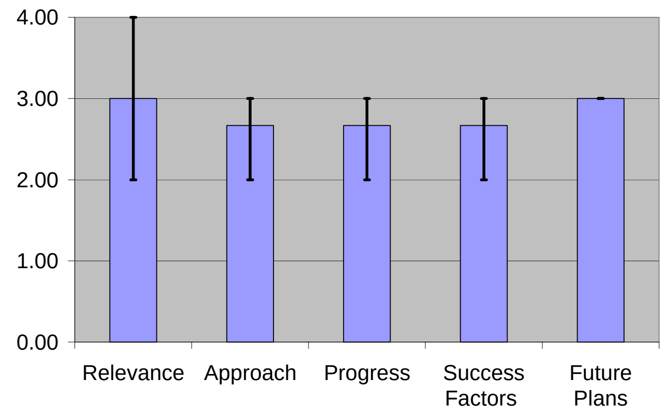
Response: For Topic 2 projects, the researcher is required to perform the benchmark fermentation using the pretreated feedstock described in their process design. The benchmark is conducted at the beginning of the project to show the deficiencies of the organism by low fermentation yields, inability to utilize all sugars, or the need to dilute the feedstock to overcome inhibition by substrate toxicity or ethanol titer. The proposed research objectives should relate to the demonstrated fermentation deficiency and improvements to the organism should be reflected in the performance targets stated at the pre-Stage Gate and Final validation audit. In the event that the substrate or fermentation conditions change over the course of this project, the researchers will be required to conduct the modified benchmark with the starting organism and the improved strain to verify that the performance targets are achieved solely on the improvements to the strain.

Specific strain improvements will also be validated by performing the series of pure sugar fermentations described in the validation plan throughout the project; #1 – 5 sugar fermentation to show sugar utilization capability, #2 – 5 sugar fermentation with acetic acid to show tolerance to known inhibitors, and #3 – elevated fermentable sugar with acetic acid to show ethanol titer in the presence of inhibitors.

The final performance target in the benchmark fermentation must be met to achieve the economic targets that are described in detail for the entire process. The process economics will be validated along with the technical performance of each group throughout the project. All cost improvements must be related to the improvement of the organism and not through other unit operations such as the inclusion of a detoxification process.

Project Title: Development of Applied Membrane Technology for Processing Ethanol from Biomass
Principal Investigator: Don Stookey, Compact Membrane Systems

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	1.00
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.67	0.67	0.33
Future Plans	3.00	0.00	0.00
Average	**2.80**		



Question 1: Relevance to Overall Objectives.
- Aims at lowering the investment and operating cost of FGE dewatering
- Not specifically related to biomass. Only incremental benefits to the overall program, if any, if successful.
- De-watering technologies will be needed for the production of FGE.

Question 2: Approach to Performing the R&D.
- The technical barrier addressed is not that much of a hurdle.
- They are applying their technology from a different application to FGE dewatering, which, if successful, can lower the operating cost and investment of this process step. It does not appear to be a significant improvement over present technology, but may have some interesting ramifications in other areas within the program
- This appears to be a product development effort as opposed to an R&D program.
- Actual process samples may present a significant challenge
- Weak understanding of biomass conversion process and challenges to process separations.
- This is not a simple water/ethanol separation. No clear plan was presented to incorporate other process stream components into tests and screens.
- Workplan may overlap with those of other projects. Care should be taken to avoid duplication of efforts.

Question 3: Technical Accomplishments and Progress
- This is more of an applications development project, and they appear to be on track
- Don't see how this relates to biochemical platform.
- Performance indicators are really the competition.
- Early progress good. Potential candidates identified with relevant characteristics.

Question 4: Success Factors and Showstoppers
- Appear to be ready to proceed with a commercial product
- Have to overcome current technology providers already offering commercial membrane dehydration systems (Mistui White Fox).
- Actual process streams will be very different from simple ethanol/ water mixtures. Realistic substrates should be incorporated in screening at earliest possible point.

Question 5: Proposed Future Research Approach and Relevance.

- Appear ready to test at large scale, though it isn't clear where.
- Savings may not be enough to interest industry
- Plans for commercialization appear to be reasonably well understood.
- Waiting for data on 25 different materials that they have identified for further testing.

Additional Comments

Strengths
- Two candidates identified with excellent characteristics in laboratory tests.
- Manufacturing arrangements have been put in place for large scale production.
- Company has had extensive experience, though not in fuel ethanol
- Candidate materials show excellent permeation at low water levels, necessary for dewatering FGE.
- May have broader applications than just FGE
- The fluorinated polymers offer superior operating life vs. other membrane systems.
- Necessary technology for production of FGE
- Partnership in place to provide realistic substrates for testing.

Weaknesses
- Only lab scale so far, need flux stability, durability with real materials.
- Operating cost savings are not that significant, though dewatering investment savings may be if full scale testing confirms lab results.
- "Significant" energy savings not substantiated in presentation, should be able to equate to $/gal savings
- Sounds like they are solving a problem that may not exist. Does not appear to have a strong understanding of the current ethanol dehydration industry.
- Weak understanding of biomass conversion process and challenges to process separations.
- This is not a simple water/ethanol separation. No clear plan to incorporate other process stream components into tests and screens.

Technology Transfer/Collaborations
- Could have positive impact in production, but need field confirmation
- Needs help from people in the ethanol industry. Membrane dehydration is currently being marketed.

Recommendations for Additions/Deletions to Project Scope
- Needs to get more detailed information on competing technologies. The current net cost of operating a mol sieve is less than $0.02 per gallon. So, claims of saving $0.01 appear to be excessive.
- The title of the presentation is highly misleading.
- Keep workplan clearly defined as distinct from projects funded from other sources.

PI Response to Reviewer Comments
Regards Q.1
The membrane technology being developed is expected to be universally applicable to drying of biochemicals, not only biochemical FGE.

Regards Q.2

CMS has chemically and thermally resistant membrane polymers. The challenge is availability of equally chemically and thermally resistant porous supports on which our membranes can be applied.
CMS' emphasis in this project has been on the most difficult final purification of FGE. Our work on other solvent and chemical services suggests this to be the most severe and that minor moieties identified are less aggressive than the FGE itself.
Azeotrope breaking is a major energy consideration in FGE and is likely to be so in other chemicals as well. The objective of CMS' R&D efforts is a long-life membrane device for azeotrope drying of Fuel Grade Ethanol (FGE) that operates in continuous processing fashion.

Regards Q.4
Indeed, many membranes have been tried for dehydration of FGE since as early as 1980; unfortunately most have failed in the harsh environment. Others are now in development and testing suggesting this is indeed a barrier and not a fait accompli.
CMS membranes have been certified and are commercial in other applications.
Our FGE dehydration product developments are in parallel and complimentary with current efforts on other products and applications.

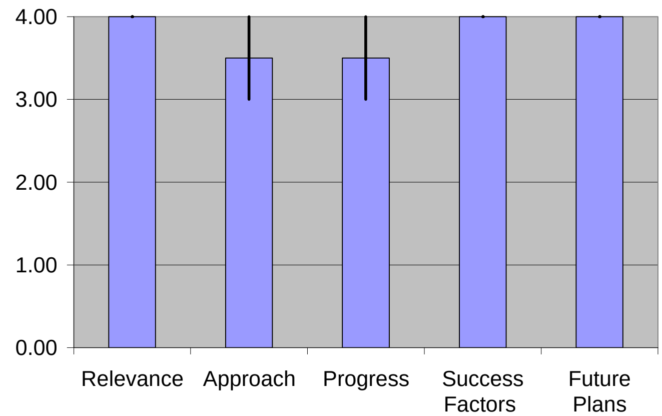
Regards Q.5
Two engineering firm collaborators confirm interest in the projected 75% reduction in capital cost and $2 million operating cost savings at the 100 mgy scale for our FGE dehydration system.

Other Comments
Indeed, CMS intends to conduct laboratory tests with materials sampled from and representative of commercial processes. The high temperature test rig currently being developed will be portable and suited for easy field installation to also allow processing of various commercial process streams.
It is expected that biomass sourced FGE whether from enzyme catalyzed fermentation or from gasification routes, like corn sourced FGE, will also be processed from an azeotrope.
Preliminary results evidence the CMS high flux membrane and associated technology can be more cost-effective than current cycling molecular sieve practice and other lower permeance membrane devices.

Biochemical Process Integration Core R&D

<u>Project Title: Biochemical Process Integration Task</u>
<u>Principal Investigator:</u> Dan Schell, National Renewable Energy Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	3.50	0.50	0.50
Progress	3.50	0.50	0.50
Success Factors	4.00	0.00	0.00
Future Plans	4.00	0.00	0.00
Average	**3.80**		



Question 1: Relevance to Overall Objectives.
- Absolutely critical to program
- This is a highly relevant project generating data and samples that are needed by many areas of the biomass conversion industry
- Working well with other platform projects to validate data and compatibility of processes that are optimized in isolation.

Question 2: Approach to Performing the R&D.
- Project focuses other programs on hurdles to process, and integrates new developments into the process. This reviewer believes that the integrated process should be run, albeit at a small scale, from start to distilled beer, as soon as practically permissible, to detect other unforeseen cats and dogs that may emerge from the process. Closing a mass balance around a unit operation or coupled unit operations is good, but not enough.
- Workplan should be redone to more clearly define the transition of some activities to the feedstock interface project.
- The feedstock variability studies within this project should remain but should focus accessing on the economics impact of feedstock variability.
- Lab-based Stover rapid analysis tools should be made available to the feedstock platform.
- Analytical method development should now include aspects of education and outreach to the greater biomass conversion community.
- Some research choices may need to be re-evaluated in light of increased budgets. , e.g. limited fermentation testing, no long runs in the pilot plant.

Question 3: Technical Accomplishments and Progress
- Good job of uncovering and addressing issues.
- Great interface with national community – valuable resource
- Excellent job of making newest analytical methods available via website and training
- Great job of focusing in on essential tasks in times of lean budget.
- Expansion/update of pilot facilities needed and well deserved.

Question 4: Success Factors and Showstoppers

- This project can be considered the “traffic cop” of the biomass platform program
- Demonstrated, clear understanding of work that needs to be done.

Question 5: Proposed Future Research Approach and Relevance.

- Project is at the mercy of other projects, but appears to be proactively managed.
- Future research plan may need to be revised to include capabilities of new facilities, greater interactions with the feedstock platform, and interactions with the new DOE-funded pilot facilities.

Additional Comments

Strengths

- Developed some on line measuring techniques for specific raw materials
- Good job of addressing mass balance issues.
- On target and meeting goals.
- Good coordination and collaboration with other groups, internal and external.
- Proactive in planning
- Relevant and needed by industry
- Working well with other platform projects to validate data a compatibility of processes that are optimized in isolation.
- Great interface with national community – valuable resource
- Excellent job of making newest analytical methods available
- Expansion/update of pilot facilities needed and deserved.

Weaknesses

- Have not run an integrated process, from start to finish, for any length of time. It is arguable whether it should be run with key issues not resolved.
- Need more “sense of urgency” in planning and operation.
- Unclear transition of activities and projects to feedstock interface.
- No clear workplan presented to evaluate impact of feedstock improvements / variability

Technology Transfer/Collaborations

- They do a good job of this.

Recommendations for Additions/Deletions to Project Scope

- None

PI Response to Reviewer Comments

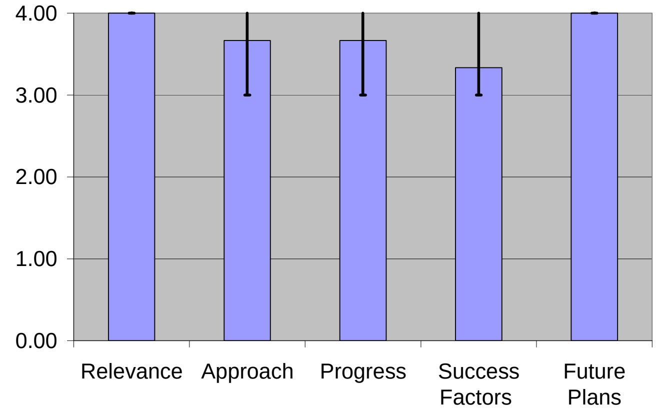
- Integrated process demonstration is important, but any unforeseen problems are currently being overshadowed by the larger performance issues in pretreatment, cellulose hydrolysis and ethanol fermentation. We intend to continue efforts to demonstrate integrated performance at the bench scale to be better positioned for FY09 or later year demonstration efforts using current and the new pilot facilities as soon as possible.
- There are some limitations with the current pilot plant that will be solved by the new facility expansion. The enhanced facility will be better able to flexibility meet varied operating and processing needs with a wider range of equipment.

- We have begun efforts in FY08 to transition new feedstock method development activities to the Feedstock Interface Task, which should be completed by the beginning of FY09.
- This year we are finishing efforts to evaluate corn stover variability on process performance. We will start working in collaboration with the Feedstock Interface Task to identify likely feedstocks in which variability and/or improvements are possible and formalize plans in FY09.

Fundamentals and New Concepts

Project Title: Targeted Conversion Research
Principal Investigator: Mike Himmel, National Renewable Energy Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.73**		



Question 1: Relevance to Overall Objectives.
- Though scale-up can commence well before Mike gets all of his answers, this work will be the heart and soul of traversing the learning curve and troubleshooting for years into the future.
- As was pointed out by other reviewers, this group has gained international recognition, and thus draws experts from world wide.
- This brings ideas into the program in an immeasurable way, as well as attracting good people to the program.
- This work is critical to the timely development of fiber degradation technologies.
- This project is developing an array of fundamental research tools that may provide insight into many aspects of plant chemistry as they relate to biomass conversion
- Impressive list of partners and collaborators.

Question 2: Approach to Performing the R&D.
- Focused on the recalcitrance of cellulose to enzymatic hydrolysis
- The group has developed a very systematic approach to understanding the underlying physical and chemical issues impacting lignocellulosic conversion.
- Fundamental investigations should be continued until they can be handed off to applied projects. I would like to see some examples of a barrier being removed through a better understanding of the fundamental science; I didn't see this in the material presented.
- I would like to see these tools applied to understanding the role of feedstock variability in downstream processing. It is not clear that more than one sample of corn stover was used.

Question 3: Technical Accomplishments and Progress
- The group has made measurable progress in developing the foundation upon which further research will be conducted
- Fundamental work in progress to support many aspects of biomass degradation

Question 4: Success Factors and Showstoppers
- The project is unraveling the mystery of cellulose recalcitrance
- The key technical parameters are well understood. The issue appears to be that success will not the either / or but in degrees. It may prove difficult for the research group to determine when they have reached the technical limits of their efforts.

- The project has identified many potential causes of recalcitrance but has not yet proven the clear connection in a manner that can be addressed in a practical way by biomass conversion processes.

Question 5: Proposed Future Research Approach and Relevance.

- Without the knowledge being developed as it is, no one would commercialize a lignocellulosic SSF process!
- Plan seems to include more interaction with other parts of the platform to test fundamental theories

Additional Comments

Strengths

- Strong, internationally acclaimed program.
- Tremendous progress in understanding recalcitrance to cellulose hydrolysis.
- Excellent communication of fundamental knowledge to the layman.
- Sound approach in a critical research area.
- Developing excellent novel capability for exploring the fundamental science of plant chemistry
- Impressive set of partners
- Some interaction with other platform projects
- Impressive animations and graphics – great communication tools.

Weaknesses

- The interface between this fundamental research and applications development resulting from it within the program is not clear.
- The effort is, imbedded in the weak acid, enzymatic hydrolysis platform.
- Should continue fundamental work to improve our understanding of plant chemistry.
- Should work with closely with feedstock interface as well as pretreatment and saccharification tasks to apply fundamental tools to applied research in overcoming recalcitrance. Stay with the fundamental science until theories can be tested.

Technology Transfer/Collaborations

- A high degree on a worldwide basis and it attracts expert knowledge and interest which is not quantifiable.
- This is one of the better applications of collaborative research.

Recommendations for Additions/Deletions to Project Scope

- The effort should be expanded to include preliminary work on other sugar platform technology options.
- Incorporate feedstock variability by working with feedstock interface task and the feedstock platform.

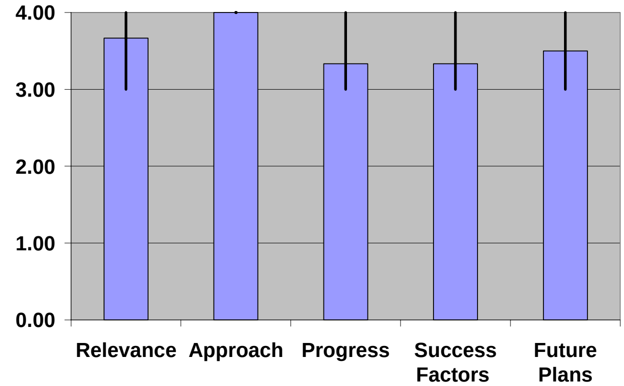
PI Response to Reviewer Comments

No comments were provided by the PI

Project Title: Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products

Principal Investigator: – K.T. Shanmugam, University of Florida, IFAS

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	4.00	0.00	0.00
Progress	3.33	0.33	0.67
Success Factors	3.33	0.33	0.67
Future Plans	3.50	0.50	0.50
Average	**3.57**		



Question 1: Relevance to Overall Objectives.

- A thermo-tolerant organism for alcoholysis, to align with upstream and downstream process conditions will be a significant development, and contribution to the program.
- Highly relevant to the sugar platform development effort.
- Highly relevant project. Organisms will be needed that can convert both C5 and C6 sugars.
- Clear pathway to commercialization
- Partners in place.

Question 2: Approach to Performing the R&D.

- Thermo tolerance, though not critical to program, can be a significant process advance, reducing operating, energy and investment cost.
- Sound approach
- Testing on realistic substrates. Approach working and showing great progress.

Question 3: Technical Accomplishments and Progress

- Difficult technical issues have been successfully addressed and good progress made. Still a long way to go toward ethanol goal
- Proof of high temperature SSF concept has been accomplished
- Impressive results shown in SSCF mode

Question 4: Success Factors and Showstoppers

- Team has a handle on what is needed.
- Clear plan to commercialization. Partners in place. Optimistic about what can be accomplished in remaining period of performance.

Question 5: Proposed Future Research Approach and Relevance.

- Team are pros in this arena embarked on a tough technical problem
- Remaining barriers clearly defined.

Additional Comments

Strengths

- Good plan and good expertise employed
- Experienced experts in this particular area

- Tough technical issues dealt with successfully
- Sound plan for staged approach to development of high temperature SSF.
- Relevant work – great progress
- Commercialization partners in place.

Weaknesses

- Success with plan will still need to deal with low ethanol concentration in fermentation broth.
- There doesn't appear to be significant supporting research to draw upon.

Technology Transfer/Collaborations

- Limited collaboration.
- Significant progress in this area since last review.

Recommendations for Additions/Deletions to Project Scope

- None

PI Response to Reviewer Comments

- As the Reviewers pointed out, the ethanol concentration in the fermentation broth with these thermotolerant biocatalysts may not exceed 4.5%, the limit of ethanol resistance of these bacteria. We believe further improvement for ethanol tolerance can be achieved, as demonstrated with the ethanologenic *E. coli.*
- "There doesn't appear to be significant supporting research to draw upon." We concur with this comment and this is due to a lack of interest in this group of thermophilic facultative bacteria in the general scientific community. Unfortunately, we have no control over this. Our own research would benefit with additional investigators who are also actively working towards developing gene transfer and mutagenesis protocols for this group of interesting bacteria.

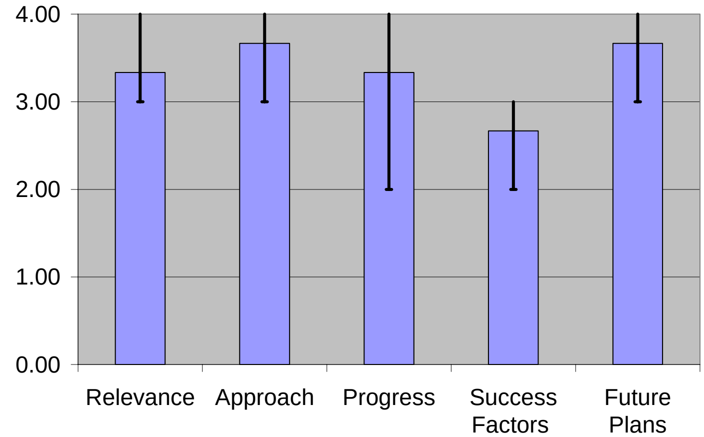
Technology Transfer/Collaborations

- Verenium corp. is interested in these biocatalysts but is waiting for the development of ethanologenic derivatives. Bioenergy International has licensed the bacteria as potential biocatalysts for L(+)-lactic acid production at higher temperatures that could minimize contamination during fermentation.

Project Title: Fungal Genomics

Principal Investigator: Scott Baker, Pacific Northwest National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.67	0.67	0.33
Progress	3.33	1.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	3.67	0.67	0.33
Average	**3.33**		



Question 1: Relevance to Overall Objectives.

- No question, this can be breakthrough technology if successful
- Relevant to the sugar platform effort
- Investigation of organisms that have potential for significant impact on the industry. Relevance demonstrated by the impressive group of partners.

Question 2: Approach to Performing the R&D.

- Impressive approach to the task. From an industrial viewpoint, this is how we like to see basic research approached. Expect new intellectual property and novel useful results.
- Sound approach in developing a better understanding of fungal genomics.
- This fundamental project is focusing on the development of genomic tools, which could be applied in biomass conversion processes.
- Work plans keep an applied focus and awareness of needs of biomass conversion processes.

Question 3: Technical Accomplishments and Progress

- Covered a lot of technological ground in a relatively short time
- Progress shown. Very early in development effort. May be behind other research efforts. Possibly too late for first or second generation projects.
- Great web-based communication tools.
- Great progress shown in the identification of organisms and understanding morphology control

Question 4: Success Factors and Showstoppers

- May be overlooking some important aspects yet to be uncovered, but a good team is available to assist.
- Clearly identified. Showstopper may be understated.
- Early in the project. Too early to gauge potential impact on biofuels production

Question 5: Proposed Future Research Approach and Relevance.

- Still in early stage of technical development, but the team of collaborators is impressive.
- Keep up the great work.

Additional Comments

Strengths

- Refreshing new look by enthusiastic team
- Fungal organisms inherently more robust
- Well constructed program with excellent collaborations
- Not hindered by “NIH” syndrome!
- Good long term plan for development. Strong team.
- Excellent group of partners
- Great focus on toolkit development
- Continues fundamental research to applied work hand-off

Weaknesses

- Needs conceptual engineering guidance at onset to help guide the program
- May be overlooking ethanol oxidation problems in aerobic reactor, and should address early.
- This project appears to be on a very long term schedule. Likely minimal return on effort for 5 0 10 years. Show stoppers identified but they need to be brought into the R&D program.
- Too early in the R&D project to evaluate the role of filamentous fungus in ethanol production

Technology Transfer/Collaborations

- PI has constructed a strong team of collaborators/cooperators which bodes well for success.
- Good partnering effort. Strong team approach.
- Impressive group of industrial partners

Recommendations for Additions/Deletions to Project Scope

- Issues related to ethanol production in highly aerobic systems needs to be evaluated early on. This could be a major show stopper that needs more attention.
- I would like them to add screens for organisms with both ethanologen and enzymatic activity

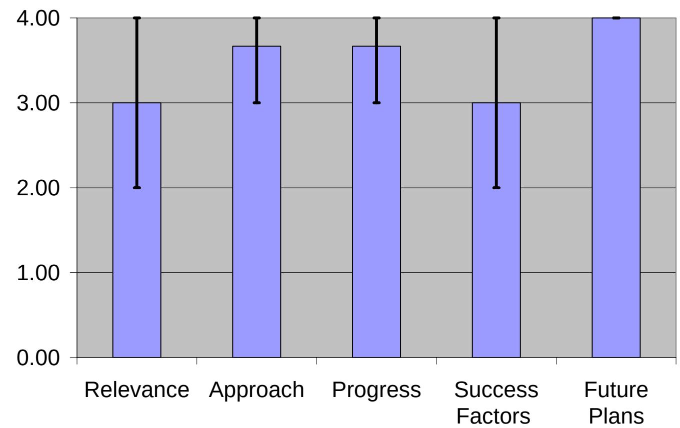
PI Response to Reviewer Comments

No comments were provided by the PI

Chemicals and Products

Project Title: Integrated Biorefinery – Separations/Separative Bioreactor - Continuous Bioconversion and Separations in a Single Step
Principal Investigator: Seth Snyder, Argonne National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	1.00
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.00	1.00	1.00
Future Plans	4.00	0.00	0.00
Average	**3.47**		



Question 1: Relevance to Overall Objectives.

- The customer here is not ADM, their collaborator, but rather the end use, yet unidentified. Separation technology is important to the overall program, but not critical. An indication of market support would have been helpful
- Highly relevant to Biorefinery goals.
- This and related technologies could find application in other aspects of the Biorefinery.
- Impressive list of partners

Question 2: Approach to Performing the R&D.

- Interesting development, Novel technology developed which can have more far reaching applications.
- Effective use of underlying technologies initially developed for other industries.
- Setting and meeting high performance goals for themselves.
- Systematic plan to address all major barriers
- Good leverage of National Lab facilities and expertise.

Question 3: Technical Accomplishments and Progress

- Taking presentation at face value, the technology is ready to move into commercialization. Which begs the question of continued DOE support!
- Seven week demonstration with ADM is a significant accomplishment
- I would have like to see more data from the pilot scale work.

Question 4: Success Factors and Showstoppers

- Would award higher score if data on raw material and results were more than anecdotal.
- Working with relevant partners to make apply these techniques to bioprocess streams.

Question 5: Proposed Future Research Approach and Relevance.

- If ADM wants to commercialize, what is there to say?
- Keeping a good economic focus in technical research.

Additional Comments

Strengths

- Strong partnership
- Novel solution to technical problem
- May have much broader application
- Claimed to have 12 week continuous pilot operation problem free
- If ADM commercializes the process, it is a success
- The R&D effort appears to be near commercial.
- Excellent group of partners
- Impressive background research and attention to process economics
- Setting and meeting high performance goals for themselves.
- Good leverage of technical strength of national lab.

Weaknesses

- Pilot results claimed were anecdotal, not validated with data.
- Though the R & D effort indicates a broad based approach for applying separative bioreactors, it appears that the focus has been limited to a specific partners needs.
- Not enough data presented from ADM partnership

Technology Transfer/Collaborations

- This technology, if commercialized, could have application in other areas of DOE interest
- Good commercialization strategy. Limited partnering.
- Partners in place and actively participating in research.

Recommendations for Additions/Deletions to Project Scope

- If commercialized as claimed to be imminent, write as success and delete project.
- Though not part of the project at hand, the concept could have applications in biomass based ethanol platform.

PI Response to Reviewer Comments

Question 1:

- As mentioned in the discussion but not detailed in the submitted materials, Argonne's CRADA provides options terms to ADM to commercialize specific targets of interest. Argonne has retains the rights to pursue targets outside of the scope of the ADM CRADA. Argonne has evaluated the several models to move the technology towards a commercialization stage including licensing the technology to separate end users, forming a partnership with a technology provider, or seeking direct investment and forming a spin-off company. Discussions with potential commercial partners are protected by non-disclosure agreements. Argonne has two other CRADA's supported by DOE-Fossil Energy to use variations of the technology to desalinate water and to capture CO2 from flue gas.
- Argonne realizes that the technology could be used for multiple chemical products and also to improve efficiency in biorefinery processes. Argonne does not currently have funding to address other aspects of the biorefinery. Argonne is very interested in identifying the core value of the technology to OBP's mission and the Integrated Biorefinery.

Question 2:

- Argonne agrees with the reviewer's comments.

Question 3:

- Argonne believes that the reviewer's comments are premature. Argonne is scheduled to commission the pilot scale work in Q1 FY2008. Data from the pilot work is not expected to be available until Q2 or Q3 from FY2008. These results will be CRADA-protected and not available for public release.
- Before the technology is ready for commercialization, the pilot scale runs must be completed to gain a better understanding of the process economics. After the process economics are refined, the technology will still require standardization of the resin wafer fabrication technology. Argonne only has the capabilities to fabricate resin wafers one or two at a time. This is not a commercial process. Second the process performance must be validated at biorefinery conditions (biomass sugars, strain replacement, etc.) not laboratory / pilot conditions. Argonne's process models indicate that commercialization is still a few years away and will take additional investment.

Question 4:

- The performance results are CRADA-protected and cannot be publically released. Argonne believes that ADM is a relevant partner and has the technical and business resources to commercialize the technology in their field of use. Argonne has interactions with potential technology providers. Argonne is approached regularly regarding the results of the project. Argonne cannot reveal CRADA-protected information and refers potential end users to public releases of information. Argonne evaluates other opportunities to pursue the uses of the technology with relevant partners when it is separate from the scope of the active CRADA.

Question 5:

- Argonne agrees with the reviewer's comments.

Weaknesses

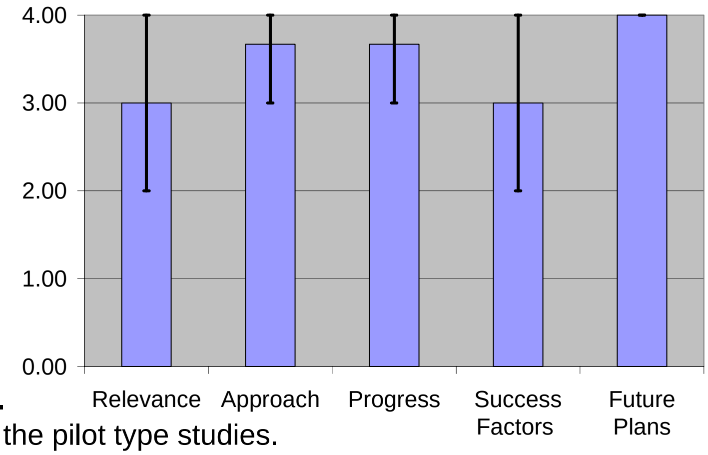
- Argonne agrees with the reviewers.

Recommendations for Additions/Deletions to Project Scope

- Argonne does not claim that commercialization is imminent. Argonne believes that the shows enough progress to continue down that pathway and warrants continued OBP investment. Before the technology is ready for commercialization, the pilot scale runs must be completed to gain a better understanding of the process economics. After the process economics are refined, the technology will still require standardization of the resin wafer fabrication technology. Argonne only has the capabilities to fabricate resin wafers one or two at a time. This is not a commercial process. Second the process performance must be validated at biorefinery conditions (biomass sugars, strain replacement, etc.) not laboratory / pilot conditions. Argonne's process models indicate that commercialization is still a few years away and will take additional investment.
- Argonne agrees that the technology cold have application in the biomass ethanol platform including multiple chemical products and also improve efficiency in the biochemical ethanol pathways. That work is beyond the scope of the current funding and project. Argonne is very interested in identifying the core value of the technology to OBP's mission and the Integrated Biorefinery.

Project Title: Advanced Catalyst Development for Polyols Production
Principal Investigator: John Holladay, Pacific Northwest National Laboratory

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**3.47**		



Question 1: Relevance to Overall Objectives.

- Commercial type feed has been used in the pilot type studies.
- Cost performance looks attractive. Actual volume potential depends upon market acceptance and other socio-economic factors.
- Highly relevant application in the biomass to chemicals arena
- Working closely with an important partner in the petroleum industry.

Question 2: Approach to Performing the R&D.

- Good job of identifying hurdles and addressing issues. Process has excellent potential for further development into large scale uses. Good team assembled and industrial partner is heavy hitter in area.
- Very good approach. Strong focus on economics and market early in the development effort.
- Strong partnership with UOP teams.
  - Working with realistic bioenergy feedstocks
  - Clear and ambitious workplan.
- Role of each partner is clearly defined
- Performance targets being met.
- Good focus on techno-economics as ultimate metric

Question 3: Technical Accomplishments and Progress

- A long road to success, but looks like the corner has been turned. The evaluations and communication between team members' has been excellent. Now it is up to commercial partners to move the project forward into large scale usage arena
- Impressive developments in the area of catalyst development.
- Major accomplishments considering the time and money spent
- Strong partnership with UOP teams.
  - Working with realistic bioenergy feedstocks
- Performance targets being met.
- Generating valuable intellectual property

Question 4: Success Factors and Showstoppers

- Good plan, carried out to successful conclusion.
- Feedstock cost will ultimately limit the commercialization effort. This will be a challenge but with petroleum prices increases it should improve the potential for commercial success.

- Only vulnerability seen was around the yet unidentified significance of the carbon support. Plan in place for UOP to fund fundamental research focused on understanding the important characteristics of the carbon supports.

Question 5: Proposed Future Research Approach and Relevance.
- Hand off to industrial partner imminent, depends upon how well market accepts. Expect some hurdles to emerge, but the team is impressive
- Could have provided more details on work plan.
- Strong workplan for both PNNL and UOP partner

Additional Comments

Strengths
- Excellent team, very good commercial partner in UOP that has broad petrochem and wet milling experience.
- Program on target, goals met, practical targets achieved
- Impressive accomplishments in light of the time and money expended. It appears that this work has drawn upon other UOP work on Green Diesel production.
- Strong partnership with UOP teams.
  - Working with realistic bioenergy feedstocks
  - Clear and ambitious workplan.
- Role of each partner is clearly defined
- Performance targets being met.
- Bringing important industrial partner from petroleum industry into biofuels.
- Good focus on techno-economics as ultimate goal
- Generating valuable IP
- Excellent future potential

Weaknesses
- No end user apparent in presentation, UOP is a process licensing company.
- Economics. Needs to be able to deliver glycerol at a lower price. Though the available volumes are significant other technologies/markets are under development and there will likely be significant competition for the feedstock.
- Vulnerability around required carbon support. UOP to fund fundamental science as cost share.

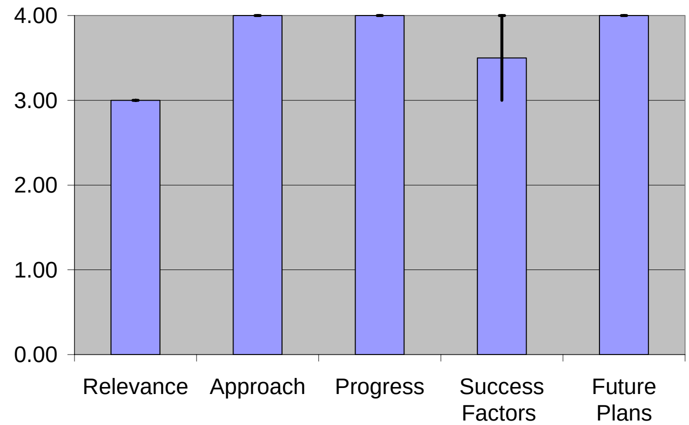
Technology Transfer/Collaborations
- Very limited partnering. Needs to bring in glycerol supplier. Sources include biodiesel and ethanol producers.

Recommendations for Additions/Deletions to Project Scope
- May want to look at alternate feedstocks or sources. Also, need to look at how substrate quality impacts catalyst activity and life.

PI Response to Reviewer Comments
No comments were provided by the PI

Project Title: Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis
Principal Investigator: Rodney Williamson, Iowa Corn Promotion Board

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	4.00	0.00	0.00
Success Factors	3.50	0.50	0.50
Future Plans	4.00	0.00	0.00
Average	**3.70**		



Question 1: Relevance to Overall Objectives.
- After the commodity chem. Feedstock area
- Great example of a successful project. This work has introduced an important slate of new bio-based materials.
- Valuable IP generated.

Question 2: Approach to Performing the R&D.
- Project was successful, what else is there to say
- Good example of bringing in best partners, wherever they are

Question 3: Technical Accomplishments and Progress
- Met the goals of the project. It is now in the hands of the market place.
- Great example of a successful project. This work has introduced an important slate of new bio-based materials.
- Valuable IP generated.

Question 4: Success Factors and Showstoppers
- Good example for DOE on a successful project.
- Some barriers remain, but excellent progress made in this project

Question 5: Proposed Future Research Approach and Relevance.
- It is going commercial. Success is out of the control of a government agency.
- Glad to see that USDA will continue to fund this work.

Additional Comments

Strengths
- Well defined program
- Good team working together
- Cross agency correlation, a model for future programs
- Focused on particular product
- Ongoing successful project
- Impressive slate of partners

- Generating valuable IP licensing strategy in place
- Clear relevance for integration into biorefineries

Weaknesses

- May not be large volume expected by DOE, (but can be)
- Uses corn starch, not cellulosic biomass (though could in the future)
- Claiming potential for integration in lignocellulosic Biorefinery, but no work planned for proof of concept.

Technology Transfer/Collaborations

- This should be a model for government labs and industry collaboration on a project
- Great example of how this should work.

Recommendations for Additions/Deletions to Project Scope

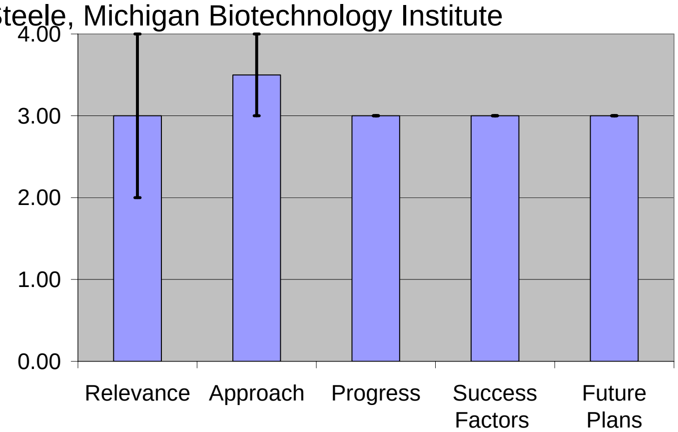
- None

PI Response to Reviewer Comments

No comments were provided by the PI

<u>Project Title: Succinic Acid as a Byproduct in Corn-Based Ethanol Biorefineries</u>
<u>Principal Investigator:</u> Susanne Kleff and Bernie Steele, Michigan Biotechnology Institute

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	1.00
Approach	3.50	0.50	0.50
Progress	3.00	0.00	0.00
Success Factors	3.00	0.00	0.00
Future Plans	3.00	0.00	0.00
Average	**3.10**		



Question 1: Relevance to Overall Objectives.
- Tough call on a good project. However, there is no indication that an end user who can set specs and economic targets is in place. It is laudable that a process licensee is on board, but making the product and selling the product are two distinct areas, both of which are critical to advancing to the next stage
- Clearly addresses the need for organisms that can ferment both C5 and C6 sugars.

Question 2: Approach to Performing the R&D.
- An outstanding job of well managed research and development. Hurdles were identified, objectives set and in general were met. Good team and good interaction demonstrated.
- Clear workplan for strain development
- Aware of economic impacts and challenges.
- Not clear what the plans are for working on the new strain with so little time left in this project.

Question 3: Technical Accomplishments and Progress
- Even though this is a very good project with excellent progress toward goals, the absence of specific economic/quality targets will hinder movement to stage 3. It is close to ready for pilot scale development, but needs market oriented inputs ($/lb at specification) to move forward. Poet may have a potential customer collaborating on the project, but it was not indicated in the presentation.
- Demonstrated ability to ferment both C5 and C6 Sugars. Significant cost reductions shown in overcoming expensive nutrient requirements of A. succinogensis.
- Generating valuable IP, partners in place to commercialize.

Question 4: Success Factors and Showstoppers
- From a process viewpoint, this could be outstanding, but from a market viewpoint, need minimum titer (is 74 G/L enough?) and other cost factors for acceptance in the market place that need to be addressed. There could be an economic showstopper of which they are unaware.
- Not quite there yet with economics of fermentation with this organism, but significant progress shown.
- Production partner identified, but end user not yet clear.
- Larger market may need to develop for Succinic acid for this approach to be economically viable.

Question 5: Proposed Future Research Approach and Relevance.

- Project has a lot of merit, but needs to address commercial aspect issues.
- Work left to be completed is clearly defined, but project period of performance nearly ended.

Additional Comments

Strengths
- Well managed project. Very good progress on goals.
- Excellent team interaction and industrial collaboration
- Raw starch fermentation impressive step
- Purity and yield data impressive.
- Uses continuous process economic updates to identify barriers.
- Commercialization partners in place for production. Hints of partner that could use succinic acid on commercial scale.
- They have developed an organism with demonstrated C6/C6 conversion, No Sterilization required
  - Identification of new isolate system with additional potential
  - Generating potentially valuable IP, licensing agreement in place.

Weaknesses
- Economic target for commercial success lacking
- Purity and yield data though impressive not clear on targets for success, or who establishes targets.
- Significant additional work required for isolation of new strain.

Technology Transfer/Collaborations
- They have a licensee (POET) which is good, but no indication of an end user who will actually buy/use the process output.

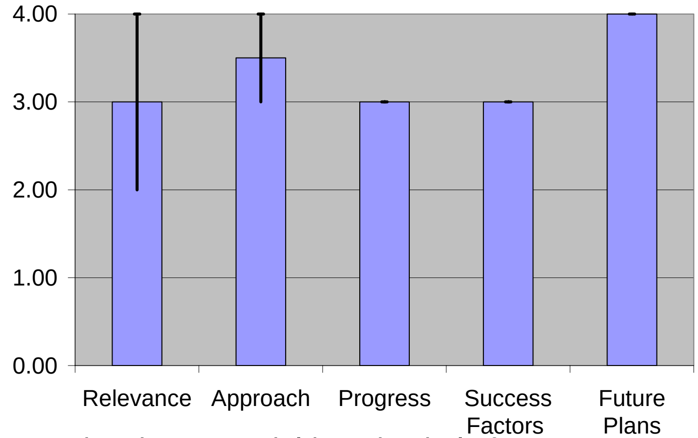
Recommendations for Additions/Deletions to Project Scope
- Need to clearly demonstrate that a commercial partner is in the wings who will take product if their commercial targets are met. Otherwise it is merely a good solution looking for a problem.

PI Response to Reviewer Comments
- End-users have been identified and contacted by MBI and the technology licensee, Poet. We are in active discussion with several chemical companies. Samples of fermentation derived succinic acid are currently being produced for end-user tests.
- The specifically targeted market segment cannot be disclosed due to the very competitive nature of the industry and affects the production price target that needs to be reached. The economic viability and market scale is dictated by the individual end-user's application.

Project Title: Development of Sustainable Bio-Based Products and Bioenergy in Cooperation with the Midwest Consortium for Sustainable Bio-Based Products and Energy

Principal Investigator: Mike Ladisch, Purdue University

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	1.00
Approach	3.50	0.50	0.50
Progress	3.00	0.00	0.00
Success Factors	3.00	0.00	0.00
Future Plans	4.00	0.00	0.00
Average	**3.30**		



Question 1: Relevance to Overall Objectives.

- Could improve overall efficiency of dry mill operation, increase yield per bushel of corn and reduce the quantity of DDGS nation-wide. The customers are the existing dry mill ethanol plants. Some important issues need to be resolved, such as value and acceptability of the resultant higher protein “DDGS” (Purdue is well equipped to do that), fermentation of the xylans and nature (processability) of the treated “DDGS.”
- Impressive group of partners.
- Clear connections to relevant industry groups

Question 2: Approach to Performing the R&D.

- Well planned and coordinated. The research was well done and credible and used results from the CAFI program among others. Addressing the resulting liquid value and processability would add to the report
- Contributing to industry standards for DDGS. This is important for the future.
- Several aspects of this work were particularly interesting and relevant.
- Exploration of different enzyme systems.
- Exploring different products.
- Plans to publish research.

Question 3: Technical Accomplishments and Progress

- Results conform with expectations (objectives).
- It is nice to see the emphasis on standardizing analytical work across the labs. This took considerable effort but it elevates the quality of science in this project to publishable levels.
- The results of this work will contribute significantly to industry standards for DDGS

Question 4: Success Factors and Showstoppers

- Some issues not well addressed
- Unknown value of enhanced feed value after hydrolysis. Due to changes in amino acids during pretreatment is a significant concern.
- Extra value given to project by feed evaluations (above and beyond scope)

Question 5: Proposed Future Research Approach and Relevance.

- Although the project is somewhat narrow in focus, the work was well managed and executed. The project is ready to go to the next step, a slipstream in a commercial plant.
- There seems to be a clear understanding of the goals, limitations and work that remains.

Additional Comments

Strengths

- Well planned, executed and managed.
- Excellent collaboration among complimentary groups.
- Clear goals and clear accomplishments.
- Credible results ready to take to the next step
- Impressive group of partners
- Contributing to industry standards for DDGS
- Excellent scientific plan and cross-lab standardization of analytical methods
- Plans to publish research.

Weaknesses

- Value of resultant “modified DDGS” not adequately addressed.
- Processability issue of modified product not addressed, this could be a serious issue, or it could be marketed as a liquid feed or other options should be more fully addressed.
- May not be economically attractive enough to be adopted, as pointed out by the PI, due to market dynamics.
- Possible showstoppers around protein / feed value degradation

Technology Transfer/Collaborations

- A strongpoint of the project is the interaction, collaboration and cooperation between diverse groups. The data generated will be helpful to groups beyond the targeted “customers.”
- The degree to which the project interacts, interfaces, or coordinates with other institutions and projects, provides additional benefits to the Program.
- Partners in place who are asking for research in this area. A team has been established for deployment.

Recommendations for Additions/Deletions to Project Scope

- They really need to address the nutritional value and marketability of the material.

PI Response to Reviewer Comments

The following are further responses to the comments, suggestions, and critiques of the Stage Gate Review Panel. The responses address both verbal comments, comments communicated via a written document based on the Stage Gate Review of August 7-9, 2007. The following extended responses identified weaknesses.

1. **Unknown feed value of eDDGS.**

The feed value of the enhanced DDGS is being determined by a combination of industrially-accepted feed assays which is being carried out by an industrial laboratory, as well as determination of amino acid profiles. This has been carried out, and further validated since the August 7 meeting. The amino acid profiles show that pretreatment reduces the amount of lysine, but at the same time increases the amount of protein. As a consequence, the value of the feed, based on the amino acid profile of a larger fraction of protein, is approximately the same on a weight basis as the incoming DDGS, prior to pretreatment. Therefore, DDGS which enters the process, which may be valued at $105/dry ton, would be equivalent in value to enhanced DDGS that leaves the process, even though the protein content in the enhanced DDGS is almost double of the DDGS that enters the process. The lysine content in the current process (which is not optimized) is chemically modified during pretreatment and/or enzyme hydrolysis. Amino acid profiles, coupled with laboratory feed energy and digestibility analyses provide a preliminary measure, although the final value of the product would be established by actual field use and testing in animals. This is outside of the scope of the current project. Generation of large quantities of enhanced DDGS for these purposes will require the development of a test bed associated in an industrial corn-to-ethanol facility so that large quantities of material may be generated for animal testing. This option is being pursued, although it is outside of the scope of the current project.

2. **Not exploring DDG diversity.**

As explained during the Stage Gate Review, and as a follow-up in response to comments and clarifications associated with this report, the diversity of DDGS is indeed being examined. Reinforced by the comments of the Stage Gate Review Panel, our group has already obtained samples from 4 geographically-diverse dry grind facilities. These samples of DDGS, wet cake, and stillage will be used in order to obtain a complete work-up of composition and baseline enzyme digestibility (for untreated materials). These analyses will be carried out, in order to obtain variability of the feedstock, as well as changes in processing characteristics (if these are found to be an issue). Based on the initial results, one of the materials will be selected as being representative of a dry grind wet cake or DDGS material from a dry grind facility. This selected material will, in turn, be used to carry out a complete work-up consisting of pretreatment (both AFEX and liquid hot water), followed by enzyme hydrolysis and fermentation. This work will be carried out as part of the current project, and is expected to be completed by March and June, 2008.

3. **Results of economic modeling not shown (during presentation).**

The economic modeling has been developed in three papers, and is much more involved than could be presented in 20 minutes. Nonetheless, the summary slides during the presentation gave an overview of the ranges of costs associated with additional processing equipment required to convert DDGS to additional ethanol and value-added products. The economic modeling indicates that based on a liquid hot water pretreatment system, the net present value is approximately 32% if an alcohol price of $1.80/gallon is assumed, and a process for the pretreatment, hydrolysis, and fermentation of DDGS components is added on to an existing corn-to-ethanol plant. The economics are attractive and deserve further examination. The economic models also show that enhanced conversion of DDGS to ethanol may extend the operating range of a grain-to-ethanol plant, by enabling the plant to operate at break-even if ethanol prices decrease below $1.80/gallon. A life cycle analysis that accompanies the economic analysis shows that winter cover crops are desirable. A cover crop would decrease the amount of fertilizer that is used, as well as decrease emissions of nitrous oxide, which themselves are greenhouse gases.

4. **DDGS – The corn leaving the market might actually lower the available grain – which would have impact on cost of DDG.**

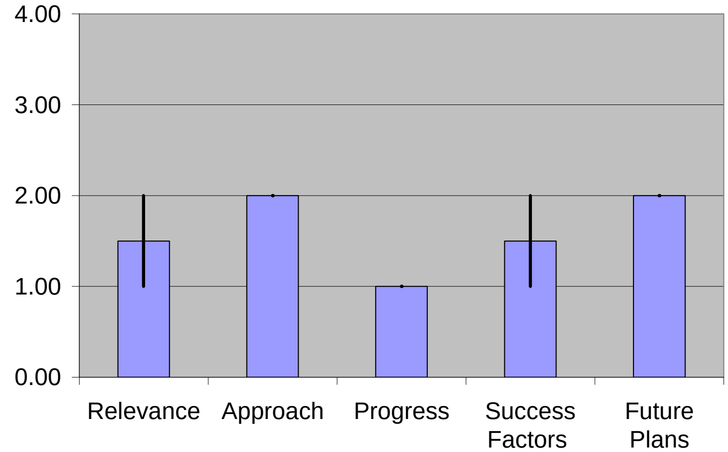
The price of corn is tied to the price of DDG, and the two price curves are parallel, with DDG having a slightly higher price per ton than that associated with corn. The price of DDG (which makes up approximately 25-30% of a bushel of corn), is included in the economic analysis and modeling. The sensitivity of the economics to DDG prices is being examined, although the quantities of DDG generated, and the geographic locations at which DDG is likely to accumulate will probably exceed the number of animals that could be fed at these same locations.

Consequently, the utility of converting DDG to ethanol is important. These analyses are still on-going, and will accompany the data that examines the impact of variability on economics of converting wet cake and DDGS to ethanol using cellulose conversion technology.

These comments give additional background for the PI responses offered during the Stage Gate Review. Economic modeling results were distributed in a detailed report given to the Stage Gate Reviewers in August. Projection of supply/demand issues and additional economics, are currently being undertaken as part of the wrap-up of this project.

Project Title: Iowa State University Biomass Energy Conversion Project
Principal Investigator: Norman K. Olson, Iowa State University

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	1.50	0.50	0.50
Approach	2.00	0.00	0.00
Progress	1.00	0.00	0.00
Success Factors	1.50	0.50	0.50
Future Plans	2.00	0.00	0.00
Average	**1.60**		



Question 1: Relevance to Overall Objectives.
- The project does support the goals and objectives of the DOE biomass program. However, the information which could make the project attractive (hydrolysis yields, etc.) was anecdotal, with no actual data presented. It is an embryonic "try it and see what happens" approach.
- This project has good potential impact for products, but success is not essential for meeting the DOE 2030 goals.
- Past projects in this area have failed to meet economic targets

Question 2: Approach to Performing the R&D.
- A claim of hydrolysis of cellulose to sugars was made, but no data presented, nor was a clear targeted plan presented. What was hydrolyzed, xylans? Glucans? Both? Reviewer recognizes that equipment availability severely hinders progress, but all that was presented was a primer on super critical fluids, with no clear plan of what was sought nor any data on why the PI thought it would offer a new approach.
- Process economics need to be incorporated into this project to a greater extent.
- Successful conversion of ensiled corn could provide unique value to this process.
- No commercial partner identified

Question 3: Technical Accomplishments and Progress
- Embryonic with no results yet reported.
- Equipment delays had significantly delayed the start of this project, but some capability exists for testing at small scale.
- Only anecdotal results presented.

Question 4: Success Factors and Showstoppers
- Project has not gotten off the ground yet, nor was a clear plan on how to do it presented.
- This project may be significantly underestimating the complexity of biomass and its impact on the ability to meet their goals.
- Clean feedstock may be difficult to find.
- Affordable size reduction options may be difficult to find

Question 5: Proposed Future Research Approach and Relevance.

- This is a generous rating, because some aspects of the project are intriguing. If some data were presented to show why the investigators felt that the process has merit (i.e. Hydrolysis without added catalysts) it would have added credibility. There are too many unknowns at this point to give the overall project a high mark in any area.
- Before their equipment arrives, they can be doing extensive background research to learn from decades of research in this area. They should also select specific model biomass feedstock for evaluation.

Additional Comments

Strengths

- Interesting idea, may have some unique value to program
- ISU has good expertise to draw upon, although such collaborators were not mentioned.
- Simple process - potential for very interesting economics if successful in overcoming techno-economic barriers
- May interface well with ensiled biomass offering valuable feedstock options

Weaknesses

- No feasibility data presented, only anecdotal.
- No coherent plan presented.
- No clear approach or targets presented.
- Significant delays waiting for equipment. It is difficult to evaluate this project without any results presented.
- Biomass feed must be pumpable. Required dilutions may limit product concentrations
- The required size reduction may be a techno-economic showstopper.

Technology Transfer/Collaborations

- Interaction with U. of Iowa alluded to, but role not clarified.
- No commercial partners identified

Recommendations for Additions/Deletions to Project Scope

- PI should present a clearly specified approach and show his preliminary data on why the project has merit. The project may have important consequences to the biomass program, but the presentation was unconvincing and left that up to the imagination of the reviewers.
- Add more emphasis on process economics.

PI Response to Reviewer Comments

IOWA ENERGY CENTER
2521 UNIVERSITY BOULEVARD, SUITE 124
AMES, IOWA 50010-8229
iec@energy.iastate.edu
PHONE: 515-294-8819
FAX: 515-294-9912
www.energy.iastate.edu

Ms. Amy R. Miranda
Biochemical Platform Technology Manager
US Department of Energy
Office of Energy Efficiency and Renewable Energy
Office of Biomass Programs, EE-2E
1000 Independence Avenue, SW
Washington, DC 20585

Dear Ms. Miranda:

Thank you for the opportunity to comment on the Summary of Results for the Review Panel of the Biochemical and Products Platform held on August 7-9, 2007.

The Energy Center concurs with many of the reviewers' comments and correspondingly low score for the Iowa State University project, "Supercritical Fluids Processing of Biomass to Chemicals and Fuels", DE-FG36-06GO86014. We had not participated in a review under your program before and, obviously, did not anticipate the precise nature of the material you wished to see presented. Moreover, we assumed that information in the quarterly reports that we have been submitting would have been supplied to the reviewers in advance, thus providing some of the data they apparently sought. By the questions asked and the comments made, this appears to have been a poor assumption on our part.

If there is a future review, we strongly encourage that more explicit guidance on your expectations should be provided. Additionally, we encourage you to provide more advance notice of the review. In this instance, the short notice prevented us from being able to schedule participation by the two primary researchers involved in our project. Had they been present, many of the reviewers' concerns could have been addressed directly and with, we believe, a far different outcome.

We do have a few additional comments that we would like to provide for your consideration. For simplicity, we have organized our comments within the categories used in the evaluation: relevance, approach, progress, success factors, and future plans.

Relevance

The highest rated project at the review focuses on enzymatic hydrolysis. One significant aspect of Iowa State University's work focuses on water hydrolysis of cellulose and has shown promising results (conversions to sugar with yields of approximately 65% without the use of catalysts), yet the ISU project received a considerably lower ranking. It leads us to question whether the reviewers truly understand the work in progress.

The ISU project has also shown, with the limited equipment available, the use of supercritical fluids for direct conversion of sugars to glycol with an 80% yield using no catalyst, production of biodiesel using no catalyst, and conversion of sugars to isosorbide. Although the project has not made progress as rapidly as we had hoped, the work still remains relevant.

Approach

Early in the project, the guidance obtained from DOE was to focus on discovery of the principles underlying supercritical processes as they apply to transformation of biomass to chemicals. We were specifically discouraged from pursuing the creation of particular end products or examining in detail the economics of producing those products commercially. It is somewhat surprising, then, to have the reviewers push for more economic analysis and even question the lack of a commercial partner for research at this early stage.

This apparent contradiction aside, a venture capitalist is now funding some work – outside the scope of this project – related to cellulose hydrolysis.

Progress

The project has been seriously delayed by the inability to quickly procure and receive required equipment. Some early delays occurred due to miscommunication between the Iowa Energy Center and ISU's Purchasing Department. This led to a bid package for the supercritical reactor to which potential equipment fabricators were unable to respond. Subsequent re-bidding was successful. However, the fabricator experienced difficulty obtaining the special alloys, in the needed stock sizes, for machining the reactor components. Further delays occurred due to shortages of valves and other components as a result of the petroleum industry's efforts to rebuild infrastructure following the Katrina hurricane.

The reactor system has subsequently been delivered to Iowa State University and is being installed and commissioned. We anticipate beginning the experimentation phase of the project soon and will be working diligently to produce experimental results relevant to DOE's biomass program.

Success Factors

While the project has been severely hampered by difficulties in obtaining advanced equipment, it has none-the-less shown promise with the less-versatile equipment at hand. We believe that there has been sufficient preliminary success to illustrate the relevance of the work and the merit of pursuing it further.

Future Plans

A suggestion was made by the reviewers to conduct extensive background review of prior research in the area of supercritical fluids. The Energy Center and its partners conducted this literature search prior to commencing this project. It is a standard part of our operating procedures. It must be noted, however, that much of the prior work with supercritical fluids is not directly related to the current scope of work. Prior work on the use of supercritical fluids for hazardous waste destruction, solvent extractions, and creation of hydrogen from biomass have helped to inform the current project, but are not direct antecedents to the reactions being explored within this project.

Thank you again for the opportunity to comment. We look forward to engaging with you in future project reviews.

Sincerely,

Norman K. Olson, PE
Principal Investigator

APPENDIX A

Agenda

Day 1 – August 7th

Welcome		
8:30 – 9:00	Welcome and Platform Overview	*Amy Miranda, Office of the Biomass Program*
9:00 – 9:10	Process Overview	*Valri Lightner, Office of the Biomass Program*

Biochemical Platform Support		
9:10 – 10:00	Biochemical Platform Support Overview	*Gene Petersen, Golden Field Office*
10:00 – 10:50	➢ Biochemical Platform Analysis	*Andy Aden, National Renewable Energy Laboratory*

10:50 – 11:00 Break

Feedstock-Biochemical Conversion Interface		
11:00 – 11:20	Feedstock Interface Overview	*Gene Petersen, Golden Field Office*
11:20 – 12:10	➢ Preprocessing and Storage Systems Development/Qualification	*Corey Radtke, Idaho National Laboratory*

12:10 – 1:10 Lunch

Biochemical Processing Core R&D		
1:10 – 1:30	Biochemical Processing Core R&D Overview	*Christy Sterner, Golden Field Office*
1:30 – 2:20	➢ Pretreatment and Enzymatic Hydrolysis	*Rick Elander, National Renewable Energy Laboratory*

2:20 – 2:30 Break

2:30 – 3:20	➢ Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol	*Larry Allen, Lucigen Corporation*
3:20 – 4:10	➢ Energy Corn Consortium	*Michael Blaylock, Edenspace Systems Corporation*

Day 2 – August 8th

Day 1 Review		
8:30 – 9:00	➢ Initial Reviewer Feedback for Day 1	*Review Chair*

Biochemical Processing Core R&D (continued from August 7th)		
9:00 – 9:50	➢ Lab Validation for Organism Development Solicitation Recipients	*Kent Evans, National Renewable Energy Laboratory*

9:50 – 10:00 Break

10:00 – 10:50	➢ Development of Applied Membrane Technology for Processing Ethanol from Biomass	*Don Stookey, Compact Membrane Systems*

Biochemical Process Integration Core R&D		
10:50 – 11:20	Biochemical Process Integration Core R&D Overview	*Christy Sterner, Golden Field Office*
11:20 – 12:10	➢ Biochemical Process Integration Task	*Dan Schell, National Renewable Energy Laboratory*

12:10 – 1:15 Lunch

Fundamentals and New Concepts		
1:15 – 1:35	Fundamental Concepts Overview	*Christy Sterner, Golden Field Office*
1:35 – 2:25	➢ Targeted Conversion Research	*Mike Himmel, National Renewable Energy Laboratory*
2:25 – 3:15	➢ Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products	*K.T. Shanmugam, University of Florida, IFAS*

3:15 – 3:30 Break

3:30 – 4:20	➢ Fungal Genomics	*Scott Baker, Pacific Northwest National Laboratory*

Chemicals and Products		
4:20 – 4:40	Chemicals and Materials Overview	*Gene Petersen, Golden Field Office*
4:40 – 5:30	➢ Integrated Biorefinery-Separations/Separative Bioreactor- Continuous bioconversion & separations in single step	*Seth Snyder, Argonne National Laboratory*

Day 3 – August 9th

Day 2 Review			
8:30 – 9:00	➢	Initial Reviewer Feedback for Day 2	*Review Chair*

Chemicals and Products (continued from August 8th)		
9:00 – 9:50	➢ Advanced Catalyst Development for Polyols Production	*John Holladay, Pacific Northwest National Laboratory*
9:50 – 10:40	➢ Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis	*Rodney Williamson, Iowa Corn Promotion Board*

10:40 – 10:55 Break

10:55 – 11:45	➢ Succinic Acid as a Byproduct in Corn-Based Ethanol Biorefineries	*Bernie Steele, Michigan Biotechnology Institute*
11:45 – 12:35	➢ Development of Sustainable Bio-based Products and Bioenergy in Cooperation with the Midwest Consortium for Sustainable Bio-based Products and Energy	*Mike Ladisch, Purdue University*

12:35 – 1:35 Lunch

1:35 – 2:25	➢ Iowa State Univ. Biomass Energy Conversion Project (IA)	*Norman K. Olson, Iowa State University*

2:25 – 3:00 Break

Plenary Session		
3:00 – 4:00	Reviewers Report-out	*Review Chair*
4:00	Adjourn	

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Amy Miranda Please copy Leslie Pezzullo (lpezzullo@bcs-hq.com)

You have been invited to serve as a Reviewer for the DOE Biochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	**No**
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Technical Area or Project on Review Agenda	Nature of conflict of interest (Leave blank if none)
Biochemical Platform Analysis	
Preprocessing and Storage Systems Development/Qualification	
Pretreatment and Enzymatic Hydrolysis	
Novel Enzyme Products for the Conversion of Defatted Soybean Meal to Ethanol	
Energy Corn Consortium	
Lab Validation for Organism Development Solicitation Recipients	
Development of Applied Membrane Technology for Processing Ethanol from Biomass	
Biochemical Process Integration Task	
Targeted Conversion Research	
Engineering Thermotolerant Biocatalysts for Biomass Conversion to Products	
Fungal Genomics	
Integrated Biorefinery – Separations/Separative Bioreactor – Continuous Bioconversion and Separations in Single Step	
Advanced Catalyst Development for Polyols Production	
Isosorbide, the Continuous Isosorbide Production from Sorbitol Using Solid Acid Catalysis	
Succinc Acid as a Byproduct in Corn-Based Ethanol Biorefineries	
Development of Sustainable Bio-Based Products and Bioenergy in Cooperation with the Midwest Consortium for Sustainable Bio-Based Products and Energy	
Iowa State University Biomass Energy Conversion Project	

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Amy Miranda (202-586-6471) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

______________________________ _____________________
Signature Date

____
Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session: 2 3 4 **Reviewer Name**: ______________________

Title of Project: ______________________

Presenter Name: ______________________

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ______________________

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach** to performing the R&D.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

Office of the Biomass Program
Integrated Biorefinery Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Integrated Biorefinery Platform Review held on August 13-15, 2007 in Golden, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the type of biorefinery they were investigating (i.e. preprocessing and storage, processing and process integration). The platform review agenda is attached to this report in Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for response. Any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Larry Russo
Integrated Biorefinery Platform Technology Manager
DOE/EERE, Office of the Biomass Program

Project Title	Relevance	Approach	Progress	Success Factors	Future Plans	Average
Advanced Biorefining of Distiller's Grain and Corn Stover Blends	4.00	4.00	3.67	3.33	4.00	3.80
Du Pont integrated biorefinery	4.00	4.00	4.00	3.67	3.00	3.73
Making Industrial Bio-refining Happen!	3.67	4.00	3.67	3.33	3.67	3.67
A New Biorefinery Platform Intermediate	3.33	3.67	3.67	3.33	4.00	3.60
New Sustainable Chemistry for Adhesives, Elastomers and Foams	3.67	4.00	3.33	2.67	3.00	3.33
Integrated Biorefinery Platform Analysis	3.33	3.00	3.00	3.33	3.33	3.20
Separation of Corn Fiber & Conversion to Fuels & Chemicals: Phase 2	3.00	3.00	3.00	2.67	3.00	2.93
sugar-based ethanol biorefinery	3.00	2.67	3.00	2.67	2.67	2.80
Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries	2.67	2.67	2.67	2.67	3.00	2.73
National Agricultural Based Industrial Lubricants Center Project	2.00	2.33	3.00	3.00	2.50	2.57
City of Gridley Biofuels Project	2.67	2.67	2.00	2.33	2.33	2.40
Biorefinery and Hydrogen Fuel Cell Research	1.67	1.67	2.00	1.67	1.67	1.73

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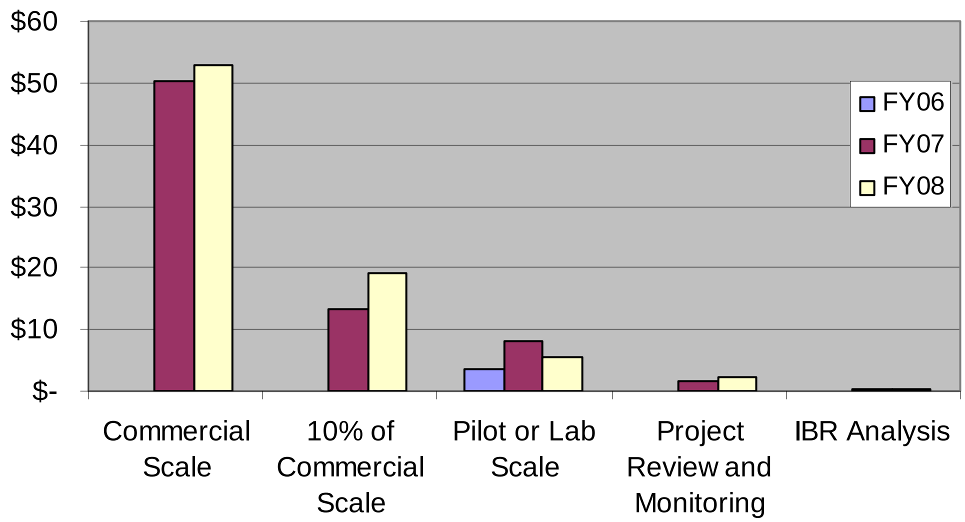
Program Peer Review Platform Results

Platform Direction

In FY2008, the IBR Platform will continue to support the awards made under Section 932 of the EPAct 05 and the 10% of Commercial Scale Biorefinery awards and the remaining awards from the 2002 solicitation. These demonstration projects will focus on completing their detailed engineering design, NEPA compliance and environmental analysis and permitting activities including more realistic feedstock production data, conversion processes and market evaluation.

By the end of FY2008, the platform will have also completed the initial construction phase for Range Fuels, completed pilot runs at the Abengoa Pilot Plant on stover, and restarted the work to produce 3-HP from cellulosic feedstocks. Finally, in FY2008, the platform will release the IBR analysis report that defines the market cost of biofuels based on feedstock logistics and conversion processes.

Platform Funding (in $M)[1]



Specific Responses to Select Comments

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
Too many WBS's, need to focus on the things that OBP is investing in (see examples in the Program Review Comments section)		Since the IBR element requires the integration of many technologies, the WBS is more detailed; however we clearly identify the priorities and the activities invested by OBP in our Annual Operating Plan and Multi-Year Program Plan

[1] Please note that FY 2007 Pretreatment funding included forward funding for FY 2008 activities.

The goals are critical but poorly defined at this time. Some good progress has been achieved such as solicitations and analyses. Some good partnerships have been developed. But all in all, the platform is still too nebulous to be as useful as it could be.		The IBR element has changed in the last year due to the demonstration and deployment activities; however, the goal of delivering a process that can produce a cost-competitive fuel remains the one goal that crosscuts all pathways.
The reviewer recommendation to publish more and encourage information sharing is understandable, but I question whether or not it is practical. Where possible, the use of public funds to develop resources that can be shared is to be encouraged, but the leveraging of private resources is so helpful it would not be wise to restrict it.		It is important to protect proprietary and company confidential information; however, it is also important to publish advances in the technology so as to attract continued private investments. It is also important to demonstrate the economic results are validated so the investors believe the results.
This platform is ideally situated, by virtue of its being at the interface with commercial implementation, to provide feedback to the feedstock, thermochemical and biochemical platforms as to what adjustments, refocusing, etc. is required in those platforms in order to assure commercially viable biorefinery processes.		The TM appreciates the reviewer's comments

Program Review Comments

Strengths

- Projects are well managed to meet specific goals.
- Liked the discussion of the options.
- The platform seems to have done a good job of assessing the barriers which are appropriate for the Program to address. The program is well funded. The development of commercial scale plants may be premature for technical reasons, but may also help identify new areas of research needed to remove impediments for future plants. The recognition that 10% scale plants are more desirable is to be commended. I applaud the program's utilization of "investment banker" philosophy and risk analysis in the 932 process. Risk mitigation is necessary for success. I am happy to see the platform planning to look at utilization of new feedstocks and conversion technologies in the months and years ahead.
- Good industry partnerships. Good synergy with the biochemical conversion platform.

Weaknesses

- There are many gaps in the program.
- Needs to have better explanation of how they fit together in this platform.
- Clarity of purpose and option development were expressed as concerns.
- No work on utilization of perennial crops, forest residues and post consumer waste. Insufficient focus on full life cycle analysis re full life cycle GHG emissions and energy balance.

R&D Portfolio Gaps

- There are many gaps in the program, as cited by the presentation. These include, little or no work on logistics of feedstock supply/ Issues around water supply and management need to be addressed/ No work on utilization of perennial crops, forest residues or post consumer waste/ Lack of full life cycle energy balance and GHG emissions/ Insufficient focus on unit process integration.

- The report noted little or no work on logistics of feedstock supply. While I agree that this is a paramount need for the overall program, I don't think it is a gap in this specific platform. I agree with the other four gaps noted by the peer review for this platform.
- Gaps were well pointed out.
- While I agree with the comment that the feedstock supply needs more attention from the Program as a whole, I am not sure that it fits under this platform rather than the Feedstock Platform. I agree with the comment that water supply issues need attention. There are opportunities in biorefinery integration to tell a good public relations story. I agree that perennial crops/forest residues could use more attention, especially regionally. Likewise wastes such as cobs are logical opportunities for attention. Full life cycle analyses are increasingly important in the investment and marketing world. In my experience, they are emerging as a real environmental and corporate investor focus.
- Agree with gaps identified in the platform review presentation.

Additional Recommendations, Comments and Observations

- The reviewer recommendation to publish more and encourage information sharing is understandable, but I question whether or not it is practical. Where possible, the use of public funds to develop resources that can be shared is to be encouraged, but the leveraging of private resources is so helpful it would not be wise to restrict it.
- This platform is ideally situated, by virtue of its being at the interface with commercial implementation, to provide feedback to the feedstock, thermochemical and biochemical platforms as to what adjustments, refocusing, etc. is required in those platforms in order to assure commercially viable biorefinery processes.

Platform Review Feedback

Specific Responses to Select Comments

Platform Peer Review		
Reviewer Comment		**Technology Manager Response**
Integration with the feedstock platform is extremely important, the review panel would like to see more integration between the platform performers		As a compliment to the new strategic planning process, more attention was focused on platform integration and the flow of information between IBR and the technology platforms. Identifying important data and other information which should be communicated on a regular basis.
Would like to see the work for IPA turn into research objectives that are working on the pieces of the plant		We are trying to incorporate more risk analysis and risk mediation into the platforms. It has been limited in the past due to methodology and the ability to quantify its impacts.
What does the development of ethanologens do for the rest of the biorefining industry? The reviewer team would like to see the Program focus on bug development to emulate the existing industry		The development of an ethanologen provides alternatives to the industry to produce fungible fuels from multiple feedstocks. This will allow them to develop their own processes and business models.
Water removal needs to be a topic of focus in the Program. Additional R&D topics of focus include: • Integrate a robust unit operation program within the program • Boosting the benefit of 45% of the capital (combustors, cooling towers, etc) - "balance		We agree and have added a technology area of sustainability to our research areas of interest. This was the application of the 10% scale demonstrations. It is important to move beyond a national laboratories perspective of

of plant" • Plant wide footprint – innovative way to address those energy sinks – crosscutting enabling technologies		the balance of plant used in the state of technology to one developed by the industry that will have to make money.
Second generation plants needs to be discussed (combining processes). Where you have other industries looking at separations/reactions in a unit operations (i.e., Consolidated Bio-Processing)		Since the program envisions more than one 10% solicitation, as the technology is developed our plan is to have industry incorporate more technology options into the demonstrations.

General Platform Comments

- The recent changes in the platform to focus on deployment activities is commendable and has lead to:
  - More industrial involvement
  - Seeing progress towards commercializing some of these technologies
- Integration with the feedstock platform is extremely important, the review panel would like to see more integration between the platform performers
- Combining the conversion platforms is essential and a good move, emphasizing the importance of utilizing biochemical and/or thermochemical processing to convert to principally a fuel (and/or heat/products)
  - Utilization of tried and true processes (biodiesel) are not and should not be a focus
- Systems Integration and IPA are essential to analyze and provide feedback to the projects. Evaluation of risk is essential, and the results of the IPA work will help inform and educate OBP on the state of technology and the planned commercial demonstration projects
  - Would like to see the work for IPA turn into research objectives that are working on the pieces of the plant
- Co-fermentation is key, but current effort focuses on two co-habiting organisms.
  - What does the development of ethanologens do for the rest of the biorefining industry? The reviewer team would like to see the Program focus on bug development to emulate the existing industry
- Water removal needs to be a topic of focus in the Program. Additional R&D topics of focus include:
  - Integrate a robust unit operation program within the program
  - Boosting the benefit of 45% of the capital (combustors, cooling towers, etc) - "balance of plant"
  - Plant wide footprint – innovative way to address those energy sinks – crosscutting enabling technologies
- Second generation plants needs to be discussed (combining processes). Where you have other industries looking at separations/reactions in a unit operations
  - Consolidated Bio-Processing (CBP)
- Communication & outreach
  - The communication needs to be expanded to both the public and scientific communities
    - Need to consider having a scientific best practices meeting in format of the 30x30 Workshop
- Need more connection b/w fundamental applications and the applications and needs in the deployment area
- Development of a sustainable lignocellulosic feedstock system to make sure the facilities are supplied 365 days a year

Initial Reviewer Feedback – Comment Summaries

Analysis and Strategic Planning Projects

Project Title: Integrated Biorefinery Platform Analysis
Principal Investigator: Bob Wallace, National Renewable Energy Laboratory (NREL)

Strengths
- Different scenario modeling is a strength
- Inclusion of capital costs in model is a strength
- Usage of model to show the difference b/w the by-product (PG and EG) showing why a pathway is better for selling the product
- Providing ASPEN models to the “public” is a strength

Weaknesses
- Financial assumptions need to be re-evaluated, decision based on IRR (100% equity) is unrealistic
- Concern is that they are getting away from “that” (above) to model the entire supply chain, need to continue to focus on important ground-truthing
- The way that the model is differentiating the economics. Concern is that the plans are to expand the modeling to the entire supply chain - need to stay illuminating those differences in the pathways

Suggestions/Comments
- Need to look at separation and individual processing for C5/C6 sugar stream
- Need to continue to do reality checks on their models
- Model feedstock transport system needs to be better defined (at the scale presented)

PI Responses
- Appreciate the comments. Financial assumptions are always something we struggle to adequately show. These are a baseline.
- There is more than one modeling issue. The models are to be integrated --- there are a couple different modeling efforts going on.

Corn Wet/Dry Mill Improvements Projects

Project Title: Sugar-Based Ethanol Biorefinery
Principal Investigator: Donal Day, Louisiana State University

Strengths
- Objective to get high value products from a unused feedstock is good
    - Extending the look at additional feedstocks that may be able be similarly processed
- AFAX pretreatment has found a potential home for commercialization
- Like the integration with the sugar industry

Weaknesses
- Needs achievable focused goals (focus is too scattered)
    - Focus on C6 fermentation for ethanol

- What else can you do with the C5s (value added products)
  - Optimize storage process for batch
  - Let someone else do the gasification work
- The technical integration of their technologies with the existing sugar mills did not appear well developed (annual cycling)
- Annual economic modeling didn't appear well thought out

Suggestions/Comments

- The market for products from lignin is not there, burn the lignin
- Harvesting equipment requirement maybe steep and has not yet been evaluated (is not yet clear)

PI Responses

- CLM will come in with the cane – you won't separate the leaf off the cane, but will require a "dry cleaning" process at the mill to separate the cane for the sugar mill
- John Deere is also investigating to modify cane harvesting
- Shutting down gasification
- We are working on a storage process optimization now

Project Title: Integrated Corn-Based Bio-Refinery

Principal Investigator: Michael Sanford, DuPont

Strengths

- Team is extremely strong and well suited to address the problem (both R&D and commercialization)
- Organized and balanced approach, addressing both economics and technical targets
- Good feedstock study to start the project (how much of the cob can be utilized)
- Looking to reduce the cost of pretreatment (Ammonia based pretreatment)
- Addressed reactor scalability (at NREL)

Weaknesses

- Lot more stress on the enzymes; if the enzymes don't produce and or are not cost efficient, the technology will fail
- Knocking out key genes to increase xylose fermentation needs clarification

Suggestions/Comments

- Reviewers encourage the group to focus on the cob rather than looking at stover
- High nitrogen in DDGS could be a problem and should be evaluated when using ammonia pretreatment (where are the beer still bottoms)

PI Responses

- None

Project Title: Separation of Corn Fiber and Conversion to Fuels and Chemicals

Principal Investigator: Nathan Fields, National Corn Growers Association (NCGA)

Strengths

- Focusing on creating high value products

- Working with the stuff in the mill, no transportation issues in the distribution chain
- Catalyst development for “plug in” technologies is a strength
- Using ethanol for oil extraction (extracting sterols, which are soon to be marketable)

Weaknesses
- Not applicable to alternative feedstocks
- Wet mill allowing 17% starch in residue is high and may not reasonable

Suggestions/Comments
- Reviewers encourage multiple licensing of these technologies

PI Responses
- None

Project Title: New Sustainable Chemistry for Adhesives, Elastomers and Foams
Principal Investigator: Scott Boyce, Rohm and Haas

Strengths
- Focus on replacing petroleum adhesives is a laudable goal
- Beneficial use of glycerol
- Scientific approach is sound
- Using established mechanisms to increase the chances of success

Weaknesses
- Need to make this available to applicable niche markets
- Niche market limited by the product being only 40% biobased

Suggestions/Comments
- Consider partnering to enhance a biodiesel facility (seems like a natural add on)

PI Responses
- None

Oil Mills Improvement Projects

Project Title: National Agricultural Based Lubricants Project
Principal Investigator: Wes James, University of Northern Iowa

Strengths
- Shotgun approach has merit in demonstrating said technologies
- Analytical analyses are comprehensive and team is well equipped
- Testing resources are needed for the industry

Weaknesses
- Project appears to be a more empirical approach rather than R&D
- This project is not researching clearly their two goals (cold weather applicability and oxidative state)

- Connection to the integrated biorefinery is not clear

Suggestions/Comments
- Reviewers question the applicability of this project to the Program goals

PI Responses
- None

Agricultural Residue Processing Projects

Project Title: Advanced Biorefining of Distiller's Grain and Corn Stover Blends
Principal Investigator: Bob Wooley, Abengoa

Strengths
- Commend the implementation of yield enhancements from pilot plant towards commercial ethanol plants
- Unique hybrid process
- Biocatalyst development for fermentation seems to be “breakthrough worthy”
- Overall hybrid concept gives scales to both utilities, e.g., distillation, evaporation (water integration, etc)
- Great team - partners are experts in their fields
- Considering back up organisms for the xylose utilization

Weaknesses
- Performance of pretreatment design reactor partner was poor

Suggestions/Comments
- Is there a concern of cross contamination between the fermentation tanks (yeast for xylose)
- Acid hydrolysis is corrosive and other pretreatment may need to be considered

PI Responses
- None

Project Title: Making Industrial Bio-refining Happen!
Principal Investigator: Pirkko Suominen, NatureWorks

Strengths
- Chemistry expertise is strong and impressive
- Development of low pH catalyst is an huge accomplishment
- Strong partnership, great team
- First indication of parallel conversion of C5 and C6 sugars

Weaknesses
- Demonstrated low pH catalyst on glucose, but not on a combined sugar stream
- Need to develop a stronger tie to the integrated biorefinery with a cellulosic feedstock

Suggestions/Comments

- Acetate tolerance needs to be demonstrated
- Clarification of contaminants the yeast is tolerant of would have helped the reviewers

PI Responses
- None

Project Title: A New Biorefinery Platform Intermediate

Principal Investigator: Hans Liao, Cargill

Strengths
- Looking at two different pathways to get to 3HP
  - 3HP is a building block chemical, adds versatility to the industry
- Energy consumption is reduced by 61% relative to the propylene pathway (petrochemical)
- Presenter alluded to competitive economics
- Strong replacement of a petroleum based product

Weaknesses
- Need to develop a stronger tie to the integrated biorefinery with a cellulosic feedstock
- Will the "experimental strains" scale up

Suggestions/Comments
- What technical risk revolves around the potential downstream separations issues

PI Responses
- None

Project Title: City of Gridley Biofuels Project

Principal Investigator: Tom Sanford, The City of Gridley

Strengths
- Concept of the thermochemical economic processing is fine
- Saying they found a gasifier technology with a longer residence time that allows for larger particle size (2-3 inch)
- Electromagnet is a solution to a major issue of silica
- Relatively high conversion/production of ethanol
- Reducing recycling/back half of the facility

Weaknesses
- Cleanup hurdle presented might be underestimated
- This is a long term project without any defined outputs, seems to be a small scale application
- Feedstock assumptions are underestimated (cost and transportation needs to be better estimated)

Suggestions/Comments
- Sounds too good to be true
- Why not going to Fischer Tropsch Liquids and power?

- Need to prove overcoming the barriers
    - Proof of catalyst and silica removal

PI Responses
- None

Project Title: Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries
Principal Investigator: Ed Lehrburger, PureVision Technology, Inc.

Strengths
- Separation is done for you in the process (three distinct streams)
- 60% yield of C5 without acid in the first stage
- Multiple benefits including removing solids benefit agitation (removes particles)
    - Removes technical risk for distillation in the back end
- Pure cellulose has opportunities for production of “high-value” products
- Solves a lot of issues for kraft pulping and the cellulose industry
- Removing the lignin has a huge impact on the enzyme costs

Weaknesses
- The scale up of the extruders is a massive undertaking (torque on the equipment)
- Selling lignin is more difficult than presented
    - Question as to where this could be marketed (polyphenol)
- Work on C5 fermentation needed to be better define, the fermentation is slow and may adversely effect the performance of the facility

Suggestions/Comments
- Need to consider the economics for multiple smaller units operating in parallel
- The GP mill referred, lignin product was shipped to Japan
- Need to do models burning the lignin

PI Responses
- None

Other Refinery-Related Projects

Project Title: Biorefinery and Hydrogen Fuel Cell Research
Principal Investigator: Cyrus Bhedwar, Georgia Environmental Facilities Authority

Strengths
- Two primary products of the pyrolysis reaction is interesting and something to build on (bio-oil and char)
- Concept of using the tree tops as a feedstock is unique (co-collected)

Weaknesses
- Project needed to be better focused
- Achievable goals need to be defined
- Focused relative to the Integrated Biorefinery
- Bio-oil stability is questionable
- Micro-algae work is not relevant

Suggestions/Comments
- The projects presented
- Char in the past have not proved to be a decent fertilizer
- Partner with a biorefinery for a feedstock and concentrate on pyrolysis-oil

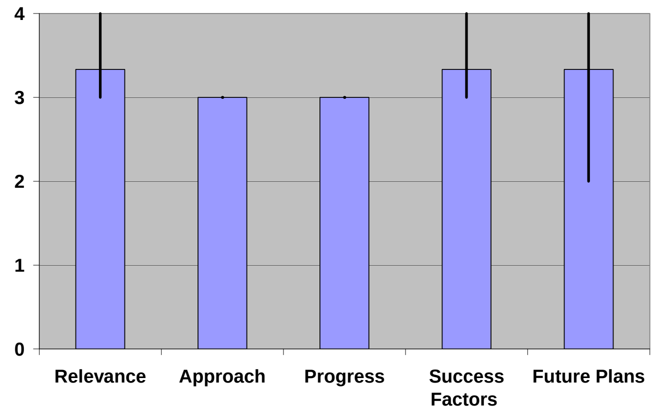
PI Responses
- None

Full Reviewer Comments and Scores

Analysis and Strategic Planning Projects

Project Title: Integrated Biorefinery Platform Analysis
Principal Investigator: Bob Wallace, National Renewable Energy Laboratory (NREL)
Proposed Stage: N/A
Recommended Stage: N/A

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.00	0.00	0.00
Progress	3.00	0.00	0.00
Success Factors	3.33	0.33	0.67
Future Plans	3.33	1.33	0.67
Average	**3.20**		



Question 1: Relevance to Overall Objectives.

- Overarching review of integrated biorefinery objectives are in line with office of biomass program objectives and long term goals.
- Various scenario models were important.
- Good work overall, although project financing assumptions are unrealistic, for example no project will ever receive 100% equity financing. Specific example (ethylene/propylene glycol) of economic Impact re co-products to current ethanol industry was good.

Question 2: Approach to Performing the R&D.

- Need to make sure that the model(s) remain tied to reality.

Question 3: Technical Accomplishments and Progress.

- This work directly relevant to and supports DOE programmatic goals.

Question 4: Success Factors and Showstoppers.

- The project demonstrates that critical technical factors have been identified; however, this may not be the case for critical business factors e.g. realistic assumptions re debt/equity ratios for project financing.

Question 5: Proposed Future Research Approach and Relevance.

- The project clearly demonstrates that it has and continues to build on NREL's recognized expertise in economic analysis and modeling.

Additional Comments

Strengths

- Excellent work on providing Aspen models for investigators to utilize for these and other DOE projects as well as for direction in parallel and unrelated studies.

- Models which will enable various integrated biorefinery designs to be compared on the same basis should provide a firm foundation for present projects to be utilized for planning of future investigations.
- Continues the tradition of NREL expertise in analysis and modeling. Provision of ASPEN models to industry.

Weaknesses

- There is a need to evaluate relative techno economics of attempting to ferment 5 carbon sugars and 6 carbon sugars simultaneously in one process as compared with utilizing separate, more efficient parallel processes for the fermentations.
- Underlying assumptions for C5/C6 processing needs clarification.
- Unrealistic assumptions re project financing.
- A concern that 100% equity may be unrealistic. There is a critical need to evaluate feedstock transport scenarios.

Technology Transfer/Collaborations

- The project needs to maintain and perhaps increase its effort to obtain "real world" technical and business input from technology developers to assure analysis/model credibility.

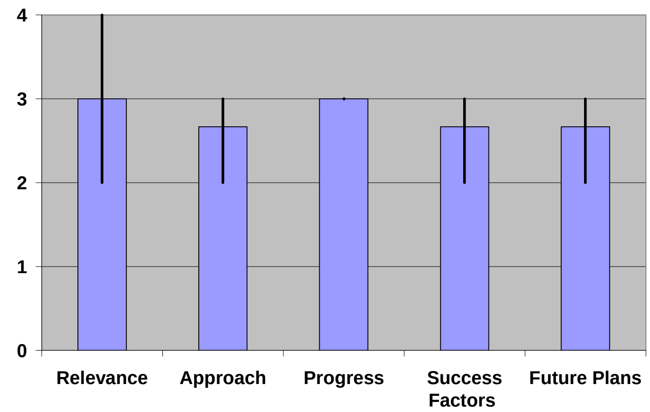
Recommendations for Additions/Deletions to Project Scope

- None

Corn Wet/Dry Mill Improvements Projects

<u>Project Title: Sugar-Based Ethanol Biorefinery</u>
<u>Principal Investigator:</u> Donal Day, Louisiana State University
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	1.00
Approach	2.67	0.67	0.33
Progress	3.00	0.00	0.00
Success Factors	2.67	0.67	0.33
Future Plans	2.67	0.67	0.33
Average	**2.80**		



Question 1: Relevance to Overall Objectives.
- Good guidance and the right type and level of analyses.
- There is a need for more economic assessment.
- The work on production of specialty chemicals from lignin should be stopped. These markets are limited and difficult to penetrate. The lignin should be burned for energy.

Question 2: Approach to Performing the R&D.
- Perhaps more focused scenarios would be of benefit.

Question 3: Technical Accomplishments and Progress.
- If the primary objective was to enhance biofuels, more emphasis should be provided in that area.
- The results from the pretreatment, hydrolysis and fermentation of the so derived sugars from biogases are encouraging.

Question 4: Success Factors and Showstoppers.
- Maybe not all were identified, but they have certainly taken a good shot
- The fermentation of pentose sugars is not considered critical and should be discontinued. The economic benefit work is essential.

Question 5: Proposed Future Research Approach and Relevance.
- Go forward to complete the whole picture.
- With the exception of the work lignin value-added chemicals and pentose fermentation, future work is well planned. The AFEX scale-up should focus only on batch processing.

Additional Comments

Strengths
- Investigators provided a number of findings, e.g., oligosaccharides as antimicrobials, molasses provides nutrients for fermentations.
- Consideration for continued work with batch process appears relevant.

- Work demonstrating the use of fiber mats was good as a potential co-product.
- Continue to focus on batch process.
- This project has the potential to ultimately provide significant economic benefits to the sugar refineries.
- Not looking at both C5 & C6 fermentation is the right approach. C6 focus conversion good.
- 6%ditilation looked at the economic impact using molasses to enhance conversion looking at value of other compounds i.e. vanillin C5 to succinic acid not competitive.

Weaknesses

- The list of lignin based coproducts was good; however, it was not apparent how marketable these items would be at the levels which they could be produced.
- Fermentation efforts should be focused on using 6 carbon sugars and not on simultaneous C5/C6 fermentations.
- Considerable work and evaluation of other crops for continuous utilization of the plant will be needed prior to pertinent economic assessments.\
- Planned work on: pentose fermentation; AFEX continuous processing and lignin value-added chemicals.
- Continued effort to provide ethanol concentrations of at least 6 to 8 per cent subsequent to fermentation appear necessary to commercialize this process. Levels of 3 to 4 per cent ethanol may not provide adequate primary product for economic feasibility.
- Pilot plant sizes for integrated biorefinery investigations need to be developed for continued work in this area.
- The potential for mutating *Pichia stipitis* for simultaneous fermentation of xylose and glucose was not clarified.
- Ascertain types of storage needed for batch processes. Gasification may be beyond the scope of the project.
- Use the lignin as a source of energy for operating the plant.
- Gasification - why pursue, keep focus on fermentation

Technology Transfer/Collaborations

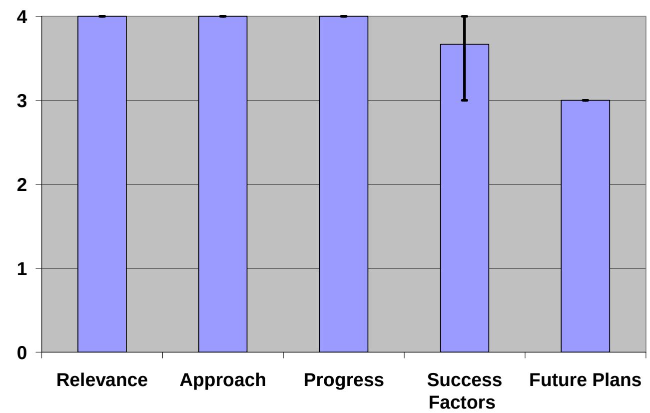
- Ongoing interaction with sugar refineries should be maintained to assure that the technology can be effectively integrated into existing operations.
- Pichia to ferment C5's

Recommendations for Additions/Deletions to Project Scope

- Question for OBP: How much are you able to take advantage of this strategic resource in publications/communication for the overall program?
- Discontinue work on: pentose fermentation; AFEX continuous processing and lignin value-added chemicals.
- Bagasse focus. high value product from cheap feed good displace bagasse as fuel
- 3 month sugar production limited
- Other feeds: harvest other stuff left in fields Cane leaf material
- Other products beside ethanol
- Economic advantage

<u>Project Title: Integrated Corn Based Biorefinery (ICBR)</u>
<u>Project Investigator</u>: Mike Sanford, DuPont
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	4.00	0.00	0.00
Success Factors	3.67	0.67	0.33
Future Plans	3.00	0.00	0.00
Average	**3.73**		



Question 1: Relevance to Overall Objectives.
- Thorough life cycle analysis. Use of ammonia to form acetamide, which is not inhibitory.
- The project seeks the solution of key technical issues relevant to commercial scale operation of an integrated biorefinery.
- Given DuPont's status, size and resources, its ability to attract customers is unlikely to be an issue.

Question 2: Approach to Performing the R&D.
- The focus on corn cobs as the sole feedstock is excellent strategy.
- The unit processes being focused on for improvement are that most directly relevant to ultimate economic viability.
- Addressing issue of sustainable quantity of feedstock is commendable.
- Balance of economics and technology

Question 3: Technical Accomplishments and Progress.
- The use of base catalyzed pretreatment avoids nasty issues associated with acid pretreatment processes.
- Operation of saccharification and fermentation at NREL PP mitigates risk re scale-up to larger and eventually commercial scale volumes.
- How much corn stover is recoverable- looked at impact
- Grain and cob result 50% mass of stover
  Cob = 65 gal/acre
- Ammonia pre-treat
- Scalable reactors
- Wanted 90% conversion, have 75% to glucose and 50% conversion xylose

Question 4: Success Factors and Showstoppers.
- Improving xylose transport as a solution to the parallel C5/C6 fermentation issue is an excellent approach.
- Cost of enzyme still an issue
- Too much focus on c5 to ethanol 72 hour fermentation…
- What happens If you ferment stream with typical beer yeast

Question 5: Proposed Future Research Approach and Relevance.

- The focus on enzyme development is key to obtaining acceptable overall process economics

Additional Comments

Strengths

- Review of life cycle analysis.
- Discussion of potential ethanol/acre from pericarp fiber, endosperm fiber and stover.
- Utilization of ammonia to convert acetic acid to acetamide.
- Knock out key genes to increase xylose fermentation.
- Use of corn cobs in conjunction with fiber from kernel.
- Excellent team for realization of achievable objectives.
- Great corporate strength re commercializing new products and processes.
- Very large and capable technical team.

Weaknesses

- A need to find simple, efficient systems to harvest, densify and transport corn cobs.
- Plan to also include corn stover as a feedstock in addition to cobs.

Technology Transfer/Collaborations

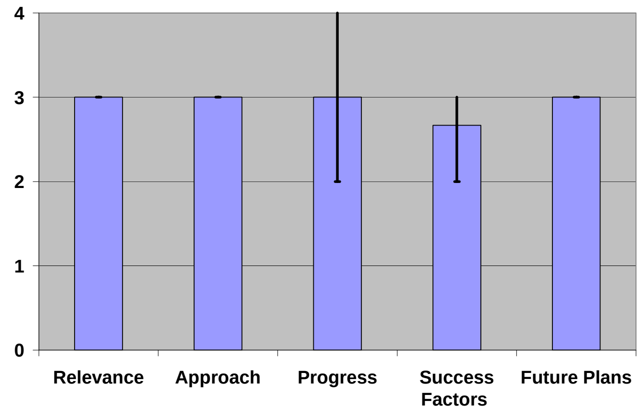
- Provides that framework

Recommendations for Additions/Deletions to Project Scope

- Suggest continued efforts be placed on work with corn cobs; cobs already to through the harvester.
- De-emphasize, or eliminate for the near- to mid term, work on corn stover i.e. getting it working for cobs then consider stover.
- Pre-treatment low cost

Project Title: Separation of Corn Fiber and Conversion to Fuels and Chemicals.
Principal Investigator: Nathan Fields, National Corn Growers Association (NCGA)
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	0.00	0.00
Approach	3.00	0.00	0.00
Progress	3.00	1.00	1.00
Success Factors	2.67	0.67	0.33
Future Plans	3.00	0.00	0.00
Average	**2.93**		



Question 1: Relevance to Overall Objectives.
- Focuses on maximizing total value of a corn wet mill via development of a suite of products.
- Feedstock to the plant corn fiber
- Alternative products to ethanol
- Starch, hemicellulose, oil

Question 2: Approach to Performing the R&D.
- Process design is good and use of ethanol to extract the oil is a positive feature.
- Use of existing pilot facilities good.
- Butanol, pet products
- Meets internal ROI

Question 3: Technical Accomplishments and Progress.
- Selection of performance indicators is appropriate and as are achievements measured against them.
- tons of fiber trialed
- Utilization of glucose and xylose using sachrimaisees?
- Time?
- Used ethanol for oil extraction

Question 4: Success Factors and Showstoppers.
- Xylose utilization is high.
- Low concentration of degradation/inhibitor compounds.
- Market for value added products
- Needed to make economics fly.

Question 5: Proposed Future Research Approach and Relevance.
- Capital cost estimates, economics and rate of return being evaluated by ADM.

Additional Comments

Strengths

- Well defined goals and objectives.
- Presentation of corn fiber composition was helpful in understanding the project.
- Good use of diverse projects at the University of Illinois.
- The use of ethanol for oil extraction was commendable.
- Utilization of a low cost feedstock for production of value-added co-products.

Weaknesses

- Few current publications and presentations.
- Production of polyols could be compromised by detrimental effect of fermentation broth on catalyst life during the hydrogenation step.
- Uncertain future re ultimate economics/rate of return/capital costs.

Technology Transfer/Collaborations

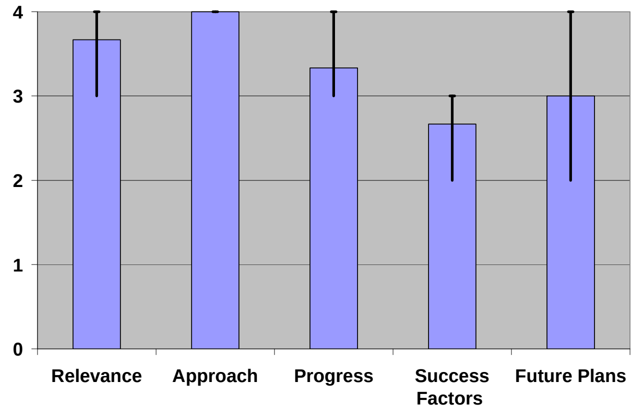
- Good/productive collaboration with ADM and PNNL.

Recommendations for Additions/Deletions to Project Scope

- Market for nutraceuticals needs to be investigated.
- Assessment of impact on product acceptability due to use of genetically modified organisms for processing.

<u>Project Title: New Sustainable Chemistry for Adhesives, Elastomers and Foams</u>
<u>Project Investigator</u>: Scott Boyce, Rohm and Haas
Proposed Stage: 2
Recommended Stage: 2/3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	4.00	0.00	0.00
Progress	3.33	0.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**3.33**		



Question 1: Relevance to Overall Objectives.
- Use of glycerol from biodiesel production addresses the major issue of markets for rapidly increasing amounts of glycerol.
- Replace petroleum based adhesives
- Good market, approximately 90 million pounds

Question 2: Approach to Performing the R&D.
- Project didn't attempt to develop fancy new chemistry. Rather, focused on replacing petrochemicals with biomass derived chemicals in established adhesive/elastomer/foam synthetic processes.
- Used material that uses biketene chemistry commercially available

Question 3: Technical Accomplishments and Progress
- Significant technical progress in terms of making bio-based reactants as petro-chemical replacements.
- Developed commercially viable prototypes
- Esterification reaction
- Foam replacement has huge volume impact

Question 4: Success Factors and Showstoppers
- The show stoppers are more economic than technical and strategies to overcome them quite possibly outside the industry's capability i.e. may require government intervention via incentives, regulation etc.
- Economics in doubt
- Can't match epoxies, too expensive
- Technically works

Question 5: Proposed Future Research Approach and Relevance.
- Future work on foams and utilization of more biobased intermediates is planned.

Additional Comments

Strengths
- Elimination of isocyanate handling.
- Utilization of glycerol to form glycerol tris acetoacetate.

- Demonstrating technical feasibility of foams and elastomers.
- Impressive number of new biobased chemical intermediates synthesized.
- Interest in biobased intermediates has been triggered in other areas of Rohm and Haas.

Weaknesses

- Ascertain relevant niche markets.
- Economics of using the new biobased intermediates is not favorable

Technology Transfer/Collaborations

- Good collaboration with Eastman, Virginia Tech University and USDA.

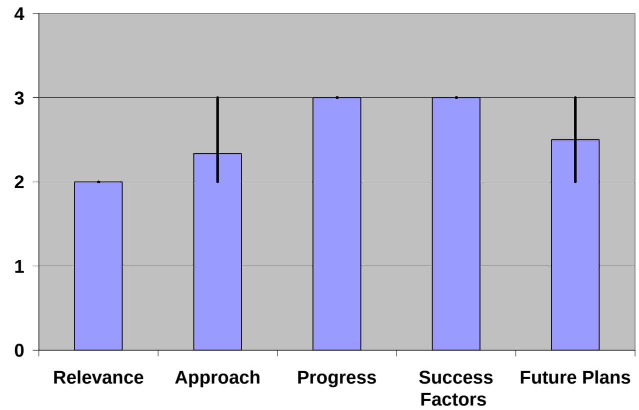
Recommendations for Additions/Deletions to Project Scope

- Partner with biodiesel production facilities.

Oil Mills Improvement Projects

<u>Project Title: National Agricultural Based Industrial Lubricants Center Project</u>
<u>Project Investigator</u>: Wes James, University of Northern Iowa
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.00	0.00	0.00
Approach	2.33	0.33	0.67
Progress	3.00	0.00	0.00
Success Factors	3.00	0.00	0.00
Future Plans	2.50	0.50	0.50
Average	**2.57**		



Question 1: Relevance to Overall Objectives.

- It's not clear how this is tied to the integrated biorefinery.
- Could be more appropriate for USDA support.
- Commercialize biobased lubricants
- $20 billion market.
- Important work with merit but not sure of relevance to this program.

Question 2: Approach to Performing the R&D.

- The approach is quite empirical in nature rather than true R&D. Nonetheless, that approach has been successful in producing near market-ready lubricants.
- The establishment of a test facility as part of the project is essential to expanded use of agricultural-based lubricants.

Question 3: Technical Accomplishments and Progress

- Commercialize products
- Syrup as feed used in drilling oil
- Testing

Question 4: Success Factors and Showstoppers

- Solutions to cold weather use and oxidation issues are essential.
- Cold temperature
- price
- Anything commercialized yet?
- What are the most likely feed and product?
- Soy based hydraulic?

Question 5: Proposed Future Research Approach and Relevance.

- Continuing to seek niche markets as an entry point for agricultural-based lubricants is reasonable.
- More focus on using waste or by-products stream as feed stock in lieu of virgin oils.

Additional Comments

Strengths

- Well equipped testing laboratory.
- Appears to fill a niche for lubricant testing.
- Establishment of a test facility for agricultural-based lubricants.

Weaknesses

- Overall objective to firmly establish a testing center is not consistent with DOE goals for an integrated biorefinery.
- Empirical rather than scientific approach to product development.
- Unclear connection to IBR.

Technology Transfer/Collaborations

- Unclear.

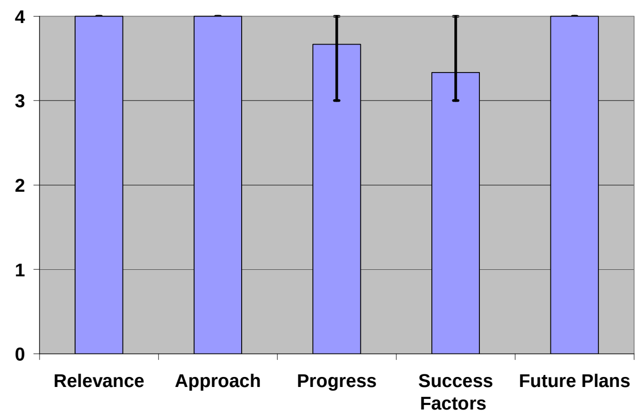
Recommendations for Additions/Deletions to Project Scope

- Important work with merit but not sure of relevance to this program.

Agricultural Residue Processing Projects

Project Title: Advanced Biorefining of Distiller's Grain and Corn Stover Blends
Principal Investigator: Bob Wooley, Abengoa
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	4.00	0.00	0.00
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.80**		



Question 1: Relevance to Overall Objectives.
- If successful, will result in an integrated biorefinery producing ethanol and valued added co-products from both starch and cellulosic feedstocks.
- Residual starch
- Yield
- Co-products
- Lab scale to pilot to production moving towards commercial
- Biocatalyst for xylose fermentation

Question 2: Approach to Performing the R&D.
- This project focuses on the key technical barriers: pretreatment; cellulose enzyme cost; and pentose fermentation.
- Team strong
- Integrated biomass into starch
- Xylose yeast

Question 3: Technical Accomplishments and Progress
- New process ready for implementation in company's corn dry mill plant and significant progress made on xylose fermentation.
- Variety of grains trialed
- Looked at economics
- Introducing into york commercial- yield improvement
- Animal feed in pilot
- Fractionation of stover
- 90%cellulose conversion
- Different strains of yeasts
- Enzyme cocktails

Question 4: Success Factors and Showstoppers
- A "back-up" strategy is in place in the event the intended route to improved C5 fermentation is unsuccessful.

- High protein beyond DDGs
- Xylose fermentation

Question 5: Proposed Future Research Approach and Relevance.

- The project team has many years of relevant, quality experience that it has brought to bear on all aspects of moving this technology to commercial scale operation.
- Co products going to users

Additional Comments

Strengths

- Good approach for developing a hybrid process.
- Development of biocatalyst is commendable.
- Laudable demonstration of increasing ethanol/acre as a result of integrating processes.
- A very strong technical team.
- Excellent partnerships.
- Use of yeast platform for xylose fermentation.
- Great project

Weaknesses

- Need to demonstrate cost effective fractionation technology.
- Failure to resolve the “Sunopta pretreatment issue” could require moving to an alternate pretreatment process with associated negative cost and schedule impacts.

Technology Transfer/Collaborations

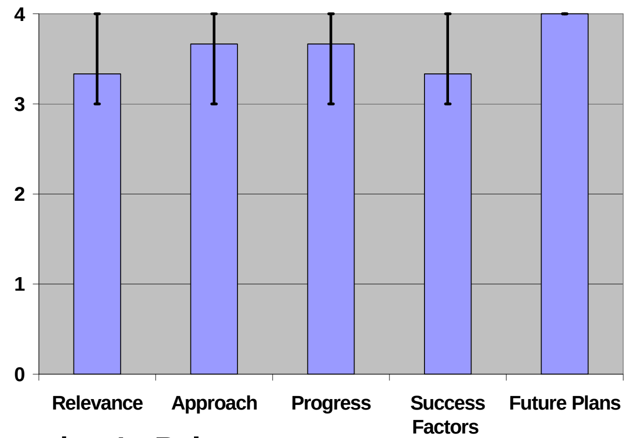
- The degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.
- The collaboration with NatureWorks has contributed significantly to the success of this project.

Recommendations for Additions/Deletions to Project Scope

- None

<u>Project Title: A New Biorefinery Platform Intermediate</u>
<u>Principal Investigator</u>: Hans Liao, Cargill
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.67	0.67	0.33
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.60**		



Question 1: Relevance to Overall Objectives.
- The development of 3-hydroxypropionic acid (3HP) from biomass derived sugar as a biobased intermediate for acrylic acid production is consistent with DOE/IBR objectives.
- 3HP can also be an intermediate for production of a number of other chemicals in an IBR.
- Glucose – 3hp- acrylic acid
- Market good 7 billion pounds /year
- 3 hp is platform chemical
- Economic advantage (based on biomass sugars?)
- Displace oil
- E coli is mechanism

Question 2: Approach to Performing the R&D.
- The project focuses on the key enzymes necessary to achieve product (3HP) specificity.
- Structure mechanism and enzymes to force 3 hp as only
- Pathway from glucose.

Question 3: Technical Accomplishments and Progress
- The required plasmid recombinant strains for each of the two selected biochemical pathways to 3HP have been successfully synthesized and 3HP production successfully demonstrated.
- Catalyst to take 3 hp to acrylic acid

Question 4: Success Factors and Showstoppers
- The selection of two pathways, one aerobic the other not, mitigates the risk of not achieving project goals.
- Fermentation titer and economic target

Question 5: Proposed Future Research Approach and Relevance.
- The plan to move to integrated strains for commercial scale production builds on the success with the plasmid bacterial recombinant strains
- Development both pathways in parallel
- Risk mitigation

Additional Comments

Strengths

- Production of an intermediate in a metabolic series which can be converted to other useful chemicals.
- Energy consumption reduced 61% compared to petrochemical route.
- Good replacement of petrochemical produced compound.
- Development two alternate biochemical routes to 3HP.
- Opportunity to use 3HP as an intermediate for at least 5 other compounds in addition to acrylic acid.
- Cargill's experience in biorefining as it pertains to the development and implementation of this 3HP production process.

Weaknesses

- No apparent connection with cellulose in a biorefinery realm.
- The integrated strains may not function as well as the plasmid strains.
- Large scale E. coli aerobic fermentations may be problematic.

Technology Transfer/Collaborations

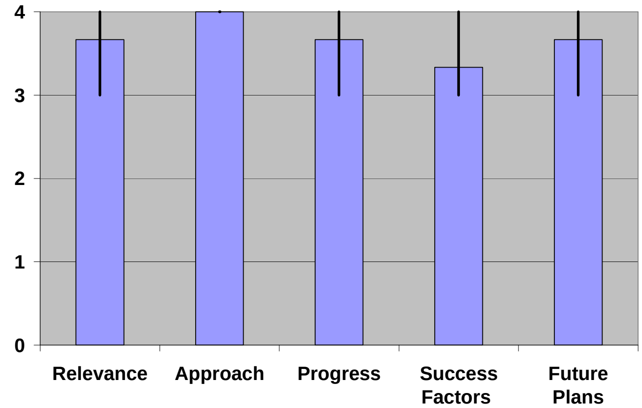
- The collaboration with Codexis was extremely fruitful with respect to strain development and selection.

Recommendations for Additions/Deletions to Project Scope

- None

Project Title: Making Industrial Biorefining Happen!
Project Investigator: Pirkko Suominen, NatureWorks, LLC
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	4.00	0.00	0.00
Progress	3.67	0.67	0.33
Success Factors	3.33	0.33	0.67
Future Plans	3.67	0.67	0.33
Average	**3.67**		



Question 1: Relevance to Overall Objectives.
- This work is critical to the development and deployment of IBR technology.
- Biocatalyst and fermentation
- Ethanol and lactic acid catalyst
- Low pH biocatalyst in hydrolyzate
- Petroleum based polymers replacement
- Lactic acid 30 billion # market PLA

Question 2: Approach to Performing the R&D.
- The key barriers are addressed for both ethanol and lactic acid production.
- Lower cost of PLA to compete with polystyrene
- Xplatfrom biocatalyst
- Robust yeast to ethanol and organic acid in PH<5

Question 3: Technical Accomplishments and Progress
- The demonstrated parallel fermentation of C5 and C6 sugars has not been reported to date in the literature. This is a major achievement for this project.
- Xylose biocatalyst to ethanol
- Lactic acid pilot trials done with biocatalyst
- Hydrolyze sugars to ethanol
- C6 and xylose yeast simultaneously
- PH<6 no xylose to ethanol
- Hydrolyzate tolerant strain
- Lactic acid commercial size fermentation

Question 4: Success Factors and Showstoppers
- A strong, experienced research team.

Question 5: Proposed Future Research Approach and Relevance.
- The future work builds on experience to date with respect to both key lactic acid and cellulosic ethanol production issues.

Additional Comments

Strengths

- Utilization of alternate pathway for xylose to be converted to ethanol.
- Yeast based biocatalysts which are resistant to contaminants.
- Methodical approach with achievable goals.
- Parallel conversions of glucose and xylose.
- Excellent partnership with Abengoa.
- Unique yeast platform for xylose fermentation strain development.
- Parallel fermentation of xylose and glucose.

Weaknesses

- A need to develop a direct association with a biorefinery concept.
- What is the xylose fermenting yeast's tolerance for contaminants/inhibitors in the "real world" sugar stream from acid pretreated cellulosic biomass.

Technology Transfer/Collaborations

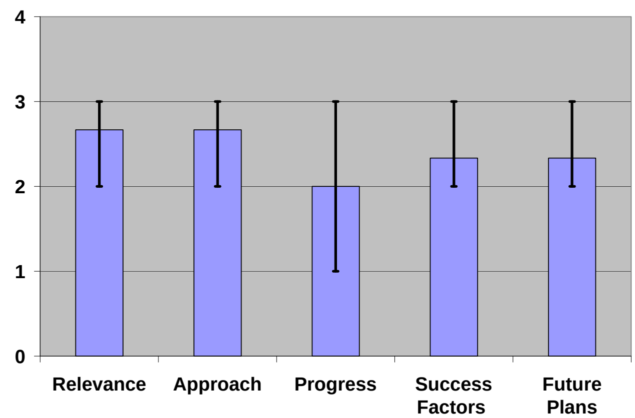
- The collaboration between NatureWorks and Abengoa has been a key factor to the success of this project.

Recommendations for Additions/Deletions to Project Scope

- None

<u>Project Title: City of Gridley Biofuels Project</u>
<u>Project Investigator:</u> Tom Sanford, The City of Gridley
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.67	0.67	0.33
Approach	2.67	0.67	0.33
Progress	2.00	1.00	1.00
Success Factors	2.33	0.33	0.67
Future Plans	2.33	0.33	0.67
Average	**2.40**		



Question 1: Relevance to Overall Objectives.
- Fits Integrated Biorefinery criteria – plan to produce ethanol, electricity, steam and silica.
- Markets for all four identified.
- Gasification rice straw
- Integrated electricity and steam produced too

Question 2: Approach to Performing the R&D.
- Gasification technology and catalyst(s) for synthesis gas to ethanol conversion have been selected.
- Silica separation technology is unique.
- Predicted yield of ethanol from syngas appears aggressive.
- 5 ton pilot plant
- Pyrolysis
- Can't bale right behind harvest
- Seasonal growth?

Question 3: Technical Accomplishments and Progress
- Not clear how much hard data (versus conjecture) was available from actual hours of gasifier operation, or at what scale.
- 99% conversion
- No O2 introduced
- 80-90 gallons/ton alcohol Fischer Tropsch liquids
- 550 kwh/ton electricity to grid
- 375 kwh/ton steam
- $1.12/gallon wow!!!!
- Longer residence time allows for bigger pieces into gasifier
- Extensive research on gasifiers

Question 4: Success Factors and Showstoppers

- Gasifier design, synthesis gas clean-up, silica removal and ethanol catalyst specificity have been correctly identified as key factors.
- Legal and regulatory issues were not addressed.
- Clean-up of gas? Prior to ethanol conversion
- Silica? Magnetic pulse removes silica (charged)
- Seasonal?
- $1.50/gal or $1.12?
- Range spin off from BCT

Question 5: Proposed Future Research Approach and Relevance.

- Lack of specific information on previous duration and scale of operation at pilot plant scale precludes assessment of adequacy of future plans presented.
- Commercial size unit in fabrication
- Not clear

Additional Comments

Strengths

- The documented capability of using 2 to 3 inch straw directly for thermochemical conversion.
- Removal of charged silica electromagnetically.
- Sourcing delivered rice straw for $30/ton.
- Reliable source of rice hulls (2.2 ton/acre) within a 30 mile radius.
- Overall concept is good.
- Catalyst for syngas conversion has high selectivity for ethanol.
- Syngas composition can be controlled.
- Alternate feedstock (fruit pits) has been identified.

Weaknesses

- For a project initiated in early 2003, the comment, “At this time, we have a plan; now we need to execute the plan.”
- Estimated cost for feedstock is considered too low.
- Lack of hard data from previous work.

Technology Transfer/Collaborations

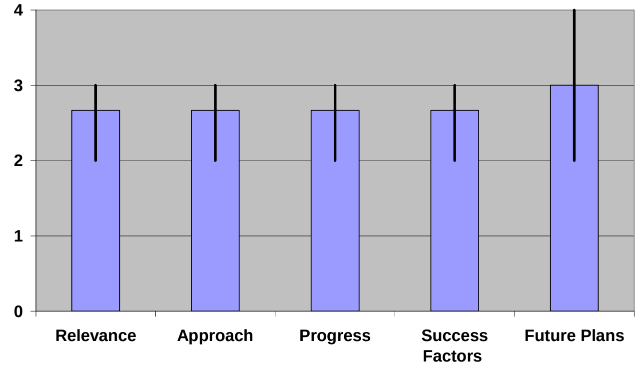
- The degree of collaboration with local and state authorities and relevant technology providers is satisfactory.

Recommendations for Additions/Deletions to Project Scope

- None

Project Title: Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries
Project Investigator: Ed Lehrburger, Pure Vision
Proposed Stage: 3
Recommended Stage: 3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.67	0.67	0.33
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**2.73**		



Question 1: Relevance to Overall Objectives.
- The technology will refine cellulosic biomass into its three basic constituents each in its own stream. From these, ethanol and valued added co-products can be produced.
- Lignin to adhesives
- C5, lignin, cellulose
- Designed experiment
- Good partners pulp and paper industry involvement

Question 2: Approach to Performing the R&D.
- Based on experience from the pilot scale operation, the extruder-based process appears to adequately define key technical issues. However, scale-up of the extruder to the size planned may not be feasible.
- 70%yield of xylose
- Counter flow reaction
- No acid addition?
- High temperature second stage –cellulose degradation?

Question 3: Technical Accomplishments and Progress
- The data from the pilot runs is very encouraging.
- Progress has been satisfactory.
- Low furfural/hmf produced
- Lignin products concrete binder, animal feed
- Pure cellulose < .5% lignin
- Less enzyme for ethanol conversion
- C5 stream products
- Optimized corn stover

Question 4: Success Factors and Showstoppers
- The critical issue in doubt is the scalability of the extruder. This could be mitigated by the use of multiple smaller units, but likely with negative capital and operating cost impact.
- Legal and/or regulatory issues were not addressed.
- Scale up of reactor to 3 tpd or larger

Question 5: Proposed Future Research Approach and Relevance.

- The future plan is clear; however, optional paths were not presented in detail.

Additional Comments

Strengths

- Xylose recovery of 65%.
- Reduction of NaOH use from 0.1. to 0.06 g/g biomass.
- Possible separation of cellulose as a clean stream.
- Companies they are intimate with can build operational 200 mm extruders which work with counter current process.
- The dynamic plug proved to be miraculous.
- Relatively simple technology that produces the three cellulosic biomass constituents in distinct streams.
- The cellulose stream, or a portion of it, may have more valuable markets than for ethanol.

Weaknesses

- Need to define the specific uses of $35 mm/yr lignin as concrete binder as well as animal food binder.
- Issues re scale up of the extruder.

Technology Transfer/Collaborations

- Collaboration with ENTEK on extruder design is commendable.

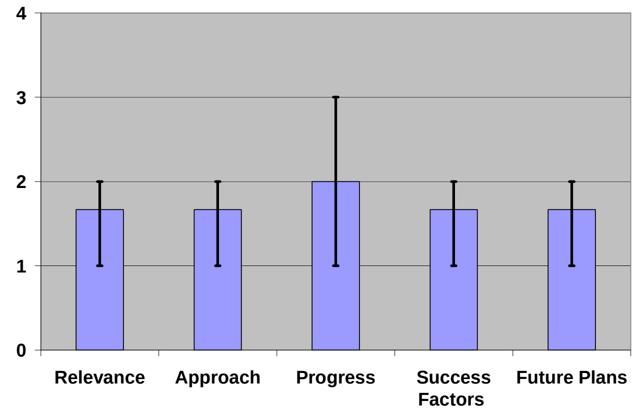
Recommendations for Additions/Deletions to Project Scope

- None.

Other Refinery-Related Projects

Project Title: Biorefinery and Hydrogen Fuel Cell Research
Principal Investigator: Cyrus Bhedwar, Georgia Environmental Facilities Authority

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	1.67	0.67	0.33
Approach	1.67	0.67	0.33
Progress	2.00	1.00	1.00
Success Factors	1.67	0.67	0.33
Future Plans	1.67	0.67	0.33
Average	**1.73**		



Question 1: Relevance to Overall Objectives.

- The project has potential to support the IBR but the R&D should be more focused.
- Gasification and H2
- Co product bio oil and charcoal products
- Bio oil blended in to diesel pyrolysis various forest
- Bio char is fertilizer
- Stability of bio oil?
- Use of solvents
- Cost of collecting forest residue
- Fermentable products
- Fuel cell
- Catalyst development
- Peanut hulls pyrolysis steam reforming H2 produced

Question 2: Approach to Performing the R&D.

- The project is too scattered and is dealing with too many sub-projects.
- Impact on ecology
- Develop catalyst from char reduce volatile organic compounds (VOC) cheaply
- Nh3 adsorption ozonating char enhances NH3 reduction
- Algae to treat waste water while producing renewable biomass.

Question 3: Technical Accomplishments and Progress

- Progress is indicated in some areas and not others.
- Performance indicators are not well defined.
- Miscible in biodiesel into petro diesel
- Vapor stream from pyrolysis
- Char as fertilizer results in productive soil

Question 4: Success Factors and Showstoppers

- Since the work is at best Stage B, many of the critical technical issues may not yet have been identified.
- ASTM certification

- Low pH of bio oil corrosive need to remove particulates to remove the corrosive particles.

Question 5: Proposed Future Research Approach and Relevance.

- Future work needs to be much more focused and strategically planned.

Additional Comments

Strengths

- Lots of ideas.

Weaknesses

- Need to focus on achievable goals; listing seven major areas may be energetic.
- For microalgae biomass production, working with mixed cultures may cloud findings with respect to important parameters.
- Use of algae as bioremdiator with respect to phosphorus removal from soil (which has been fertilized extensively with poultry manure) has not proved successful in the past.
- Not focused.
- Too scattered, too many things being researched – need to really focus

Technology Transfer/Collaborations

- None

Recommendations for Additions/Deletions to Project Scope

- Cut out everything except the work on bio-oil and char/carbon

APPENDIX A

Agenda

DOE Office of the Biomass Program

Integrated Biorefineries Peer Review
August 13-15, 2007

Day 1 – Monday, August 13th

Welcome and Platform Overview		
1:00 – 1:20	Welcome & Overview(s)	*Larry Russo, Office of Biomass Programs*
1:20 – 1:50	Project Management Overview	*Jim Spaeth or Gene, Golden Field Office*
1:50 – 2:10	Review of 932 Solicitation and Status	*Gene Petersen, Golden Field Office*
2:10 – 2:30	NEPA Requirements and Support for 932 and future Projects	*GFO NEPA (Kristen) representative, Golden Field Office*
2:30 – 2:50	Role of IE and IPA in 932 and future projects	*Cindy or Gene or Fred*

Break 2:50 – 3:00

Analysis and Strategic Planning		
3:00 – 3:30	Analysis Review and Strategic Plan	*Zia or Cindy*
3:30 – 4:10	➢ Integrated Biorefinery Platform Analysis	*Bob Wallace, National Renewable Energy Laboratory*

Corn Wet/Dry Mill Improvements		
4:10 – 4:30	Session Overview	*Gene Petersen - OR- Fred Gerdeman, Golden Field Office*
4:30 – 5:20	➢ Sugar-Based Ethanol Biorefinery: Ethanol, Succinic Acid and Byproduct Production and the Production of Ethanol, Chemicals, Animal Feed, and Biomaterials from Sugar Cane	*Donal Day, Louisiana State University AgCenter*

DOE Office of the Biomass Program
Integrated Biorefineries Peer Review
August 13-15, 2007

Day 2 – Tuesday, August 14th

Day One Review		
8:30 – 9:00	Day One Reviewer Feedback	*Dave Kelsall and Bill Cruickshank, Co-Chairs*

Corn Wet/Dry Mill Improvements (continued)		
9:00 – 9:50	➢ Integrated Corn-Based Bio-Refinery (ICBR)	*Michael Sanford, DuPont*

9:50 – 10:00 Break

10:00 – 10:50	➢ Separation of Corn Fiber and Conversion to Fuels and Chemicals Phase II: Pilot-Scale Operation	*Dr. Richard W. Glass , National Corn Growers Association*
10:50 – 11:40	➢ New Sustainable Chemistry for Adhesives, Elastomers and Foams	*Scott Boyce, Rohm and Haas Company / Rohm and Haas Chemicals LLC*

Oil Mills Improvement		
11:40 – 12:00	Session Overview	*Golden Field Office*
12:00 – 12:50	➢ National Agricultural Based Lubricants Project	*Wes James, University of Northern Iowa-NABL Center*

12:50 – 2:00 Lunch

Agricultural Residue Processing		
2:00 – 2:20	Session Overview	*Gene Petersen - OR- Fred Gerdeman, Golden Field Office*
2:20 – 3:10	➢ Advanced Biorefining of Distiller's Grain and Corn Stover Blends: Pre-Commercialization of a Biomass-Derived Process Technology	*Bob Wooley, Abengoa*
3:10 – 4:00	➢ Making Industrial Bio-refining Happen!	*Pirkko Suominen, NatureWorks, LLC.*
4:00 – 4:50	➢ A New Biorefinery Platform Intermediate	*Hans H. Liao, Cargill, Inc.*

DOE Office of the Biomass Program
Integrated Biorefineries Peer Review
August 13-15, 2007

Day 3 – Wednesday, August 15th

Day Two Review		
8:30 – 9:00	Reviewer Feedback	*Dave Kelsall and Bill Cruickshank, Co-Chairs*

Agricultural Residue Processing (continued)		
9:00 – 9:50	➢ City of Gridley Biofuels Project	*Tom Sanford, The City of Gridley*

9:50 – 10:00 Break

10:00 – 10:50	➢ Generating Process and Economic Data for Preliminary Design of PureVision Biorefineries	*Ed Lehrburger, PureVision Technology, Inc.*

Other Refinery-Related Projects		
10:50 – 11:10	Session Overview	*Gene Petersen - OR- Fred Gerdeman, Golden Field Office*
11:10 – 12:00	➢ Biorefinery and Hydrogen Fuel Cell Research	*K.C. Das, Georgia Environmental*
NOT ATTENDING	➢ *Energy from Biomass Research and Technology Transfer Program*	*Consortium for Plant Biotechnology Research Inc.*

12:00 – 1:00 Lunch

NOT ATTENDING	➢ *Biomass Biorefinery for Production of Polymers and Fuel*	*Not presenting*

Plenary Session		
1:50 – 3:00	Reviewers Report-out	*Dave Kelsall and Bill Cruickshank, Co-Chairs*
3:00	Adjourn	

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Larry Russo Please copy Melissa Harris (mharris@bcs-hq.com)

You have been invited to serve as a Reviewer for the DOE Integrated Biorefinery Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	**No**
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Technical Area or Project on Review Agenda	Nature of conflict of interest (Leave blank if none)

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Larry Russo (202-586-5618) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

____________________________ ____________________
Signature Date

____
Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session:

Reviewer Name: ____

Title of Project: ____

Presenter Name: ____

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement: ____

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to Overall Objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach to Performing the R&D**.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

U.S. Department of Energy
Office of the Biomass Program
Thermochemical Platform
Summary of Results

Dear Colleagues:

This document discloses the comments provided by a review panel at the:

- U.S. Department of Energy Office of the Biomass Program Peer Review held on November 15-16, 2007 in Baltimore, MD.
- Biomass Program Peer Review for the Thermochemical Platform, held on July 9th and 10th in Golden, Colorado.

The work evaluated in this document supports achieving DOE goals and the results of the review are major inputs used by the Department in making future funding decisions.

The research and development projects presented to the reviewers were organized by the thermochemical area they were investigating (i.e. analysis, gasification, cleanup, fuel synthesis or pyrolysis). The platform review agenda is attached to this report as Appendix A.

At the end of both meetings, a collection of summary comments was presented by the reviewer chairperson to the attendees at the end of the meeting. At the Platform Review, each PI was invited to provide responses to the initial reviewer feedback at and after the meeting. These summary comments and PI responses are included in the main body of this document.

The table below lists the projects in a ranked order based on the average score received from the Reviewer Panel. The average scores are based on a four point scale, with four being the highest. A full listing of all the reviewers' scores and comments (taken directly from their evaluation forms) is included in the main body of this report. The PIs will be sent the full reviewer comments, scores, and highlighted comments for comment, and any comments received will be added to the final report.

We would like to express our sincere appreciation to the members of the Review Panels. Your diligence and hard work during the review process resulted in many insightful comments that will help us improve our Programs.

Regards,

Paul Grabowski
Thermochemical Platform Technology Manager
DOE/EERE, Office of the Biomass Program

Project Title	Relevance	Approach	Progress	Success Factors	Future Plans	Average
Pyrolysis Oil to Gasoline	4.00	3.67	3.33	3.33	3.00	3.47
Syngas Platform Analysis/Thermochemical Platform Analysis	4.00	3.33	3.67	3.33	2.50	3.37
Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer Project	3.33	3.00	3.00	3.33	4.00	3.33
Thermochemical Conversion of Corn Stover	3.67	3.00	3.00	3.00	3.33	3.20
Integrated Catalyst Testing	3.33	3.33	3.33	2.33	2.33	2.93
Engineering New Catalysts for In-Process Elimination of Tars	3.67	3.33	2.33	2.67	2.67	2.93
Pyrolysis Oil R&D	3.33	2.67	3.00	2.67	3.00	2.93
Catalyst Fundamentals (Integration and sub tasks)	3.67	3.00	2.67	2.00	2.50	2.77
Syngas Quality for Mixed Alcohols	3.33	2.67	2.67	2.33	2.50	2.70
Gasification of Biorefinery Residues (lignin/modeling and optimization)	3.00	2.67	2.67	2.33	2.67	2.67
Biomass Gas Cleanup Using a Therminator	3.33	2.67	2.67	2.33	2.00	2.60
Biomass Derived Syngas Utilization for Fuels and Chemicals	3.33	2.67	2.33	2.67	1.50	2.50
Applications of Thermo-Depolymerization Technology	2.50	2.00	1.50	2.00	1.50	1.90
Small Scale Biomass System (Biomax)	3.00	1.00	2.00	1.50	1.50	1.80
Developing Thermal Conversion Options for Biorefinery Residues	2.00	2.00	1.33	1.67	2.00	1.80
Mississippi State University Sustainable Energy Center (MS)	2.33	2.00	2.00	1.33	1.33	1.80
Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant	2.33	2.00	1.67	1.33	1.33	1.73
Mississippi State University Sustainable Energy Center (MS)	2.00	1.67	1.67	1.33	1.33	1.60

Table of Contents

Program Peer Review Platform Results

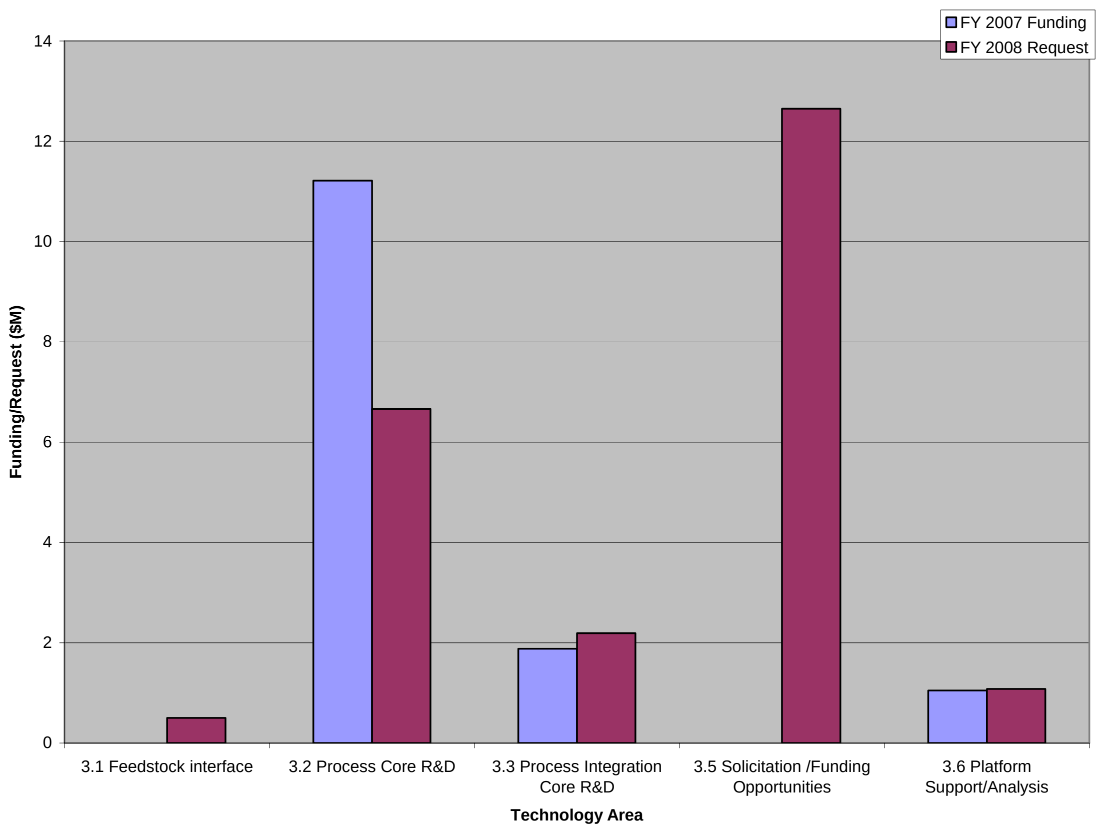
Platform Direction

In 2007 and 2008, the TC platform made a concerted effort to expand its R&D activities to include a wide range of available feedstock (agricultural residues to wood), a wide range of processing options (gasification and various liquefaction options), and a wide range of fuels synthesis technologies (alcohol, gasoline, diesel, jet). Two solicitations (one in 2007 and 2008) are key in developing projects for this expanded R&D effort. Beginning in 2008 these initial efforts have received additional funding. Additionally, the platform expanded an effort in feedstock analysis and logistics. These activities address multiple strengths and weakness.

The Thermochemical Conversion Platform is facilitating technology that can process multiple feedstocks, including those less suitable for biochemical conversion technologies and can produce a wide range of fuels.

In 2007 the platform completed design reports for both gasification to alcohol fuel and 2008 a design report for pyrolysis to a refinery feed for gasoline/diesel production.

Platform Funding (in $M):



Specific Responses to Select Comments

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
Good partnering with UOP who has experience in both petroleum processing and biochemical processing. Good university, industry and national lab cooperation. Using technology that for the most part has long experience.		We agree, thank you
This platform has such potential in addressing multiple issues – biorefinery integration, integration with existing fuel infrastructure, utilization of multiple feedstocks, etc. In the gasification focus of the platform, there seems to have been an appropriate focus on bottlenecks (catalysts/tar removal).		We agree, thank you
Innovative dryer designs would benefit from a wide range of technologies if successful, including the biochem projects.		Not sure what this comment means. We agree that a wide range of conversion technologies would benefit from feedstock processing technologies, including cost-effective dryers. Our interface with the feedstock platform work is addressing that.
Concern about what has changed that makes this attractive now, and worth reopening		Internal and external analyses have indicated that both gasificationa and pyrolysis of biomass for cost-competitive fuels production are cost competitive with biological conversion technologies. Commercial interest has validated the analyses as has 932 and 10% selections.
Subsequent to many years of funding projects to produce syngas, perhaps work should be oriented to separation of producer gas components. A review of current data should be accomplished to delineate relevance of simple and/or multiple technology procedures. Numerous projects were not focused; a shotgun approach often was evident. Economic assessments could have been made with current available information.		Our analysis, which is updated annually, shows that gas cleaning and fuels synthesis are the best areas for our investment. While gas separation technologies are fairly well-developed commercially. We agree that a review of separation technologies may be valuable. Agree, reviews such as this and the peer review help us to identify projects that need to be refocused and projects that should potentially be eradicated.

Program Peer Review		
Reviewer Comment		**Technology Manager Response**
It is not clear that DOE has been under funding gasification and pyrolysis R&D once the DOD and DOE coal R&D activities and the commercial R&D investments are considered. Clearly OBP needs to integrate these technologies into their Bioconversion platform but a more rigorous effort is needed to define what needs to be done for OBP and OBP's goals, not necessarily to benefit the industry at large. I want to reiterate one of the reviewer's comments as I support these strongly. ▪ Techno-economic modeling is needed to help determine the priority direction for platform funding. ▪ The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach. ▪ The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE, (coal) and DOD R&D.		We continually try to coordinate and exchange info with other agencies. Successful implementation of this is difficult, at best. Agree, we perform this TECO modeling annually Agree Agree
Duplication of effort re cellulosic biomass gasification and coal gasification as they pertain to the use of the syngas produced.		Our primary activities focus on gas cleanup, and conversion of biomass-produced syngas to fuels. This syngas can often contain poisons to fuel catalysts). Once the syngas is cleaned syngas from coal and biomass can be used equally well to produce fuel, however, the fuels focus of OBP may differ from fuels important to DOE-FE resulting in complimentary programs.
The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.		We do partner with the feedstock platform. Due to funding levels this began in FY08. Potential interactions with DOE-Sc and NSF are handled through the Biomass Research R&D Board Conversion Group.
Project outlines need to be developed to focus on particular, relevant objectives.		Agree
Look for opportunities to share research and development with some of the fossil fuel programs**.**		Agree, we generally have done this via industry projects. We have discussed with DOE's coal gasification group, with limited results.
It would be beneficial (but probably very difficult), for the thermochemical conversion program to establish criteria to validate the claims of the plethora of companies purporting to have viable, operating gasifiers.		Agree, this is probably better suited for an industry group. However, the TC platform is developing a data base of companies/universities/labs involved in this technology—a first step.

Program Review Comments

Strengths

- The program is based on an excellent understanding of the issues.
- Good partnering with UOP who has experience in both petroleum processing and biochemical processing. Good university, industry and national lab cooperation. Using technology that for the most part has long experience.
- This platform has such potential in addressing multiple issues – biorefinery integration, integration with existing fuel infrastructure, utilization of multiple feedstocks, etc. In the gasification focus of the platform, there seems to have been an appropriate focus on bottlenecks (catalysts/tar removal).
- Innovative dryer designs would benefit a wide range of technologies if successful, including the biochem projects.
- Decision to increase focus on pyrolysis has tremendous opportunity. Focus on producing a range of biofuels, several of which would be attractive to the existing petroleum industry.

Weaknesses

- The weakness is in the goals as articulated in the MYPP, which seem to not be in agreement with the MYPP's statements about the opportunities and challenges with a wider variety of feedstocks. This platform is the primary platform to address their use.
- Concern about what has changed that makes this attractive now, and worth reopening.
- As previously noted on this form and in the platform review, the platform should widen its scope to reach its potential in achieving the President's goals.
- Subsequent to many years of funding projects to produce syngas, perhaps work should be oriented to separation of producer gas components. A review of current data should be accomplished to delineate relevance of simple and/or multiple technology procedures. Numerous projects were not focused; a shotgun approach often was evident. Economic assessments could have been made with current available information.
- Some of the projects seem unfocused; a shotgun approach often was evident. It seems that these are older projects and projects that were not solicited by the platform. The stronger platform focus on fuels should to remedy this.
- It is not clear that DOE has been under funding gasification and pyrolysis R&D once the DOD and DOE coal R&D activities and the commercial R&D investments are considered. Clearly OBP needs to integrate these technologies into their Bioconversion platform but a more rigorous effort is needed to define what needs to be done for OBP and OBP's goals, not necessarily to benefit the industry at large. I want to reiterate one of the reviewer's comments as I support these strongly.
    - Techno-economic modeling is needed to help determine the priority direction for platform funding.
    - The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach.
    - The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE, (coal) and DOD R&D.
- Duplication of effort in regards to cellulosic biomass gasification and coal gasification as they pertain to the use of the syngas produced.

R&D Portfolio Gaps

- There wasn't a separate slide for gas, but this matter was embraced in comments and recommendations. The most important gap is to increase funding. Other "gaps" cited is acceptable to this reviewer.
- The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.
- I agree with the platform review's analysis of the existing gaps.
- The potential of this platform is so great it deserves additional funding to determine whether the remaining challenges can be resolved. This may be the same state of affairs that existed when the platform was downsized some years ago, but the world has moved forward since that time.
- Project outlines need to be developed to focus on particular, relevant objectives. Perhaps because of considerable past work, the researchers did not feel the need to define specific items, rather to continue with general approaches which can be projected well with enthusiastic show persons. In particular studies, there appeared to be little awareness of DOE goals. Available dollars may have been spent on state of the art equipment; however, lack of securing researchers capable to utilizing the equipment as well as the data. There is a need to have given projects exhibit coherent approaches to posed questions.
- No additional gaps to those identified in the platform review report.

Additional Recommendations, Comments and Observations

- It would be beneficial (but probably very difficult), for the thermochemical conversion program to establish criteria for to validate the claims of the plethora of companies purporting to have viable, operating gasifiers.
- Look for opportunities to share research and development with some of the fossil fuel programs**.**
- Project outlines need to be developed to focus on particular, relevant objectives.
- The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.

Platform Review Feedback

Specific Responses to Select Comments

Platform Peer Review		
Reviewer Comment		**Technology Manager Response**
Considering the value and potential, the thermochemical platform has been under funded for several years.		Agree, however the funding increase is gradual.
The thermochemical route is a valid endeavor, and perfectly situated to handle a variety of feedstocks and solve problems that still exist in the biochemical side – producing real fungible liquid transportation fuels		Thank you
The panel feels that the expansion of the platform to include other products and fuels is		Agree

very positive, but suggests that the focus be broadened to include Fischer- Tropsch liquids and a more rigorous effort on pyrolysis oil.		
Would like to see some more fundamental approaches to pressing problems of the thermochemical platform.		Agree, we would like the Office of Science to engage the fundamental science around thermochemical conversion including how the mechanisms of how biomass deconstructs under heat (gasification or liquefaction).
The focus on tar removal maybe too limited in scope, the program should consider alternative gasification approaches that limit tar production, and other alternative research paths.		We agree and are seeking to improve gasfication and pyrolysis processes.
Techno-economic modeling is needed to help determine the priority direction for platform funding.		Yes, our analysis does just this.
The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach.		Agree
The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE office and laboratories that specialize in coal gasification.		Agree, see above
Needs to be an assessment of fossil vs. biomass vs. co-processing: policy, economic and deployment		Our analyses consider these issues, as well as several environmental issues.
Should not assume that gasifiers have to make high level of tars		See above
Standardized/consistent economic and process modeling should be done to provide a baseline for comparison of all project goals and work		agree

General Platform Comments

- Considering the value and potential, the thermochemical platform has been under funded for several years.
- The thermochemical route is a valid endeavor, and perfectly situated to handle a variety of feedstocks and solve problems that still exist in the biochemical side – producing real fungible liquid transportation fuels
- The panel feels that the expansion of the platform to include other products and fuels is very positive, but suggests that the focus be broadened to include Fischer Tropsch liquids and a more rigorous effort on pyrolysis oil.
- Would like to see some more fundamental approaches to pressing problems of the thermochemical platform.
- The focus on tar removal maybe too limited in scope, the program should consider alternative gasification approaches that limit tar production, and other alternative research paths.
- Techno-economic modeling is needed to help determine the priority direction for platform funding.

- The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach.
- The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE office and laboratories that specialize in coal gasification.

General Comments (applicable to all presentations)

- Understanding this is a reinvigorated program:
  - There was a great deal of variation in quality and focus within the Portfolio of projects.
  - There was a lack of continuity within the scope of several projects
  - Needs to be an assessment of fossil vs. biomass vs. co-processing: policy, economic and deployment
  - Several of the projects would have benefited from a guiding scientific hypothesis, novel technology or high through-put technology
  - Standardized/consistent economic and process modeling should be done to provide a baseline for comparison of all project goals and work
  - Should not assume that gasifiers have to make high level of tars
  - Current analysis work should be broadened

Initial Reviewer Feedback – Comment Summaries

Analysis Projects

Project Title: Syngas Platform Analysis/Thermochemical Analysis
Principal Investigator: Andy Aden, National Renewable Energy Laboratory

Strengths
- This work is "critical" to the platform
- It was technically competent analysis
- The PI is using industrial sound analysis methodology
- The thermochemical design report is a very valuable, publicly available document

Weaknesses
- Before selecting a process to be used in the analysis, there needed to be a back of the envelope analysis for multiple technologies processes.

Suggestions/Comments
- This type of analysis should be used in guiding R&D efforts, which currently may be understated
- Critical literature review of current pyrolysis reports before pursuing the new pyrolysis design report
- Need to work hard to get cost numbers that are representative of current industry

PI Response
- There was back of the envelope analysis performed, but not presented in the time allotted.

Gasification Projects

Project Title: Gasification of Biorefinery Residues
Principal Investigator: David Dayton, National Renewable Energy Laboratory

Strengths
- Good fundamental and supporting deployment work
- The completed feedstock comparison is valuable

Weaknesses
- Gasifier is fixed and tar is looked at as inevitable
  - Several large-scale demo gasifiers are available and should be considered in this task.

Suggestions/Comments
- Program needs to address how this project is coordinated. (there seems to be a little of everything happening)
- Should be using one process engineering model (ASPEN/ChemCAD)

- Should look at MFIX as an analytical tool

PI Response

- Tars are inevitable, it's more of a question of concentration and quantity
- ASPEN & ChemCAD have different uses

Project Title: Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant

Principal Investigator: Ed Gray, Antares

Strengths

- A focus on otherwise intractable waste
- Good recognition that the target has changed, and a good faith response to the initial plan

Weaknesses

- Need to critically look at the merit of this technology, the review panel sees limited impact and the need for good economics and catalyst performance evaluation

Comments/Suggestions:

- Technology has been extensively explored for a number of options, but technology does not seem to meet performance requirements
- Project was not related to current Program goals, but the shift towards utilization of biorefinery residue focus should be encouraged.
    - Methane is not a liquid transportation fuel

PI Response

- The process is supporting the Program, we are making power to facilitate ethanol production and developing another way of addressing other wastes

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Project Title: Mississippi State University Sustainable Energy Center

Principal Investigator: Mark Bricka and Mark White, Mississippi State University

Presentation was not consistent with the presentation formatted, making this project difficult to evaluate

Strengths

- MTG element produces a fungible transport fuel.

Weaknesses

- Some project activities are clearly redundant and the remaining tasks are not aligned with the Program goals and priorities.
- Overall project lacked direction and clear justification
- The project was based on using regional feedstocks with off the shelf technology, not utilization of novel technologies or processing
- A poor understanding of literature led to duplication of prior work lacking novelty

Comments/Suggestions:

- Project activities are clearly redundant
- Take direction from program to better align with the Program goals and priorities (liaison with DOE office)
- Need to work hard to understand program goals and focus work on innovative technologies
- The project needs guiding outside committee to organize projects under this task
- Need outside collaborators

PI Response

- Presentation would have better address the issues with more guidance

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Project Title: Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer
Principal Investigator: Kevin Whitty, University of Utah

Strengths

- Very well thought-out and executed around good sound science
- Outstanding technical approach
- Good collaboration

Weaknesses

- Gasifier technology weak

Comments/Suggestions:

- Not a current priority feedstock to the Program
- Continue to look for opportunity for use of facilities that would fit the program goals

PI Response

- Presentation would have better address the issues with more guidance

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Gas Cleanup and Conditioning Projects

Project Title: Biomass Gas Cleanup Using a Therminator
Principal Investigator: Santosh Gangwal, Research Triangle Institute

Strengths

- Great approach
- Relevant to the Program goals
- Reasonable participants and plays to RTI's strengths

Weaknesses

- Unclear as to the innovation of the catalyst.

Comments/Suggestions:

- Focus majority of effort on truly making the tri-functional catalyst work.

- Reviewers had a hard time understanding the details of the technology presented. What was the funding for?
- CFD modeling should be performed to help with scale up

PI Response
- No response given.

Project Title: Engineering New Catalysts for In-Process Elimination of Tars

Principal Investigator: Larry Felix, GTI

Strengths
- Novel technology
- Multiple options for use and decoking
- Nice integrated approach with several collaborators

Weaknesses
- Novelty of approach may limit the implementation
- Poisons effect on the process should be evaluated

Comments/Suggestions:
- Economic comparison needs to be evaluated
- Suggest careful consideration of commercialization pathway

PI Response
- No response given.

Project Title: Catalyst Fundamentals

Principal Investigator: David Dayton for Kim Magrini, National Renewable Energy Laboratory

Strengths
- Good collaboration between national laboratories
- Good utilization of analytical tools
- Good integrated approach

Weaknesses
- Progress is incremental
- Innovation with new catalyst formulation is weak

Comments/Suggestions:
- Future purpose and direction is questionable
    - Suggest a "CAFI" like solicitation for testing
- Higher through-put screening of current or new catalysts is vital

PI Response
- The current work with the nickel catalyst is on further understanding the shape and activity of Nickel. Two aspects that are not well known, but once classified can improve with other metals.

Project Title: Integrated Catalyst Testing
Principal Investigator: Calvin Feik, National Renewable Energy Laboratory

Strengths
- There is value in having the capability (and using it) to test on a large-scale – with “real” syngas
- Methodical testing approach

Weaknesses
- Needs to run more catalyst evaluations in pilot scale reactor

Comments/Suggestions:
- The reviewers would like a closer inspection of the anomalies in the data presented

PI Response
- No response given.

Fuel Synthesis Projects

Project Title: Thermochemical Conversion of Corn Stover
Principal Investigator: James L. Gaddy, Bioengineering Resources Inc

Strengths
- Novel technology
- Pilot plant running – it looks like it works

Weaknesses
- No performance or economic\data supplied
- Didn’t approach the project with any optimization of the gasifier, fermenter, or gas clean-up system
- Separation of ethanol/water was under defined and seems to be problematic

Comments/Suggestions:
- Gasifier eliminates tar
- What is left to be done, project seems to be close to commercialization

PI Response
- Is being used in a 932 selected project

Project Title: Small Scale Biomass System (BioMax)
Principal Investigator: Robb Walt, Community Power Corporation

Strengths

- They are building on past successes
- Liquid fuels technology presented is revolutionary.
- Operational small scale unit

Weaknesses
- Provided no information on the liquid fuels technology to validate claims
- Not high efficiency conversion of biomass to fuel due to the power co-product

Comments/Suggestions:
- Need a long-term demonstration for liquid fuels production System as designed for producer-gas production, not supposed to operate 24 hrs, on/off system as needed. (amended based on comments in review)

PI Response
- No response given.

Project Title: Biomass-Derived Syngas Utilization for Fuels and Chemicals
Principal Investigator: Santosh Gangwal, Research Triangle Institute

Strengths
- Building on past success
- Good facility and capabilities for this project

Weaknesses
- Modest and undifferentiated catalyst advancements
- Focus on Fischer-Tropsch liquids vs. mixed alcohols is unclear
- An industrial partner needs to be replaced for the project to continue

Comments/Suggestions:
- Need to aggressively focus on catalyst evaluation with realistic gas streams

PI Response
- No response given.

Project Title: Syngas Quality for Mixed Alcohols
Principal Investigator: Jim White, Pacific Northwest National Laboratory

Strengths
- Sound technical approach
- Team demonstrated an understanding of literature and have looked at other options
- Plan for high through-put screening is valuable
- Good collaboration between NREL & PNNL

Weaknesses
- Target (for goals) selection does not seem to be done on sound economic model and mixed alcohol (vs. just ethanol)

Comments/Suggestions:

- Engineering solutions to reactor geometry would strengthen this project

PI Response

- Project (including the target goals selection) is being heavily driven by analysis work, early DOE focus on ethanol vs. mixed-alcohol. Will have internal discussions to broaden scope.
- Reactor design was never defined as priority, though always planned to examine reactor to demonstrate ability and look more at poisons.

Pyrolysis Projects

Project Title: Pyrolysis Oil R&D

Principal Investigator: Doug Elliott, Pacific Northwest National Laboratory

Strengths

- Standards development will benefit industry (amended based on comments)
- Seems like the project is evaluating design options and looking at new opportunities and concepts (and goals align with program)
- Project lays out a program direction for DOE
- Tied with the UOP effort
- Good collaboration between NREL&PNNL

Weaknesses

- Goals and technical plan could have been a little more ambitious
- Focus of overall project needs to be better defined

Comments/Suggestions:

- Project would benefit from a more intense computational and economic modeling effort

PI Response

- Please provide target specific comments on the draft targets established. The project is not far enough along to have economic modeling.
- Need a process model to a point to what we know needs to eliminate, modeling able to inform technical progress, right now no model, once get it to re-work will need specific variables.

Project Title: Pyrolysis Oil to Gasoline

Principal Investigator: Richard Marinangeli, UOP

Strengths

- Credible industrial player
- Good partnerships, partners playing to their strengths
- Exceeded DOE targets
- Good approach, nice development of both economic and technical work
- Environmental impact analysis is beneficial

Weaknesses

- Uncertain of initial economics (stage 1, understood, just be careful with the chart)

Comments/Suggestions:

- Team would be strengthened with the additional of a production partner
- The reluctance of government to give equal credits to this type of diesel as other diesel. It will be eligible for credit (renewable diesel), just not for the gasoline fraction (also LR – are people trying to reverse decision)

PI Response

- No response given.

<u>Project Title: Developing Thermal Conversion Options for Biorefinery Residues</u>

Principal Investigator: Vann Bush, Gas Technology Institute

Strengths

- Developing an universal front end processing unit for regional feedstock applications (NV and AL)

Weaknesses

- Project plan was unclear
- Didn't appear to have investigated potential technical and economics showstoppers small scale/portable complex systems
- Did not define economic analysis needs to be performed on the process
- Handling and cleaning of woody biomass has been extensively studied by the pulp and paper industry

Comments/Suggestions:

- The panel suggests an in-depth stage gate prior to initiation of new work
- This technology has been funded at very high levels (estimated at $70MM), and the added value for this particular project is unclear
- The panel suggests the team consider other pre-treatment technologies

PI Response

- No response given.

<u>Project Title: Mississippi State University Sustainable Energy Center</u>

Principal Investigator: Phil Steele and Leonard Ingram, Mississippi State University

Strengths

- Pyrolysis reactor is currently available and have identified a supplier that can manufacture it
- Recognized the need to narrow focus to areas of interest to the DOE program

Weaknesses

- No use of innovative technology was presented to the panel

- Prior to commencing R&D, engineering/process analysis to help define technical targets was needed to better guide this work
- Some project activities are clearly redundant and the remaining tasks are not aligned with the Program goals and priorities.
- Overall project lacked direction and clear justification
- A poor understanding of literature led to duplication of prior work lacking novelty

Suggestions/Observation:

- Take direction from program to better align with the Program goals and priorities (liaison with DOE office)
- The project needs a guiding outside committee to organize projects under this task
    - Need outside collaborators
- Presentation was not consistent with the format
- Project activities are clearly redundant
- Need to work hard to understand program goals and focus work on innovative technologies that

PI Response

- No response given.

Project Title: Applications of Thermo-Depolymerization Technology

Principal Investigator: Tom Butcher, Brookhaven National Laboratory and Gabe Miller, Society for Energy and Environmental Research

Strengths

- Process to economically convert waste material into a transportation fuel is beneficial

Weaknesses

- Representative of technology provider should have been present to help explain project goals
- This project is not in alignment with Program goals
- Impact on biofuels industry will be insignificant
- Technology will have to compete with credible industrial organizations that have processes that can utilize waste grease

Comments/Suggestions

- The panel suggests an in-depth stage gate prior to initiation of new work
- Inclusion of Brookhaven with the specialized analysis capabilities would strengthen this project
- This technology has been funded at very high levels (estimated at $70MM), and the added value for this particular project is unclear
- There are other technologies for conversion of fats that maybe a better process option.

PI Response

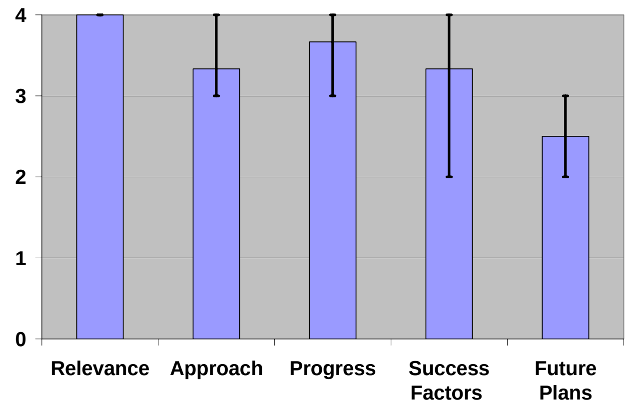
- No response given.

Full Reviewer Comments and Scores

Analysis Projects

Project Title: Syngas Platform Analysis/Thermochemical Platform Analysis
Principal Investigator: Andy Aden, National Renewable Energy Laboratory
Reviewers Comments on Stage – Several stages hit; key to total process since Analysis provides economic foundation for all efforts.

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	3.33	0.33	0.67
Progress	3.67	0.67	0.33
Success Factors	3.33	1.33	0.67
Future Plans	2.50	0.50	0.50
Average	**3.37**		



Question 1: Relevance to Overall Objectives.

- Very important work. Needs to include better validation from engineering firms with real life experience and cost information.
- This task defines the basis of all activities in the thermochemical area. It provides the measuring stick to rate optional technologies on a level playing field.
- Process design and engineering analysis as demonstrated in this study is an essential tool in both the evolution of design of renewable fuel plants and in the selection of research projects to support the technology development.

Question 2: Approach to Performing the R&D.

- Thermochemical conversion is complex, but this is a very good start.
- Need to keep focus on the current process, and not worry about addressing all the options. If someone wants additional analysis on new option then let them pay for it.
- Given the position that this task plays in the evaluation of the entire program, a better approach is needed. Pick and stay with an evaluation procedure.
- The approach should identify what technologies are being evaluated and why (what benefits are expected)
- Since no gasifier is commercial, the baseline needs to consider several of the pre-commercial gasifiers out there
- Need to assess data in e.g. Aspen data bases more carefully in a few cases.

Question 3: Technical Accomplishments and Progress

- Great progress with the current base case.
- This work is of the greatest importance and they have done a good job to date.
- Need to work with an engineering, procurement, and construction company to get good costing data
- Need to use one simulation package – suggest ASPEN Plus

- The key accomplishment is the completion of the design report. The report is very good.
- Room for improvement still exists in the using the economics to better target Program R&D goals. This work provides the foundation for all of the Program efforts and is absolutely essential.

Question 4: Success Factors and Showstoppers

- Need to include the LCA issues (more than cost) of converting biomass oxygen to water and CO_2.
- The project needs to be used for comparison evaluations of the products of the R&D activities. Head to head comparison to identify the expected benefit.
- That a technology will provide towards lowing the cost of the Fuel.
- Need to make sure there is detailed external review of models. Since too many assumptions are "buried" that impact the models
- The real shortcoming is in credibility of the capital estimates. NREL is in a position to be directionally correct but unlikely to be as accurate as an engineering or producing company.
- The analysis still requires some integration considerations.
- Economics and capital estimates are still need industrial input.

Question 5: Proposed Future Research Approach and Relevance.

- Good plans especially the integration with biochemical platform and other targets. Don't need to solve every problem.
- The specifics of the pyrolysis design need to be validated. These plants are "commercial" so how well do the ASPEN models follow these designs?
- It is not clear in the presentation how the future program will be used to evaluate the benefits from the other R&D activities.
- The effects of scale for pyrolysis need to be clearly defined. Different DOE/Lab studies at different times have different conclusions.
- What is new with this pyrolysis design report vs. prior work?
- Continuing to evaluate options is completely appropriate and necessary

Additional Comments

Strengths

- TC design report great base case and accomplishment
- It was technically competent analysis and important work "critical" to the platform
- This is a foundation area – key in understanding how other programs affect the key cost to production. The methods used are state of the art for the petrochemical industry
- Good balance of partners with regard to technical expertise
- Need is recognized for feedback from engineering analysis to guide technology development
- Engineering analysis is being applied across a range of feedstocks – residues, energy crops, wood
- Good approach: using engineering analysis to benchmark and then comparing alternative designs with the case benchmarked.

Weaknesses

- Need to work with an EPC for costing.
- Need independent engineering validation of models. This is more than a consultant who wants to come back for another subcontract. It is easy to talk about the cost of the feed or

price of product, but the internal details of the ASPEN Models are key and need their own review.
- Why focus on Pac NW for pyrolysis model?
- A weakness must be the lack of critical evaluation by outside engineering and producing companies.
- Integration issues and sensitivity effects on R&D targets are good, but could be improved.
- Not yet considered value of mixed alcohols as fuels (?)
- Too much confidence in Aspen Plus and its databases? Esp. on methanol-ethanol-1-propanolcharacteristics as zeotropes?

Technology Transfer/Collaborations
- Some subcontracts for parts of the modeling, but a true external validation by a large integrated engineering firm would be useful.
- Not Applicable
- Appears to be well integrated.
- Good balance of partners with regard to technical expertise

Recommendations for Additions/Deletions to Project Scope
- Good work. Plans look reasonable. The pyrolysis models should be done as a stand alone, but also give some consideration for how they will be integrated with the oil refinery.
- This program is very important. Careful attention needs to be paid to defining the baseline – part of which they have. All of the gasifiers need to be considered for the baseline. Then define a plan to modify the baselines to incorporate new technology being developed to overcome shortcomings in the process -- all to lower the cost of fuel
- None.
- Provide life cycle assessments in parallel to economic analyses
- Broaden scope to consider other alcohol products (e.g., butanol)
- Consider process integration with other fuel production options (e.g. fermentation) to improve utilization of low- to intermediate-level heat utilization between a net heat generating plant and a net heat-consuming plant

PI Response to Reviewer Comments

Question 1: Relevance to Overall Objectives.
- This is an ongoing process that is scheduled for the coming years as funding permits. A schedule of which unit operations will be done each year should be generated based upon the current level of uncertainty and the potential impact on total cost. Because these types of sub-contracts are expensive, perhaps a lower-level validation can be done for some unit operations based on an E&C's experience but without an extensive design being used for costing.

Question 2: Approach to Performing the R&D
- The current process has plenty of opportunities for improvements if the focus remains on ethanol production. As the call from industry to look at other fuels becomes louder, we will undoubtedly need to evaluate those processes also (e.g. Fischer-Tropsch). Our focus has to be on supporting the DOE OBP's needs for analyses to evaluate potential shifts in direction of the overall program.
- Different evaluation procedures are sometimes necessary depending on the level of development of a project. Full-blown design reports are expensive to do and can typically only be justified on projects that are further along in development. It would be

useful for NREL to document what evaluation procedures should be done for the various stages of project development so that it is clear what evaluations are merited.
- The decision to look at indirect gasifiers and moly sulfide catalysts were documented in the design report but time did not permit presenting this information in the review. As new technologies are evaluated, this will be increasingly important to do and compare with past evaluations. The thermochemical ethanol design report provided us with a starting point for future analyses.
- Other gasifiers will be evaluated as soon as possible within funding constraints. NREL has already started a report of an oxygen blown direct gasifier. To some degree, the impacts of using other gasifiers can be captured through sensitivity analyses that evaluate a range of costs, heat integration, oxygen needs, gas compositions, etc. without specifying a gasifier per se.
- The need to assess data used in ASPEN is always a concern for modeling. More guidance on which cases were of concern to the review would be helpful. Because of uncertainty with the VLE modeling, molecular sieves were used in the ethanol design report to avoid the question of azeoptrope formation with mixed alcohols separation.

Question 3: Technical Accomplishments and Progress
- The need to work with E&C companies to help validate and acquire better cost and performance information is noted in Question 1's response above.
- NREL uses ASPEN Plus and occasionally other spreadsheets for Mass and Energy simulations.
- The models behind the design report are used to guide R&D efforts to a degree. It would be useful for NREL to formalize and document how its analysis results get used to set R&D directions and targets. A more transparent feedback procedure between analysts, researchers, and program management would be useful.

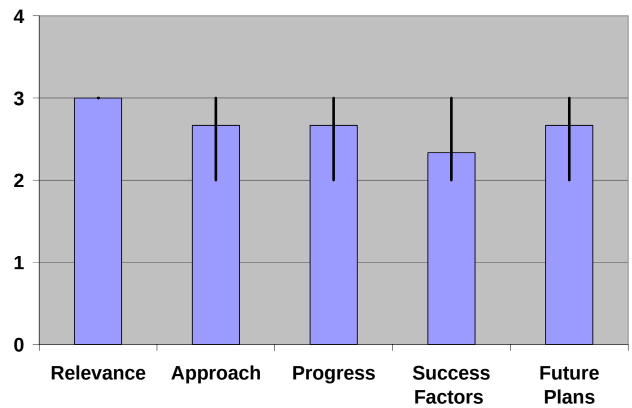
Question 4: Success Factors and Showstoppers
- This is a good idea. LCA work is scheduled in the strategic analysis tasks.
- Comparisons of projects head to head are scheduled. The first step was to develop a peer-reviewed design report against which to compare other processes, products, etc.
- An external review of the models used for evaluation is a good idea. The cost of doing this is significant. Two subcontracts are being placed in FY08 to look at parts of the model as well as to compare the overall model to another model at a second independent research facility (non-DOE.)
- Updated costs for equipment are needed. The sensitivity of equipment costs was evaluated in the report. Installation factors are also a point of uncertainty associated with the equipment costs. It would be useful to the analysis models for DOE to facilitate the transfer of cost information from the 932 projects that are in progress.
- Integration issues within plant are complex and need additional evaluation. A pinch analysis was done for one scenario (base case) but not alternate cases. Each case may have a different integration optimum depending on the heat integration within the plant.

Question 5: Proposed Future Research Approach and Relevance
- The pyrolysis work ended several years ago and was just re-started in OBP. The current state of technology needs to be documented and used to evaluate the model assumptions.
- The need to make a more transparent process for connecting analysis results with future plans for R&D work was noted above in Question 3.

Gasification Projects

Project Title: Gasification of Biorefinery Residues (lignin/modeling and optimization)
Principal Investigator: Dave Dayton, National Renewable Energy Laboratory
Proposed Stage: A/B
Reviewer Recommended Stage: A/B

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	0.00	0.00
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	2.67	0.67	0.33
Average	**2.67**		



Question 1: Relevance to Overall Objectives.

- Good approach to provide fundamentals that should inform many additional projects in future plants
- Actual running of the PDU with different feedstocks is very important. Need to have enough time on stream at steady state for the feedstock comparisons to be useful
- The project, all though needed, only partially supports the program in its present state.
- Problem is the study of model compounds as surrogates for lignin and the belief that the kinetics can be used to improve the byproduct yield.
- This is important support work for development of thermochemical conversion processes. The greatest problems wet gasification is associated with the inorganic components. They need relatively more attention in this work.
- The general goals were appropriate. However, the specific goals were not well delineated.

Question 2: Approach to Performing the R&D.

- Good approach and combination of work between labs and University partners, fundamental and pilot plant work.
- The program needs a gasifier that minimizes tar production and this program should be focused on finding operating conditions that minimize the tar formation.
- This is a gas-solid reaction. I just can’t fathom that the fundamental model is the approach that will yield results.
- I have real problems with kinetic models being used for tracking what are close to trace components.
- Limitation to using the Ferco style gasifier is also too limiting
- The approach is reasonably good but the poor focus of the goals is reflected in an approach that sometimes leaves one wondering why specific things were undertaken in the approach.

Question 3: Technical Accomplishments and Progress

- Production of “real” lignin residue very important step.

- Need to validate that the PNNL work is actually adding value, e.g. how much faster and how accurate relative to ASPEN models
- Good progress with S removal
- The project has obtained good data in its limited cope at this time.
- I see little indication of true advancement.
- Part of the issue is the mixed nature of the project- ranging from model compounds and an operating pilot plant.
- Arguments about why a pilot plant is needed are circular and non-compelling.
- From the presentation it was very difficult to assess actual progress. Like one of the members of the audience, I wanted to know "what was the most important thing you learned in the last 12 months?" The answer (most feedstocks don't represent gasification problems) was not satisfactory, being well known by those who practice gasification.

Question 4: Success Factors and Showstoppers

- Very complex work, will be a challenge to make the work connect to the design and operation of gasifiers
- The project has obtained good data in its limited cope at this time.
- The success factors are ill-defined and nebulous.
- Showstoppers are simply the status quo.
- Did not well delineate what are the potential roadblocks let along explain how they would be overcome.

Question 5: Proposed Future Research Approach and Relevance.

- Not clean how the gasification work at the labs will connected to the deployment projects.
- Need to continue to routinely run the NREL PDU to validate models.
- Need to decide if the molecular modeling should be done at the labs or by partners.
- The kinetic modeling task will be very challenging and the labs will have to look at their staff skills to insure that this work can be effectively completed.
- I would favor more focus on other schemes to handle tar. I think that the programs seems to ignore outside, non-Battelle gasifiers

Additional Comments

Strengths

- The feedstocks comparisons are essential. Need to validate the effects of minerals and interactions.
- The project is a very good start, how ever it its scope is limited at this time.
- Existence of a pilot unit. Real biogas enables other facets of the program.
- Focus of linking fundamental molecular level reaction data to large-scale reactor performance is an excellent direction. The work is likely to be slow, and it will require patience by funders for this to succeed.
- Tar reduction focus is important.
- Can the kinetic parameters desired for pyrolysis be obtained from fluidized bed measurements, where the flow dynamics and therefore residence times are not well defined?
- Validation of e.g., Fluent model/laboratory fluidized bed data predictions with pilot-scale performance could be a valuable contribution
- The 300 kg of solid residue from fermentation studies obtained from this project is a valuable feedstock for future work – both at NREL and elsewhere.
- Recognizes the major issues in gasification. Excellent facilities.

Weaknesses

- Need to emphasize refereed publication/reports not simply presentations that have little archival value (weakness across TC program).
- Why is the PNNL engineering modeling work in this task instead of the analysis task? Where is the added value vs. ASPEN?
- Project scope needs to be broadened to determine the characteristics of a gasifier that minimizes tar formation.
- The major weakness is one of targeting. This project attempts to understand essentially trace chemistry through a mix of computational and kinetic tools. This is unlikely to work in a way that will produce game-changing results. If the project were sold as an analytical / explanation effort it might have more resonance. It is sold as a discovery effort with little foundation.
- A wider study of gasifier options for reducing or eliminating tar is what is called for.
- This project has a large number of sub-projects – too many?
- Not clear why work is being done with ChemCAD when ASPEN seems to be the primary process simulation tool used at NREL
- It seems like the NREL gasification program is being guided by annual shifts in Headquarters' current interests rather than a long-term strategic plan of research (the past year's focus on lignin gasification is prominent example). Goals and objectives are too "big picture" for presentation to a technical review panel. These overall goals are not easily reviewed in a stage-gate process. Give us more specific goals and justifications for pursuing them. Give us data in a form that would appear in a technical journal. Possibly the format required of the presenters does not lend itself to a "close to the ground" review.

Technology Transfer/Collaborations

- Should the selection of the biomass gasifier be a DOE function or left to industry? DOE/Labs should have the ability to run and operate gasifiers for the needed gas clean-up and fuels synthesis tasks.
- Interfaces well with downstream efforts
- Seems to be a good potential integration with Andy Aden's process simulation and engineering evaluation work.
- Appears to be good.

Recommendations for Additions/Deletions to Project Scope

- Continue to emphasis the interactions between the science and the data generated from the steady state operation of the pilot plant to valid the performance of the catalysts.
- Improvements in the project could be made by using MFIX and collaborating with the in-house research activities at NETL.
- Scope should be expanded to use the data that they have to date in simulated gasifier configurations to determine operating parameters that minimize tar formation.
- Pilot must run, but more consideration should be given to understanding those that claim lower to no tar production. There may be another way to skin this cat that doesn't look like the existing pilot gasifier. Be open to and incorporate those thoughts.
- Overall, this is important support work for development of thermochemical conversion processes. However, the greatest problems with gasification of biomass are associated with (a) tar and (b) the inorganic components; primarily alkali metals, S, Cl, and N. Tar and especially inorganic contaminants need relatively more attention in this work.
- Provide a clearer presentation on what has been accomplished

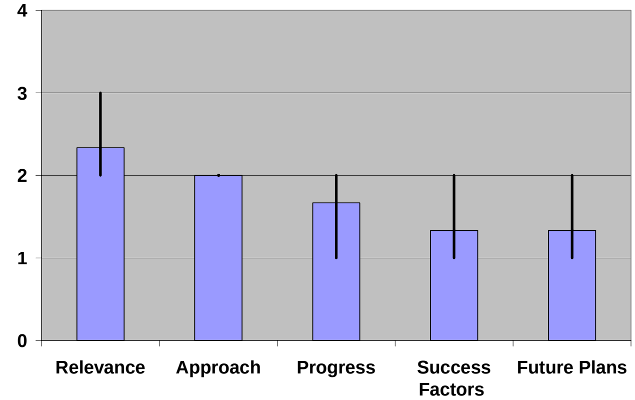
PI Response to Reviewer Comments

The PI for this task, Dr. David Dayton, has left NREL and this task is being significantly refocused for FY08. This task will focus on developing understanding of the chemistry and heat and mass transport that are important in biomass gasification. The goal will be to develop tools to help design efficient gasifiers that produce minimal amounts of undesirable products (tars, sulfur, alkali metals, etc). Computational Fluid Dynamics models will be developed and tested on bench scale gasifiers. Eventually these models will contain chemical models for gasification and tar formation, intra-particle mass and heat transport and bulk heat and mass transport. Chemical models will be focused on specific products, such as tar formation. They will be developed through quantum mechanical modeling, kinetic modeling, and careful experimentation using model compounds, model biopolymers and biomass fractions. Intra-particle dynamics will be modeled and measured using controlled experimentation. The knowledge learned through this effort will be transferred to the general scientific and technical community through the publication of peer-reviewed articles in topical journals and through presentations at technical conferences and review meetings.

Project Title: Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant

Principal Investigator: Chris Lindsey and Ed Gray, Eastman Chemical
Proposed Stage: 2
Reviewer Recommended Stage: 2

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.33	0.33	0.67
Approach	2.00	0.00	0.00
Progress	1.67	0.67	0.33
Success Factors	1.33	0.33	0.67
Future Plans	1.33	0.33	0.67
Average	**1.73**		



Question 1: Relevance to Overall Objectives.

- Could fit in will the Biorefinery concept to handle waste streams. BUT need to much more clearly define the costs and energy balance.
- Project was not related to current Program goals.
- High water content wastes are key feed. Key is finding a particular, appropriate feeds.
- Original focus on bio-sludge was not a good match with the goals of the DOE Biomass Energy Program. Shift to biorefinery byproducts as feedstocks is a good one.

Question 2: Approach to Performing the R&D.

- Good recognition of the need to refocus and identify suitable streams.
- Technology does not seem to meet performance requirements.
- This looks like a disaster – failure and narrowing of focus
- Catalyst poisoning should have been recognized from the outset as the major impediment to success. I would have expected an approach to acknowledge this problem by focusing its efforts on implementing the appropriate desulfurization and demineralization technology.

Question 3: Technical Accomplishments and Progress

- Seems like very limited technical progress.
- Even with the problems that were discussed, the program has made very little progress.
- Milestones not met due to delay in getting PDU to Kingsport, TN.
- Modifications to PDU failed carbon conversion steps.
- Program is behind schedule. It is not clear that the new plan will address problems that placed the program behind schedule.

Question 4: Success Factors and Showstoppers

- The value of a “waste” processing technology, that requires “clean streams”, seems to be limited.
- What are the catalyst regeneration and Ru loss issues?
- Extremely dilute conditions are a show stopper.
- Way too finicky based on the feasibility diagram.

- The need to separate inorganic matter from the fuel prior to hydrothermal processing may be too overcome. A more contaminant-tolerant catalyst might be an easier solution.
- Show stoppers have been identified, but it is not clear that credible paths around have been identified. I fear the new feedstocks will still be problematic.

Question 5: Proposed Future Research Approach and Relevance.

- With 25 years of experience at PNNL it is not clear why the catalysts performance issues, economic and energy balances is not very well defined.
- The chemical composition of the Biorefinery streams can be collected pretty easy and screened for the composition range of interest.
- Even if they find a more suitable waste stream, the technology has commercially very little potential.
- The presentation convinced me that the process was not working and that they were developing new partners without some of the limitations.
- Although identifying alternative partners to continue this research is admirable, it is not clear that the underlying problems (high catalyst costs, carbon loss, and unproven sulfate removal) have been addressed.

Additional Comments

Strengths

- Could be good fit for the future.
- Focus on intractable wastes.
- The concept of processing low-solids content wastes economically is a useful one.
- Industrial partners who could apply this process
- Represents an alternative approach for thermochemical conversion of biomass, especially the high moisture streams.

Weaknesses

- This looks like a very old technology and still does not have a good fit. Technology looking for a home. As they look to refocus project they need to focus on the Biorefinery options, not pulp and paper, or dairy targets.
- Need to run sensitivity analysis on Ru price and decide if this is worth moving forward. They can assume that Ru goes back to the historic prices, if they assume that oil and ethanol go back as well; you can't have it both ways.
- Doesn't fit this program.
- The need to remove inorganic contaminants prior to conversion to fuel gas is a major weakness in this concept.
- This project seems to be struggling with more fundamental aspects that need(ed) to be dealt with prior to plant site PDU evaluations.
- I am surprised that such a project moved beyond the batch testing stage without having demonstrated novel and effective approaches to removing minerals and sulfur that compromise the process.

Technology Transfer/Collaborations

- Identified users that are credible partners both for original and modified research program.

Recommendations for Additions/Deletions to Project Scope

- It is recommended that no further work be conducted.

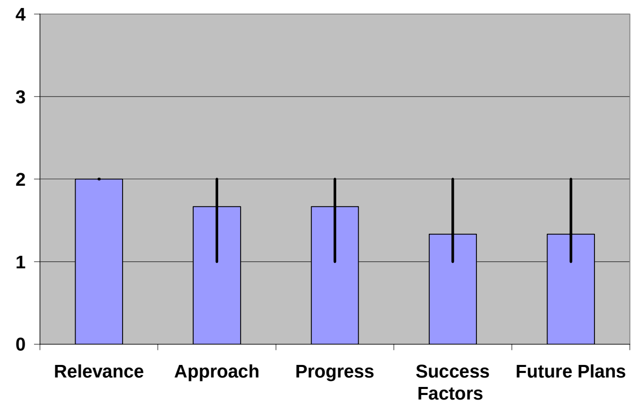
- Discontinue – use money on the major biomass efforts
- This project probably should not be continued.

PI Response to Reviewer Comments

Response not provided.

Project Title: Mississippi State University Sustainable Energy Center
Principal Investigator: Mark Bricka, Mississippi State University
Proposed Stage: Not Provided
Reviewer Recommended Stage: Stage A

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.00	0.00	0.00
Approach	1.67	0.67	0.33
Progress	1.67	0.67	0.33
Success Factors	1.33	0.33	0.67
Future Plans	1.33	0.33	0.67
Average	**1.60**		



Question 1: Relevance to Overall Objectives.
- Several project elements are not of interest to DOE OBP goals. Little apparent relevance.
- No information of performance targets, are they making progress?
- No economic analysis, If they are making progress does it matter
- The plan is not well focused for the most part.
- The plan was not designed to integrate with the overall program.
- PI and other investigators seemed to just take available funds and do whatever they wanted regardless of how their activities might integrate with the overall program.
- Too many topics covered. Some fit, some didn't
- This project seems to be in early stage – largely equipment shake-down
- At first blush, the project appears to be very relevant to the objectives of the DOE OBP. However, the research appears to be covering well-trodden ground and offers little that is new to the field.
- This systems-level project should ideally have a commercial partner, which apparently is not the case.

Question 2: Approach to Performing the R&D.
- Re-scoped plan looks more promising, but still lacks performance targets
- The resulting approach, having no guiding plan, was fair at best.
- Working in a vacuum – not well referencing the patent literature or potential for collaborations with companies.
- This project seems to be in early stage – largely equipment shake-down.
- Much of the work consists of purchasing commercially available equipment or reinventing methodologies to set-up a small-scale biomass-to-liquids system. This is a systems-level project with many subsystems integrated. The question is whether the research offers much new information and whether it is relevant to developing commercial-scale systems.

Question 3: Technical Accomplishments and Progress
- Early in work, but very limited results and poor focus. They have a lot of money and looks like a bunch of individual academic projects.
- Gasoline catalysts work is not bench marked and was no apparent effort to understand the problems.

- Again as a result of no focus, accomplishments and progress were not to be found with the exception of cooking at the MTG process.
- too wide a number of projects covered
- This project seems to be in early stage – largely equipment shake-down.
- The approach to tar destruction is not well conceived. Results presented are already known. Benzene and naphthalene are known to be more difficult to destroy than any other aromatic or polyaromatic tars.
- The researchers have accomplished quite a bit in the past year (unless some of this was done with funding from other sources in earlier years). However, the results offer little that is novel or advances the goals of the DOE OBP.

Question 4: Success Factors and Showstoppers

- There biggest problem is running a program at the university that will help support DOE goals.
- Safety issues were not addressed in the presentation and are likely to be a significant issue in the University environment.
- The lack of an integrated plan with the program is a SHOWSTOPPER.
- Too many projects covered.
- This project seems to be in early stage – largely equipment shake-down.
- Showstoppers not clearly identified (this project not configured as a high-risk undertaking).

Question 5: Proposed Future Research Approach and Relevance.

- There was no plan for the future presented.
- Should focus on educating students not paying research staff or postdocs!
- They nave no plan and presented no plan and as a result
- There is little confidence that there will be any success from the program.
- This project seems to be in early stage – largely equipment shake-down.

Additional Comments

Strengths

- Limited strengths to point out in this project
- Methanol to gasoline look is a good direction to explore.
- Striving to demonstrate the production of gasoline from biomass via the syngas route.
- They have made progress in their work plan.

Weaknesses

- Mixture of projects with little focus.
- Safety issues with students handling CO, H2S could be a concern.
- MTG is known and has been commercialized in NZ, not clear how this work improves on this know process. There was no mention of the known MTG process then very concerned about the innovation.
- Limited innovation in other areas.
- Programmatically out of line with the program.
- Lack of focus leads to lack of success.
- Methanol to gasoline was fully commercialized by a US company. What will MSU bring that we don’t already know?
- This project seems to be unfocused.

- The overall program is unfocused.
- There is no innovation in the research – most of the project is based on “off-the-shelf” equipment.

Technology Transfer/Collaborations

- Need industrial partners to help get focus.
- Need to closely study the DOE program goals, and prior work to make sure they are bringing innovative technology to the projects.
- No collaboration with industry or other institutions indicated.

Recommendations for Additions/Deletions to Project Scope

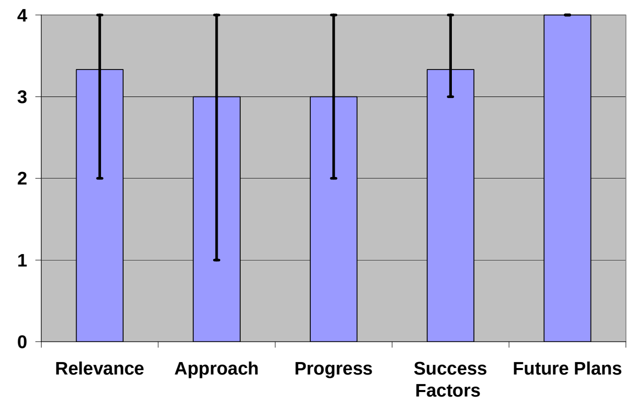
- Needs to work with one of the DOE analysis groups to get some targets.
- It is strongly recommended that, before any additional funds be added to the project, a detailed plan that is integrated with the program be prepared that has measurable milestones.
- The researchers should focus on specific issues. The current goals (“develop coordinated approach to biorenewable energy…”) are too broad to achieve significant advances.

PI Response to Reviewer Comments

Response not provided.

Project Title: Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer
Principal Investigator: Kevin Whitty, University of Utah
Proposed Stage: Stage C
Reviewer Recommended Stage: Stage C

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	1.33	0.67
Approach	3.00	2.00	1.00
Progress	3.00	1.00	1.00
Success Factors	3.33	0.33	0.67
Future Plans	4.00	0.00	0.00
Average	**3.33**		



Question 1: Relevance to Overall Objectives.
- Black liquor gasification is a very narrow opportunity for the biomass program
- The project no longer supports the program goals as black liquor is not a target feedstock.
- The market potential for the technology essentially does not exist. The industry is making use of existing technology and is unlikely to change
- Black liquor is outside main thrust
- This project recently ended.

Question 2: Approach to Performing the R&D.
- Good combination of modeling and pilot plant work. Both bed modeling and process modeling are useful
- The gasification technology is unworkable as it does not scale. This is not to say that the presenter (Dr. Whitty) did a poor job, he did a great job modeling a pore system
- Building on commercial technology with company input.
- Approach is technically sound.
- This project recently ended.

Question 3: Technical Accomplishments and Progress
- Good work and progress.
- Analytical tools/approach are valuable
- Dr. Whitty did a great job, the technology does not move DOE towards its program goals
- Excellent progress – questionable overlap with broad DOE goals.
- This project recently ended.
- Excellent progress toward project goals, not necessarily aligned with DOE or USDA program goals.

Question 4: Success Factors and Showstoppers
- Good work plan.
- The gasification materials problem is the key limitation and outside the scope of this project.
- The TRI risks are not well-defined upfront, and have lead to the shutdown on the GP Big Island project, although Norampac continues.
- Dr. Whitty's analysis was very forthcoming, relating that the gasification technology cannot be scaled and that a mill would require 30 or more of these gasifiers.
- Project is over – challenges determined to be too difficult

- This project recently ended.

Question 5: Proposed Future Research Approach and Relevance.
- Project is ending
- Not applicable
- project is done
- This project recently ended.
- No plans to proceed, project complete.

Additional Comments

Strengths
- Good partnership, universities and private partners.
- Good combination of modeling and pilot plant operation
- Great technical work performed by Dr. Whitty.
- Very well thought out program with good science applied in a reasonable way.
- Good transfer of collected data to wisdom

Weaknesses
- Black liquor is a very narrow opportunity
- The overall operation and maintenance of Black Liquor gasifiers is a major concern, although not the focus of this work.
- The fundamental gasifier design limits ability to be scaled.
- There is no market for the technology.
- Black liquor is not critical to the biomass program.

Technology Transfer/Collaborations
- Good partnership including industrial partners
- Make tar sampling procedure public and promote it.
- Good collaboration with other academic institutions and industry.

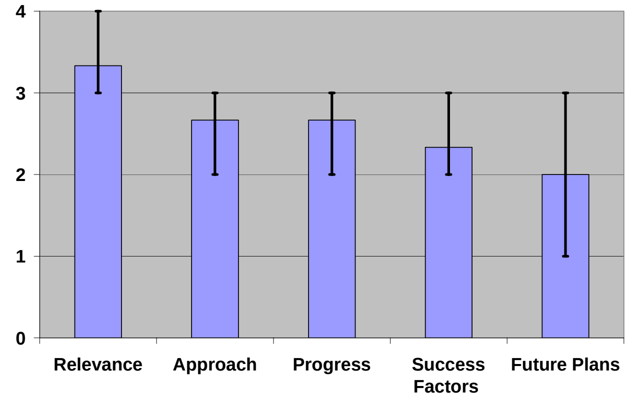
Recommendations for Additions/Deletions to Project Scope

PI Response to Reviewer Comments
Response not provided.

Gas Cleanup and Conditioning Projects

Project Title: Biomass Gas Cleanup Using a Therminator
Principal Investigator: Santosh Gangwal, Research Triangle Institute (new PI: Dave Dayton, RTI)
Proposed Stage: Stage B
Reviewer Recommended Stage: Stage B

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	2.00	1.00	1.00
Average	**2.60**		



Question 1: Relevance to Overall Objectives.

- Very good relevance.
- Very good understanding of how the project fits into the DOE goals.
- Able to refocus the project from its original focus to the changed DOE goals with fuels synthesis
- The project supports the DOE program goals.
- No market information was provided. RTI is a technology developer and not an OEM that will provide this technology to the market. As commercializing team member is required.
- Very relevant to current program
- Goal should be stated in terms of cost of syngas, not cost of ethanol.

Question 2: Approach to Performing the R&D.

- Good combination of science, modeling and experimental work.
- Good technology and process benefits (process intensification that will combine tar cracking and NH3/H2S/HCl clean-up.
- Project understands the interaction between both the technical and economic goals.
- The desire to develop a three-way catalyst is noble.
- RTI does not have a plan/method to develop the catalysis at this time. They are looking at placing three separate catalysts in the reactor as one alternative – where is the innovation.
- Very reasonable approach to clean-up reactors and material synthesis.
- Toluene cracking experiments produced benzene. Why no concern about this?
- Not very much detail given on approach (spent too much time justifying work).

Question 3: Technical Accomplishments and Progress

- Good start with lab work, but needed more information on the carbon balance (toluene, benzene, methane, CO, H2)
- Good recognition of need to combine chemistry and fluid bed modeling.
- RTI has done quite a bit of catalyst scoping, but has not done any multi-contaminant testing. This is needed soon
- On agreed timeline
- The project has made reasonable progress.

Question 4: Success Factors and Showstoppers

- Real strength in technology development.
- RTI has good experience with project management and technology development.
- Experience with Eastman on pilot scale and process development.
- Given RTI's background and experience with the reactor technology they have done a poor job at identifying showstoppers associated with the development of a three way catalyst and the reactor.
- Toluene cracking experiments produced benzene. Why no concern about this? Benzene is not an acceptable syngas component for catalytic fuels production.
- Showstoppers are not been well detailed.

Question 5: Proposed Future Research Approach and Relevance.

- Unlikely to finish in one more year.
- Good pathway forward.
- Need to have a fallback option for gasification partner/testing.
- Given that they are behind schedule and under spent, they provide no plan showing how they plan to get back on schedule
- Ambiguous definition of what success would really look like
- Toluene cracking experiments produced benzene. Need to be able to destroy benzene and any other C-ring compounds.

Additional Comments

Strengths

- Good focus and able to redirect the project on the DOE needs.
- Good reactor technology.
- Good experience with sorbent and catalyst development.
- Reasonable participants and plays to RTI strengths due to coal background.
- Can eliminate NH_3 and capture H_2S.
- Appears to be making good progress in obtaining results.

Weaknesses

- A gasification partner will be important for ultimate demonstration.
- Are not using their experience to drive the program to develop a multifunctional catalyst.
- Catalysts are NOT tri-function. They are adding several catalysts in hopes of managing varying reactivity
- Unsure why bubbling fluidized bed is selected (more difficult to both operate and model)
- The presenter had some problem explaining to reviewers what he was trying to accomplish.

Technology Transfer/Collaborations

- Would be useful to have the gasification manufacturer as a very active member of the team
- Very good experience with commercialization
- Need a commercializing partner.
- Looks to have path to commercialization
- Toluene cracking experiments produced benzene. Need to be able to crack benzene and other C-ring compounds.

Recommendations for Additions/Deletions to Project Scope

PI Response to Reviewer Comments

Since this project was awarded in FY04, the goals of the Thermochemical Conversion Platform have changed to focus gas cleanup and conditioning to achieve syngas quality targets for fuel synthesis instead of power production. Consequently, the goals and objectives of this project have been modified to align with the Office of Biomass Program goals to produce cost-competitive biofuels. Additionally, an interruption in project funding during FY06 and the subsequent loss of Cratech as a cost-share partner and biomass gasification host-site for Therminator testing required a revised project scope and work plan moving forward.

Question 1: Relevance to overall objectives

The goal of this project from the beginning has been to develop a thermodynamically efficient 2-stage gas cleanup up process with continuous catalyst regeneration for tar removal, ammonia conversion, and sulfur removal. The Therminator concept was developed to address OBP's goal of reducing the cost of the gas cleanup unit operation in an integrated biomass gasification system. Now that the focus is on liquid transportation from biofuels, the concept can still apply.

The cost goal of $1.07/gal of thermochemical ethanol was used as a benchmark to align with the NREL Design Case for an integrated, indirect biomass gasification mixed alcohol synthesis process. The $1.07/gal ethanol cost in this process equates to a syngas cost of $5.25/MMBtu. This design case was optimized for ethanol yield not syngas production so this value should not be considered ideal, but specific to the referenced process configuration.

A market analysis for the Therminator concept applied to biomass gasification for power production was completed in the early stages of the project. With OBP now focused on liquid transportation fuels, this is no longer relevant. A similar market analysis can be developed, especially with three of the six commercial demonstration projects (700 tpd biorefineries) selected by OBP focusing on biomass gasification. The work plan for FY08 was revised to include a techno-economic assessment of the Therminator technology by incorporating cost and performance data for this cleanup operation in the NREL Thermochemical Design Case.

Question 2: Approach to Performing the R&D

Catalyst testing is being conducted by our partners at Clemson University. They are using model compounds in microreactors to determine the optimum temperature ranges and regenerablility of various materials for cracking tars, converting ammonia, and removing sulfur. A variety of zeolite materials are being evaluated as tar cracking catalysts. Materials tested to date do yield benzene as a result of toluene cracking. Technically, benzene is not classified as a tar but could still pose problems in downstream fuel synthesis processes. We are currently investigating increasing the acidity of the zeolite materials to improve hydrocarbon cracking that could potentially also crack benzene. However, if the Therminator concept is successful, benzene and other light hydrocarbons could be removed in an additional downstream cleanup step. This precludes all gas cleanup being performed in a single step for the ultimate in process intensification, however, additional downstream gas conditioning/polishing steps have a greater chance of being effective if tars can be removed.

Novel catalysts are being formulated and tested for ammonia decomposition and RTI sulfur removing sorbents are being targeted for H_2S removal. The innovation is determining the optimum temperature, pressure, and gas composition window where these three reactions occur and how to regenerate the materials after they have deactivated (again optimum temperature and stoichiometry). A single material that has activity for all of these gas cleanup operations is desirable but a significant challenge that is beyond the scope of this project.

Question 3: Technical Accomplishments and Progress
Additional details of the carbon balance from the catalyst testing being performed at Clemson will be available after the completion of their work.

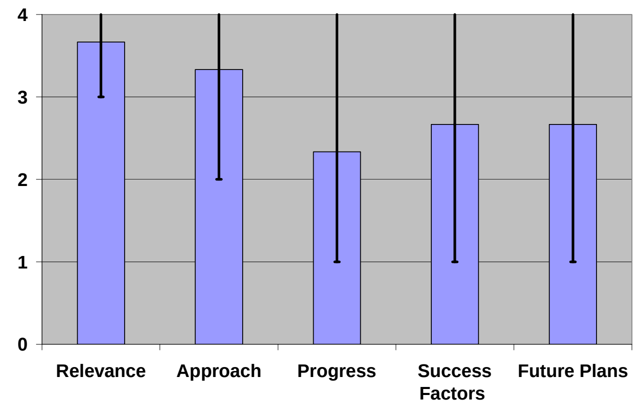
As stated, one of the near-term goals for this project is to find a biomass gasification host site and cost-share partner to test the Therminator. This will serve as the opportunity to test the process on actual biomass-derived syngas and determine the multi-contaminant performance of the unit.

Question 4: Success Factors and Showstoppers
One of the key challenges for having the 3-way mixture of materials perform the desired gas cleanup function is determining the operating temperature windows for the reactor and regenerator. Therefore, one showstopper would be poor temperature overlap between the tar cracking, ammonia conversion, and sulfur removal processes. We think we have identified a suitable window based on the testing of the individual materials, however, this needs to be verified in the integrated testing. Another potential showstopper is the integrity of the tar cracking catalysts when exposed to the high steam environments in biomass-derived syngas. This relates to the process temperature and will need to be carefully explored during the integrated testing.

Question 5: Proposed Future Research Approach and Relevance
Given delays in funding and the loss of our cost-share partner and gasification host site, we have requested to DOE that the project be extended for an additional year beyond the original FY08 completion date without additional cost. This no-cost extension is reflected in the FY08 Annual Operating Plan for the project. We are actively seeking a biomass gasification test site and additional cost-share partners. In the mean time, RTI is providing cost share towards the project to complete the fabrication of the Therminator unit as originally outlined. Successful long-term operation with biomass-derived syngas at measured target impurity levels will define the successful completion of this project.

Project Title: Engineering New Catalysts for In-Process Elimination of Tars
Principal Investigator: Larry Felix, Gas Technology Institute
Proposed Stage: Stage A/2
Reviewer Recommended Stage: Stage A/B

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	3.33	1.33	0.67
Progress	2.33	1.33	1.67
Success Factors	2.67	1.67	1.33
Future Plans	2.67	1.67	1.33
Average	**2.93**		



Question 1: Relevance to Overall Objectives.
- Good understanding of the DOE Biomass Program goals and how their project fits into these goals.
- The project aligns with the program objectives.
- No Customers or Markets information was given or are identified as being important.
- Hitting one of the tar problems head-on

Question 2: Approach to Performing the R&D.
- Good understanding of how the technology will be used and the strengths of the different approaches.
- Several technical options for moving forward.
- Appropriate to make sure that their IP position is covered.
- Two approaches given. Appear unable to evaluate the better of the two and focus.
- Novel approach to catalyst production
- Good focus: on finding tar destruction/methane reforming catalysts that are attrition resistant and are sulfur tolerant. For Fl bed gasifiers; may have other applications.

Question 3: Technical Accomplishments and Progress
- Some technical progress. Good understanding of how the catalyst properties and performance will impact the overall process economics.
- PI presented no data that indicates that they are likely to achieve their goals.
- Moved from a good idea that turned out not to work, to a novel concept that seems to work well. Impressive performance by the research team.

Question 4: Success Factors and Showstoppers
- GTI has lots of experience in project development and commercialization, but a gasifier developer or catalysts company that will actually commercialize the process.
- PI gave lip service to toping in preparing a list of possible showstoppers, but gave no prioritization or indication of which were the most critical or indication that they could be overcome
- Thoughtful approach to attacking problems

Question 5: Proposed Future Research Approach and Relevance.
- Good plans to move forward.

- Project is behind schedule and no plan was provided to bring the program back on schedule.
- Will likely ask for no cost extension.
- No focused commercialization plan identified.

Additional Comments

Strengths

- Good technology, good skills with multiple options for use and for decoking
- Integrated approach, several collaborators
- Novel approach to fixing problems
- Well focused.
- Technically strong partner group.

Weaknesses

- Need to get the economics completed soon.
- Need to focus on one of the three systems to maximize the likelihood of success.
- Catalyst have very little surface area – will likely require a large reactor increasing the cost.
- Need to focus, pick one technology and move on, it cannot commercialize two new catalysts with funds for one
- Novelty of approach may limit implementation
- No mention of poisons or leaching of catalysts and attrition

Technology Transfer/Collaborations

- It would be useful to have a commercialization partner to move this forward.
- Good interaction with both companies and universities

Recommendations for Additions/Deletions to Project Scope

- Economic comparison needs to be evaluated, continue testing

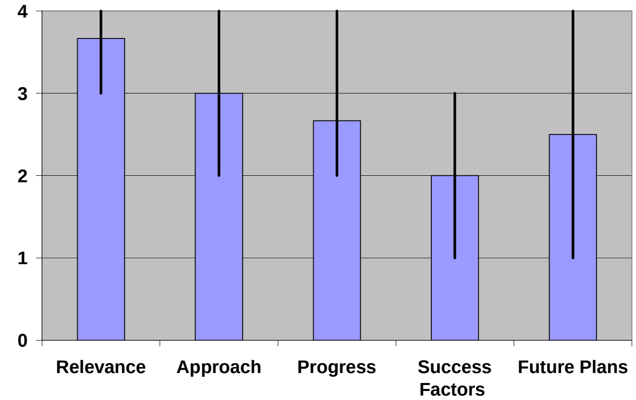
PI Response to Reviewer Comments

- The project's revised Statement of Work includes facility design and economic analysis for different product conversion and direct use routes. This includes integration with a petroleum refinery for production of ASTM diesel. With the addition of consideration of alternative conventional uses for the brown grease feedstock, this planned effort should address the concerns raised by the reviewers.
- It has been estimated by NREL that trap grease, nationally, has the potential for production 495 million gallons of biodiesel annually. Given U.S. biodiesel production levels of 250 million gallons in 2006, it would seem that waste greases could make a contribution to the national situation. Further – any trap grease process is likely to actually incorporate yellow grease feeds, increasing the potential impact.
- While alternative pathways are possible and have been proposed, the management of trap grease remains a very significant local problem. Solution requires an integrated regional program including building codes, enforcement, collection, analysis and monitoring, conversion, product quality management, and product distribution. The solutions being explored under this project may be suitable for local implementation, avoiding logistical issues associated with large industrial facilities and providing a more consistent feedstock.

- The thermal process to be used in this project offers some advantages that could make it attractive relative to direct refinery integration of trap grease. This includes no requirement for hydrogen, no catalyst, and the ability to accept a very mixed and variable feedstock. The current plant in Missouri that processes turkey waste accepts considerable solids in the feedstock.

Project Title: Catalyst Fundamentals (Integration and sub tasks)
Principal Investigator: Kim Magrini (presented by Dave Dayton), National Renewable Energy Laboratory
Proposed Stage: Stage A/B
Reviewer Recommended Stage: Stage A/B

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	3.00	1.00	1.00
Progress	2.67	0.67	1.33
Success Factors	2.00	1.00	1.00
Future Plans	2.50	1.50	1.50
Average	**2.77**		



Question 1: Relevance to Overall Objectives.
- Good understanding of how the work fits into the DOE goals.
- The project clearly supports the Program goals and objectives
- There is no path forward defined and no potential market or customers discussed.
- Puts all efforts into an assumption that tar is inevitable.
- Other methods for reducing or handling tars will render this approach moot.

Question 2: Approach to Performing the R&D.
- The team clearly understands the issues and has the infrastructure to test materials, but the tar cracking catalyst efforts seem like a small, sub-critical effort.
- The approach to get new catalysts is sound.
- Focusing an eye towards the future goals will define the critical path for the development. The projects are not purpose driven and as such wanders along the development path.
- Fundamentals approach to an awful mess of reactions – seems destined for difficulty

Question 3: Technical Accomplishments and Progress
- Good work but should focus on testing and evaluation of catalyst at micro and PDU scale.
- Development of catalysts less clear.
- Due to a lack in focus noted above, the progress falls short of what should and could have been obtained.
- Progress hasn't really progressed against goals – progress made has been against interim targets that may ignore the real issues.
- Project seems mired in reality that S is a poison for the catalysts selected. Baby steps taken when giant leap required.

Question 4: Success Factors and Showstoppers
- The project lacks the gasification developers or well recognized catalyst manufacturing partners (different than support manufacturers) that are needed for commercialization.
- The extent and strength of the partnerships listed in the presentation is not clear
- No efforts and thoughts, at least presented, have gone into the evaluation of the technology as a commercial product. When is it needed? What are the required minimum performance requirements?

- No real strategies illuminated for avoiding poisoning of conventional catalysts.

Question 5: Proposed Future Research Approach and Relevance.

- Plans are clear, but the Labs need to define the innovation and make sure that their catalysts development efforts do not limit their ability to help DOE compare different catalysts.
- This technology will be a technical success and a commercial failure if the continued development effort proceeds without a commercializing partner.
- No real plan for attacking poisoning

Additional Comments

Strengths

- Collaboration between NREL and PNNL catalyst group appears to be productive.
- Good collaboration between national laboratories
- Good utilization of analytical tools and integrated approach – small to pilot scale, with theory added in
- Good partnerships with other labs, universities.
- Solid plan for next years.

Weaknesses

- Good work, but appears to be less innovative than the other two tar cracking projects.
- Need to continue to publish their work in archival resources.
- Innovation with new catalyst formulation is weak
- There may be no solution
- This is a project seems to be headed toward the trap of explaining why something doesn't work rather than finding something that does. I have doubts that the described analytical regime will provide fixes to the problem of sulfur poisoning of Ni catalysts. These catalysts are know and industrially used. I can't help but feel that companies have investigated this space and, to their dismay, sulfur still poisons nickel reforming catalysts.
- Need detector for HCl to evaluate its removal and impact on catalyst activity (the research team recognizes this).

Technology Transfer/Collaborations

- Does fact that the national laboratories are developing catalysts limit their ability to serve as an honest broker for DOE? Some of these same issues were faced by the Biomass Program and the CAFFE (sp) pretreatment verification.
- Is there a way to get the catalysts testing tools and skill into the big demo projects to increase the likelihood of success?
- A commercialization strategy needs to be developed. How will these advancements be commercially introduced?
- Reasonable

Recommendations for Additions/Deletions to Project Scope

- It seems like some sort of comparison/round robin testing of the three catalyst projects should be considered.
- This project suffers because it solves some problems in parallel without the realization that a single failure means that nothing will work.

PI Response to Reviewer Comments

Question 1: With respect to the path forward, the Catalyst Fundamentals task is focused on developing moderately sulfur tolerant reforming catalyst that can operate in a fluidized reactor. Initial screening of the best available commercial reforming catalysts in a fluidized bed showed that losses from attrition were significant and economically unsustainable. Commercial fluidizable reforming catalysts are not available and we thus had to develop our own fluidizable catalysts based on novel attrition resistant alumina supports. Fluidization also simplifies catalyst regeneration. We produce up to 100 kg batches with industrial participation. Larger quantities will have to be produced with the help of catalyst manufacturers. GTI and NexTech took a similar approach to develop olivine-based reforming catalysts and we are working with them to test their emerging reforming catalysts in our reactors. We are collaborating with companies, who responded to a recent DOE solicitation to develop biomass-derived fuels, to provide and test emergent tar reforming catalysts. Thermal gasification of biomass produces tars with the amount produced dependent on process operating conditions. NREL's thermochemical ethanol from biomass process was developed based on overall process heat integration, waste stream reduction, and maximized syngas production from tar reforming. Other options considered included wet scrubbing, which results in significant aqueous waste streams; dry scrubbing; and hot gas cleanup. A significant benefit of this approach is that process methane can be recycled through the reformer. If tar reforming catalysts can not be efficient then wet and dry scrubbing are process options.

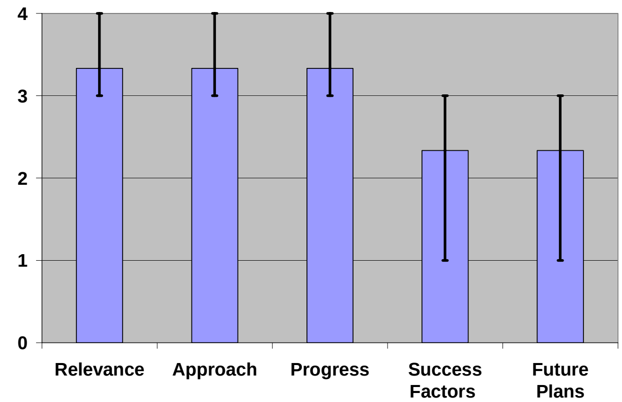
Question 2: This task operates on two levels: developing fluidizable tar reforming catalysts based on the best compositions that industrial catalysts offer for pilot scale deployment and testing and developing the fundamental understanding of catalyst structure/function relationships to rationally design next generation reforming and mixed alcohol catalysts. Tar reforming in the petroleum and coal industries is successfully conducted and thus is applicable to the "awful mess of reactions" generated by biomass-derived syngas.

Question 3: Sulfur is a significant problem for tar reforming catalysts as are other potential poisons contained in biomass-derived syngas and to be investigated (Cl and C). Our approach is integrated in that feedstock choice (determines H_2S level), placing a sulfur capture unit operation before the reformer, and developing a moderately sulfur tolerant reforming catalyst should provide a clean syngas that can be converted to mixed alcohols. The current alcohol synthesis catalyst, modified moly sulfide, requires approximately 25-50 ppm of H_2S in the feed syngas to maintain activity. So integrating H_2S into the overall process is reasonable for this specific process. Industry to date has not yet provided a giant leap forward with respect to sulfur tolerant reforming catalysts.

Question 4: Although the NREL tasks are not directly tied to commercial processes, as the current biomass gasification to fuel industry is nascent, the recent DOE funding opportunity announcements have provided the ability for NREL to develop biomass to fuels industrial partnerships. NREL is currently included in one of these potential partnerships to provide tar reforming catalyst development. We have discussed tar reforming catalysts and other approaches with Conoco Philips, WR Grace, Sud Chemie, Albemarle, and NorPro and no suitable catalysts have been identified for testing. We continue to talk with commercial catalyst suppliers. GTI and NexTech have emerging catalysts designed for tar reforming in fluidized environments and we are working with them to test these materials at NREL. We have and are testing emerging tar reforming catalysts and our ability to evaluate with real syngas allows us to objectively test tar reforming catalysts. We additionally are talking with the coal gasification community to identify appropriate catalysts. The addition of a sulfur capture unit operation before the tar reformer is underway.

Project Title: Integrated Catalyst Testing
Principal Investigator: Calvin Feik, National Renewable Energy Laboratory
Proposed Stage: Stage B
Reviewer Recommended Stage: Stage B

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	3.33	0.33	0.67
Progress	3.33	0.33	0.67
Success Factors	2.33	1.33	0.67
Future Plans	2.33	1.33	0.67
Average	**2.93**		



Question 1: Relevance to Overall Objectives.
- The project clearly supports the Program goals and objectives
- There is no path forward defined and no potential market or customers discussed. See comments in questions 4 and 5.
- targets tar – key identified component
- Addresses need to evaluate catalysts at pilot-scale and validate laboratory scale testing.

Question 2: Approach to Performing the R&D.
- The approach to get new catalysts is sound.
- Focusing an eye towards the future goals will define the critical path for the development. The project is not purpose driven and as such wanders along the development path.
- Methodical and logical

Question 3: Technical Accomplishments and Progress
- Significant of value of having the capability (and using it) to test with “real” syngas
- Identified S, not carbon as key deactivator
- Making good progress on challenging pilot-scale evaluations of catalyst deactivation, catalyst regeneration, and sulfur sorbents.

Question 4: Success Factors and Showstoppers
- No efforts and thoughts, at least presented, have gone into the evaluation of the technology as a commercial product. When is it needed? What are the required minimum performance requirements?
- There may be no solution.
- Showstopper is inability to demonstrate a regenerable catalysis. No alternative paths suggested.

Question 5: Proposed Future Research Approach and Relevance.
- This technology will be a technical success and a commercial failure if the continued development effort proceeds without a commercializing partner.
- Pilot is run to get clean gas for other testing is OK.
- Hopes for real improvement and plan for getting it was ill-defined.
- Overlap with other programs means a merging of goals

Additional Comments

Strengths

- Methodical
- The large-scale catalyst synthesis and testing part of this project is essential in support of other, smaller-scale testing of catalyst candidates.
- Sulfur sorbent work with high steam concentrations is valuable.
- Good capability for testing at pilot scale.

Weaknesses

- Uncertain whether solution exists – deactivation is still too fast for commercial reasonable implementation
- The mix of discovery and pilot research is more detrimental than additive – the mixed focus is hard to evaluate
- Need better catalysts to test at pilot scale.

Technology Transfer/Collaborations

- Good interaction with both companies and universities
- Good. May be more opportunities to collaborate with others in catalyst development.

Recommendations for Additions/Deletions to Project Scope

- Investigator needs to take better care to fully characterize experimental facility. The observance of a periodic peek in the concentration slide 15 is an indication that some process oriented transient is occurring in forced period. This could lead to errors in the analysis of the data and need to be understood.
- continue testing
- Evaluation of the rate of loss of catalyst activity with alkali metals and chloride would be valuable.

PI Response to Reviewer Comments

Question 2: With respect to critical path development, the Integrated Catalyst Testing task is comprises a significant portion of the overall integrated gasification to mixed alcohol synthesis project at NREL. Task research focuses on producing clean syngas from gasified biomass via sulfur capture and steam reforming unit operations. These unit operations are guided by a progressive series of intermediate goals that produce clean syngas to meet the 2012 targets with overall task progress is guided by the operating parameters defined in the mixed alcohol design report.

Question 4: Although the NREL tasks are not directly tied to commercial processes, as the current biomass gasification to fuel industry is nascent, the recent DOE funding opportunity announcements have provided the ability for NREL to develop biomass to fuels industrial partnerships. NREL is currently included in several of these potential partnerships. Additionally, the Thermochemical Platform Analysis task provides an important link between industry and the current NREL R&D. The process models are based on commercial or pre-commercial systems. The research in this task is directed toward demonstrating improved catalyst performance and providing additional relevant data to improve the process models. The interaction and dual flow of information between tasks is key to improving the integrated process.

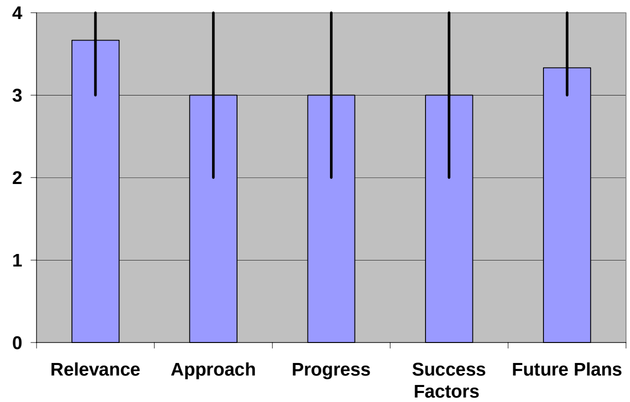
Catalyst performance and regeneration improvements are being conducted in the Catalyst Fundamentals task, which is closely integrated with this task. As noted by the reviewers, sulfur deactivation of catalysts is not new and catalyst regeneration and sulfur (and other heteroatom) mitigation will be key to successful integrated system success. Regeneration protocol research is ongoing with promising lab scale results to be demonstrated at the pilot-scale. The evaluation of sorbent materials is ongoing with several materials showing promise in the high steam environment. Full stream testing of available and promising materials is planned in the near future. We agree that coking and chlorine exposure may also significantly deactivate the reforming catalysts. FY08 and beyond will focus on evaluating the impact of adsorbed carbon and chlorine on catalyst performance. We are also engaged since the review in identifying commercial and emerging reforming catalysts that can operate under our process conditions. The best catalysts identified in laboratory scale evaluation will go on to pilot scale evaluation.

Slide 15 concerns: The upset peaks in the data s were caused by process adjustments (sample valve cycling) associated with startup and were not a factor during the experimental period.

Fuel Synthesis Projects

Project Title: Thermochemical Conversion of Corn Stover
Principal Investigator: James Gaddy, Bioengineering Resources Inc
Proposed Stage: Stage 3
Reviewer Recommended Stage: Stage 2/3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.67	0.67	0.33
Approach	3.00	1.00	1.00
Progress	3.00	1.00	1.00
Success Factors	3.00	1.00	1.00
Future Plans	3.33	0.33	0.67
Average	**3.20**		



Question 1: Relevance to Overall Objectives.
- Understands the DOE program goals.
  Good partnership that includes engineering Company.
- The project supports most aspects of the program goals
- All components tested from feed conversion through to fuels
- Supports DOE OBP goals with a novel approach to ethanol.

Question 2: Approach to Performing the R&D.
- Good team to help with the design and construction. Need to make sure they have good analysis team to help with characterization of the emissions
- Lacked details on how many other organics and how much cellular biomass
- The approach to thermally decompose biomass (fast process) coupled to a biological process (SLOW) is a weakness that is not being addressed. These rates need to be comparable or equipment sizes very significantly which adds complexity in scaling the technology.
- Didn't approach the project with any optimization of the gasifier, fermenter, or gas clean-up system
- Bio approach complements catalytic
- Scale of equipment is an issue. Currently, plants would be modular, limited in size by 150 t/d gasifier.
- This project is a continuation in the development of syngas fermentation that has taken place over 15 years. This project would have been a good opportunity to rethink gasifier design, reactor design, and ethanol recovery. This does not appear to have been incorporated into this project.

Question 3: Technical Accomplishments and Progress
- Seemed to gloss over some of the issues with long term operation and accumulation of tars and impurities
- Did not show any parametric data to provide confidence that technical barriers can be overcome.
- Looks very solid technically at this point. Would be useful to evaluate benefits of higher pressure.

Question 4: Success Factors and Showstoppers

- Quite a bit of experience with running the system and the focus is on the process economics.
- Economics need to be addressed.
- Indicates no technical problems remain
- No apparent technical barriers. Economic barriers? Need to evaluate economics.
- Clearly a number of challenges have been met and overcome. These were not well described in the presentation.

Question 5: Proposed Future Research Approach and Relevance.

- Well on the road to commercialization
- No market data were given
- Unclear what future work is required- things listed looked like pretty low bars and not critical to success.
- The future plan now should include economic evaluation and, if viable, a demonstration plant.

Additional Comments

Strengths

- Quite a bit of experience
- Good partnership and key to have engineering design partner
- Good gasifier, minimizing tar formation with long residence time, high temperature second stage.
- Integrated – working system
- Excellent fundamentals
- Very solid platform from basic & development work that has been done.
- Has taken a novel technology to the pilot-scale.

Weaknesses

- Near term they are focused on this one gasifier but this may be a limitation.
- Unclear how the carbon bed will be regenerated, biomass from the fermenter and other waste streams will be captured.
- Chemical analysis of the waste streams needs some more attention.
- Separation of ethanol/water was under defined and seems to be problematic
- Low productivity and slow fermenter start-up
- Does not appear that the project was approached with the goal of optimizing the gasifier, fermenter, gas clean-up, or ethanol separation equipment.

Technology Transfer/Collaborations

- Good interactions and collaborations.

Recommendations for Additions/Deletions to Project Scope

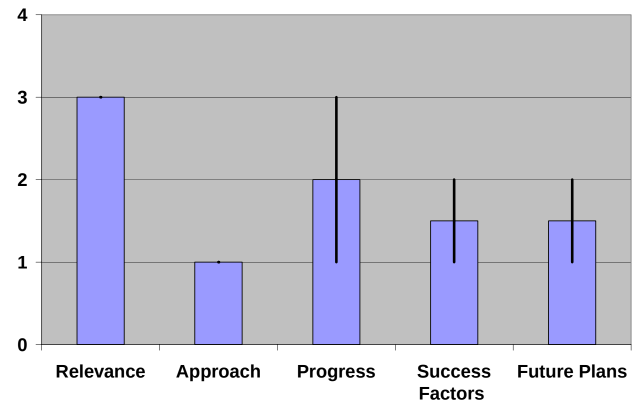
- Only gap is detail on how to get fermenter productivity up.

PI Response to Reviewer Comments

Response not provided.

Project Title: Small Scale Biomass System (Biomax)
Principal Investigator: Robb Walt, Community Power Corporation
Proposed Stage: Stage 4/3
Reviewer Recommended Stage: Stage 4/3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	0.00	0.00
Approach	1.00	0.00	0.00
Progress	2.00	1.00	1.00
Success Factors	1.50	0.50	0.50
Future Plans	1.50	0.50	0.50
Average	**1.80**		



Question 1: Relevance to Overall Objectives.
- Several interesting aspects, but not all aspects clearly focus on the current goals
- Production of a gasifier based liquids production aligns with the Program goals
- The power focus of the presentation does not.
- Liquid production on small scale – completely relevant
- It might be relevant but I am not convinced that on-farm production of diesel fuel is economical or efficient enough to pursue. CPC spent too much of their time talking about how successful they were rather than showing us that this concept makes sense.

Question 2: Approach to Performing the R&D.
- Focused on technical issues, but the economics are not well addressed. What is the cost of the liquid product per gallon?
- Approach was for power – fuels an afterthought with very little information provided regarding this aspect of the project.
- Success speaks
- Hard to evaluate from the presentation.

Question 3: Technical Accomplishments and Progress
- No data for the long term operation of the liquid fuels system.
- NEED some information/data! It is very difficult to evaluate the claims made in the presentation.
- There was no discussion on costs.
- Results are remarkable. Need to be verified by independently by NREL or other.
- Truly amazing results against liquid fuels catalysis development
- The focus seemed to be on past accomplishments (rather than the synfuels part of the project.
- I can't judge the technical merits of a project when no technical information is provided.

Question 4: Success Factors and Showstoppers
- The market driver for liquid fuels at the small scale is not clear
- Seems to need some partnerships.

- The catalyst performance discussed is nothing short of revolutionary and remarkable. Independent verification of the performance is required.
- If it holds up, results are revolutionary. Plans to further test are the only logical choice.
- Economics of small-scale systems.
- Meeting emissions standards
- Finding a workable catalyst given the constraints imposed by small, self-sufficient systems.
- Show stoppers: funding; durability of the gasifier system.
- Not presented.

Question 5: Proposed Future Research Approach and Relevance.
- Some real need for partners and real look at manufacturing costs.
- Need a long-term demonstration for liquid fuels production System as designed for producer-gas production, not supposed to operate 24 hrs, on/off system as needed.
- not discussed relative to liquids
- No information provided

Additional Comments

Strengths
- 24 systems built and 17 in operation, this is a real technology
- Interesting developments in catalysis – seems too good to be true
- Truly commercial products
- Fascinating presentation!
- Great showman.

Weaknesses
- No discussion on the costs of the technology and the details on how the manufacturing will be scaled-up.
- Need to refocus company to market catalyst if performance is verified by independent lab.
- Costs and economics are needed.
- Results are miraculous – need to validate with others in the DOE programs with more catalysis experience
- Will it really work?
- Provided us virtually no technical information on the synfuels part of the project.

Technology Transfer/Collaborations
- There may be interest in local production of liquid fuels, but this does not seem to be a real market. The fuel will be VERY expensive and the skills needed to keep the system running may not
- Good mix

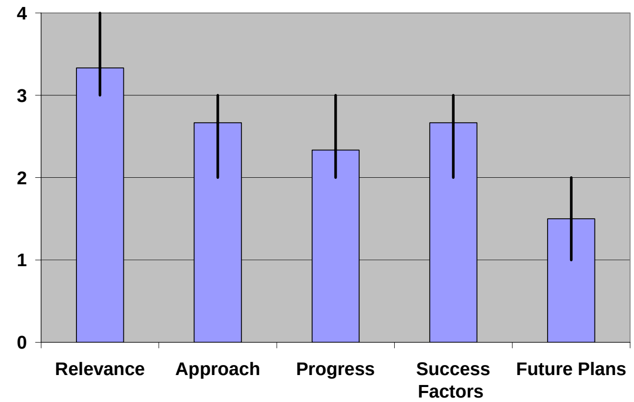
Recommendations for Additions/Deletions to Project Scope
- Get catalyst tested.
- Economics on the liquids is clearly needed
- Catalyst testing to confirm results by other party needed.

PI Response to Reviewer Comments
Response not provided.

Project Title: Biomass Derived Syngas Utilization for Fuels and Chemicals

Principal Investigator: Santosh Gangwal, Research Triangle Institute (new PI: Dave Dayton, RTI)
Proposed Stage: Stage B/2
Reviewer Recommended Stage: Stage B/2

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	2.33	0.33	0.67
Success Factors	2.67	0.67	0.33
Future Plans	1.50	0.50	0.50
Average	**2.50**		



Question 1: Relevance to Overall Objectives.

- Good relevance and understanding of the DOE targets
- Project supports goals and objectives.
- No information on customers and markets provided
- Attacking conversion improvements
- Providing the DOE OBP a systematic evaluation of synfuel catalysts.

Question 2: Approach to Performing the R&D.

- RTI has good experience and skills with technology development
- The approach is aimed at making only incremental gains in performance when revolutionary advances are required.
- Reasonable steps
- The program would be improved if it was based on some guiding scientific hypothesis, novel technology, or high throughput evaluation.

Question 3: Technical Accomplishments and Progress

- Good progress with the pilot reactors and FT work.
- In the case of the mixed alcohols it is less clear how much progress has been made.
- The performance and progress to date are modest at best.
- Project is significantly behind schedule.
- Progress is in infrastructure, not in new developments
- Progress is OK
- Review article is a duplication of existing literature reviews in an area where very little recent work exists
- Does not appear that superior catalysts have been produced as of yet.

Question 4: Success Factors and Showstoppers

- RTI has good experience with developing and deploying technology
- They have identified showstoppers, but have not identified a probable pathway to eliminate them.
- This is an evolutionary project

Question 5: Proposed Future Research Approach and Relevance.

- Future work plans identified and the success of the program depend on finding a partner to provide the cost sharing. This seems unlikely to me based upon the information presented
- No details given on path

Additional Comments

Strengths

- Good experience and technical skills
- Pilot reactors will be very valuable and remote running.
- Good facility and capabilities for this project
- Some past success
- Systematic approach to evaluating catalysts for synfuels.

Weaknesses

- Need partners to insure deployment of commercially viable
- No partner proving cost sharing for balance of program.
- Modest and undifferentiated goals
- A superior catalyst has not yet appeared from this project. The project would be better if it was based on some guiding scientific hypothesis, novel technology, or high throughput evaluation.

Technology Transfer/Collaborations –

- OK – nice to be with real catalyst vendor

Recommendations for Additions/Deletions to Project Scope

- Secure partner before conducting any additional work or expending any additional funds.

PI Response to Reviewer Comments

The objective of this project is to develop and demonstrate new catalysts and catalytic processes that can efficiently convert biomass-derived syngas into diesel fuel and C2-C4 alcohols. Our goal is to improve the economics of the processes by improving the catalytic activity and product selectivity, which could lead to commercialization. To achieve our goals, we will optimize the RTI-6 FT catalyst for use in a slurry bubble column reactor (SBCR). For the synthesis of higher alcohols, we will identify economically viable routes and develop stable and selective catalysts.

The project is divided into 4 major tasks that was originally to be carried out over a 24 month period. This schedule has been delayed with the loss of our original cost share partner, Eastman Chemical and the addition of a new cost-share partner. Task 1 will involve construction and commissioning of reactor systems. Task 2 will involve development of an attrition-resistant iron-based FT catalyst. Task 3 will involve development of selective catalysts for the synthesis of C2 to C4 alcohols. Modeling, engineering evaluation and commercial assessment of the catalytic processes developed will be performed in Task 4.

Question 1: Relevance to overall objectives

The cost goal of $1.07/gal of thermochemical ethanol was used as a benchmark to align with the NREL Design Case for an integrated, indirect biomass gasification mixed alcohol synthesis process. The new “20 in 10” goal established after the 2007 State of the Union Address is the new focus of the Biomass Program. This ambitious goal has led to a revised outlook on lignocellulosic biofuels production to include other “non-ethanol” biofuels. RTI has long history of developing Fischer-Tropsch catalysts that has culminated in the development of RTI-6; an attrition resistant, high alpha, Fe-based catalyst that has demonstrated high CO conversion to hydrocarbon wax product.

With OBP now focused on liquid transportation fuels, a market analysis can be developed, especially with three of the six commercial demonstration projects (700 tpd biorefineries) selected by OBP focusing on biomass gasification. The work plan for FY08 was revised to include a techno-economic assessment to include cost and performance data for developed fuel synthesis catalysts in the NREL Thermochemical Design Case.

Question 2: Approach to performing the R&D
We have completed the bench-scale testing of the attrition resistant Fe-based FT catalyst (RTI-6). Alcohol synthesis catalyst testing is being done in collaboration with our new cost-share partner, who will provide novel materials and formulations to evaluate in our bench-scale microreactors. We are relying on the experience of our cost-share partner (major catalyst supplier) to rationally and scientifically develop these novel catalysts based on their proven expertise. High throughput screening was never within the scope of this project.

Catalyst development and testing is only one aspect of this project where significant gains can be realized, Novel slurry bubble column reactors are also being considered for scaling up these fuel synthesis processes. Consequently, catalysts are being developed with optimum performance anticipated for this specific reactor design. Hence, the revolutionary advances may be in combining developing catalyst formulations in novel reactors designs to maximize yield and optimize performance.

Question 3: Technical Accomplishments and Progress
Much of the progress to date has been in the development of 2 reactor systems – a bench-scale catalyst microreactor test stand and a laboratory scale slurry bubble column reactor for process scale up. The microreactor system has proven to be a robust design that has been duplicated 3 times to meet RTI’s high demand for fuel synthesis catalyst testing from other government and private clients. The slurry bubble column reactor design is being scaled up in a Department of Defense project to produce FT-derived jet fuels for the Air Force. Long-term (500 hour) testing of the RTI-6 FT catalyst in a continuously stirred tank reactor was also completed as part of this project. This highlighted the exceptional performance of this catalyst in terms of CO conversion efficiency and wax yield and demonstrated the attrition resistance of the RTI-6 catalyst that is crucial for operation in a slurry bubble column reactor.

The progress in the mixed alcohol catalyst testing was hindered by the loss of Eastman Chemical as our cost-share partner after they decided not to pursue this technology development. This work has recently been re-initiated with a new cost-share partner and will continue through the completion of the project in FY08.

Question 4: Success Factors and Showstoppers
Cleary, one of the main showstoppers in producing biofuels through a syngas intermediate is synthesis catalyst productivity and selectivity. This drives the economics of the process and poses the greatest technical challenge. The development of RTI-6 for FT synthesis provides an excellent process option should less than expected progress be made in developing mixed alcohol catalysts. Additionally, RTI is developing partnerships with catalyst manufacturers to

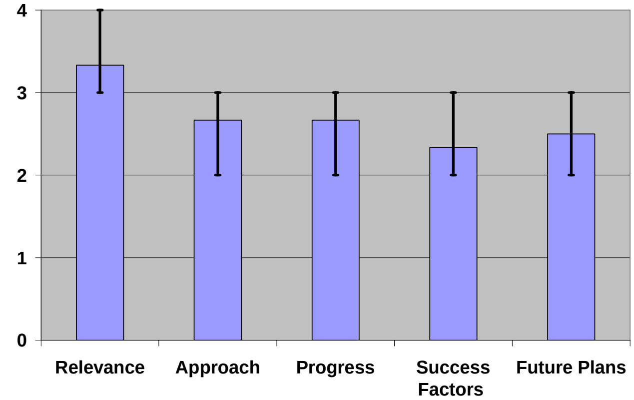
explore the possibility of methanol as an intermediate for fuel (gasoline, ethanol, and mixed alcohols) production. Selectivity and productivity of methanol synthesis catalysts is very high (at least 3 times greater than mixed alcohol catalysts). These processes are beyond the scope of this project but are being considered for future work.

Question 5: Proposed Future Research Approach and Relevance
A new cost-share partner has been secured for this project and bench-scale testing of a variety of mixed alcohol catalysts is underway. Final construction and commissioning of the slurry bubble column reactor will culminate in a laboratory-scale demonstration of wax synthesis from syngas using the RTI-6 catalyst. This technology will be scaled up in a separate (non-DOE) project.

Project Title: Syngas Quality for Mixed Alcohols

Principal Investigator: Jim White and Steve Deutch, Pacific Northwest National Laboratory
Proposed Stage: Stage A/B
Reviewer Recommended Stage: Stage A/B

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	2.67	0.67	0.33
Success Factors	2.33	0.33	0.67
Future Plans	2.50	0.50	0.50
Average	**2.70**		



Question 1: Relevance to Overall Objectives.

- Clearly understand the targets and barriers
- The project aligns with the program objectives.
- No Customers or Markets information was given or are identified as being important.
- Catalysis is key to enabling syngas to fuels
- Provided nice justification for mixed alcohols as a pathway to the DOE OBP goals.

Question 2: Approach to Performing the R&D.

- Good partnership between PNL and NREL, each is working is an area of strength
- No systematic approach to develop catalyst identified.
- Approach seems to be – try everything and maybe something will work
- Methodical, not revolutionary

Question 3: Technical Accomplishments and Progress

- Good facilities and experience within the team.
- No presentation of data on catalysts testing with real syngas.
- How is the syngas clean-up prior to fuel synthesis catalysts testing being done?
- Progress to date has been only modest
- Effort is reasonable but is far too focused on reproducing the past.
- Slurry studies should be encouraged
- Developed a systematic approach to improving mixed alcohol catalysts. However, the approach could have been improved if it was based on some guiding scientific hypothesis, novel technology, or high throughput evaluation.
- The project is generating data but I did not get the sense that the investigators see light at the end of the tunnel.

Question 4: Success Factors and Showstoppers

- Would help to get commercial partners into the project early
- Good understanding to the technical and economic challenges
- Some showstoppers have been identified as performance
- Targets, but no plan to overcome these was identified.
- Unclear that true critical issues are realized

Question 5: Proposed Future Research Approach and Relevance.

- An industrial partner needs to be replaced for the project to continue modest goals

Additional Comments

Strengths

- Very strong team, good experience, each lab is working in areas of strength.
- PNL access to high-throughput screening tools
- Looking both at fixed bed and slurry
- Systematic approach to developing new mixed alcohol catalysts.

Weaknesses

- Not clear how the testing with "real" syngas will be conducted, e.g., biomass feedstock, gasification operating conditions and gas clean-up.
- Poor target selection – no mention of methane make or CO2 rejection
- Lack of engineering investigation
- The approach could have been improved if it was based on some guiding scientific hypothesis, novel technology, or high throughput methodology.
- Missing an industrial collaborator.

Technology Transfer/Collaborations

- Need to work to find industrial partners.
- A bit self focused

Recommendations for Additions/Deletions to Project Scope

- An industrial partner needs to be replaced for the project to continue
- More focus on engineering solutions

PI Response to Reviewer Comments

General CommentsWe strongly agree with the reviewers comments about the need for collaborating with a commercial partner. This has been difficult as most catalyst manufacturers ceased active research in this area in the early 1990's. We are currently discussing collaborations with a large US chemical company and an oil company. These discussions should lead to a defined path forward for securing a commercial partner.

Question 2: Initial project focus was to identify the most likely commercial catalysts and begin alcohol synthesis evaluation using model syngas. Only one commercial source was identified, the existing catalyst literature was found to be dated and conflicted, and so we had to produce our own catalysts from the best of the literature claims. Future work will encompass catalyst discovery. Project guiding principal is focused on improving catalyst space time yields (STY) up to 4x by increasing the number, stability, identity, and activity of catalyst sites for alcohol formation.

Question 3: This project began in FY06 and difficulty in obtaining commercial alcohol synthesis catalysts required that these materials be synthesized at PNNL and NREL based on the existing literature, which is significantly conflicted with respect to catalyst compositions, process conditions and products yields. Since the review, PNNL has identified a promising promoted rhodium-based catalyst and NREL is performing a parametric study of process condition impact on alcohol synthesis with a $CoMoS_2$ series of catalysts in a slurry reactor. Both laboratories are exploring how computational catalysis can be coupled with surface analyses to develop catalyst structure/function relationships to be used in rational catalyst design. A new approach being developed at PNNL is homogeneous alcohol synthesis catalysts. Currently, NREL and PNNL do not have appropriate hardware tools for high throughput catalyst evaluation in the gas phase. Syngas cleanup is accomplished via tar and methane reforming as described in the Catalyst Fundamentals task. Future tests are planned with biomass-derived syngas and both fixed bed and slurry reactors are in use at NREL.

The project will continue to focus near term on maximizing ethanol production from biomass syngas, based on FY2012 technical goal from the Program's Multi Year Technical plan. However much of what is learned on catalyst requirements for biomass syngas quality would be applicable to a longer-range target of any liquid fuel from syngas. The project will rely heavily on the analysis project to help guide the future work to identify the fuel that can have the greatest impact in the overall energy picture, based on cost, technical feasibility, sustainable volume and acceptance into the fuel pool.

<u>Weaknesses</u> We recognize that hydrocarbon production is undesirable and research efforts will focus on minimizing this process through catalyst modification that includes varying reduction and activation conditions and reducing acidity. We also recognize that CO_2 is a necessary by-product of biomass derived syngas catalysis as biomass is oxygen rich compared to the intended products and CO_2 is a convenient oxygen rejection mechanism. Thus in absence of a “free” hydrogen source, modest carbon loss via oxygen rejection in the form of CO_2 is required as the alternate process rejects oxygen through water formation, which also rejects valuable hydrogen.

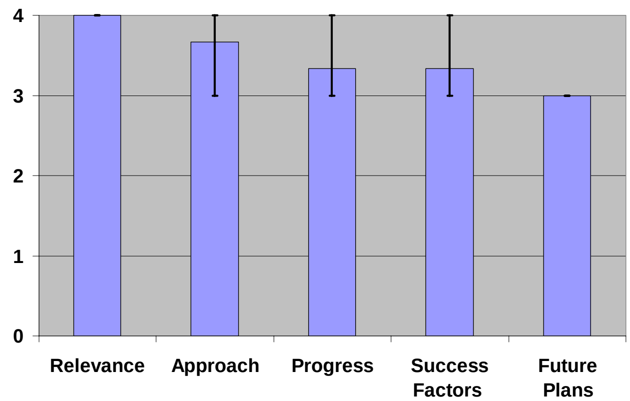
The help guide catalyst selection, rather then simple parametric tests to measure catalyst productivity and performance, a more systematic testing of the catalyst is being developed to include characterizing the general kinetics of a catalyst. This approach will allow us to 1) identify a more productive operating point for a catalyst in a way that can minimize the possibility of missing a prime point and 2) provide insight into why one catalyst is performing better then another. This opens the opportunity for ways to combine the best properties of several catalysts into a superior material.

The suggestion to add research into reactor geometries would help maximize alcohol productivity and allow the program to reach its target goals. However it is felt that adding this task to the project at this time is premature until a catalyst with suitable performance is identified and well characterized, since these characteristics will also help define a preferred reactor design. This issue can be addressed in later years as long term testing and catalyst stability is being addressed.

Pyrolysis Projects

<u>Project Title: Pyrolysis Oil R&D</u>
<u>Principal Investigator:</u> Doug Elliott, Pacific Northwest National Laboratory
<u>Proposed Stage</u>: Stage A/B
<u>Reviewer Recommended Stage</u>: Stage A/B

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	3.33	0.33	0.67
Approach	2.67	0.67	0.33
Progress	3.00	1.00	1.00
Success Factors	2.67	0.67	0.33
Future Plans	3.00	1.00	1.00
Average	**2.93**		



Question 1: Relevance to Overall Objectives.

- Team has a clear understanding of the OBP goals and the market needs
- Project aligned with program goals
- Pyrolysis oil still requires integration into refinery, without it, there is no path directly to motor fuel.
- Taking leadership in developing a pyrolysis core to the DOE OBP.

Question 2: Approach to Performing the R&D.

- The team is focused on some specific targets and understands the connection to the other OBP goals.
- The targets for improvements do not seem very aggressive
- Good inclusion of industrial and international partners
- Plan/approach poorly identified.
- Where did targets come from?
- What is the basis of comparison?
- Heat transfer modeling is conspicuously absent
- Comprehensive. Much of it is “high level” as the participants develop a plan for pyrolysis technologies, which is important but detracts from the desire for the approach to be “sharply focused.”

Question 3: Technical Accomplishments and Progress

- There is a great deal known about pyrolysis and stabilization so some of the tasks do not seem very ambitious.
- New start – not really applicable – but comments above also apply.
- Just starting
- Reasonable set of technical targets although these should include targets for water content, stability as measured by viscosity, and particulate matter in the bio-oil.

Question 4: Success Factors and Showstoppers

- The project has identified some key barriers and the team has the skills to overcome barriers.
- Not presented well and appear not to be utilized in making program plan
- Too early to tell, economics are the key
- Uncertain path to market – three or more options
- Identified showstoppers but did not describe in much detail how these things might be overcome.

Question 5: Proposed Future Research Approach and Relevance.

- Team needs to aggressively publish work since much of the early work was not well disseminated.
- Not clear that the specific targets were justified based on large enough changes to “matter” to the end-user, e.g. reduction of oxygen from 30% to 28% over 3 years
- Where is the project going? What is needed from the technology to make the overall concept economic?
- Very reasonable and well integrated into other global
- efforts

Additional Comments

Strengths

- Good team with a great deal of experience.
- It is good that project is starting to layout a new path.
- Well integrated, still early
- Historic experience in pyrolysis research.
- Good team of PNNL and NREL.
- Team is developing a program (not just a project).

Weaknesses

- Seems like series of modest improvements.
- TEA should be done with ASPEN so that the models can be compared across the program.
- Goals and technical plan could have been a little more ambitious
- Focus of overall project needs to be better defined, lack of model development to insure successful scale up from bench to full scale
- Very early stage and lacking definitive targets.
- Work at the bench scale probably needs to be validated by work at the pilot scale (generally it will be much easier to meet performance targets at the bench scale).

Technology Transfer/Collaborations

- Tied into European efforts

Recommendations for Additions/Deletions to Project Scope

- Discuss how you arrived at the future goal values – like 67% conversion
- Utilize other work in the area that identifies the baseline – why is this part of the project – should have been done ahead to identify a need for a the project doing baseline to incorporate DOE standards for process simulations
- add a reactor model / chemistry model effort
- Continue and build on collaboration with VTT. The Finns are beginning to really take off in the renewable fuels area, and VTT is clearly their lead institution on this.

PI Response to Reviewer Comments

- The reviewers recognized that the project is well-aligned with OBP goals and that this project provides the leadership for developing core R&D for pyrolysis.
- The reviewers did not provide specific feedback on our draft goals but seemed to be suggesting that they were not bold enough. They recognized that these are under development as this project was just getting started. Our initial effort in modeling will provide the feedback we need to identify barriers and showstoppers and guide our future research efforts. The collaboration efforts with Finland were lauded at several points.

Specific Responses:
Question 1 and 2:
We agree that pyrolysis oil is an intermediate in the biomass to gasoline pathway and it has to be integrated into refinery operations for processing to motor fuel. Therefore, we assumed and have been developing two approaches leading in this direction: 1) hydrotreating of bio-oil in a stand alone reactor (possibly using a refinery infrastructure, especially for hydrogen supply) and 2) a modification of bio-oil to make it compatible with refinery processing to motor fuels.

The targets for improvement were proposed based on the PIs' long experience in the area. They may not look very aggressive but they reflect the progress in technology development in the last twenty years. With the increased research effort we hope to achieve faster progress and the though targets may change based on future results, they are sufficient to guide our research this time.

We acknowledge the importance of heat transfer in fast pyrolysis, however, our research is not focused on pyrolysis reactor development but rather on the existing product upgrading and on exploring catalytic processes that could potentially modify the bio-oil composition to make it more suitable for further conversion to motor fuels.

Question 3:
We acknowledge that there is some but not a great deal of knowledge on bio-oil stabilization. Our research in this area takes it into account and goes beyond what is known at present both with respect to stabilization by hydrotreatment and by "capping" of the reactive functional groups. Future work will characterize the chemistry of the modified oils and also water and particulate content and viscosity.

Question 4:
The project is in the early phase. Our ongoing effort in technoeconomic modeling will provide the feedback to identify barriers and showstoppers and guide our future research efforts.

Question 5:
The goal of the project is to develop a fast pyrolysis-based process for producing automotive fuels from biomass. The proposed targets specified improvements for each process step to be achieved during the five-year period. If these targets are reached the technology will be economic – 90 gallons of hydrocarbon fuel will be produced from 1 ton of biomass at a cost competitive with $1.31/gal ethanol.

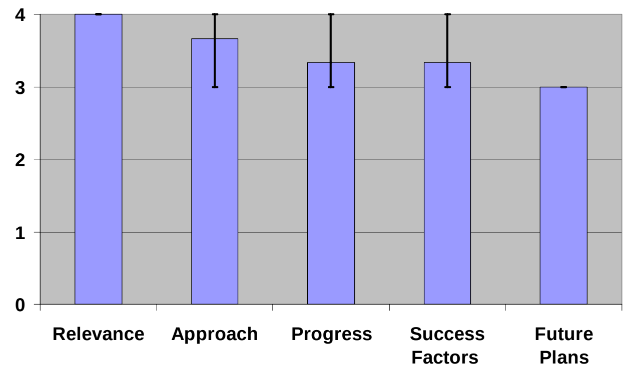
Weaknesses
Technoeconomic models using Aspen are currently being developed to assess the feasibility of both pyrolysis/upgrading approaches and then to understand the minimum upgrading that will be required.

Recommendations:
The future goal values were set considering the best performances achieved so far in laboratory experiments. For example, 67% of biomass to bio-oil conversion (dry basis) is somewhat higher than that reported for a bench-scale system using clean (debarked) wood (65%). The product yields from larger-scale units are still lower but have a chance to match those from small systems.

We are aware of the VTT work, are following it closely, and cooperate with them on setting bio-oil standards and on hydrotreatment.

Project Title: Pyrolysis Oil to Gasoline
Principal Investigator: Richard Marinangeli, UOP
Proposed Stage: Stage 2
Reviewer Recommended Stage: Stage 2

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	4.00	0.00	0.00
Approach	3.67	0.67	0.33
Progress	3.33	0.33	0.67
Success Factors	3.33	0.33	0.67
Future Plans	3.00	0.00	0.00
Average	**3.47**		



Question 1: Relevance to Overall Objectives.
- The team clearly understands the DOE OBP goals and needs, and the market needs
- The project is critical to and fully supports plan objectives.
- UOP as the entity commercializing the product knows the Customers/Markets
- Ties to real world refining

Question 2: Approach to Performing the R&D.
- Good combination of modeling and TEA, and experimental work
- Development approach is well though out.
- Good mix of model and experiment

Question 3: Technical Accomplishments and Progress
- Good progress in both experimental and modeling. UOP appears to bring a great deal of value to the project, and this is a very good example of the public/private partnerships
- Reasonable progress has been made against the project goals
- Still early
- Intriguing and very promising results.

Question 4: Success Factors and Showstoppers
- A major issue is the cost of the oil. Since biomass is 40-45% oxygen and you throw it away as H_2O or CO_2. This is both an economic cost and an environmental cost of not using the land very well.
- Very good understanding of the issues
- UOP has identified a number of potential showstoppers and identified possible strategies to overcome them
- Good progress in understanding. That said, risk analysis seems lacking
- Lack of subsidy versus ethanol, biodiesel
- Nearly the entire processing chain needs to be developed to reach commercialization
- Composition and characteristics of feedstocks and products needed
- Identified a variety of risks and appear to be proactive about overcoming them.

Question 5: Proposed Future Research Approach and Relevance.
- Good plans

- SSF residues look like a very attractive target to help with the economics and LCA
- The future work plan is defined well, building on the success of the project.
- Could be more aggressive

Additional Comments

Strengths
- Very good team!
- Good combination of experimental work and modeling.
- Great inclusion of LCA early in the process
- UOP is a credible industrial player
- UOP has identified good partnerships with each partner playing to their strengths
- UOP has identified a good approach
- It is a nice development effort for both the economic and technical work
- Credible industrial player
- Very reasonable approach
- Flexibility of pyrolysis to different biomass feedstock; conversion of oils needed badly.
- "Doing quite well relative to DOE targets."

Weaknesses
- The approach only uses 30% of the original biomass (no oxygen in product and only 50% of the carbon in the produce) so this is not a great use of land relative to some of the gasification options.
- none
- Not clear where they go from here (results are very promising and suggest a move toward commercialization).

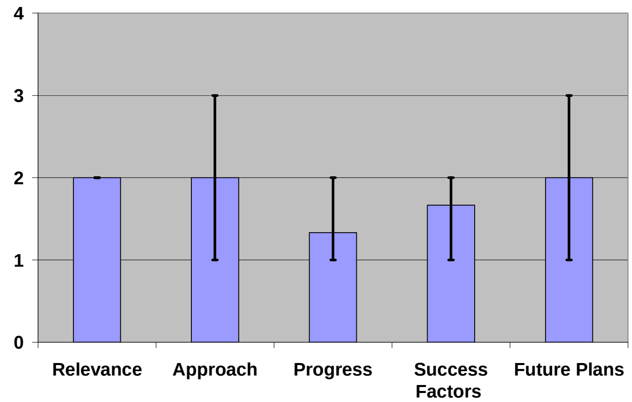
Technology Transfer/Collaborations
- Good interaction with the government labs

Recommendations for Additions/Deletions to Project Scope
- Stay the course
- Consider separating lignin from bio-oil and hydro cracking it rather than the whole oil.
- Move work to pilot-scale.

PI Response to Reviewer Comments
Response not provided.

Project Title: Developing Thermal Conversion Options for Biorefinery Residues
Principal Investigator: Vann Bush, Gas Technology Institute
Proposed Stage: Stage B/Development Research, Stage 3 and 4/Development/Validation
Reviewer Recommended Stage: Stage B/3

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.00	0.00	0.00
Approach	2.00	1.00	1.00
Progress	1.33	0.33	0.67
Success Factors	1.67	0.67	0.33
Future Plans	2.00	1.00	1.00
Average	**1.80**		



Question 1: Relevance to Overall Objectives.

- The project does not define the potential value of the technology if it were successful. They want a consistent feedstock but do not define the quality/cost targets
- The project provides little support to the Program goals and objectives
- No customers or market data are provided
- Clearly an attempt to place a square peg earmark into a round OBP hole
- Pretreatment of biomass to improve its subsequent processing is important to the DOE OBP program. However, it is not clear how pretreating biomass at 33 atm makes it easier to gasify at 10 atm.

Question 2: Approach to Performing the R&D.

- The base CWT technology is not reliable or well-documented and this work plan does nothing to increase confidence.
- The approach is not responsive and is unlikely to make any significant progress
- It is unlikely that the value of the product can support the capital and processing costs approach is defined based on location of feedstock, not rational target

Question 3: Technical Accomplishments and Progress

- The work has not begun. The history of the projects or CWT does not provide great confidence.
- The PI has made no progress towards its objectives
- No technical work done yet
- N/A: Project not yet started.

Question 4: Success Factors and Showstoppers

- CWT has a mixed image in the market place.
- Need an independent engineering company that can increase confidence
- There are a myriad of showstoppers, both technical and economic with very little discussion presented.
- It is unclear what is different from the existing pilot and commercial plant
- N/A
- This project is just beginning.

- Showstoppers identified but strategies for overcome not described.

Question 5: Proposed Future Research Approach and Relevance.

- GTI has a long history of project development, but this presentation did not give any insight into what they will actually do and why it makes sense.
- Realistic plans for future work were not given.
- goals seem modest

Additional Comments

Strengths

- None
- Universal front-end not requiring TDP reactors
- GTI is well qualified to perform thermochemical research.

Weaknesses

- Very disappointing presentation of the work plan.
- How the small scale process will work is not clear and naive. Loggers can not even afford a chipper they will have no ability or interest in a more expensive/complex project.
- The project plan was unclear
- PI did not appear to have investigated any of the multiple potential technical and economics showstoppers small scale/portable complex systems
- Nebulous goals
- Needs economic analysis to make a convincing case for this work.
- The team must force-fit a particular technology to a problem it was never intended to solve.
- CWT was not present for the review of their project.

Technology Transfer/Collaborations

- uncertain – collaborators seem to be chosen by congressional district, not capabilities
- Working with CWT, but not sure this is strength.

Recommendations for Additions/Deletions to Project Scope

- This project should be canceled because it is a poorly thought through alternative to the original project. For that matter, the original project represented a duplication of other federally-supported commercialization of TDP.

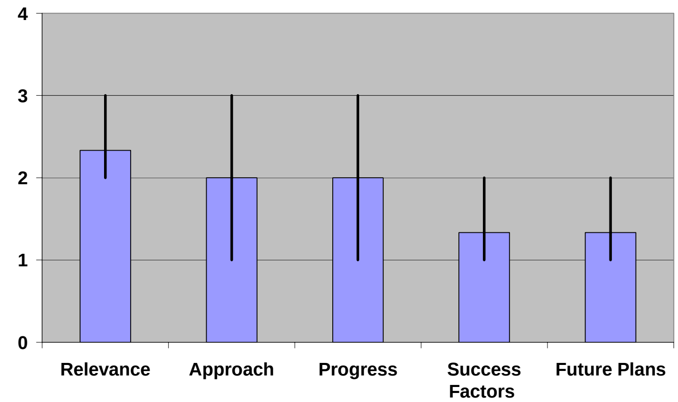
PI Response to Reviewer Comments

- The reviewers make two dismissive comments that appear to be grounded more in perception than fact. First, they assert that "This technology has been funded at very high levels (estimated at $70MM), and the added value for this particular project is unclear." Then they suggest that "the team consider other pre-treatment technologies." While thermo-depolymerization (TDP) technology has received extensive public support, the reviewer's comments imply that technologies for biomass pretreatment to facilitate gasification and pyrolysis that derive from TDP have been fully explored within the scope of previous DOE-supported research and found to be of minimal utility. We believe that this is an unsupportable, unnecessarily broad assertion. ***Indeed, GTI and its project partners are unaware of previous or current, domestic or international R&D efforts that are focused on deriving an effective biomass pretreatment technology from <u>components of</u> the TDP technology to facilitate gasification and pyrolysis****.* GTI and its project partners strongly believe that the technical approach proposed for these redirected projects represents a unique solution to a difficult, but general problem and that valuable intellectual property will result from our efforts.

- The two projects were treated by the reviewers as if they had been awarded and funded, which was not the case. At the time of the Thermochemical Platform Peer Review, a DNFA was underway at DOE Headquarters to determine if the redirected projects fit within the scope of DOE's legitimate interests. This circumstance was duly noted in GTI's presentation.
- The reviewers also appear to have overlooked the fact that project funds were not available to support GTI's preparation or their participation in a comprehensive project review process. In light of this reality, the review panel may have adopted a set of expectations that, in this instance, could not be accommodated for unfunded projects.
- The reviewer's comment with respect to "potential technical and economics showstoppers" is unclear; perhaps the concern is with development and deployment of a portable pretreatment system. Those issues, and many others directly related to the concerns expressed by the reviewers are addressed in the project management plans submitted to DOE.
- The reviewers cite as a weakness that "Handling and cleaning of woody biomass has been extensively studied by the pulp and paper industry." This is a gratuitous comment that does not address either the strengths or weaknesses of the proposed work and fails to take into account that while woody biomass is an important fuel, it is one fuel of interest in the broad suite of native biomass resources this project seeks to accommodate.
- The reviewers suggest that these projects would benefit from an in-depth stage gate prior to initiation of new work. In general, this is a useful comment that probably should be part of any project that seeks to develop a novel approach to a difficult problem.
- The reviewers apparently expected a technical exposition with detailed project plans. However, DOE's instructions explicitly requested a broad overview, with less emphasis on specific results or plans.

Project Title: Mississippi State University Sustainable Energy Center - Pyrolysis
Principal Investigator: Phil Steele and Leonard Ingram, Mississippi State University
Proposed Stage: Multiple tasks at different stages
Reviewer Recommended Stage: Stage 2

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.33	0.33	0.67
Approach	2.00	1.00	1.00
Progress	2.00	1.00	1.00
Success Factors	1.33	0.33	0.67
Future Plans	1.33	0.33	0.67
Average	**1.80**		



Question 1: Relevance to Overall Objectives.
- Poor understanding of the DOE goals and the merits of their approach.
- CCA treated wood is way off the DOE target. This may be a local or EPA issue, but not a DOE target
- The project as presented does not support the Program at all.
- The project needs to conform with the Program
- Confuses technical targets (quantifiable metrics) with tasks.

Question 2: Approach to Performing the R&D.
- Simply a collection of academic projects with no overall focus or
- No plan/mechanism for selecting more useful, valuable projects
- No approach was presented.
- The presentation did not identify a systematic approach to solving problems associated with the Program
- Novel approaches and thorough analytical program that is well organized with specific tasks and targets.
- An extremely diffuse approach. It is hard to see where all this leads.

Question 3: Technical Accomplishments and Progress
- No focus or targets that let them know if they are making progress
- No progress was made towards the Program needs or was it possible to evaluate the scattergun methodology which the PI presented.
- Early stage – less than a year since inception
- A potpourri of results was presented. However, the relationship among the results was not clear and the significance o f many of the results are questionable (example: what is so surprising about find lower molecular weight products in the bio-oil).

Question 4: Success Factors and Showstoppers
- Without targets they don't know if they have overcome a critical barrier or are working on the most important tasks.
- No success factors or showstoppers were given

- Recognizes that cost of hydrogen for upgrading, low yield, and water solubility of are potential major problems.
- Only cursory attention, if any, was given to the issue of showstoppers and potential solutions.

Question 5: Proposed Future Research Approach and Relevance.

- Recognize the need to eliminate future work on CCA treated wood since it is not aligned with the DOE goals
- The plans for future work did not exist
- New target: rapid commercialization of upgraded oils.
- Specifics not clear.

Additional Comments

Strengths

- Limited
- Spending money
- Built mobile pyrolysis unit
- Recognizes that fast pyrolysis has good potential.

Weaknesses

- No economic analysis to justify/guide process selection
- Thermal treatment of CCA treated wood will have an Arsenic vapor stream that is hazardous
- The bio-oil preservative is not of interest to the DOE program
- Do not appear to understand the limitations of their analytical tools, need LC or NMR to understand the non-volatile components.
- The PI presented no innovative technology
- Prior to commencing additional R&D activities, engineering/process analysis is needed to help define technical targets to better guide this work
- Some project activities are clearly redundant and the remaining tasks are not aligned with the Program goals and priorities.
- Overall project lacked direction and clear justification
- Need economic analysis to justify value of project.
- Project lacks a coherent approach.
- Project would have been strengthened by the addition of external partners (universities and companies).
- The project would be better if it was based on some guiding scientific hypothesis or novel technology.

Recommendations for Additions/Deletions to Project Scope

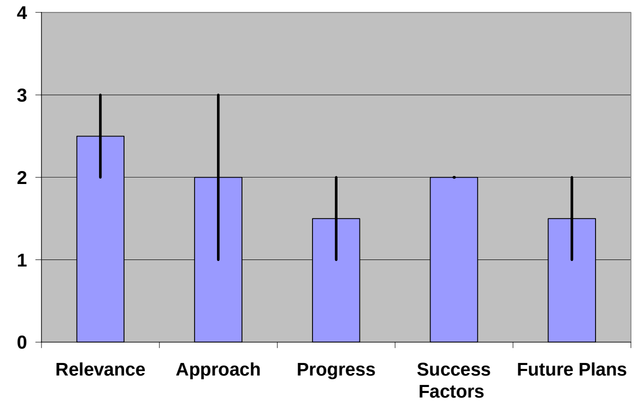
- Need to work with DOE program staff to identify the priorities for their work as if moves forward.
- Work with Program Director to better align project to Program goals and needs.
- Bring focus to the effort. Drop efforts that are not directly related to the goal of thermochemically transforming biomass to transportation fuels and focus on fast pyrolysis (drop the hydrothermal treatment task).

PI Response to Reviewer Comments

Response not provided.

Project Title: Applications of Thermo-Depolymerization Technology
Principal Investigator: Tom Butcher, Brookhaven National Laboratory and Gabe Miller, Society for Energy and Environmental Research
Proposed Stage: Stage B/Development Research
Reviewer Recommended Stage: Stage B/Development Research

Project	Average Score	Delta Minimum	Delta Maximum
Relevance	2.50	0.50	0.50
Approach	2.00	1.00	1.00
Progress	1.50	0.50	0.50
Success Factors	2.00	0.00	0.00
Future Plans	1.50	0.50	0.50
Average	**1.90**		



Question 1: Relevance to Overall Objectives.
- Little attention to DOE goals.
- Lots of claims from CWT but no success in the marketplace.
- Unclear how bio-oil is being refinery integrated
- Project on hold and goals being reevaluated. It appears targeted at waste grease (not one of the DOE OBP pathways) to transportation fuel (although it is not clear how the TDP oil is converted into commercial fuel).

Question 2: Approach to Performing the R&D.
- TDP could be useful for wet Biorefinery wastes.
- Fixing critical problems in the process
- How many TDP commercialization projects does the federal government have to support before the commercial destiny of the process is evident? This is unnecessary replication.

Question 3: Technical Accomplishments and Progress
- Need the engineering and process economics to be a major component of the future work
- Problem is determining why pilot unit
- Intriguing and very promising results.

Question 4: Success Factors and Showstoppers
- TDP provides a liquid product so has some advantage vs. wet gasification that makes CH_4
- Not at all clear what is unknown
- Identified a variety of risks and appear to be proactive about overcoming them.
- Missed an important showstopper: loss of their commercial partner.

Question 5: Proposed Future Research Approach and Relevance.
- There was no specific plan that could be evaluated. General discussion on trap grease does not provide technology or engineering detail.
- Project on hold.

Additional Comments

Strengths

- None
- Viable concept, large potential market, demonstrated in part on commercial scale at a Missouri turkey processing plant.
- Has potential for double winner: produce fuels and eliminate wastes.
- I find no strengths.

Weaknesses

- There is a real lack of clarity and to the plans and options. The partners should develop their plan, and then DOE should conduct a very detailed review of the merits of the detailed proposal.
- Need to identify industrial partner(s)
- CTW was not present for the review of their project.

Technology Transfer/Collaborations

Recommendations for Additions/Deletions to Project Scope

- Is it possible to just cancel this project?

PI Response to Reviewer Comments

- The project's revised Statement of Work includes facility design and economic analysis for different product conversion and direct use routes. This includes integration with a petroleum refinery for production of ASTM diesel. With the addition of consideration of alternative conventional uses for the brown grease feedstock, this planned effort should address the concerns raised by the reviewers.
- It has been estimated by NREL that trap grease, nationally, has the potential for production 495 million gallons of biodiesel annually. Given U.S. biodiesel production levels of 250 million gallons in 2006, it would seem that waste greases could make a contribution to the national situation. Further – any trap grease process is likely to actually incorporate yellow grease feeds, increasing the potential impact.
- While alternative pathways are possible and have been proposed, the management of trap grease remains a very significant local problem. Solution requires an integrated regional program including building codes, enforcement, collection, analysis and monitoring, conversion, product quality management, and product distribution. The solutions being explored under this project may be suitable for local implementation, avoiding logistical issues associated with large industrial facilities and providing a more consistent feedstock.
- The thermal process to be used in this project offers some advantages that could make it attractive relative to direct refinery integration of trap grease. This includes no requirement for hydrogen, no catalyst, and the ability to accept a very mixed and variable feedstock. The current plant in Missouri that processes turkey waste accepts considerable solids in the feedstock.

APPENDIX A

Agenda

Day 1 – Tuesday, July 10th

Welcome and Platform Overview		
	Welcome	*Paul Grabowski, Office of the Biomass Program*
8:30 – 8:50	Platform Overview	*Paul Grabowksi, Office of the Biomass Program*
8:50 – 9:00	Process Overview	*Valri Lightner, Office of the Biomass Program*
9:00 – 9:10	Stage Gate Overview	*Bob Wooley, National Renewable Energy Laboratory*
9:10 – 9:30	Feedstock Interface	*Richard Hess, Idaho National Laboratory*
Analysis		
9:30 – 9:50	Analysis Overview	*John Scahill, Golden Field Office*
9:50 – 10:35	➢ Syngas Platform Analysis/ Thermochemical Analysis	*Andy Aden, National Renewable Energy Laboratory*

10:35 – 10:45 Break

Gasification/Black Liquor Gasification		
10:45 – 11:05	Gasification Session Overview	*John Scahill, Golden Field Office*
11:05 – 1:00	➢ Gasification of Biorefinery Residues (lignin/modeling and optimization)	*Dave Dayton, National Renewable Energy Laboratory*
	➢ Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant	*Chris Lindsey and Ed Gray, Antares Group Incorporated*
	➢ Mississippi State University Sustainable Energy Center (MS)	*Mark Bricka, Mississippi State University*
1:00 – 2:00 Lunch		
2:00 – 2:40	Presentations on Black Liquor Gasification Projects	
	➢ Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer Project	*Kevin Whitty, University of Utah*

Day 1 – Tuesday, July 10th (continued)

Clean-up and Conditioning		
2:40 – 3:00	Gas Clean-up and Conditioning Session Overview	*John Scahill, Golden Field Office*
3:00 – 5:30 (3:45 – 4:00 break)	➢ Biomass Gas Cleanup Using a Therminator	*Santosh Gangwal, Research Triangle Institute*
	➢ Engineering New Catalysts for In-Process Elimination of Tars	*Larry G. Felix, Gas Technology Institute*
	➢ Catalyst Fundamentals (Integration and sub tasks)	*Kim Magrini, National Renewable Energy Laboratory*
	➢ Integrated Catalyst Testing	*Calvin Feik, National Renewable Energy Laboratory*

Day 2 – Wednesday, July 11th

Fuel Synthesis		
8:30 – 8:50	Fuel Synthesis Session Overview	*John Scahill, Golden Field Office*
8:50 – 10:20	➢ Thermochemical Conversion of Corn Stover	*James L. Gaddy, Bioengineering Resources Inc*
	➢ Small Scale Biomass System (BioMax)	*Robb Walt, Community Power Corporation*
	➢ Biomass-Derived Syngas Utilization for Fuels and Chemicals	*Santosh Gangwal, Research Triangle Institute*
	➢ Syngas Quality for Mixed Alcohols	*Jim White of Pacific Northwest National Laboratory*

10:20 – 10:35 Break

Pyrolysis		
10:35 – 10:55	Pyrolysis Projects Session Overview	*John Scahill, Golden Field Office*
10:55 – 2:55 (12:00 – 1:00 Lunch)	➢ Pyrolysis Oil R&D	*Doug Elliott, Pacific Northwest National Laboratory*
	➢ Pyrolysis Oil to Gasoline	*Richard Marinangeli, UOP*
	➢ Developing Thermal Conversion Options for Biorefinery Residues	*Vann Bush, Gas Technology Institute*
	➢ Mississippi State University Sustainable Energy Center (MS)	*Phil Steele and Leonard Ingram, Mississippi State University*
	➢ Applications of Thermo-Depolymerization Technology	*Tom Butcher, Brookhaven National Laboratory and Gabe Miller, Society for Energy and Environmental Research*

2:55 – 4:15 Break

Plenary Session	
4:15 – 5:00	Reviewers Report-out
5:00	Adjourn

APPENDIX B

Conflict of Interest Form

DOE Conflict-of-Interest Policy and Agreement

(Please forward this form, along with your Curricula Vita, to the DOE Review Leader – Paul Grabowski
Please copy Leslie Pezzullo (lpezzullo@bcs-hq.com)

You have been invited to serve as a Reviewer for the DOE Thermochemical Platform Review. Your participation in this review is greatly appreciated. However, it is possible that your personal affiliations and involvement in certain activities could pose a conflict of interest or create the appearance that you lack impartiality in your evaluations and recommendations for this review. In order to assess if you have a real or perceived conflict of interest in regard to the program/projects that will be evaluated in this review, please complete the information below. This information will be reviewed by the review leader in order to identify potential conflicts of interest.

SECTION 1: AFFILIATIONS, ACTIVITIES AND PROGRAM INVOLVEMENT

At the end of this section you will be asked to identify those specific projects or areas on the agenda where a conflict or appearance of conflict could exist and briefly explain the nature of that conflict. A conflict does not exclude you from serving as a reviewer. However the review leader may call you for more information.

Affiliations or activities that could potentially lead to conflicts of interest may include:

a) work or known future work for parties that could be affected by your judgments on projects that you have been asked to review;

b) your personal benefit (or benefit of your employer, spouse or dependent child) from the developments of the program/projects you have been asked to review;

c) any previous involvement you have had with the program/projects you have been asked to review;

d) any financial interest held by you (or your employer, spouse or dependent child) that could be affected by your participation in this matter; and

e) any financial relationship you have or have had with DOE such as research grants or cooperative agreements.

Personal involvement with the research program or with other DOE program areas:

	Yes	**No**
I previously was involved in research funded by this program/project	_____	_____
I am currently funded through a DOE program, or in some way might be seen as involved in work competing with this program/project	_____	_____
I reviewed this program/project previously.	_____	_____
I am a former professor, student, or co-worker of a Principal Investigator	_____	_____
I previously collaborated with the Principal Investigator in a research activity in program/project area.	_____	_____

Technical Area or Project on Review Agenda	Nature of conflict of interest (Leave blank if none)
Syngas Platform Analysis/ Thermochemical Analysis	
Gasification of Biorefinery Residues (lignin/modeling and optimization)	
Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical Production Plant	
Mississippi State University Sustainable Energy Center (MS)	
Fuel Chemistry and Bed Performance in a Black Liquor Steam Reformer Project	
Biomass Gas Cleanup Using a Therminator	
Engineering New Catalysts for In-Process Elimination of Tars	
Catalyst Fundamentals (Integration and sub tasks)	
Integrated Catalyst Testing	
Thermochemical Conversion of Corn Stover	
Small Scale Biomass System (BioMax)	
Biomass-Derived Syngas Utilization for Fuels and Chemicals	
Syngas Quality for Mixed Alcohols	
Pyrolysis Oil R&D	
Pyrolysis Oil to Gasoline	
Developing Thermal Conversion Options for Biorefinery Residues	
Mississippi State University Sustainable Energy Center (MS) – (pyrolysis)	
Applications of Thermo-Depolymerization Technology	

SECTION 2: CONFLICT OF INTEREST AGREEMENT

CONFLICT OF INTEREST AGREEMENT

This agreement must be completed by individuals prior to their participation in DOE peer reviews. Please contact the DOE Review Leader – Paul Grabowski (202-586-0478) if you want to discuss any potential conflict of interest disclosure issues.

I have reviewed the information contained on this form and to the best of my knowledge I have disclosed any actual or potential conflicts of interest that I may have in regard to the program/projects that I have been invited to evaluate. In addition, prior to my participation as a reviewer, I agree to disclose any actual or perceived conflicts of interest as soon as I am aware of the conflict.

________________________________ _______________________
Signature Date

____
Printed Name

APPENDIX C

Reviewer Evaluation Form

Project Evaluation Form

Session:

Reviewer Name: ____

Title of Project: ____

Presenter Name: ____

Reviewer Self Assessment of Subject Knowledge (Circle)**: None Novice Intermediate Expert**

Proposed Stage Placement (Circle One)**: A B 2 3 4 NA**

Reviewer Recommended Stage (Circle One)**: A B 2 3 4 NA**

Comments on Stage Placement:____

____

Using the following criteria, rate the work presented in the context of the program objectives and provide **specific, concise** comments to support your evaluation.

Write/print **clearly** please

1. **Relevance** to overall objectives.

The degree to which 1) the project supports the goals and objectives of the DOE Biomass Program Multi-Year Technical Plan, and 2) the market potential is attractive and customers are identified for project outputs.

4-Outstanding. The project is critical to and fully supports plan objectives. Customers/Markets are identified and critical.		Specific Comments
3-Good. Most aspects of the project align with the plan objectives. Customers/Markets are identified and important.		
2-Fair. The project partially supports the plan objectives. Customers/Markets are identified.		
1.-Poor. The project provides little support to the plan objectives. Customers/Markets not identified.		

2. **Approach** to performing the R&D.

The degree to which technical barriers are addressed, the project is well-designed, technically feasible, and integrated with other research. Also, it is clear why the approach is better than alternatives.

4-Outstanding. The project is sharply focused on one or more key technical barriers. Difficult for the approach to be improved significantly.		Specific Comments
3-Good. The approach is generally well thought out and effective but could be improved in a few areas. Most aspects of the project will contribute to progress in overcoming the barriers.		
2-Fair. Some aspects of the project may lead to progress in overcoming some barriers, but the approach has significant weaknesses.		
1.-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions to overcoming the barriers.		

Project Evaluation Form

3. Technical Accomplishments and Progress

Toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits).

4-Outstanding. The project has made excellent progress towards DOE goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments
3-Good. The project has shown significant progress toward against DOE goals and objectives and to overcoming one or more technical barriers.		
2-Fair. The project has shown modest progress in overcoming barriers, and the rate of progress has been slow.		
1.-Poor. The project has demonstrated little or no progress towards its objectives or any barriers.		

4. Success Factors and Showstoppers

The degree to which the project has identified and addressed the most critical technical or business factors impacting or impeding achievement of the project goals. Factors include legal or regulatory issues that may be barriers to commercialization.

4-Outstanding. All critical success factors and showstoppers are identified and reasonable strategies developed to overcome showstoppers.		Specific Comments
3-Good. Most critical success factors and showstoppers are identified and possible strategies developed to overcome showstoppers.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are very high level or not developed.		
1.-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

Project Evaluation Form

5. **Proposed Future Research** approach and relevance (as defined in the project).

Stage Gate Criteria 7: Plan to Proceed

The degree to which the project has effectively planned its future, considered contingencies, understands resource or schedule requirements, built in optional paths or off ramps, etc.

4-Outstanding. The future work plan clearly builds on past progress and is sharply focused on one or more key technical barriers in a timely manner.		Specific Comments
3-Good. Future work plans build on past progress and generally address removing or diminishing barriers in a reasonable period.		
2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key barriers in a reasonable timeframe.		
1.-Poor. Future work plans have little relevance or benefit toward eliminating barriers or advancing the program.		

Provide Comments on Overall Strengths and Weaknesses

Strengths

Weaknesses

Technology Transfer/Collaborations - the degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.

Recommendations for Additions/Deletions to Project Scope

APPENDIX D

Letter to PI

(Requesting PI Responses to the Reviewer Feedback)

From: Leslie Pezzullo [mailto:LPezzullo@bcs-hq.com]
Sent: Tuesday, October 30, 2007 4:53 PM
Subject: Thermochemical Peer Review Draft Report -- Need your feedback by Nov. 30

PIs,

Thanks again for all your hard work at the Peer Review. We have had some difficulties in receiving the final feedback from the reviewers in a timely fashion and we are still waiting to hear from 1 reviewer. We've decided that we should not wait anymore and go forward with what we have so far. If we receive the comments from them we will send them forward.

As promised we will give all the PI's an opportunity to reply to the comments offered by the reviewers. For this we need your input and we would like to collect this information by COB Friday, November 30th. The draft report is available online at http://obpreview07.govtools.us/review/documents/FinalReport-Thermochem%20Review%2010-13-2007.pdf.

Please provide your input (bulleted in Word) to Leslie at lpezzullo@bcs-hq.com.

Thanks,
Paul and Leslie

Leslie Pezzullo
BCS, Incorporated
8920 Stephens Road
Laurel, MD 20723
(410) 997-7778 ext. 234

Dear Colleague:

This document summarizes the comments provided by the peer reviewers at the U.S. Department of Energy (DOE) Biomass Program's Peer Review meeting, held on November 14-15, 2007 in Baltimore, MD and Platform Reviews conducted over the summer of 2007. The Platform Reviews provide evaluations of the Program's projects in applied research, development and demonstration. The Program Review provides evaluations of the Program's projects in analysis and an evaluation of the overall program strategic approach, balance across research areas, resource allocation and future plans.

This Report includes first a review of the presentations from the Program Review (analysis and the program element overviews) then includes project reviews from the Platform Reviews (feedstock production and logistics, biochemical conversion, thermochemical conversion, integrated biorefineries, infrastructure, and biodiesel and other). Each presentation was evaluated and scored. The weighted scores are based on a 4-point scale involving five criteria. The scores and peer review comments are included in this report. To furnish all presenters with direct feedback, all evaluations and comments are provided to each presenter; however, the authors of the individual comments remain anonymous. The principal investigator of each project is instructed to fully consider these summary evaluation comments, as appropriate, in their FY 2008 plans. Additionally, the recommendations of the reviewers have been taken into consideration by DOE Technology Development Managers in the generation of future work plans. This report includes highlights of program adjustments in response to reviewer comments.

I would like to express my sincere appreciation to the reviewers. It is they who make this report possible, and upon whose comments we rely to help make project and programmatic decisions for the new fiscal year. Thank you for participating in the 2007 Peer Review meetings.

The Biomass Program plans to conduct their next Peer Review in the spring of 2009. Details about the next review will be posted on our website at www.eere.energy.gov/biomass. We look forward to your participation.

Jacques Beaudry-Losique
Biomass Program Manager
Office of Energy Efficiency and Renewable Energy

Program Peer Review Summary Report

Introduction

The first section of this report focuses on the Peer Review Panel at the 2007 DOE Biomass Program Merit Review, held on November 15-16, 2007, at the Tremont Plaza Hotel in Baltimore, Maryland. The purpose of the program review was to evaluate the Program's performance and strategic planning as well as the contribution of the individual Platforms to Program goals, and alignment with the President's "20-in-10" plan.

The Peer Review process followed the guidelines of the Peer Review Guide developed by the Office of Energy Efficiency and Renewable Energy (EERE). The Peer Review Panel members, listed in Table 1, attended the meeting and provided comments to the Biomass Program on the Multi-Year Program Plan, Program Overview Presentation, Platform Overview Presentations, Platform Peer Review Reports and Presentations, and Analysis presentations. Peer review panel members include experts from a variety biomass related backgrounds representing academia, industry, finance environmental and the environmental communities. Additional members of the panel served as chairs of the platform reviews across the biofuels supply chain (feedstock, conversion, biorefineries, infrastructure and end use, and other). Each of the eleven panel members was screened from a conflict of interest perspective per the Peer Review Guide.

Name	Organization	Expertise/Area
Ralph Cavalieri	Washington State University	Academia
Terry Jaffoni	Clean Transportation Fuels	Ethanol industry
Irvin Barash	Vencon Management, Inc.	Finance
Daniel Sonke	Protected Harvest	Environmental
Todd Werpy	Archer Daniels Midland	Products
Lyle Stevens	John Deere (retired)	Feedstocks
Donald Johnson	Grain Processing Corporation (retired)	Biochemical Conversion
Mark Jones	Dow Chemical	Thermochemical Conversion
Bill Cruickshank	Natural Resources Canada (retired)	Biorefineries
Mike Tumbleson	University of Illinois	Biorefineries/Neutraceuticals
David Terry	Governors' Ethanol Coalition	Infrastructure and End Use
Shaine Tyson	Rocky Mountain Biodiesel	Biodiesel and Other

In addition to the program peer review panel comments this section of the Peer Review Report gives an overview of the program direction and funding as background for the comments that follow. The second section of the report provides a description of the process used for the Platform Peer Reviews and the peer review panel comments on individual projects.

Discussion of Program Direction

President Bush laid out aggressive goals for moving biofuels into the marketplace to reduce the nation's dependence on foreign sources of energy and reduce greenhouse gas emissions from the transportation sector. Specifically, the President's goals are to:

- Foster breakthrough technologies needed to make cellulosic ethanol cost competitive with corn-based ethanol by 2012[1]
- Increase the supply of alternative and renewable fuels to 35 billion gallons per year by 2017 (the 20-in-10 plan)[2]

The federal government responded to the 20-in-10 plan by increasing the membership of the Biomass Research and Development Board (Board) and the frequency of meetings. The Board is co-chaired by the DOE and Department of Agriculture (USDA) and includes senior level members from eleven federal agencies. The Board is developing a National Biofuels Action Plan that supports the 20-in-10, which is planned for release in the summer of 2008. Even though the Plan has not been released publically, the Board has already begun to organize and oversee Interagency Working Groups to begin implementation of the Plan.

Additionally, the DOE Biomass Program has laid out an aggressive strategy in research and development of biomass feedstock and conversion technologies; demonstration and deployment of large-scale, integrated biofuels production facilities; and development of biofuels infrastructure in support of the President's goals. The Program strategy is currently focused on cellulosic ethanol; however, a study will be conducted in FY2008 to evaluate the potential contribution of fuels other than ethanol toward the 20-in-10 plan and the federal role in developing those fuels. The study will inform future Program planning to add targets and goals for additional biofuels to the Biomass Program Plan.

The Program recognizes the need to continue to increase emphasis on feedstock production and logistics. More emphasis is also planned for thermochemical conversion through platform research and development and demonstration in integrated biorefineries. Distribution Infrastructure and End Use development was initiated in FY2007 in partnership with the Vehicle Technologies Program with testing of intermediate blends of ethanol (E12, E15 and E20) as a potential pathway to enable full utilization of increased ethanol production, while minimizing cost and infrastructure challenges. The testing will evaluate potential environmental, health and safety impacts of these intermediate blends. Additional Distribution Infrastructure and End Use plans will be developed in FY2008.

Program Funding

The Biomass Program budget more than doubled from FY2006 to FY2007 with an appropriation larger than the request and no congressionally directed projects within appropriated funds. As a result, FY2007 was a planning year with several active solicitations for key program areas including: commercial scale integrated biorefineries; integrated biorefineries that are 10% of commercial scale; saccharification enzymes; fermentation organisms; and synthesis gas clean up and fuel synthesis.

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[1] Advanced Energy Initiative. (February 2006) The White House National Economic Council http://www.whitehouse.gov/stateoftheunion/2006/energy/energy_booklet.pdf

[2] 2007 State of the Union Address, 20-in-10: Strengthening America's Energy Security, http://www.whitehouse.gov/stateoftheunion/2007/initiatives/energy.html

Specific Program Responses to Select Reviewer Comments

Reviewer Comment		Program Response
Program Overview (Initial Reviewer Comments)		
Program should better define “transportation fuels”, and use the standard definitions to set R&D priorities (Need to articulate why the fuel of choice is the priority)		The Biomass Program agrees and is evaluating the potential of biofuels other than ethanol to contribute to the President’s 20-in-10 plan. Fuels that have the potential to be deployed within the next 10 years will be given priority. The Program plans to release a report on the potential of transportation biofuels other than ethanol in the fall of 2008.
Appreciate use of systems approach to decision making. Review panel encourages further use of analysis results to effect program changes and decisions. (tracking vs. managing)		The Biomass Program agrees and will seek to implement the reviewer recommendation.
Resource allocation does not seem to mirror the needs of industry • Thermochemical is underfunded • Feedstocks funding increase is applauded, but should continue to be increased		The Biomass Program agrees and will seek to implement the reviewer recommendation. The study to evaluate the potential of fuels other than ethanol to contribute to the President’s 20-in-10 plan will inform the direction of the thermochemical area and resource allocation.
Platform-level Comments		
Feedstock Logistics and Integration are instrumental pieces to the Program. Resources should be allocated accordingly.		The Biomass Program agrees and is conducting a 10-year planning process to update the biofuels strategy and evaluate resource needs across the supply chain. Feedstock logistics and integration activities will support both the conversion R&D activities and the integrated biorefineries. As such resources will be allocated appropriately.
Applaud the creation of an infrastructure and end-use platform		The Biomass Program has initiated end use activities of evaluating the impact of intermediate blends of ethanol on vehicle emissions, performance and lifetime. The Program will coordinate with other Federal agencies, specifically the Department of Transportation and the Environmental Protection Agency to inventory biofuels distribution infrastructure and end use activities and develop a cohesive federal plan.
Middle distillate replacement potential needs to be quantified and evaluated to help define priorities of “diesel replacement”		The potential opportunities and needs for middle distillates will be included as part of the study to evaluate the potential for fuels other than ethanol. This study will be completed in the fall of 2008.
Other Comments		
The reviewers encourage the Program to review and implement the Reviewer Comments noted at the Platform Reviews.		The platform reviewer comments are included in the appropriate sections of this report with Biomass Program response.
Would like to see more coordination in intra- & inter-agency relationships (i.e., USDA and DOE feedstock activities)		The Biomass R&D Board is a federal interagency Board with senior level representation from eleven agencies. Since May 2007, the Board has been meeting monthly to coordinate federal biomass activities with a focus on biofuels to support the President’s 20-in-10 plan. The Board is developing a National Biofuels Action Plan that is planned for release in the summer of 2008. Implementation is through interagency working groups across the supply chain and in cross cutting areas.

Initial Reviewer Feedback

- Applaud the program's portfolio expansion to include alternative biofuels in addition to ethanol
- Program should better define "transportation fuels", and use the standard definitions to set R&D priorities (Need to articulate why the fuel of choice is the priority)
- Appreciate use of systems approach to decision making. Review panel encourages further use of analysis results to effect program changes and decisions. (tracking vs. managing)
- Resource allocation does not seem to mirror the needs of industry
  - Thermochemical is significantly underfunded
  - Feedstocks funding increase is applauded, but should continue to be increased
- Reviewers recognize increased diversity of feedstocks in Program focus, and encourage linking between all platforms' feedstock work to maximize effort

Platform-level Comments

- Feedstock Logistics and Integration are instrumental pieces to the Program. Resources should be allocated accordingly.
- Biochemical Platform is well organized and focused correctly
- Conduct a critical review of the thermochemical conversion program – if the potential for fuel production exists – additional funding should be applied
- How will the results of program success be used in terms of setting future direction (i.e., UOP – pyrolysis, syngas conversion)
- Applaud the creation of an infrastructure and end-use platform
- Middle distillate replacement potential needs to be quantified and evaluated to help define priorities of "diesel replacement"
- Potentially include biodiesel in the end-use platform

Other Comments

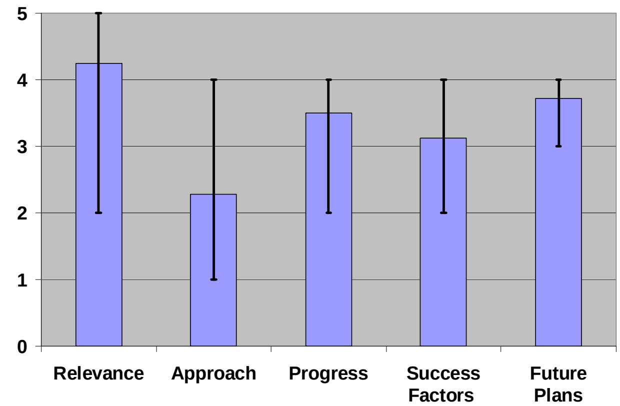
- The reviewers encourage the Program to review and implement the Reviewer Comments noted at the Platform Reviews.
- Would like to see more coordination in intra- & inter-agency relationships (i.e., USDA and DOE feedstock activities)
- The reviewers thought some of the presenters could have done a better job of relating their efforts to the program goals and conversion technologies discussion

Program Peer Review Full Comments and Scores

Program Overview

<u>Presenters</u>: Jacques Beaudry-Losique (Biomass Program)

	Average Score	Delta Minimum	Delta Maximum
Relevance	4.25	2.25	0.75
Approach	2.29	1.29	1.71
Progress	3.50	1.50	0.50
Success Factors	3.13	1.13	0.88
Future Plans	3.71	0.71	0.29
Average	**3.38**		



Question 1: Program Planning

- How many people are involved in the program? How many department heads? What is the mechanism to solicit external changes? What are reporting relationships? How is he program monitored as quarterly?
- The MYPP is of very high quality. Barriers, targets, goals et al. are appropriate, logical and considered sufficient to meet Program objectives.
- Rigorous impressive document. Clearly establishes rationale for focus on biofuels as most immediate path to achievement of program goals. Strategic goal aligns well with DOE, EERE vision, mission and strategy, with key drivers (climate change, petroleum fuel displacement) and with President's "20-in-10" and Advanced Energy initiatives. Supply chain model provides correct framework. Plan achieves an appropriate balance between focus on ethanol and other biofuels
- The document is excellent and a treasure trove of information, targets and plans.
- The program is well aligned and managed to about the 85% level. There are issues that seem to being addressed to balance the portfolio.
- This is my first interaction with the Biomass Program and I was quite impressed by the way the Program has utilized planning, analysis, systems integration, and related tools to develop and guide its MYPP. Overall, the MYPP does an excellent role at targeting its resources at appropriate and logical activities. I am also pleased at the way industry resources are utilized, such that the Program supports the development of the industry rather than competing or working against it.

Question 1b. What improvements can be made to improve the MYPP effort?

- The quality of the plan is best understood from the tasks of the individual managers and their resources for accomplishing the tasks.
- The MYPP and the Biomass Program's movement toward a more comprehensive approach to a variety of biofuels from a larger variety of feedstocks as well as its response to the 20-in-10 challenge are admirable. While the draft I reviewed still has some incomplete sections and some inconsistencies of structure, it reflects an excellent effort at strategic, programmatic planning.
- Specific Comments: The role of biodiesel/renewable diesel needs to be critically evaluated and its role in achieving Program goals better defined.
- I don't have much to say in the way of changes-I think the plan is outstanding and we need to move forward with it. Suggest more thought be given to how current petroleum

distribution system works e.g. how a single fuel and a fungible system keeps costs down and assures reliable supplies. Diversity of fuels will be problematic in the marketplace as there is no practical way to identify and preserve fuels. Performance targets are important but they may actually end up being irrelevant- $1.33/gal by 2012 and $1.20/gal by 2017 are based on EIA gasoline price projections which I think are too low---given uncertainties in commodity price relationships and policy environment, it is entirely possible that higher cost targets would work-thus lowest cost technologies should be developed and deployed as quickly as possible. Biodiesel should be given special emphasis as it is a fuel that is commercially available today, however, I don't think a separate platform should be established for Biodiesel.

- Need to get a better handle on real cost of feedstock.
- Re-examine the thermo-conversion (why is it so attractive now when it was shelved twenty or so years ago by NREL.)
- There are still projects that are carry-overs or are inserted into the program. This detracts from the overall program. As already stated, this seems to be improving.
- My major suggestion is that the Biomass Program seek a forum with high-level USDA administration to specifically pursue coordination of feedstock (and, to some extent, infrastructure) platform activities. There certainly seems to be cooperation occurring, and staff report that this has improved from previous years. However, there still seems to be a sense of the right hand not knowing what the left is doing. While DOE certainly can't force action from USDA, if I was to attend a review in future years I would like to hear that this had been attempted. A similar relationship with the EPA may also be beneficial. My suggestion in #1 is primarily out of concern that the Biomass Program not be caught behind the curve on sustainability issues. The utilization of biomass has much potential for environmental benefit; however, it also has potential for harm. The Program cannot afford to be caught unprepared on these issues, even if the production of feedstocks technically falls into the domain of USDA. I am pleased to see the Program looking into issues of water conservation. While this is a hot button issue right now, it is hardly the only sustainability issue. I am pleased to see the Program pursuing non-ethanol renewable fuels, thermochemical production pathways, and integration of production systems. These may prove to be important in the future and hopefully the Program will be responsive if and when these investigations show promise. That said, I think that Program has done a good job, for the most part, at using systems integration to prioritize its current activities.
- Consumer participation is required to achieve fuel displacement goals. The Plan should emphasize paths that are least disruptive to consumers; e.g. produce fuels that are most similar to current fuels. No pressurized gases, maximum vehicle driving range reduction of 10%.

Question 2: Resource Allocation

- It appears that the resources are inadequate. 15 staff at DOE HQ and a similar amount in Golden, although the labs contribute, requires substantial adjustment. A significant budget increase for this program is required. The capabilities of the individuals in the program are excellent.
- The total resources dedicated to this effort are insufficient to meet the challenge. While it appears that success is likely on the conversion processes, there is a huge gap in effort and resources in feedstock development, which is of immediate concern due to the long term nature of such development activities. There should also be more resources dedicated to strategic analysis activities, including life cycle assessment (LCA).

- More resources should be allocated to feedstocks, particularly with regard to logistics. Thermochemical resources should be increased if justified following a full re-evaluation of its potential to contribute to meeting Program goals.
- FY08 request of $179 million is double that received in FY05-this seems reasonable in light of Herculean effort required. Need to beef up funding for thermochemical platform and in particular for gasification, which was cut 40% in FY08 request. Don't know what FY08 funding request is for integrated biorefineries and distribution and end use platforms as well as crosscutting market transformation activities so I cannot comment. Prioritization must be given to generic pathways that have best chance of generating immediate and impactful results. Support public-private partnerships to mitigate risk, leverage expertise and funds, which improve overall chances for successful demonstration and deployment.
- A critical look at thermochemical conversion technology is needed, and if the technologies hold promise, more funding should be afforded. Also, more funding is appropriate to get at real cost of feedstocks when they are being utilized at volumes anticipated.
- Feedstocks and thermochemical seem to be underfunded. Other funding is about OK, congressionally directed not figuring into this comment.
- I would suggest an increase in the feedstock and thermochemical platforms to address some of the suggestions made by reviewers.
- The potential for the thermochemical platform to produce fuels that are more compatible with existing infrastructure than ethanol requires that it be given as serious a look as ethanol has gotten.

Question 3: Program Strategic Approach

- The new MYPP reflects the responsiveness of the program to changing national and stakeholder priorities.
- The conversion platforms and integrated biorefinery platform are responsive to stakeholder needs.
- There is no evidence that the feedstock platform is responsive to the needs of feedstock growers or providers.
- Strategy exhibits good understanding of biofuels market dynamics, competing technologies, barriers and policy issues. More focus is needed on outreach to environmental community, auto/oil stakeholders. Program must consider economics in mandated markets separately from economics in so called discretionary markets whereas in mandated markets there are no substitutes for meeting requirements of RFS, in discretionary markets, refiners can chose to blend their gasolines using more iso-octane and alkylate, thereby reducing demand for ethanol.
- Good planning, targets. The updating of strategies is being done incorporating externalities such as market changes and societal concerns.
- There is too little involvement of the oil industry and too little international involvement. It might be that neither can be addressed, but they are lacking.
- The use of systems integration tools and independent analyses certainly paints a picture of a program which is responsive to external market changes and stakeholder needs. Based on my limited knowledge of the Program's past, it appears there has been a response to new developments, but with an increasing focus on investing resources where they will have the greatest impact.
- The number of flexible fuel vehicles (FFVs) and E85 fueling stations needed to meet gasoline displacement goals is far more than the general public (stakeholders) will be willing to invest in.

Question 4: Biomass Program Portfolio R&D Balance

- (Balance over Biomass Supply Chain (i.e., Feedstock Production, Feedstock Logistics, Conversion, Integration, Deployment and End Use))
- More activities should regard infrastructure requirements and impacts.
- More effort is needed in feedstock production. The biomass projects assume a doubling of productivity. The only way to drive down the cost of purposely grown feedstock is to improve per acre and per input cost productivity. It is also necessary to improve the cost of feedstock logistics including in field and off field technology.
- The Program is considered balanced with respect to the platforms included in it i.e. no new platforms needed (save for the decision regarding the future of biodiesel). However as indicated above, there is need for rebalancing within and/or between several platforms.
- Balance over supply chain appears to be good but would like to see more emphasis on areas downstream of the biorefinery-lack of adequate and efficient distribution infrastructure will be a critical barrier to overcome ---this is an area not well understood and often overlooked-also more emphasis needed on end use.
- I thought the work breakdown structure for these areas as described in the MYPP was lacking substance.
- The program appears to be on target for the 2017 objectives. The supply chain needs more emphasis, to get at the real cost of feedstock when done on a large scale. An integrated pilot plant must be run soon on a continuous basis to uncover issues with recycle streams.
- Feedstock area seems under funded.
- The issues related to Feedstock Production are my biggest concern for the Program. I would advocate for more investment here to invest more in sustainability issues, feedstock development (not just corn and switchgrass, though these are certainly worth of attention too), and regional resources outside of the Midwest.
- I think it wise to add the infrastructure platform, as this might otherwise be a weak link in the chain.
- Inadequate funding for feedstock production. DOE's version of the supply chain really starts at logistics.

(Balance over Research Categories (i.e., Analysis, R&D, Deployment, Demonstration, Communications))

- I think more funding should be directed at analysis. Good policy and program direction is based on adequate analysis. R&D should not be decreased.
- Communications can be enhanced through partnerships.
- To this point the balance is good. However as commercial scale biorefineries near reality, there will be a need for increased outreach and communication to the public and stakeholders.
- More focus needed on communications and outreach, especially to environmental community, and the general public.
- Core R&D remains an important activity, but analysis should be done to identity policy initiatives that will support program goals.
- Good balance of tasks to reach targets.
- Overall I am very pleased with the way the Program has targeted its investments in R&D. A slightly greater look at non-ethanol processes and non-switchgrass energy crop development might be worthwhile, but overall it is impressive.

- Demonstrations need something important to demonstrate, such as a solution to the fuel mileage problem of ethanol.
- Analysis requires a lot of ground truth to be sure models reflect reality. Not sure I see adequate stakeholder input to analyses.

Question 5: Proposed Future Research

- As noted above, feedstock development (across all potentially significant production and collection sources) must be increased. Genetic improvements come slowly, so efforts that will be successful in 10 to 20 years have to be supported now and for the duration. Implicit in feedstock quantity and diversity is the need to develop the collection and related logistical systems.
- There is an urgent need to enhance the funding in thermochemical conversion as it can be useful for the 20-in-10 plans through its ability to convert heterogeneous biomass (already collected woody materials and MSW in particular) into useful imported petroleum replacement fuels and chemicals.
- As identified in the reviewer report-out, it appears that thermochemical conversion is under-represented and should be critically evaluated for an increase in resources. Thermochemical conversion can provide several alternative transportation fuels or blend stock not available via biochemical conversion.
- The feedstock platform requires an increase in resources. This is considered to be the most critical requirement for the Program. No reliable supply of feedstock to any biorefinery equals no biofuels and bioproducts, no matter how great the conversion technology.
- Higher priority should be given to 1) gasification 2) environmental impacts of biofuels 3) energy balance well to wheels definitive analysis 4) food vs fuel economic analysis 5) LCA carbon footprint of biofuels 6) pipeline R&D, 7) policy research and in particular how biofuels can tie in to Climate Change cap and trade program 8) market research (if needed) to demonstrate value of branding program like “Energy Star” 9) research on ethanol corrosivity, permeability, volatility, biodiesel NOx emissions 10) feedstock logistics R&D.
- As mentioned above, more emphasis on feedstock cost is needed and perhaps specific availability. This may be achieved with the 10% of commercial scale and commercial biorefinery demonstration programs, but they are down the road a spell and the data are needed now. It was also mentioned above that an integrated continuous pilot run is needed soon for a reasonable length of time to uncover the many recycle issues that are bound to appear.
- The program generally holds together well, meeting the stated goals. It is generally well managed and funded. It is an important program and DOE funding broadly probably does not reflect this importance. As already stated, within the Program, feedstocks and thermochemical seem anemic.
- My comments related to exploration of non-ethanol processes and a wider array of energy crops stem mainly from a desire to see the Program remain nimble to take advantages of developments which may come from any sector. Overall, I think the Program has done a good job at targeting its R&D resources to technical barriers in cellulosic ethanol production and furthering the expansion of ethanol use. However, if our goal is to maximize the production of renewable fuels there may be other avenues of opportunity which could assist, especially regionally.
- Dedicated energy crop production needs fundamental research, not demonstrations.

Additional Comments

Strengths

- This program, as document in the new MYPP, demonstrates a comprehensive understanding of the nature of the challenge it is confronting. Given adequate resources and allowed to follow its MYPP, with the adjustments noted above, it likely will lead to successful achievement of the 20-in-10 and subsequent biomass program goals.
- The quality of the personnel managing and implementing the Program. The strategic integration and analysis components of the program. The efforts to seek stakeholder input.
- Program strategy focused on generating near term results. Program achieves right balance of core R&D and demonstration/deployment. Direct investment in new technologies. Good collaboration with other agencies, state/local groups, key stakeholders. More targeted approach than in previous years-focus on cellulosic ethanol. Government providing markets i.e. reverse auction is terrific idea. Enhanced communication activities (but more is needed here)
- Strengths include good project management, good communication across platforms, excellent industry academia and national laboratory partnerships and a strong cohesive plan driving the program.
- The program generally holds together well, meeting the stated goals. It is generally well managed and funded.
- The use of systems integration to target limited resources is a real strength for the Program. I hope that the staff can weather politics and use this tool appropriately. Funding seems to be largely adequate for the Program

Weaknesses

- As discussed, the program appears to be severely underfunded.
- The Program is understaffed. The biodiesel component is weak (but not beyond redemption)
- Not enough people resources at the program management level (only 15 people). More target outreach needed to general public i.e. radio/TV. Lack of standardized definitions. Must be close collaboration with USDA especially in feedstock area. More sense of urgency in feedstocks logistics R&D. Downstream R&D needed (see above). More funding for thermochemical. Too much redundancy in review process. Avoid reinventing the wheel…there is huge quantity of information already out there on Biofuels.
- A concern is that the national labs will have difficulty recruiting and maintaining the technical staff at this critical time to maintain the momentum seen in the program. Competition for bio-engineers and scientists is only going to get more intense.
- There are clearly still pockets that aren't really addressing the overall program goals. These need to be pruned and replaced with additive programs.
- Sustainability should be made more visible. Human resources, as reported in response to a question, sounded less than adequate for the number of projects being managed. A clear strategy for dealing with codes and standards was not apparent to me during the review.

Recommendations for Additions/Deletions to Project Scope

- Consider having a platform/activity to consider various entities that could be appropriate and bear some of the budget requirements of the program to meet the President's objectives. This could involve a government/private sector entity, funded principally by private sector development financing.

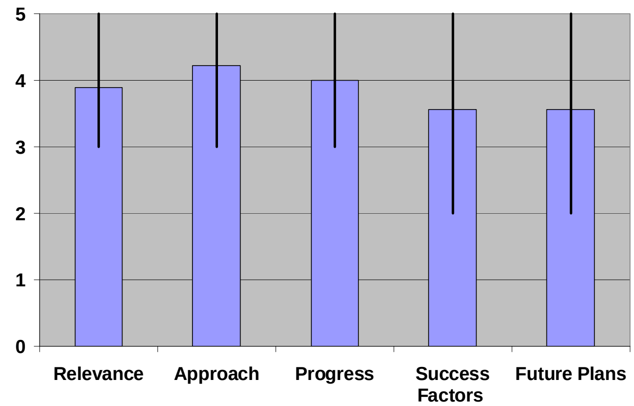
- Some of the communications methodologies used in the Technology Revitalization Program (TRP) of about 15 years ago should be considered. In this Defense Advanced Research Projects Agency Program, there were stakeholder meetings in many cities for communications and input. Such meetings usually had many hundreds of attendees. To gain public acceptance and expand media awareness, such programs would be worthy of consideration.
- The Program should estimate what the requirements will be for suitably trained /engineering technical staff to operate the number of biorefineries that will be in production if Program goals are achieved. There may be a requirement for post-secondary technical colleges and university engineering/science programs to adjust their curriculums to meet the aforementioned requirements.
- Given size and complexity of the task at hand, I strongly recommend greater oversight role for Biomass R&D Board. This will be especially important to ensure effective collaboration across agencies. Platform strategic and performance goals must align with program goals but must also be in sync with what is going on in other platforms. Biochemical platform FY08 funding request is 4X that of request for the feedstock platform-why such a difference? Crosscutting market transformation needs to be its own platform—a lot of work is needed in this area and stand alone platform will give it focus in particular more policy research needs to be done as mandates, incentives account for nearly all biofuels growth to this point---in addition, growth in international biofuels trade is raising many complex trade policy issues.
- This is a strong program, well run, and achieving positive results. The targets are crucial to the well being of the United States.
- I would encourage the communications and outreach staff to utilize new media (e-mail newsletters, web, podcasts, etc.) to achieve wide distribution and even to increase penetration into the old media. I am glad to see an effort to penetrate key conferences and workshops as well. One last note about the review process. I would encourage a bit more up front explanation of the process, perhaps even one-on-one during the initial contact with each reviewer. I would also encourage the Program to assemble the Steering Committee earlier in the process, and even utilize them to assist with the platform review process. This would likely result in the reviewers having a better understanding of the Program when they walk into the MYPP review later.
- The MYPP describes the feedstock production component of the Feedstock Platform as “selecting feedstocks and resolving production issues”. The Feedstock Platform review had only one production presentation, an earmark project of switchgrass establishment. The MYPP describes a grower payment of $13 per ton in 2012. In high yielding corn (200 bu. per ac.) it may be possible to remove 3 tons per acre and still meet erosion control goals. However the $13 must buy replacement Potassium and Phosphorus nutrients at a cost of perhaps $6 (current prices may be higher), leaving a net of perhaps $20 per acre. That is the price of 5 bushels of corn, which may be the amount of yield reduction due to the loss of soil carbon. We don’t know the value of soil carbon, but farmers know it has value. The MYPP predicts a price of $26 per ton in 2017, but only if the industry grows, which it will not do if farmers aren’t willing to sell for $13 in 2012. USDA doesn’t seem to be doing this research, either, but it needs to be done. I think this is a modern version of “For want of a nail (soil carbon management) a kingdom (cellulosic biofuels) was lost”.
- The MYPP includes an enzyme cost target of 33 cents per gallon of ethanol in 2009 and 10 cents in 2012. Is there any support for that figure?

Platform Overviews (from the Program Peer Review)

Feedstock Platform

Presenters: John Ferrell (Biomass Program) & Lyle Stevens (Formerly of John Deere), Review Chair

	Average Score	Delta Minimum	Delta Maximum
Relevance	3.89	0.89	1.11
Approach	4.22	1.22	0.78
Progress	4.00	1.00	1.00
Success Factors	3.56	1.56	1.44
Future Plans	3.56	1.56	1.44
Average	**3.84**		



Question 1: Platform Approach

- In general, the approach is moving the R&D effort forward. I believe it is too little effort and one that does not recognize the location specificity of feedstocks and the challenge of developing new genetics that will improve the amount, characteristics, and cost structure of new feedstocks.
- Well directed projects, focused targets across a somewhat narrow arena. Projects appear to be diverse, but localized to particular area, no apparent overarching tie among them. Especially with new crops, i.e. switchgrass, unless a broad large acreage is harvested, we won't know the real cost.
- Seems like all angles are being investigated and direction of platform is valid.
- My assessment from the presentation and materials is the feedstock platform is just getting up and running. Some broad assessments have been done of the potential supply, but much work remains to be done on logistics and more detailed analyses.
- In the realm of platform organization, I continue to desire to see more high-level coordination with USDA. From the comments I heard, I recognize cooperation but not overarching coordination. I would recommend that an effort be made to seek an audience with the new Agriculture Secretary as soon as he is confirmed.
- This platform is well planned and managed. It uses good engineering and science to attack the objectives spelled out.
- Feedstock logistics and logistics technology from the farm to the delivery point is key to the Program's success. Funding level of 5% of total Biomass Program budget is too low unless one major project is selected and tightly defined. The Biomass Program has too many feedstocks and regions for the money, and the benefit of this diversification is questionable other than political support.
- The platform concept—harvest, collection, storage, preprocessing, transport, queuing, and handling is well defined and can create scenarios (if integrated together as scenarios or pathways) that can help the program identify what the current cost of existing systems are, what the barriers are or what the cost hurdles are that need to be reduced, where money should be invested, what R&D targets should be, what the value of the investment should achieve, and whether or not one or more pathways/scenarios are needed to be successful in the first facility, the second facility, etc. The Program's organization has diversified from ORNL to include INL, which is good, but still needs a Midwest partner to succeed.

- Unfortunately, no clear allocation of funding between residues and energy crops, or between each technology stage (harvesting, storage, preprocessing, queuing, handling); and no justification for these allocations.
- The division between production, logistics and system integration is well balanced. The attention to sustainability is key. More work on preprocessing should be done.

Question 2: Platform Goals (in relation to the Program)

- The platform is engaged in important aspects of the program's goals and the recent effort to engage in regional feedstock development is a very positive platform enhancement.
- Good support for overall program. Need this information to move program forward. A lot of diversity, innovation not apparent in presentation. Addressing sustainability issues, Potassium and Phosphorus replacement, Carbon issue in doubt. Need better handle on real availability at what price.
- As explained, the platform is identifying and addressing issues.
- My impression was that the platform goals are generally in line with the Program's goals. I appreciated the references to "not betting on one winner." I think it would be prudent to continue investing in research on multiple feedstock crops and forest residues, as sustainability and geographic issues will likely result in regionally appropriate feedstocks.
- Feedstock logistics are crucial to the success of the Biomass Program.
- Integration with USDA agriculture and forestry services appeared weak, which is the biomass program's responsibility to ensure better coordination. DOE should focus on one major project that can be succeed, such as a fully integrated design for corn stover to ethanol at some achievable scale and target date that can meet DOE's cost and performance goals. Targeted focus, such as the "man on the moon" focus is more likely to succeed than to "put a little money into three or four feedstocks and three or four regions for political reasons." These diversified investments should be employed only after the main project (stover to ethanol) is fully funded. Without this one major stover to ethanol integrated system, the biomass program's feedstock activity is not fully integrated with their biochemical conversion activity. Without a single objective or focus, it will be very difficult to get USDA to coordinate with the biomass program.
- The platform goals are considered to fully support the Programs goals.

Question 3: Platform Goals (in relation to industry)

- The overall goal and the specific performance goals in the MYPP are clear. I believe the performance goals are too narrowly focused and ignore the enormous challenge of conducting cropping systems research, pest mitigation research, etc. The partnership with USDA is critical. However I did not find any acknowledgement that the platform must cooperate closely with each state's agricultural experiment station system. Connection with Extension was made in the report by the peer review team, but the critical connection with the land grant university agricultural experiment station system was not mentioned. It is the scientists in the agricultural experiment stations that conduct the genetics, breeding, cropping systems, and economics studies that are needed.
- Goals are realistic for the way things are now, but need some "out of the box" thinking is needed on moving the biomass around.
- I felt that the presentations and reports could have been clearer about the specific objectives of the platform. My impression was that there is much activity to be done. I think some strong coordination with USDA (not just cooperation or "friendly competition") needs to help give firm delegation of activities.

- Of the two goals—production and logistics—the majority of the focus of the program is on logistics, and presumably the production focus is integrated with the USDA, although this is not clearly articulated nor are any USDA integration activities identified or connections shown with DOE program goals. There needs to be more detailed USDA integration. The goals are a good start, since the program is moving from practically zero to $10 million, but as a result, the goals appear to be generic and do not demonstrate strategic focus or priorities yet, even though there was a “discussion on priorities”, there wasn’t any prioritization presented.
- The cost reduction goals for dry herbaceous materials appear to stagnate, which tends to imply that the program should focus on the wet herbaceous materials that show significant cost reductions with R&D. As an aside, INL does not appear to be well informed about current cost for stover harvesting, transport and storage. It would also tend to imply that INL is not up to date on material degradation based on previous NREL work. Program needs a feedstock production interface, technologies that may modify or improve any of the logistical steps. Program needs a conversion interface to the biochemical platform, which is focused on stover and switchgrass. Including this interface will help focus the entire feedstock program.
- Sufficient detail was not provided to discern the realism or logic of each goal. Any focus on woody biomass should be prioritized on the fraction of resources the program invests in the thermochemical platform.
- The program lacks realistic risk reduction strategies. The program will need to develop a good database of variability to support equipment manufacturers. What is the scale of the first plant? Scale will have a significant impact on technology.
- There was a high level attempt to quantify the value of each goal, but an aborted attempt to transfer those estimates into strategic priorities. There wasn’t an attempt to focus on which step of the process chain (from harvest to handling) is the key barrier? Is it storage, densification? Not all steps can be equally important all the time. Some good technology focus was provided, but how these are crucial to the entire effort not clear. Too much focus on modeling and not enough ground truth data development and identification of key barriers and technologies necessary to overcome.
- Work to date has been largely done by universities and/or government laboratories. More industry involvement should be sought.

Question 4: Focus and Balance of the Platform R&D

- The necessity to conduct the work that is the focus of the feedstock platform is unquestionable. However, the need to invest in improved genetics and to understand the role of energy crops in sustainable production in the diversity of production areas is under-emphasized.
- Focused on meeting feedstock goals, will need continued scrutiny to get good handle on actual costs at refinery.
- I would like to see more specific activities in the realm of exploring sustainability issues (soil carbon, nitrogen leaching and phosphorus runoff, pest and disease issues, etc.). Alternatively, I would like to know what Program/platform activities are being done to support EPA USDA in this sector.
- Too much focus on political expediency, such as multiple regions and multiple feedstocks and not enough focus on making the first facility successful, where ever that may be. Within the various steps (harvesting, storage, preprocessing, handling, etc.) there are numerous gaps that should be addressed as an integrated scenario with well-justified investments into each. Do the future developers really have a lack of data? Which regions are developers focusing in? Which feedstocks are the developer’s

focused on? Focus on lifecycle pathways and environmental impacts is good, but should be prioritized to the regions and feedstocks that the developers are interested in. Building an inventory by crop/residue and region should start with where the priority is.

- The platform would benefit from more work on preprocessing and storage logistics.

Question 5: Platform Progress

- The peer review team for this platform noted that there is a sound plan and progress is being made. It is my perspective that substantially more effort (i.e., funding) will be necessary to achieve the biomass feedstock goals.
- This platform is expanding to meet the needs of the integrated refineries. It must keep doing more, because of the importance of feedstock cost. We do need more innovation in harvesting and transporting these bulky materials.
- My impression is that the platform is gearing up its activities, but needs some focus which may not be able to come until some technological advances are made. I am not sure that this platform is ready to meet the targets of the Program.
- Need Midwest partnership, perhaps USDA Peoria Laboratory. Need more integration on corn stover. Need to have a better vision of what is a real priority and what will become a priority in the future once the first plant gets off the ground. One year of funding does not give a track record for the program, but the program is too diffuse and needs a better focus on what the developers are going to focus on. Bring in the developers. INL needs to diversity its area of interests. Good start on one year but now is a key time to refocus.
- It’s not clear if the platform is on course to meet the feedstock cost targets for 2012 and 2017.

Additional Comments

Strengths

- Strong teams working on gathering this important information.
- As explained, the parts of the platform are working together well and are logically derived.
- The program is making progress on complex issues. The realization that a diversity of feedstocks is needed to fulfill program goals is positive. This will be important in regions outside the Midwest.
- Good organization using good science. Work at INL on storage and queuing as well as harvest and collection appears to be on target.
- The platform has identified the key areas necessary to achieve program goals.

Weaknesses

- Not enough switch grass has been collected to get a handle on real cost. The fertilizer the biomass removed does not appear to be factored into the cost of the biomass. Current phosphate, nitrogen and potassium costs are significant.
- It screams for DOE and USDA involvement that don’t appear to be happening sufficiently.
- I appreciate the Program’s (and platform’s) growing consideration of sustainability issues. I think that many of the issues which may emerge have readily available answers, but the Program and Department need to be prepared to respond when questions are raised. An example is the realm of nitrogen and phosphorus contamination of water. In the short term, there are concerns about the expansion of corn production for biofuels. However, there are long-established production practices and agronomic research which can be implemented in production to mitigate these concerns (if

implemented). Also, a sustainable harvesting technique to protect soil carbon levels may assist (but will not completely mitigate) this effort. Additionally, a long-term shift to perennial crops may involve dramatically lower nitrogen and phosphorus needs, depending on the crop species selected and the production practices which emerge. Some research on these emerging species is needed, but likely would not take much effort.
- Scaling up to handle corn stover will create new challenges. Need to lay out a plan now.
- Critical concern for separation of biomass components must be reviewed with appropriate scientists and engineers. Perhaps this area is for early treatment studies; however, some separation may be accomplished in the field
- Lack of industry partnership/involvement. Lack of clarity as to how DOE and USDA activities are complimentary/synergistic.

R&D Portfolio Gaps
- I agree with the gaps assessment which was identified.
- The gaps identified by the review team are OK, but they do not go far enough. The yield productivity anticipated by the Billion Ton Study requires sustained funding of genetics and breeding programs across most production areas. Likewise, there is an urgent need for longer term sustainable production research.
- The real cost of biomass has not been convincingly determined.
- As noted above, I agree with the need for sustainability attention. The need for life cycle analyses likewise is an important area for attention. Increasingly, the science of environmental analysis is focused on this methodology, as are international corporate social reporting standards. I don't have the resources/information to analyze the recommendation to resolve different cost targets; however, it was reported that this effort has already progressed. Similarly, I don't feel prepared to comment on the econometric recommendation. The comment that the platform should conduct statistical analysis on yield trials is worthy of attention from the Program. Yield variability is a fact of life and is well document for grain crops. It will surely be an issue in future feedstocks.
- If giant biorefineries are needed in order to obtain low operating costs, logistics is crucial. That critical weakness in the Program justifies research to identify conversion technologies that can operate at acceptable cost at smaller scale (thermochemical processing is one option). Pyrolysis oil is much more energy-dense than wheat straw. A number of feedstocks were identified (MSW, forest residues) were identified that are quite different from wheat straw, and will have quite different handling, storage, and pretreatment needs and will broaden the research challenges even more than corn stover will.
- A critical area of interest for accomplishing the overall goals with respect to conversion of cellulose (and perhaps hemicellulose at a later date) is procurement of feedstocks. Considerable discussion has occurred about source of material as well as delivering functional, microorganism free fiber. However, minimal data are available for ascertaining realistic economic numbers with respect to possible tons to be delivered during the next five years. Also, conflicting information has been presented with respect to cost/ton delivered. A specific area of need is for appropriate interagency personnel involvement for convincing growers (farmers) to select change with little enticement for:
    - Sale of present planting, tilling and harvesting equipment and purchase of needed equipment; however, necessary modifications to possible equipment have not been achieved.
    - Ability to collect straw, stover, corncobs etc without contact with the soil (which will result in hydration as well as bacterial and fungal contamination).

    - Storage sites and equipment.
    - Equipment to transport chips, straw, stover etc, which often is ¼ the density of cereal grains and debarked trees.
- A major need is to identify opportunity costs of fiber production. Tons/acre often do not encompass duration from planting to harvesting, altering soil quality, need for nutrient replacement or productivity of land utilized. Duress to plants grown without pesticide protection, adequate nutrients and concern of harvesting time is paramount; this may result in plant chemical production and/or cohabitation with fungi to produce appropriate chemical compounds to repel predators.
- Cooperation with machinery manufacturers should proceed early in the overall game plan, rather than after arbitrary decisions on source materials have been made. Subsequent to elucidating enhanced value of current products or value of to be identified fractionated products, contact can be initiated with possible agricultural and forest producers. Questions about drying of material in the field or forest need to be identified and answered. Harvesting dates and methods will be site specific, e.g., dry air in KS is a bit different than wet air in SD; also, ability to harvest without deleterious effects on soil quality must be delineated.

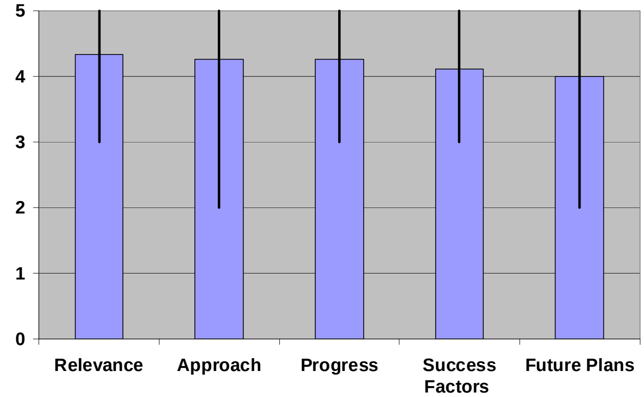
Additional Recommendations, Comments and Observations

- I would have appreciated hearing about the Regional Biomass efforts in conjunction with this platform. I understand that this is a new endeavor, but the presentation on Thursday afternoon about the NW regional study seemed to indicate that there are opportunities in this realm.

Biochemical Conversion Platform

Presenters: Amy Miranda (Biomass Program) & Don Johnson (Formerly with GP), Review Chair

	Average Score	Delta Minimum	Delta Maximum
Relevance	4.33	1.33	0.67
Approach	4.25	2.25	0.75
Progress	4.25	1.25	0.75
Success Factors	4.11	1.11	0.89
Future Plans	4.00	2.00	1.00
Average	**4.19**		



Question 1: Platform Approach

- Clearly moving in the right direction
- This platform has the weight of history behind it and therefore was the best "packaged" of all the platforms presented. It appears to have adequate funding, a good sense of mission and corresponding activities (fundamental and applied science, enzymes and organisms, etc.).
- R&D portfolio and funding distribution well presented. Benefits of biochemical platform accomplishments are excellent, and demonstrate value of R&D investments (page 12 of Miranda's presentation). The milestones and R&D portfolio was clear and well presented.
- Overall, the platform approach is well set up to reach the proposed goals. Consideration should be given to decreasing the emphasis on C5 conversion to ethanol and redirecting those resources to production of other bioproducts from C5 sugars.

Question 2: Platform Goals (in relation to the Program)

- Completely consistent.
- This platform seems to have a clear understanding of the Program's role in relation to the biochemical industry and research needs. As is true for the whole program, the platform should remain able respond to emerging technologies and feedstocks while being focused on current needs.
- Clearly the platform is core of the liquid fuels program. However, there is a tendency for the program to focus on the high liquid yield potential of the program, no matter how far out into the future it may be and no matter how complex it will be and how difficult it may be to duplicate these highly complex facilities; compared to a lower yield, and more simplistic approach that could produce liquid fuels in the near term through gasification.
- For the most part, the platform goals support the Program's goals.

Question 3: Platform Goals (in relation to industry)

- The only suggestion I have after reviewing MYPP 3.2.1.2 is that the goals for energy crop pathway should include other, high volume energy crops, such as poplar, and not just switchgrass.
- Good goals and good involvement of Government labs and universities.
- This platform was presented in a logical and clear manner and it appears that the goals are very appropriate to the Program's role in relation to the industry.

- There is still a perception that the complexity of the entire biochemical system will be very difficult to achieve, much less multiply facilities successfully. Need more industry involvement throughout the biochemical system, primarily to prepare the industry to provide various approaches to success without reinventing the wheel once these technologies are presented as a first facility.
- No major changes to the goals are needed and if achieved will meet the needs of industry.

Question 4: Focus and Balance of the Platform R&D

- Good balance
- The platform research seems to be balanced very well. A small amount of research into feedstocks other than corn stover, poplar and switchgrass may be valuable. As indicated in both presentations, knowledge of plant science is needed to address differences in plant chemistry at different harvest dates, regions, etc. Storage may additionally impact results dramatically and should be considered as research continues.
- WBS needs to show interaction of partners, solicitations, outside of core program. The budget associated with the fermentation/saccharification area does not reflect the potential benefit of investment in that technology. Related to this comment, the integration investment may be premature to some degree, allowing the program to move some funding from that area to fermentation.
- I disagree with the reviewers who wanted to include more feedstocks, such as wood. It would dilute near term success. Once near term success has been achieved, future industry partners will assist with the harder to integrate feedstocks such as wood.
- The focus of the platform is excellent.

Question 5: Platform Progress

- As documented in the peer review, many of the projects are performing quite well. There are some that are lagging or even virtually irrelevant.
- Program is varied and complete.
- Funding to attract quality staff and/or utilize private industry partnerships will be needed. I'm not qualified to analyze the progress on enzymatic pathways and genomics; however, I appreciate their importance and am pleased to see a focus on these research needs.
- Needed to put more effort into getting more presentations into the program review: only 17 out of 27 attended.
- I support the recommendation that the program build an integrated processing structure as soon as possible. It is not clear that the pilot plant at NREL is suitable for this effort without substantial remodeling and reworking. It may be cheaper to abandon the NREL pilot plant and build a pilot plant somewhere else in partnership with a major construction and engineering company and a funding partner. Perhaps building more than one pilot plant will accelerate commercial development and allow for more variations and novel cost improvements. NREL and Midwest Research Institute will need to make licensing agreements clear, easy, and quick to accommodate.
- Publication of unique testing and evaluation standards would be highly beneficial for creating an industrial structure for success. The program should continue identifying and retaining high quality partnerships, particularly as the R&D moves from bench scale to pilot and pre-commercialization stages. Creating these partnerships may allow for more access to personnel and engineers that the program has difficulty retaining.
- Elimination of disruptive NREL management (occurred in FY2007) may also reduce turn over.

- The platform is progressing well and the degree of process integration is commendable.

Additional Comments

Strengths

- This platform is noted for its strong progress and focus on critically important topics. The quality of much of the science and engineering is internationally recognized for its excellence.
- Integration and singularity of focus are good. The program really seems to be abiding by guiding principals.
- I appreciate this platform's understanding of its role as a government program and how it has utilized its resource to focus on technical barriers. This platform appears to be well funded. Utilization of university consortium taps a wider intellectual resource base. I am pleased to note increased interaction with USDA. I hope that a coordination relationship can be developed as well. I would recommend an early request for an audience with the new Secretary of Agriculture (once confirmed).
- Good liaison with industry. Work on process integration. Correct focus on work required to meet platform and Program goals.

Weaknesses

- Several programs were mentioned in a negative light, indicating that better management could be warranted.
- Focusing on switchgrass and hybrid poplar is a logical development, but a small amount of research of other feedstock species may be valuable. For example, woody biomass was mentioned by the platform review.
- No major weaknesses; however, decreased emphasis on C5 fermentation to ethanol should be considered.

R&D Portfolio Gaps

- Review was of summer proceedings. It was needed to close the loop of what will be done with the assessments and if comments are taken seriously.
- I find the list of critical gaps (challenges and barriers) discussed in MYPP 3.2.1.3 to be fairly comprehensive, if not daunting.
- The platform review recommended use of pilot runs as soon as is practical. This seems to be a theme of the week and therefore deserves attention.
- No significant gaps were identified.

Additional Recommendations, Comments and Observations

- I agree with the peer review team's recommendations, in general. However, while I agree that woody biomass be included in the platform's goals, such work must be limited to those feedstocks that are in sufficient abundance and logistic availability to justify their incorporation into this platform. I suspect that the thermochemical platform can more readily handle a temporally varying mix of heterogeneous woody materials.
- I have to express some disappointment that we have to revisit the enzyme development process. We have been given misleading information about the cost of enzymes in the past, and I have no reason to be any more confident in the future. The enzyme cost goals shown in the MYPP seem to be drawn from thin air.
- Pretreatment and enzymatic hydrolysis program at NREL is focused to the overall objectives. A project which encompasses both esoteric and applied research aspects; therefore, finding should be of benefit to the industry while utilizing background

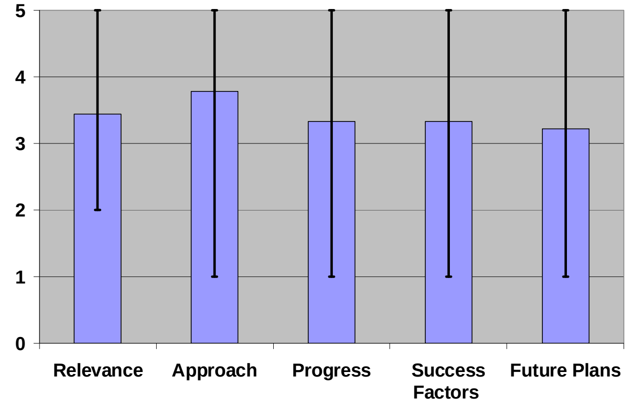
information. As scientists and engineers within the NREL program continue to relate with those individuals with knowledge about needed outcomes, this program will flourish.

- Biochemical Process Integration Task has been designed to provide samples and relevant findings to other NREL programs as well as extramural researchers. Perhaps a bit more coordination with feedstock needs would be helpful. A critical portion of this program will be to provide state of the art instrumentation as well as data generated from the analytical objectives.
- As work continues towards converting cellulose to ethanol, the fundamental drivers in this project will be critical to future investigations. Well designed studies to assess relevance of providing clean cellulose from samples containing hemicellulose and/or lignin will be imperative to advancing cellulose conversion science. Continued extra and intra-agency discussions and joint projects will be relevant to future success.
- A higher sense of urgency on planning and operation.
- Ongoing evaluation of the value of CAFI work to achieving platform goals. The work is very academic and several of the pretreatment processes CAFI is studying are unlikely to ever be implemented at commercial scale.

Thermochemical Conversion Platform Overview

Presenters: Paul Grabowski (Biomass Program) & Mark Jones (Dow Chemical), Review Chair

	Average Score	Delta Minimum	Delta Maximum
Relevance	3.44	1.44	1.56
Approach	3.78	2.78	1.22
Progress	3.33	2.33	1.67
Success Factors	3.33	2.33	1.67
Future Plans	3.22	2.22	1.78
Average	**3.42**		



Question 1: Platform Approach

- The immediate focus on only agricultural residues and energy crops as feedstocks as documented in the MYPP is too narrow. Robust processes, able to handle a wider variety of materials will solve many problems associated with seasonal availability of feedstock and limitations in amounts of certain types of feedstocks. Connecting with other DOE groups working on gasification of coal makes sense.
- As presented the projects are doing an excellent job of supporting platform goals and are on track and meeting goals. The results are so encouraging that the reasons for shelving this approach twenty or so years ago must be revisited.
- This platform has much potential. I can understand the political and budgetary reasons for the focus on agricultural residues and energy crops, but there is a logical role for government to play in utilization of wastes and forestry residues in this platform. Likewise, the historical focus on gasification is not enough. I am pleased to hear of a new focus on pyrolysis. This should be funded well. Fischer-Tropes processes appear to require more investigation as well.
- The thermochemical platform has the potential to produce a wide variety of end products that are compatible with existing infrastructure. It deserves greater funding.
- The MYPP comment on page 3-45 “The Program, therefore, has prioritized gasification R&D in its near term efforts” is overblown, and would be more accurate to say that program has recognized the value of modest funding to the program commiserate (or perhaps not) to is near term benefits. Similarly any claims that pyrolysis R&D may be increased in the future is premature until a clear and unbiased evaluation of the cost and benefits and fuel supply impact is fully evaluated. Any pyrolysis fuels used as refinery feedstocks should include petroleum industry partnerships to achieve these goals. Rather than continue in a point-by-point debate, the thermochemical portion of the MYPP document is not fully integrated in terms of near term impacts, barriers, costs, supply impacts, and, byproduct market saturation risks compared with other program areas such as biochemical. The relative merits of each program area should be clearly defined and not shown as a debate between each program area. As a program area with new funding, the biomass program should show what the benefits would achieve, the costs, the risks, and the impact to fuel supply compared with other strategies.
- Since many of the “10% pilot scale projects” were thermochemical, the maturity of the thermochemical technology is much advanced and the rational for investing in this area is in doubt unless clearly defined and always associated with a commercial partner. As

like the biodiesel and corn ethanol industry, the program should not invest in program areas that are commercial.

- The platform approach supports achievement of its goals.

Question 2: Platform Goals (in relation to the Program)

- This is a very important platform area that is critical to achieving program goals. It is good to see that it has received renewed emphasis.
- The estimated capital costs and plant gate price are where we want to be. So why aren't we doing it. What is missing?
- The platform goals do support the Program's goals, but need to be expanded.
- Feedstocks and feedstock interface targets should include water/moisture reduction and biochemical lignin quality assessment as a priority, and a focus on feedstocks residues and crops as a secondary priority unless the thermochemical area can show that value to the public that is equal to the value of the biochemical area.
- The lack of focus on the co-product produced from the biochemical area shows that this program area is not supporting the other program areas, but competing for existing feedstocks.
- Barrier Tt-B should be a priority over Tt-A.
- Feedstock selection processes are too broad and display a lack of prioritization. The cost performance goals and dates are the same as the biochemical areas cost goals and performance data, which is unusual as these two technologies are different and may have different cost starting points and different milestone achievement dates.
- Grabowski's modeled ethanol price on slide 9 (see also slide 13) in his presentation conflicts with his slide on slide 5. The Biomass Program should clarify current ethanol costs and performance dates for each technology area (biochemical and thermochemical). They should not be the same unless serendipity occurs.
- Funding all feedstocks and all fuel pathways denotes a lack of strategic planning and prioritization. Only one or two of these will offer the best options. This type of approach denotes the lack of prior analysis and independent review of technologies.
- Production of mixed alcohols will require a high degree of biofuels distribution area investment in ASTM fuel standards, fuel registration, and demonstration with fuel infrastructure partners; not shown in program. Ditto with pyrolysis fuels, product is clearly not ASTM quality diesel fuel and does not meet EPA's fuel registration of diesel fuel.
- The platform's goals are well aligned with those of the Program. The milestones selected are relevant and the dates for their achievement are reasonable.

Question 3: Platform Goals (in relation to industry)

- The goals as outlined in the MYPP 3.2.2.2 are nearly comprehensive and are good, as far as they go. However, it strikes me as odd that there are challenges noted but no goal for woody biomass and MSW. This seems to ignore the opportunities to use these abundant feedstocks for which logistical challenges are solved or nearly solved, but which will require some research and development to achieve commercial viability.
- The goals are reasonable and logical, and if met can be easily implemented into existing petroleum processing facilities. It will take capital to implement, as will all, and could require less capital than biological processes. Need to verify at larger scale, and let industry run with it (verified).
- The platform review was well done and pointed out some clear needs for this platform. I support the recommendations of the reviewers, which were specific and logical.

- There is little analysis, less strategic planning, poorly defined goals, and given all that, the results cannot be clear, realistic or logical. Projects such as Tt-G for alcohol synthesis with better selectivity and better yields should be a priority. The pyrolysis investment should equal the impact of a homogenous fuel infrastructure opportunity (e.g., very little opportunity, similar to Oxygen Diesel). The value of pyrolysis over gasification should be questioned and the answer should be clearly articulated. Given the pre-commercialization nature of thermochemical technologies; how much of the R&D should be bench scale, how much should be pilot scale, and how much should the R&D be partnered with private industry? Task Tt-H has low value to the program, e.g., small market impact to gasoline displacement, high barriers to fuel distribution commercialization, etc.
- The goals will definitely meet the needs of industry i.e. clean syngas and new catalysts for mixed alcohol production.
- Recognition of increased profile for pyrolysis is good.

Question 4: Focus and Balance of the Platform R&D

- Program is narrowly focused and has enough projects to be comprehensive and balanced within the scope.
- An increased emphasis on pyrolysis and Fischer-Tropes should be made. The infrastructure benefits could lead to a more rapid achievement of 20-in-10.
- If the Tt-A project is poorly defined, redefine the name of the project to reflect the goals.
- Balance and focus is good and appropriate to achieving the goal of producing a range of biofuels from a broad range of biomass feedstocks.

Question 5: Platform Progress

- As noted in the peer review report, there is good progress in a number of the platform's projects and there are some projects that have little connection with the platform and have not contributed to achievement of its goals.
- The information presented showed that the platform is progressing well and meeting important targets. I am still concerned with what has changed in the last twenty years to make this now feasible and better than the biochemical route.
- I am pleased to see that the platform is making some course corrections in recognition of emerging technologies because this is such a diverse collection of processes; it was difficult to assess platform progress in the brief time frame of this review.
- The Gasification of Biorefinery Residues was ranked midway between all the projects reviewed; and either that was because the reviewers don't think that is a priority or that the presentation was poor, is unclear from the comments. At a minimum, the relevance should have been higher.
- There are few projects in task Tt-G in the reviewer's lists, where R&D invested in this category (higher yields, higher alcohol selectivity) would provide major benefits to the program.
- The platform is making satisfactory progress.

Additional Comments

Strengths

- The program is based on an excellent understanding of the issues.
- Good partnering with UOP who has experience in both petroleum processing and biochemical processing. Good university, industry and national lab cooperation. Using technology that for the most part has long experience.

- This platform has potential in addressing multiple issues – biorefinery integration, integration with existing fuel infrastructure, utilization of multiple feedstocks, etc. In the gasification focus of the platform, there seems to have been an appropriate focus on bottlenecks (catalysts/tar removal).
- Innovative dryer designs would benefit a wide range of technologies if successful, including the biochemical projects.
- Decision to increase focus on pyrolysis. Focus on producing a range of biofuels, several of which would be attractive to the existing petroleum industry.

Weaknesses

- The weakness is in the goals as articulated in the MYPP, which seem to not be in agreement with the MYPP's statements about the opportunities and challenges with a wider variety of feedstocks. This platform is the primary platform to address their use.
- Concern about what has changed that makes this attractive now, and worth reopening.
- As previously noted in the platform review, the platform should widen its scope to reach its potential in achieving the President's goals.
- Subsequent to many years of funding projects to produce syngas, perhaps work should be oriented to separation of producer gas components. A review of current data should be accomplished to delineate relevance of simple and/or multiple technology procedures.
- Numerous projects were not focused; a shotgun approach often was evident. Economic assessments could have been made with current available information.
- It is not clear that DOE has been under funding gasification and pyrolysis R&D once the DOD and DOE coal R&D activities and the commercial R&D investments are considered. The Program clearly needs to integrate these technologies into their Biochemical conversion platform but a more rigorous effort is needed to define what needs to be done for the Program and program goals, not necessarily to benefit the industry at large. I want to reiterate one of the reviewer's comments as I support these strongly.
    - Techno-economic modeling is needed to help determine the priority direction for platform funding.
    - The industry and platform would benefit from an analysis effort to determine the state of gasifier technologies available; the review team suggests a "Consortium for Applied Fundamentals and Innovation (CAFI)" style approach.
    - The reviewers urge the thermochemical platform to evaluate the benefit to attempting to partner with other DOE (coal) and DOD R&D.
- Duplication of effort regarding cellulosic biomass gasification and coal gasification as they pertain to the use of the syngas produced.

R&D Portfolio Gaps

- There wasn't a separate slide for gas, but this matter was embraced in comments and recommendations. The most important gap is to increase funding. Other gaps cited are acceptable to this reviewer.
- The challenges (gaps) identified in the MYPP 3.2.2.3 are comprehensive. I suggest that Tt-E include a partnership with the feedstock platform (and probably Office of Science) as it may be possible for plant scientists to modify plant structures to facilitate the desired chemistry in the bio-oil.
- I agree with the platform review's analysis of the existing gaps.
- The potential of this platform is so great it deserves additional funding to determine whether the remaining challenges can be resolved. This may be the same state of affairs

that existed when the platform was downsized some years ago, but the world has moved forward since that time.

- Project outlines need to be developed to focus on particular, relevant objectives. Perhaps because of considerable past work, the researchers did not feel the need to define specific items, rather to continue with general approaches which can be projected well with enthusiastic show persons. In particular studies, there appeared to be little awareness of DOE goals.
- Available dollars may have been spent on state of the art equipment; however, there is a lack of researchers capable of utilizing the equipment as well as interpreting the data.
- There is a need to have projects present coherent approaches to posed questions.
- No additional gaps to those identified in the platform review report.

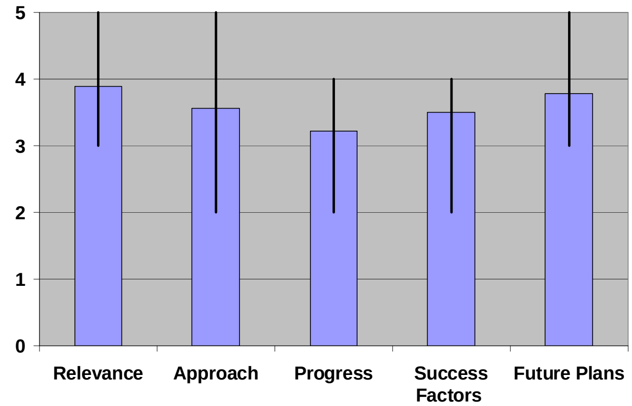
Additional Recommendations, Comments and Observations

- Excellent presentation. The appropriate amount of details was covered in a short presentation.
- Look for opportunities to share research and development with some of the Fossil Energy programs.
- The platform review was nicely presented.
- It would be beneficial (but probably very difficult), for the thermochemical conversion program to establish criteria for validating the claims of the plethora of companies purporting to have viable, operating gasifiers.

Integrated Biorefinery Platform

Presenters: Larry Russo, Biomass Program & Dr. William Cruickshank (formerly of National Resources Canada) and Dr. Michael Tumbleson (University of Illinois, Co-Review Chairs

	Average Score	Delta Minimum	Delta Maximum
Relevance	3.89	0.89	1.11
Approach	3.56	1.56	1.44
Progress	3.22	1.22	0.78
Success Factors	3.50	1.50	0.50
Future Plans	3.78	0.78	1.22
Average	**3.59**		



Question 1: Platform Approach

- The integrated biorefinery platform's approach is largely sound, yet its effectiveness is clearly dependent on the performance of the feedstock, biochemical conversion, and thermochemical conversion platforms. The generalized approach documented in the MYPP 3.3.4 is logical.
- Seems like a potpourri of projects to develop high valued products concurrently with ethanol that can enable economic production of fuel alcohol.
- Seems like to be taking the whole view.
- The platform seems to have a good focus within the program. The current focus on building the commercial scale and pilot scale plants is appropriate.
- This platform supports a wide range of projects, some of which (wet mill/dry grind improvements) are in the "commercialized" category.
- Too many work breakdown structure (WBS) elements. Need to focus on the things that the Program is investing in. May simplify WBS to include feedstocks (a-z), conversion technologies (a-z), byproduct production with linkages to feedstocks and/or technologies,
- Project definition (techno-economic analysis, LCA, Food vs Fuel, environmental, waste minimization, etc.). Technology verification and integration (including solicitations, 2nd plants, process integration, risk minimization, etc.).
- Since the Program is trying to get TECHNOLOGIES into commercial use in order to achieve some 20% gasoline displacement goal, why are the milestones not technology based? At least we could see if a technology is successful or not, and it's a lot more difficult to say that a feedstock is successful (see Milestones for this discussion).
- Need to focus on program priorities: why oil processing, forest resources, waste processing, etc.? OK as part of WBS as defined above, but begs the question of priorities if broken out separately.
- No milestone deadline targets. No info on solicitations, so not clear as to how well defined or the value of the partnerships to date.
- How much co-product benefits are enough?
- Platform area is new and under various definitional changes, but so far, we don't see much substance, although substance is possible and desirable.
- The platform organization and milestones facilitate reaching its goals as well as those of the Program.

- The R&D portfolio is constrained to some degree by the availability of relevant industrial partners and/or their willingness to partner in projects.

Question 2: Platform Goals (in relation to the Program)

- The general platform goal (MYPP 3.3.1) clearly is supportive of the overall Program goals. I have some concern about one of the two pathways selected for initial performance goals inasmuch as collection and transport of agricultural residue is still under development whereas collection and transportation of forest materials (not slash) and MSW is already commercially available. Somewhat in mitigation of this point is its recognition as a barrier in the MYPP.
- As reported, some projects do not support program goals, but most of them do. Could have better tie in or linkage among projects to see they function together to meet platform goals, which would support program goals.
- The platform seems to have focused well on the technical and market barriers.
- The goals are critical but poorly defined at this time. Some good progress has been achieved such as solicitations and analyses. Some good partnerships have been developed. But all in all, the platform is still too nebulous to be as useful as it could be. The goals of the platform need to be better defined via a better defined WBS.
- The goals may also be improved by created a list of partnerships that would provide specific benefits to the Program and then design around that (using solicitations). The scattergun approach is no different than the earmark approach. While the solicitations for the pilot plants and the 10% facilities are crucial, the solicitations should be more targeted to define Program benefits.
- Technology transfer products need to be improved, especially the publications of patents, standardized leasing agreement, or at least the identification of trade secret processes. The benefits would be quantified via technical improvements (yields, etc.) and costs.
- More thought should be invested in personnel training programs. Where are all the complex biochemical experts going to come from?
- Consider a solicitation that invests in multiple biochemical pilot plants rather than reinvest in the NREL pilot plant.
- No change to platform goals is considered necessary.

Question 3: Platform Goals (in relation to industry)

- If successful, they will clearly achieve the goal of achieving commercially acceptable performance. Achieving the cost goals likely will be dependent on optimization of plant designs and creation of maximum value from all mass and energy flows. Such optimization may take longer than the 2017 time horizon.
- Goals for projects are clear and realistic, but how they tie together to meet platform goals is not clear. Platform does pull different platform performers together.
- Issues raised by separation of C5 and C6 sugars give impression that there are issues around clarification of goals.
- The goals are clear, but broad. In this case, the activities chosen to support the goals will be more important to success than the goals themselves.
- Need more quantifiable goals and milestone dates.
- Need better targeted solicitations, for example a challenge/solicitation to densify dry corn stover in wrapped cubes for flat beds (may also include stacking height demonstrations). Or demonstration of using ethanol plant gases (such as CO2 gases) for drying and stabilizing dried materials. Etc. Identify the integration needs and focus them as solicitations. Try waste minimization, biochemical inhibitors.

- Present industry partnerships are contributing well to the platform's goal and meet industry needs.

Question 4: Focus and Balance of the Platform R&D

- Looking at the specific projects that were included in the materials, it does not appear that they all meet the needs of this platform's goals.
- Not clear whether platform R&D is focused and balanced, seems more like a collection of projects which don't fit elsewhere.
- Comments indicate lack of concern for the animals and final land disposal of the solids.
- By necessity, the platform has its fingers in a lot of pies. It appears the platform reviewers felt that some of the projects were not useful to promote the overall Program goals. This may include earmark projects. However, the 10% scale plants appear to be a beneficial focus as the platform moves forward.
- The Techno economic portion of the platform is excellent and investment in this task area should continue. This should provide better focus on where portions of integration are weak and need to have more focused solicitations. Specifically the market barriers are very poorly defined and not clearly needed as a platform barrier with the exception of Im-D.
- Focus on deployment is commendable. Water issues need to be a focus area. Need to focus on cross-cutting technologies.

Question 5: Platform Progress

- The platform peer review report that was presented indicated that the platform is moving in a commendable way toward emphasis on deployment. It also stated that integration with feedstock platform is exceptionally important, and I agree with this statement. I also agree with the recommendation to focus on water management and cross-cutting technologies – particularly those that can handle heterogeneous and time-varying feedstock supplies.
- The review is essential to keep program on track and mission oriented. Progress is made in the individual projects and with the scope as explained at this review; it will mitigate the issues with the 632 and 10% projects.
- While Congress appears to have put a hiccup in the platform's methodology, I am pleased that the platform is simultaneously moving forward on the 10% scale plant development and has a stepwise plan of implementation.
- The platform is on track but still in its infant stage of development and planning. It will be critical to bring this platform up to speed as soon as possible. The solicitations have generated a lot of interest but it isn't clear yet if the responders are high quality or will provide value, since none of that information has been presented yet.
- The analysis and strategic planning component of the platform must be used not only for tracking but also for effectively managing the platform's progress.

Additional Comments

Strengths

- Projects are well managed to meet specific goals.
- Liked the discussion of the options.
- The platform seems to have done a good job of assessing the barriers which are appropriate for the Program to address. The program is well funded. The development of commercial scale plants may be premature for technical reasons, but may also help identify new areas of research needed to remove impediments for future plants. The

recognition that 10% scale plants are more desirable is to be commended. I applaud the program's utilization of "investment banker" philosophy and risk analysis in the 932 process. Risk mitigation is necessary for success. I am happy to see the platform planning to look at utilization of new feedstocks and conversion technologies in the months and years ahead.
- Good industry partnerships. Good synergy with the biochemical conversion platform.

Weaknesses
- There are many gaps in the program.
- Needs to have better explanation of how they fit together in this platform.
- Clarity of purpose, and option development were expressed as concerns.
- No work on utilization of perennial crops, forest residues and post consumer waste. Insufficient focus on full life cycle analysis specifically, full life cycle GHG emissions and energy balance.

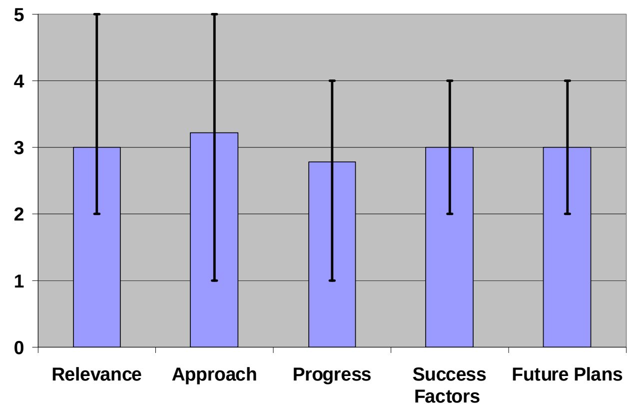
R&D Portfolio Gaps
- There are many gaps in the program, as cited by the presentation. These include little or no work on logistics of feedstock supply; issues around water supply and management; no work on utilization of perennial crops, forest residues or post consumer waste; lack of full life cycle energy balance and GHG emissions; and insufficient focus on unit process integration.
- The report noted little or no work on logistics of feedstock supply. While I agree that this is a paramount need for the overall program, I don't think it is a gap in this specific platform. I agree with the other four gaps noted by the peer review for this platform.
- Gaps were well pointed out.
- I agree with the comment that water supply issues need attention.
- There are opportunities in biorefinery integration to tell a good public relations story.
- I agree that perennial crops/forest residues could use more attention, especially regionally. Likewise wastes such as cobs are logical opportunities for attention.
- Full life cycle analyses are increasingly important in the investment and marketing world. In my experience, they are emerging as a real environmental and corporate investor focus.
- Agree with gaps identified in the platform review presentation.

Additional Recommendations, Comments and Observations
- The reviewer recommendation to publish more and encourage information sharing is understandable, but I question whether or not it is practical. Where possible, the use of public funds to develop resources that can be shared is to be encouraged, but the leveraging of private resources is so helpful it would not be wise to restrict it.
- This platform is ideally situated, by virtue of its being at the interface with commercial implementation, to provide feedback to the feedstock, thermochemical and biochemical platforms as to what R&D adjustments, refocusing, etc. is required in those platforms in order to assure commercially viable biorefinery processes.

Infrastructure Platform

Presenters: Joan Glickman (Biomass Program) & David Terry (State Line Energy for Governor's Ethanol coalition), Review Chair

	Average Score	Delta Minimum	Delta Maximum
Relevance	3.00	1.00	2.00
Approach	3.22	2.22	1.78
Progress	2.78	1.78	1.22
Success Factors	3.00	1.00	1.00
Future Plans	3.00	1.00	1.00
Average	**3.00**		



Question 1: Platform Approach

- The issues of product distribution infrastructure and product standards are important and their recognition as a platform component is a positive development.
- A very important component of the biomass program. Once we double the amount alcohol in the pool, we will need to know how to move it around.
- This was a workshop review, not a platform peer review.
- It is wise for the Program to add this platform to address the final link in the chain.
- The platform approach could support the Program goals, except that the platform as described does not have enough content to achieve anything. The platform as presented does not contain any substance, no key milestones or date, no focus or strategic value, no priorities.
- Clearly this platform needs to differentiate its self from the Freedom Car and create a focus that has value. For example, shooting for an E22 world, realistic or not, would be a goal.
- The conception of existing and future Infrastructure does not accommodate new facility locations, or incentives to get new facilities to build in the right places. That would minimize rail, pipeline, etc.
- Focus on new fuels creates a huge chicken and egg issue. If you are going to add new fuels, then why not mixed alcohols with better fuel economy and lower conversional costs? At least there is a rational here. Furthermore, how will you prioritize the fuel choices? Where are the following platform activities necessary to support a new fuel: fuel registration, demonstration, ASTM standards, fuel quality optimization activities, engine design, material compatibility, etc. Where are the partnerships to achieve all that? How will you justify some new fuels (based on volume and cost) versus other new fuels with limited niche markets, limited volumes, limited cost benefits, etc?
- Who really cares about lawnmowers, trimmers, etc? How much volume for how much investment will be needed for these? Tractors are NOT small engines. They are larger than all transportation fuel vehicles except semi-tractor trailers. Alcohols have not been good fits for large engines, what will you do differently?
- Isn't there enough private investment in automotive alcohol engine research? You will need to focus on a large blend such as E22.
- Your list of potential partners is good, but how the partnerships will be managed and directed is nebulous.

- There are adequate federal incentives for ethanol blending infrastructure.
- Given that some issues regarding infrastructure fall outside DOE's mandate, the platform approach is considered satisfactory.
- Since this is a new platform, it is expected future reviews will indicate refinements to its approach.

Question 2: Platform Goals (in relation to the Program)

- Based on the slide presentation, which updated the MYPP, this platform's goals are fully supportive of the program goals.
- Not a platform, but certainly supports the program.
- The goal at this point seems to be simply exploring what is the national infrastructure status, and what are the early-identifiable bottlenecks. From what I saw, the emerging concerns seem to be appropriately identified.
- No, the platform goals don't seem to support Biomass Program goal of 20-in-10 or any other related vision except for the vague decision to do something in the ethanol and biodiesel arena.
- To generate a volume equal to 20 Billion or 20% of gasoline industry, you are not going to play around with lawnmowers.
- The key areas are storage infrastructure and investment and pipeline incentives—no one has given the pipelines any incentive to move ethanol. The rest (material compatibility, standards, etc.) will be partially driven by industry if they decide to get invested.
- The platform's goals support the Program goals.

Question 3: Platform Goals (in relation to industry)

- As noted in the presentation, the platform is evolving rapidly. It is important that the goals address the range of biofuels and develop the platform's goals in consultation with the appropriate industrial partners.
- No goals, but a number of recommendations came out of project, and more outreach planned to get input on this important area.
- These goals will have the benefit of making a lot of people feel good about the biofuels program. The history of slow acceptance of E10 by uninformed car owners (still a problem) shows the benefit of public education.
- There are good Geographic Information System programs already available for liquid fuel transportation and storage. In addition to research on stress corrosion cracking, pipeline and storage infrastructure research to move ethanol will require research on pumps, seals, cleanout operations, safety, environmental impact analysis, risk analysis, etc.
- The goals of the platform are realistic, but the platform will need to expend a major effort on consultation/communication with other agencies, industry groups, standards, organization etc. in order to achieve them.

Question 4: Focus and Balance of the Platform R&D

- Need to focus on infrastructure to get good data on how we distribute the large amount of biofuels planned.
- The platform R&D portfolio could perhaps focus on some larger issues (small engines are very important in emissions for certain regions, but maybe this is EPA's responsibility?). I trust that R&D will mature as the program matures.

- All over the map, needs some real focus with solid value. They may be on the right track with some issues but unable to prioritize and identify where the value is for some of the things they want to include.
- The platform is as well balanced as can be expected given that it's new and subject to influence by many stakeholders.

Question 5: Platform Progress

- The workshop was an excellent first step.
- Good progress (held workshop) and plans to generate much more information.
- Since this platform is new, there is no progress to report.
- Just getting started.
- Poorly, who ever is supporting this area, they should bring focus groups specific to fuel storage firm and pipelines and even rails for unit train operations, and see exactly what the barriers are and how important each barrier is and what to do about it and who to do it.
- Too early to assess how well the platform is progressing. Progress of the platform may well be limited by factors beyond its control and/or mandate.

Additional Comments

Strengths

- Outreaching to end users and addressing issues on fuel ethanol.
- The platform is to be commended for its early effort to coordinate with other agencies, industry, and organizations to determine the needs and the work being done by others. Outreach to the public is wise. Partnering with private industry will likely allow greater penetration into media markets than government efforts alone. I am glad to see the door being left open for efforts for other renewable fuels, though I agree that, for now, a priority focus on ethanol and biodiesel is appropriate.
- Outline of work to be accomplished was provided. Need for intra and interagency cooperative efforts were described.
- The platform's initiative to engage all relevant stakeholders right from its beginning is a key strength.

Weaknesses

- Distribution and storage of the feedstocks will likely be a serious issue and should have some attention from this platform and/or close communication with the feedstock platform.
- The weakness of this progress is that its ability to achieve its goals may be limited or prevented by the actions of organizations beyond its influence.

R&D Portfolio Gaps

- Gaps were not identified, but this reviewer is in agreement with the programs objectives, of:
    - Identify challenges, barriers, and opportunities that need to be addressed in order to promote the increased use and distribution of biofuels, and,
    - Gain industry (i.e., producers, petroleum wholesalers and retailers, pipeline operators, rail, etc) insight into how the Biomass Program can best focus its infrastructure efforts.
- It appears that this program is its early stages. This reviewer believes it should be accelerated and that investor considerations and interests being part of the program. As

important as any of the other presentations, this should be considered to be a major externality towards meeting the overall program goals. This reviewer emphatically agrees with the conclusion that an infrastructure plan be prepared.

- I don't believe gaps were presented to the reviewers.
- Efforts to achieve goals were not apparent.
- The weakness of this progress is that its ability to achieve its goals may be limited or prevented by the actions of organizations beyond its influence.

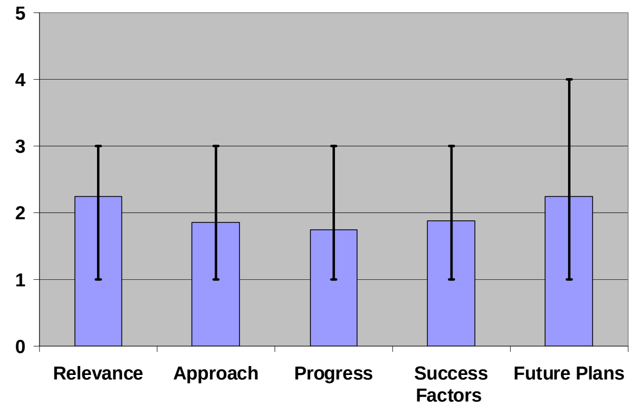
Additional Recommendations, Comments and Observations

- Focusing on transporting fuel, may learn useful information about moving around biomass.
- Explore partnership with the state of CA on your emissions work for possible synergy with their San Joaquin Air Quality District needs.
- Infrastructure issues can deter the growth of biofuels consumption, so workshops like this can help. Their outcomes need to be communicated more broadly, however.
- This reviewer was unable to glean the relevancy of the direction presented.
- Will there be joint presentations and deliverables provided to the public, staffers on the hill, DOE administrators and industrial organizations?

Biodiesel and Other Technologies

<u>Presenters</u>: Mark Decot (Biomass Program) & Shaine Tyson (Rocky Mountain Biodiesel), Review Chair

	Average Score	Delta Minimum	Delta Maximum
Relevance	2.25	1.25	0.75
Approach	1.86	0.86	1.14
Progress	1.75	0.75	1.25
Success Factors	1.88	0.88	1.13
Future Plans	2.25	1.25	1.75
Average	**2.00**		



Question 1: Platform Approach

- Difficult to answer – there is no biodiesel platform. The interest across the nation in this subject makes it seem appropriate to have some effort directed to improve the base of knowledge concerning oilseed feedstocks, conversion processes including co-products, and distribution issues.
- Not a platform, group of congressional mandated projects. Lack of structure at the review. Broad diversity of projects, mostly related to biodiesel. $1.00/gal subsidy brought scads of people to the table.
- Discord and discontinuity stressed.
- There are no platform approaches or organization to review. I am glad that the Program has put these under review, and hope that the feedback the "platform" reviewers provided will be utilized.
- Many of these projects support local interests, but not national program goals. Platform managers have little ability to refocus project goals or require good quality research.
- This platform's approach is very scattered and serves as a prime example of how earmarks negatively impact achievement of the Biomass Program objectives.

Question 2: Platform Goals (in relation to the Program)

- There are no platform goals, so the response to this question should be N/A
- Not a platform, but supports the overall program.
- Unclear
- No platform goals to review. Some of these projects should be moved into the new Infrastructure platforms so that they can be judged in light of the goals of that platform.
- No. If the Program decides that biodiesel is worthy of platform status, it should make the effort to define realistic goals etc.

Question 3: Platform Goals (in relation to industry)

- There are no industry reviewers in this program. It appears that this program is a technical activities program.
- There are no stated goals.
- Goals not clearly articulated, but assumed to replace gasoline. No articulation of goals or how much diesel could be replaced.
- Congressionally directed seem to be a problem.
- No goals.

- What goals??

Question 4: Focus and Balance of the Platform R&D

- Since the projects are primarily not directed by the DOE staff, there does not appear to be any planned balance in the set of projects.
- Good assessment by review committee, tried to get answers. Have good handle on how to bring the program together.
- Clearly some disconnects in focus.
- Obviously, the research is not focused or balanced, though I thank the reviewers for highlighting those projects which had some usefulness for achieving Program goals.
- What focus?

Question 5: Platform Progress

- Future assessment should be better detailed.
- Some projects appear to have some value to addressing imported petroleum replacement.
- Needs organization, review committee gave helpful suggestions, recommendations, but no indication that input would be incorporated.
- No platform for which to track progress.
- Fifteen different projects going in fifteen different directions will not contribute to progress towards goals.

Additional Comments

Strengths

- This is not a platform, rather a collection of mandated projects. It was a good review of the projects with many good suggestions/recommendations.
- The reviewers performed a valuable service in analyzing these “orphan” projects. Leveraging with private funding is to be commended. Pipeline testing projects may have use to the new infrastructure platform.

Weaknesses

- As the presentation indicates, a biodiesel platform does not exist. Much more work is needed on this activity.
- Didn’t appear likely that many of the recommendations would be followed.
- There is no platform. Some of the projects could be moved into existing platforms for better review. However, I don’t fault the Program for conducting the review in the manner they did.
- No focus.

R&D Portfolio Gaps

- Gaps are not indicated.
- The reviewers’ comment that a biodiesel/renewable diesel platform is needed is interesting. I don’t think that a separate program is appropriate, but should rather be integrated into existing platforms. However, we did not see much attention to biodiesel this week. As clean diesel engines have certain advantages over gasoline engines for improved fuel use, there is a need to give this some attention (at least a cost analysis). I would suggest that the Program follow up on the suggestion that the Program attempt to bring PIs from these types of projects together early and educate them on the Program goals and useful tools for project success.

- Overall, the projects presented were not focused on DOE Office of the Biomass Programs. Project timelines did not appear to be a major area of concern. As some of the projects were earmarked with a lack of coordination with more stable research programs, accomplishments were minimal. Inadequate data on cost benefits from utilizing biodiesel. Prior to demonstration projects, dollars should be spent on basic aspects of bioconversion and sourcing. Studies on engine performance and responses to regulatory requirements must be conducted. Relevant relationships with biorefineries were not apparent. Project innovations must be listed and acknowledged. Economic analyses are needed to ascertain relevancy to utilization of current and proposed materials.
- Too many to comment on.

Additional Recommendations, Comments and Observations

- Much work is required in this activity.
- The need for middle distillates is known. It seems that a biodiesel or middle distillate platform is needed.
- Biodiesel ought to be relegated to niche applications, such as mandated usage in recreational vehicles and boating where it is affordable. Biodiesel costs are prohibitive in view of other renewables. It has value to replace petro-diesel in ecologically sensitive areas.
- I agree with the ideas presented for managing earmarked projects. They can't hurt, and a few PIs might actually cooperate.
- The Program should consider abandoning support for biodiesel (fatty acid esters) and instead focus on renewable diesel as supported by a strengthened thermochemical conversion platform. If the decision is to retain oil based biodiesel, the focus should be on new (as in economically viable) feedstocks.

Platform Peer Review Summary Reports

Process Overview

Introduction

The Technology Platform Peer Reviews for the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Biomass Program were conducted over a three month period prior to the November 2007 Biomass Program Peer Review. The summary report of each meeting provided in the following sections includes a summary of comments from the Review Panel, scores and feedback on individual projects and PI responses to the reviewer comments. The primary intent of the peer reviews was to provide information that assists the Program Manager and staff in their efforts to improve program performance. Other important potential outcomes of the reviews include: improving program management, demonstrating public accountability, providing an honest independent review of the projects and program, and transparently communicating the value of the programs to the larger public.

The objectives of this meeting were to demonstrate the R&D projects':

- Relevance to platform objectives
- Progress against planned milestones and likelihood of commercial success
- Relationship to mission and goals and contribution to 20-in-10 targets
- Strategic mix of industry, academic, laboratory involvement in the research
- Appropriateness of industry-government cost share
- Recommendations (i.e. go/no-go decisions, redirection, etc)

The work evaluated at these reviews support achievement of DOE goals and the results of the reviews are used by the Program as inputs for future funding decisions. In addition to the initial reviewer comments, the report anonymously discloses the full comments, scores for each of the criteria rated, and the average project score in the body of this report.

Platform	Date	Location	Projects Reviewed	Project Technology Areas
Feedstocks	August 21 - 23, 2007	Washington, DC	12	• Feedstock Supply & Sustainability • Feedstock Logistics Core R&D • Feedstock Systems Integration
Biochemical Conversion	August 7 - 9, 2007	Golden, CO	17	• Biochemical Platform Support • Feedstock-Biochemical Conversion Interface • Biochemical Processing Core R&D • Biochemical Process Integration Core R&D • Fundamental New Concepts • Chemicals and Products
Thermochemical Conversion	July 10 - 11, 2007	Golden, CO	18	• Thermochemical Platform Support • Gasification/Black Liquor Gasification • Clean-up and Conditioning • Fuel Synthesis • Pyrolysis
Integrated Biorefineries	August 13 - 15, 2007	Golden, CO	14	• Analysis and Strategic Planning • Corn Wet/Dry Mill Improvements • Oil Mills Improvement • Agricultural Residue Processing • Other Refinery-Related Projects
Biodiesel and Other Technologies	August 15 - 16, 2007	Golden, CO	18	• Biodiesel and Fuels Demonstration • Combined Heat and Power • Associated Products • Anaerobic Digestion • Communications, Outreach, & Partnerships • Other Technologies
Infrastructure	October 30, 2007	Washington, DC	0	

Technology Platform Reviewers (*Review Chairs)

Platform	Name	Organization
Feedstocks	Lyle Stephens*	Lead Reviewer; John Deere (retired)
	Beth Calabotta	Monsanto
	Peter Flynn	University of Alberta
	Tom Miles	T.R. Miles Technical Consultants
	Phil Rasmussen	Utah State University
Biochemical Conversion	Bonnie Hames	Ceres
	Don Johnson*	Retired from GPC
	Dale A. Monceaux	AdvanceBio LLC
	Sharon Shoemaker	Univeristy of California, Davis
Thermochemical Conversion	Jim Frederick	Georgia Institute of Technology
	Lisa Myers	Conoco Phillips
	Mark Jones*	Dow Chemical
	Robert Brown	Iowa State University
	Ron Breault	National Energy Technology Laboratory
	Steve Kelley	North Carolina State University
Integrated Biorefineries	William Cruickshank*	Natural Resources Canada (retired), Consultant
	Carol Babb	R.W. Beck
	Dr. Michael Tumbleson*	University of Illinois
	Jason Denner	Point 380
Biodiesel and Other Technologies	Dr. Shaine Tyson*	Rocky Mountain Biodiesel
	Rodney Boyd	McMinnville Electric Systems
	Dr. Joe Bozell	University of Tennessee
	Rick Handley	Coalition of Northeastern Governors (CONEG)
	Dr. David Sjoding	Washington State University
	Dr. Philip Shepherd	National Renewable Energy Laboratory
	Dr. Matt Smith	USDA – Agricultural Research Service
	Dr. Mark Zappi	University of Louisiana at Lafayette
Infrastructure	David Terry*	Governors’ Ethanol Coalition

Review Design and Process

The following outline was provided to the Principal Investigators (PIs) to help them present their project information in a format that addresses the review objectives. Additionally, project background summaries were submitted by the PIs in a similar outline before the meeting.

1) Project Overview
   a) Timeline
   b) Barriers
   c) Budget
      i) Total project funding
      ii) Funding received in FY06 and FY07, Future funding, if applicable
   d) Partners
   e) Stage of Development
2) Goals and Objectives
   a) Project objective(s)
   b) Relevance to the Biomass Program
3) Approach
   a) Overall technical approach
   b) Unique aspects of approach
4) Technical Accomplishments/Progress/Results
   a) Describe most important technical accomplishments achieved and their significance
   b) Describe the significance of the accomplishments by relating the results to the appropriate DOE targets and milestones from the MYPP
   c) Benchmark progress to previously reported results (if applicable)
   d) Benchmarks results against technical targets (if applicable)
5) Accomplishments/Progress/Results
   a) What was done leading to technical accomplishments
   b) Data and results
6) Success Factors and Showstoppers
   a) Top 2-3 potential showstoppers to achieve successful project results
   b) Window of opportunity to develop the technology
7) Future Work
   a) Plan of work through to the end of the project
   b) Highlight upcoming key milestones
   c) Remaining issues
8) Summarize key points for reviewers and audience to take away

Evaluation Criteria

Scoring Guide Used by Reviewers

4 **Excellent** overall.
3 **Good** overall; no major and only some minor weaknesses.
2 **Acceptable** overall; no major and some moderate weaknesses.
1 **Marginal overall**; one or more significant weaknesses that cast doubt on the merit of the program in this area.
0 **Unacceptable** overall; clearly little or no merit in this area.

Platform Review Summaries