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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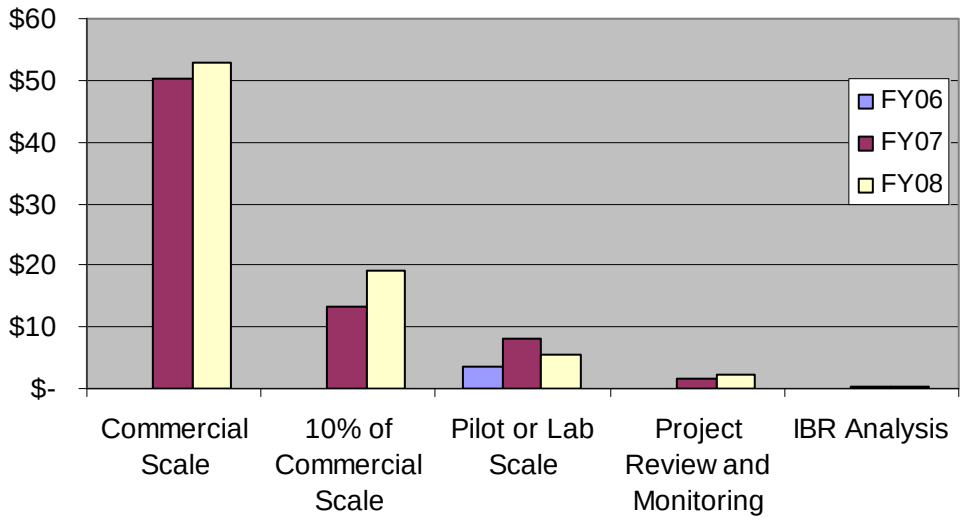
Program Peer Review Platform Results

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

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

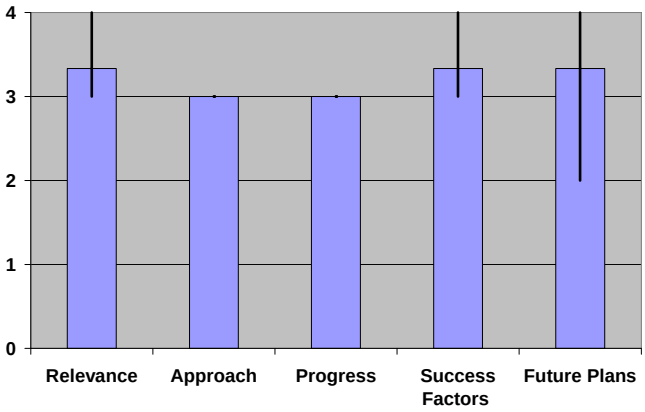
- None

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

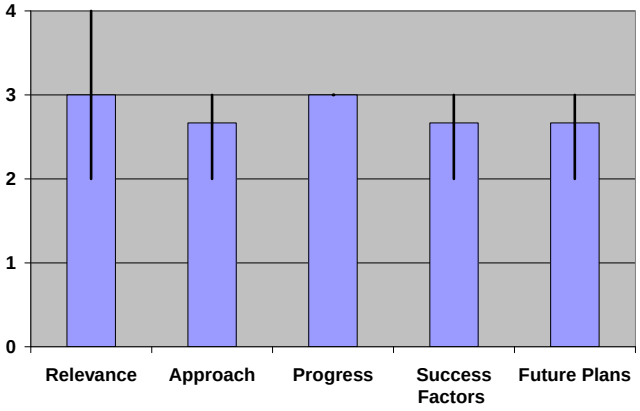
- None

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

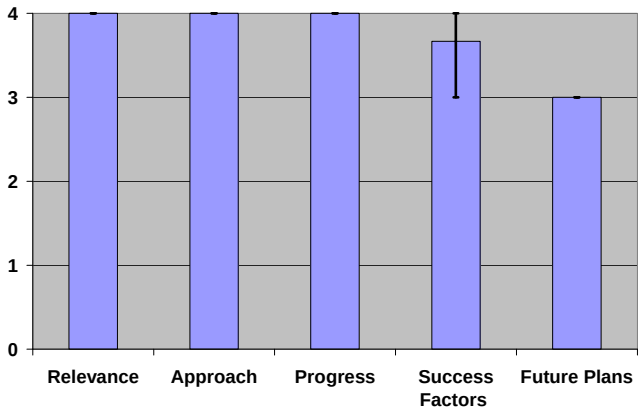
Recommendations for Additions/Deletions to Project Scope

- 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

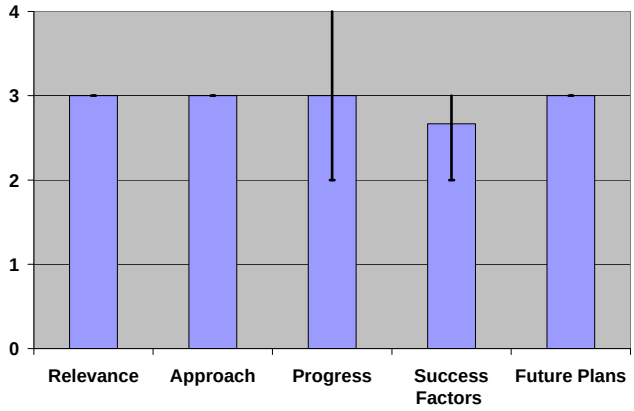
Recommendations for Additions/Deletions to Project Scope

- 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.

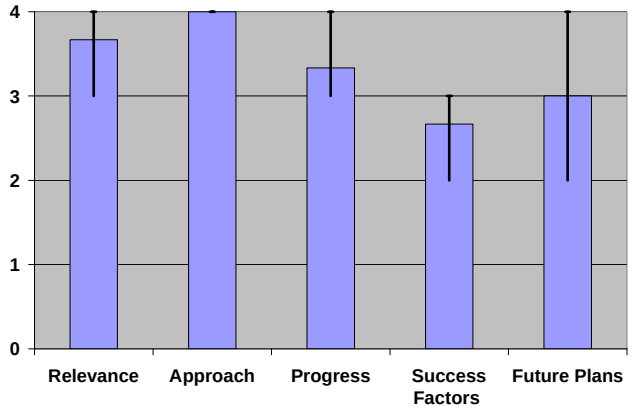
Recommendations for Additions/Deletions to Project Scope

- 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

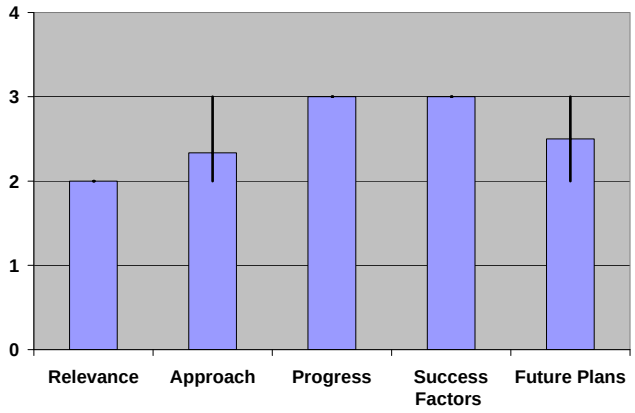
- Partner with biodiesel production facilities.

Oil Mills Improvement Projects

Project Title: National Agricultural Based Industrial Lubricants Center Project

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

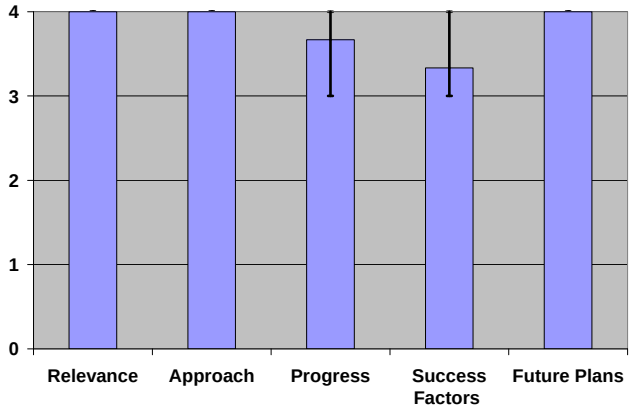
- Important work with merit but not sure of relevance to this program.

Agricultural Residue Processing Projects

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.

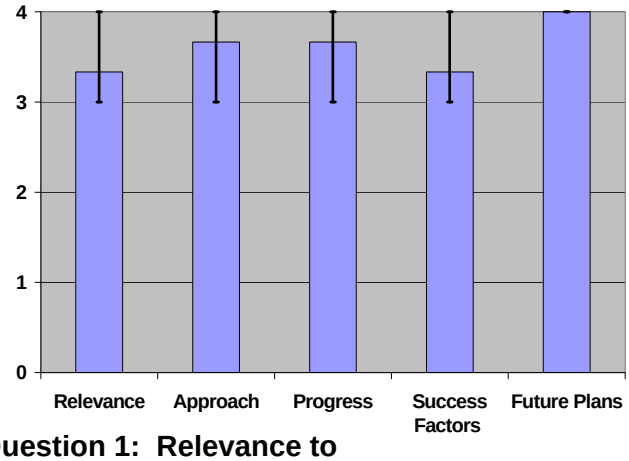
Technology Transfer/Collaborations
- The degree to which the project interacts, interfaces, or coordinates with other institutions and projects, providing additional benefits to the Program.
- The collaboration with NatureWorks has contributed significantly to the success of this project.

Recommendations for Additions/Deletions to Project Scope
- None

Project Title: A New Biorefinery Platform Intermediate

Principal Investigator: 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

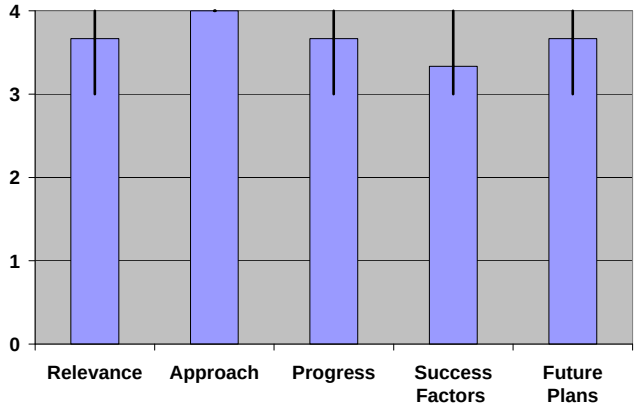
- The collaboration with Codexis was extremely fruitful with respect to strain development and selection.

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.

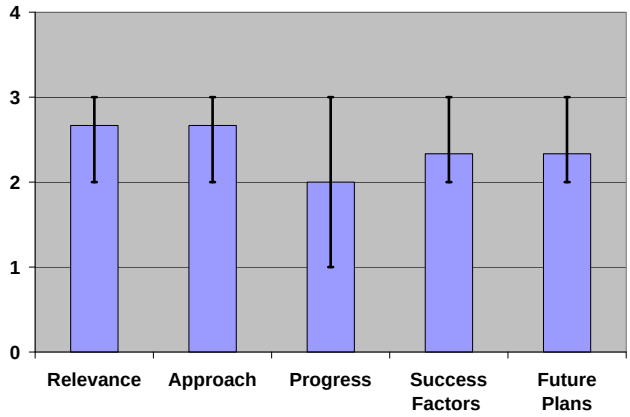
Recommendations for Additions/Deletions to Project Scope

- 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.

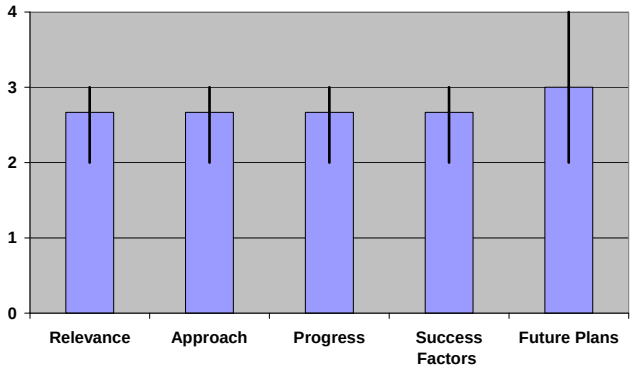
Recommendations for Additions/Deletions to Project Scope

- 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

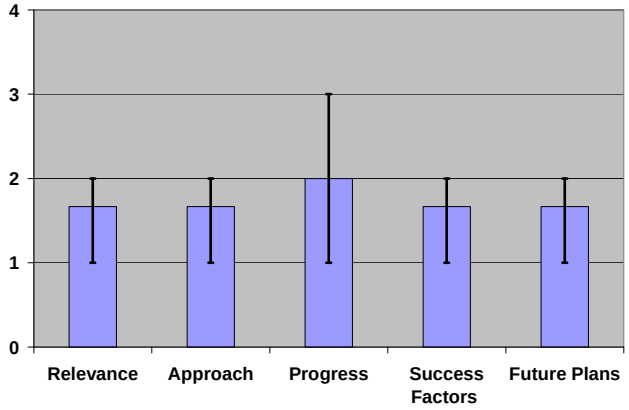
- None.

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