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

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Program Peer Review Platform Results

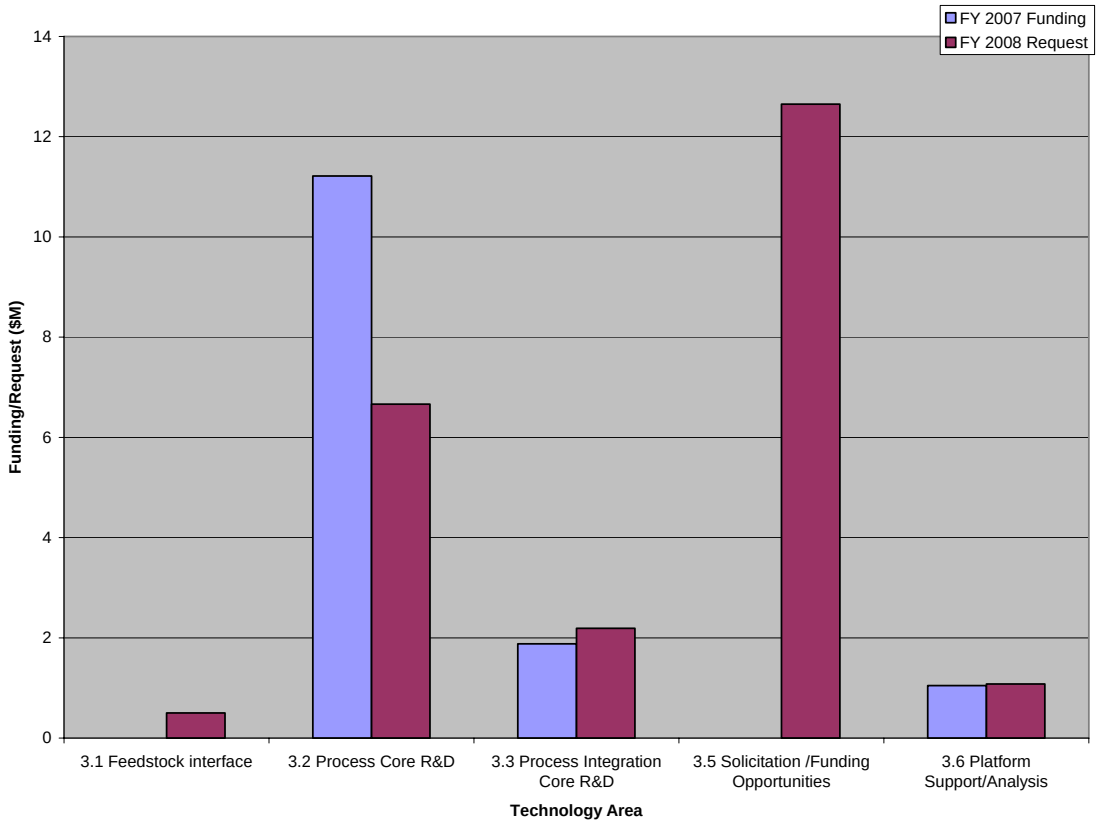
Platform Direction

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

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.

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

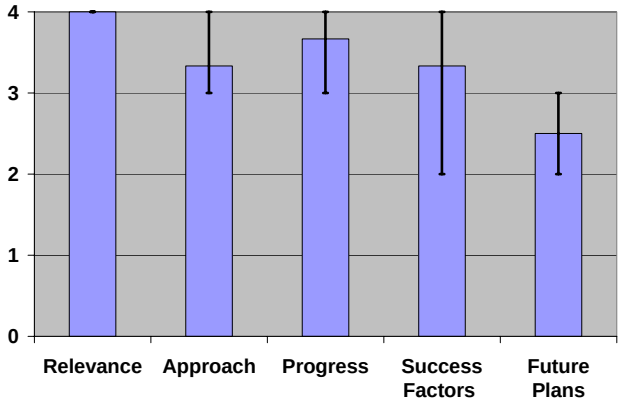
- No response given.

Full Reviewer Comments and Scores

Analysis Projects

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 CO2.
- 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

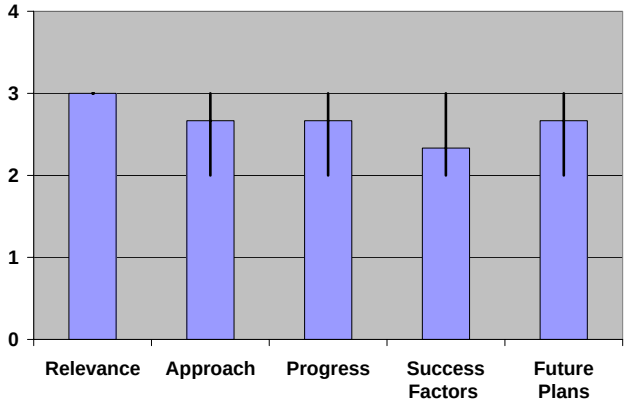
- The pyrolysis work ended several years ago and was just re-started in OBP. The current state of technology needs to be documented and used to evaluate the model assumptions.
- The need to make a more transparent process for connecting analysis results with future plans for R&D work was noted above 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

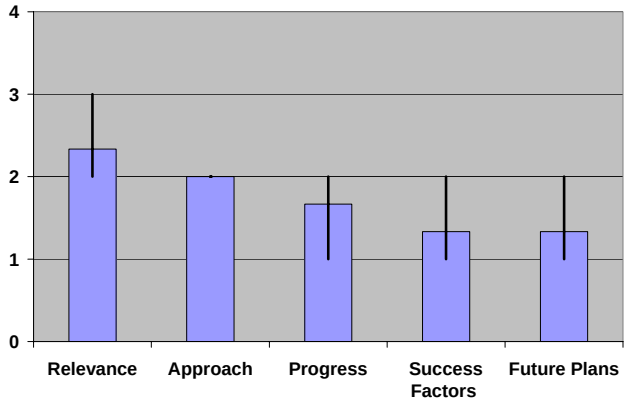
PI Response to Reviewer Comments

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

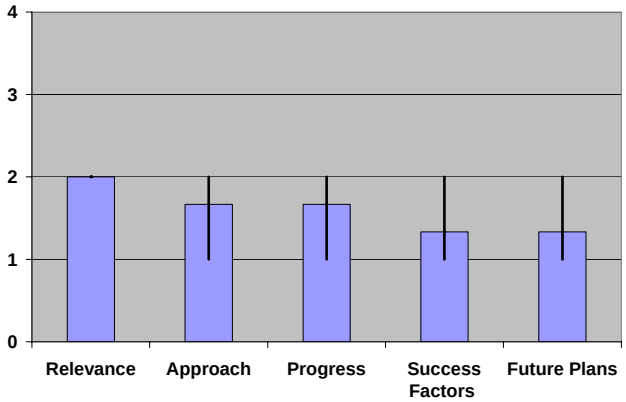
- It is recommended that no further work be conducted.

- 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.

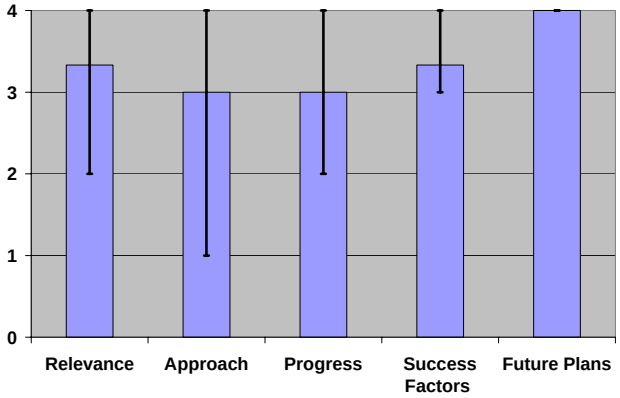
PI Response to Reviewer Comments

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

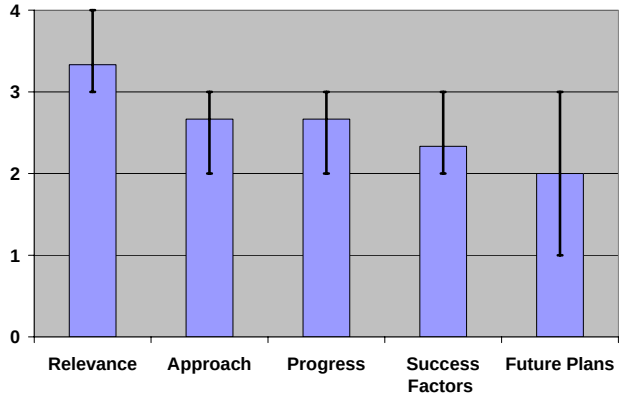
PI Response to Reviewer Comments
Response not provided.

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.

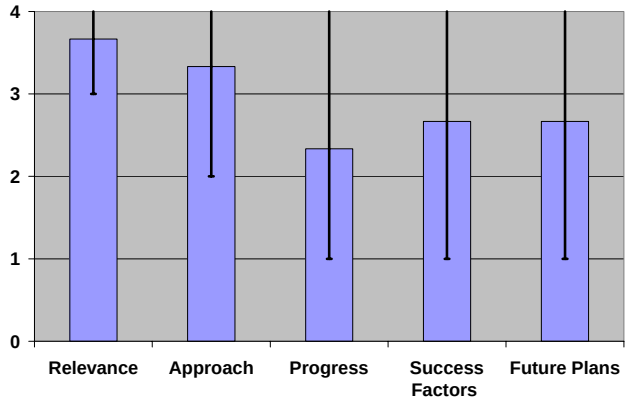
As stated, one of the near-term goals for this project is to find a biomass gasification host site and cost-share partner to test the Therminator. This will serve as the opportunity to test the process on actual biomass-derived syngas and determine the multi-contaminant performance of the unit.

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

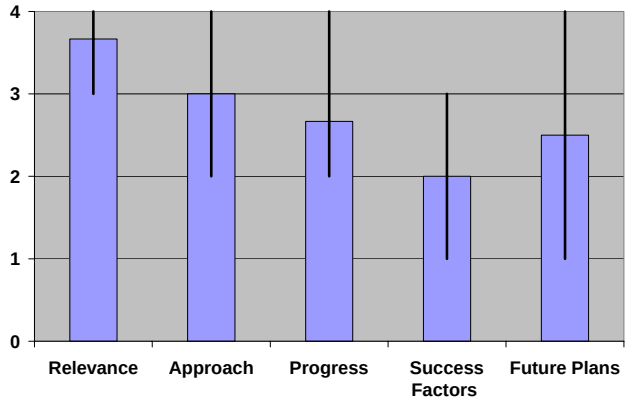
PI Response to Reviewer Comments

- 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.

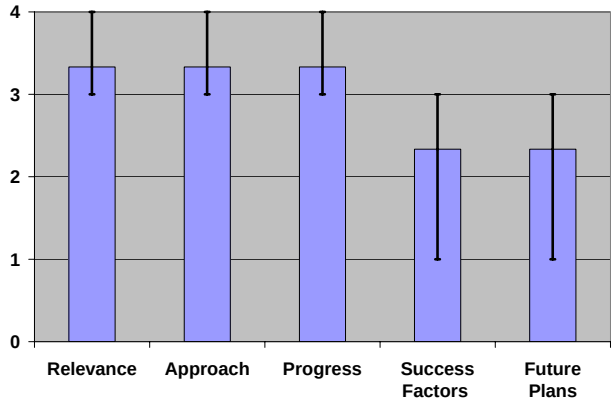
Question 3: Sulfur is a significant problem for tar reforming catalysts as are other potential poisons contained in biomass-derived syngas and to be investigated (Cl and C). Our approach is integrated in that feedstock choice (determines H_2S level), placing a sulfur capture unit operation before the 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.

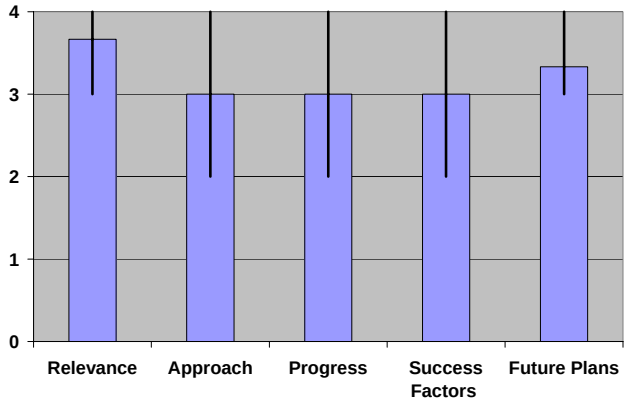
Slide 15 concerns: The upset peaks in the data s were caused by process adjustments (sample valve cycling) associated with startup and were not a factor during the experimental period.

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.

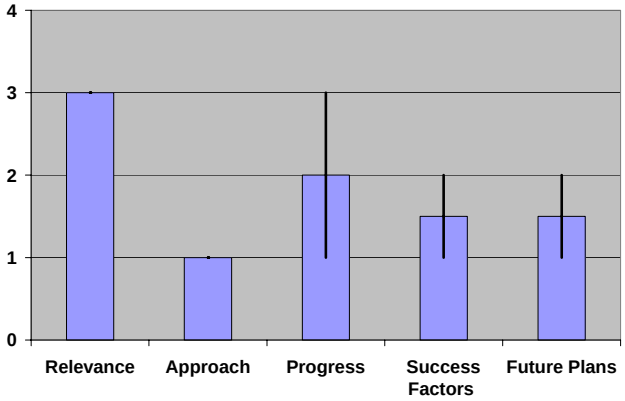
PI Response to Reviewer Comments

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

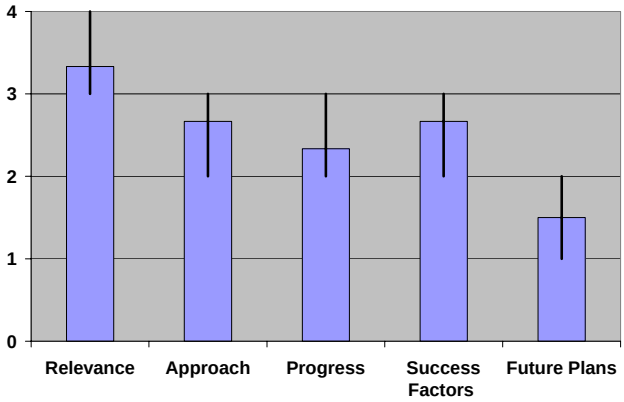
- Get catalyst tested.
- Economics on the liquids is clearly needed
- Catalyst testing to confirm results by other party needed.

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

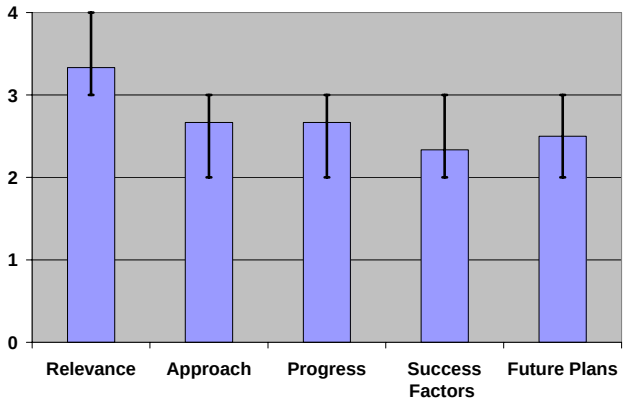
explore the possibility of methanol as an intermediate for fuel (gasoline, ethanol, and mixed alcohols) production. Selectivity and productivity of methanol synthesis catalysts is very high (at least 3 times greater than mixed alcohol catalysts). These processes are beyond the scope of this project but 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.

Weaknesses 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.

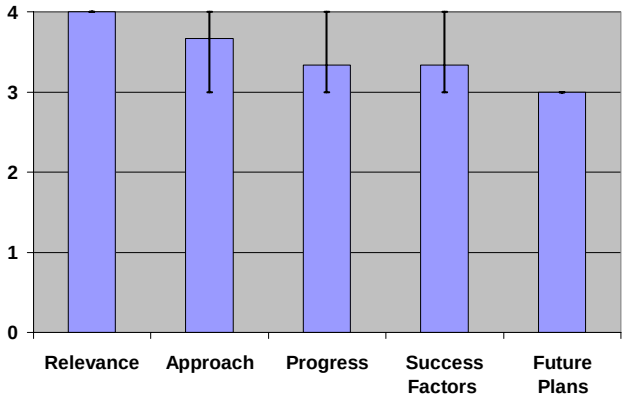
The suggestion to add research into reactor geometries would help maximize alcohol productivity and allow the program to reach its target goals. However it is felt that adding this task to the project at this time is premature until a catalyst with suitable performance is identified and well characterized, 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

Project Title: Pyrolysis Oil R&D

Principal Investigator: Doug Elliott, 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	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.

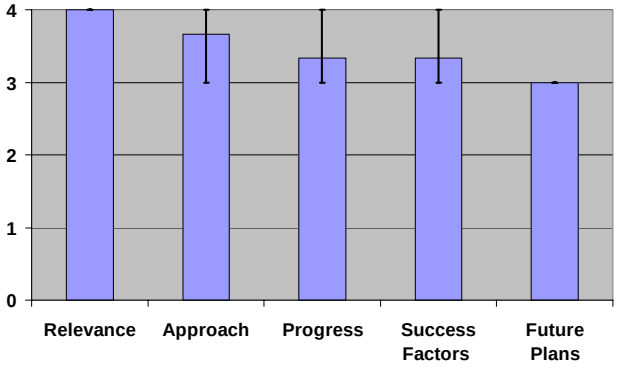
Weaknesses
Technoeconomic models using Aspen are currently being developed to assess the feasibility of both pyrolysis/upgrading approaches and then to understand the minimum upgrading that will be required.

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 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).

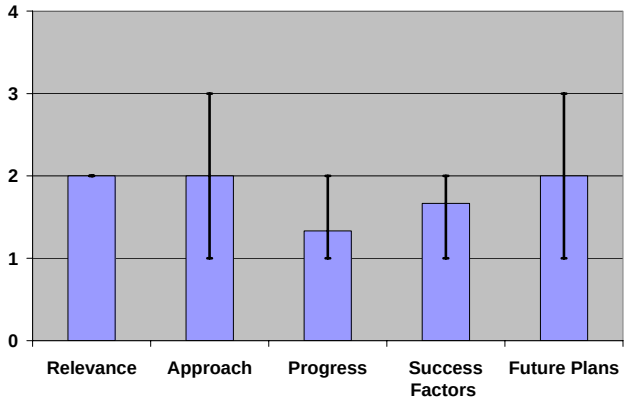
Technology Transfer/Collaborations
- Good interaction with the government labs

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

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.

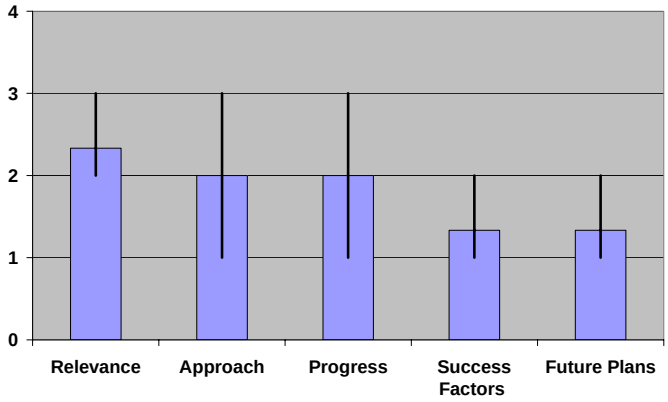
PI Response to Reviewer Comments

- 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 components of 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.

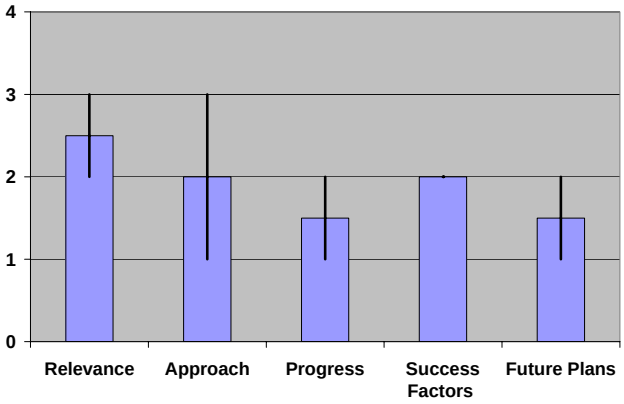
Recommendations for Additions/Deletions to Project Scope
- Need to work with DOE program staff to identify the priorities for their work as if moves forward.
- Work with Program Director to better align project to Program goals and needs.
- Bring focus to the effort. Drop efforts that are not directly 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 CH4
- 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

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