U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BIOMASS PROGRAM

2009 Thermochemical Conversion Platform Review Report:

An Independent Evaluation of Platform Activities for FY 2008 and FY 2009

December 2009

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Dear Colleague:

This document summarizes the recommendations and evaluations provided by an independent external panel of experts at the U.S. Department of Energy Biomass Program's Thermochemical Conversion platform review meeting, held on April 14-16, 2009, at the Sheraton Denver Downtown, Denver, Colorado.

All programs in the Department of Energy's Office of Energy Efficiency and Renewable Energy are required to conduct a biennial peer review of their project portfolios, and this report is intended to officially document the process utilized by the Biomass Program, the results of the review, the program's response to the results and recommendations, and a full compilation of information generated during the review of the Thermochemical Conversion platform. Additional information on the 2009 platform and program review meetings—including presentations for all of the individual platforms and the program review—is available on the program review Web site at www.obpreview2009.govtools.us.

The Biomass Program peer review process included a systematic review of the project portfolios in the six separate technology platforms managed by the program and a separate meeting where the program is comprehensively reviewed. The Biomass platform reviews were conducted between March and April 2009 in the Washington, D.C., and Denver, Colorado, areas. The platform reviews resulted in the peer review of the program's projects in applied research, development, and demonstration, as well as analysis and deployment activities. The program peer review held in July 2009 was conducted to evaluate the program's overall strategic planning, management approach, priorities across research areas, and resource allocation.

The recommendations of these expert reviewers are routinely used by the Biomass Program staff to conduct and update out-year planning for the program and technology platforms. The review results are reviewed in combination with other critical project information to result in a complete systematic evaluation of the accomplishment of programmatic milestones, project goals, and objectives.

I would like to express my sincere appreciation to the reviewers. It is they who make this report possible, and upon whose comments we rely to help make project and programmatic decisions for the new fiscal year. Thank you for participating in the 2009 Thermochemical Conversion platform peer review meeting.

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Executive Summary

2009 Thermochemical Conversion Platform Peer Review
U.S. Department of Energy
Biomass Program

On April 14–16, 2009, the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Biomass Program held a peer review of its Biochemical and Thermochemical Conversion platforms. These peer review meetings were collocated, but held in separate, adjoining rooms. Both meetings featured introductory presentations by program staff to provide information on the platform and presentations by the principal investigators of the federally funded projects that make up the Conversion platforms' project portfolio. Approximately 200 people attended the conversion platform review meetings and learned about the state-of-the-art research, development, and deployment (RD&D) activities being performed by the program. Among the attendees were two separate and individual panels of independent experts from outside the program who were tasked with reviewing the RD&D activities managed by the Conversion platforms. This report is specific to the review of the Thermochemical platform.

Presentations given during each of the platform review meetings, as well as other background information, have been posted on the registration Web site: www.obpreview2009.govtools.us. Additional information, such as the reviewer comments, recommendations, meeting agendas, and the list of attendees, can be found in the individual platform reports.

Thermochemical Conversion Platform Peer Review Process

The Thermochemical Conversion platform review was one of the seven (six platform and one program) reviews held as part of the 2009 Biomass Program peer review. The peer review is a biennial requirement for all EERE programs. The results of the peer review are used by Biomass Program technology managers in the generation of future work plans and in the development of Annual Operating Plans, Multiyear Program Plans, and potentially in the redirection of individual projects.

The goals of the independent review panel were to provide an objective and unbiased review of the individual projects in the platform portfolio, as well as the overall structure and direction of the Thermochemical Conversion platform. In forming its review panel, the platform evaluated a total of 15 candidates from industry, academia, and government, with a range of experiences in the technical areas related to thermochemical conversion. An outside, objective steering committee established to help ensure the independence and transparency of the overall peer review process reviewed available biographies for review panel candidates during the planning process and provided feedback and recommendations to the platform teams. Six reviewers were selected to ensure a breadth of experience and expertise relevant to the platform portfolio. A list of review panel members for the Thermochemical Conversion platform can be found on page 4 of this report.

At the platform review meeting, project principal investigators (PIs) presented their project budgets, goals, accomplishments, challenges, and relevance to the Thermochemical Conversion platform and answered questions from the review panels and general audience. Projects were evaluated by the review panel solely on the basis of information that was either presented by the PI or contained in a standard program management plan. Reviewers used a software tool developed to facilitate both scoring and constructive comments on a range of evaluation criteria. The results of these evaluations (along with those of the other five platforms) formed the basis for the overall Biomass Program review meeting, which was held July 14–15, 2009.

Thermochemical Conversion Platform Information

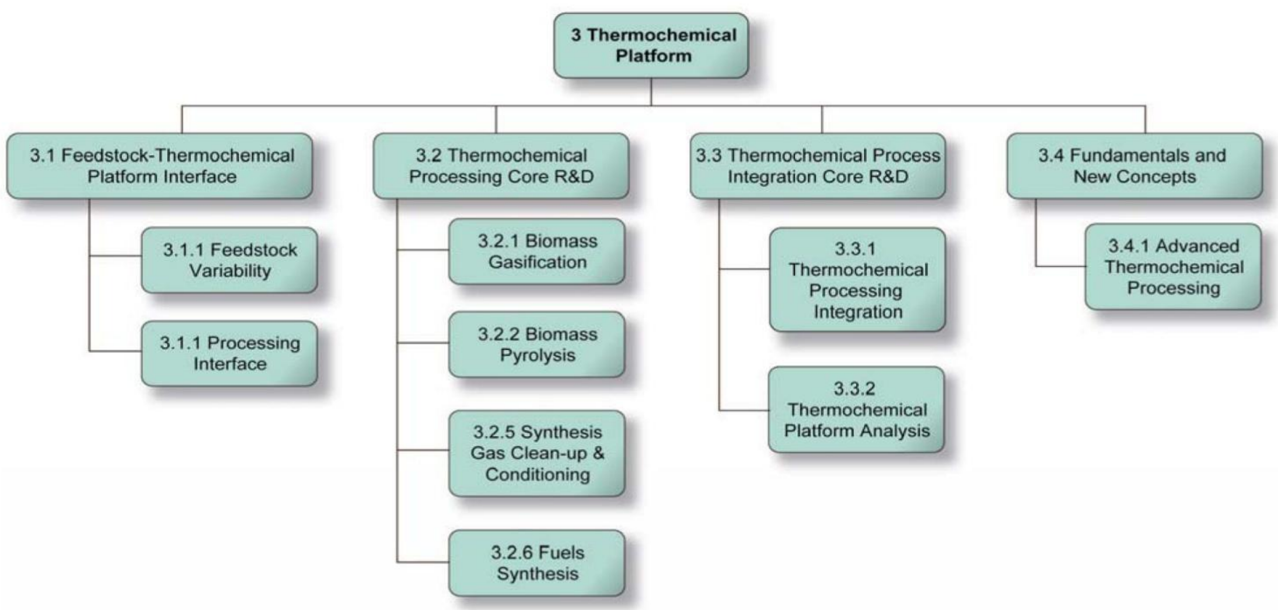
The Thermochemical platform develops technology to convert biomass to fuels, chemicals and power via thermal and chemical processes such as gasification, pyrolysis and other non-biochemical processes. Intermediate products include clean synthesis gas or syngas (a mixture of primarily hydrogen and carbon monoxide, resulting from gasification), bio-oil (a liquid product from pyrolysis), bio-char (a solid product from pyrolysis), and gases rich in methane, ethane, or hydrogen. These intermediate products can then be upgraded to products such as ethanol, other alcohols, renewable gasoline, renewable diesel, renewable jet fuel, ethers, synthetic natural gas, chemical products, or high-purity hydrogen, or may be used directly for heat and power generation. It is important to recognize that some of these products are direct substitutes for fossil-fuel-based intermediates and products and therefore, can likely use portions of the existing fossil fuel processing and distribution infrastructure.

Based on the current stage of development of thermochemical conversion technologies, gasification provides higher potential for near-term deployment, while pyrolysis will be important in meeting longer-term biofuels goals and in providing a route to infrastructure-compatible fuels. The program, therefore, has prioritized gasification R&D in its near-term efforts. Pyrolysis technologies are being evaluated by the program and efforts may increase in the future based on the outcome. Pyrolysis presents the additional benefit of leveraging investments in the petroleum industry since its intermediate product of bio-oil can, after stabilization, be potentially used as a petroleum refinery feedstock.

Thermochemical conversion technology options can maximize biomass resource utilization to produce biofuels because they can more easily convert low-carbohydrate biomass materials such as forest and wood resources than biochemical conversion options. In addition, they can convert the lignin-rich non-fermentable residues from biochemical conversion processes. Advanced conversion technology scenarios rely on considerable yield enhancements achievable by combining the two conversion technologies into an integrated biorefinery; such integration would maximize the liquid fuel yield per ton of biomass and enable higher overall energy efficiencies by allowing integration of high-efficiency heat and power production systems, such as combined cycle gas turbines or fuel cells.

Exhibit 1 summarizes each task element's work as it relates to specific Thermochemical Conversion platform barriers and biorefinery pathways. At the peer review meeting, the platform's R&D portfolio was presented in seven technologies area groupings.

Exhibit 1 – Work Breakdown Structure for Thermochemical Platform Core R&D



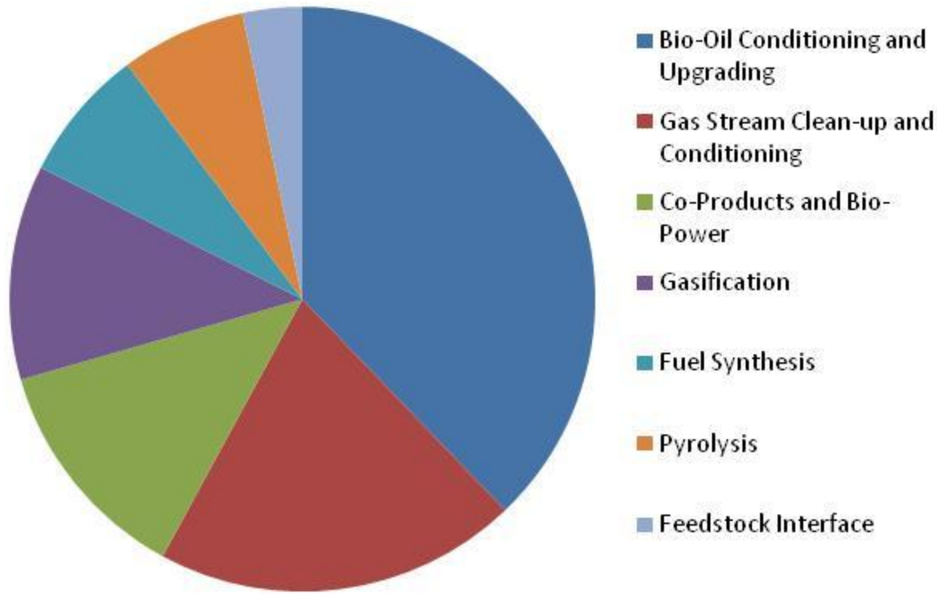
FY08 and FY09 Budgets

The total spend plan allocation to projects in each of the seven technology areas within the Thermochemical platform is given in Exhibits 2 and 3.

Exhibit 2 – Total Spend Plan Allocations, Peer Reviewed Thermochemical Conversion Project Portfolio, FY2008 & 2009

Technology	Total Spend Plan Allocation FY08 & FY09
Bio-Oil Conditioning and Upgrading	$26,642,125
Gas Stream Clean-up and Conditioning	$14,182,718
Co-Products and Bio-Power	$8,907,725
Gasification	$8,343,552
Fuel Synthesis	$5,189,735
Pyrolysis	$4,876,338
Feedstock Interface	$2,325,290
Total	**$70,467,483**

Exhibit 3 – Distribution of Total Spend Plan Allocations, Peer Reviewed Thermochemical Conversion Project Portfolio, FY2008 & 2009



Platform Direction for FY10

In FY 2010, the Thermochemical Conversion platform will continue its RD&D activities with heavy focus on meeting the 2012 ethanol cost targets. This will include activities involving catalyst lifetime studies and improved process integration steps (i.e., syngas clean-up and mixed alcohol catalyst). In FY10, the thermochemical conversion pathway will also begin to transition its activities toward the pursuit of infrastructure-compatible biofuels using gasification and pyrolysis.

Summary from the Review Panel

The Thermochemical Conversion platform was presented to the review panel in eight focus areas: Modeling and Analysis, Feedstock Interface, Fuel Synthesis, Pyrolysis, Gasification, Co-products and Biopower, Gas Stream Clean-up and Conditioning, and Bio-Oil Conditioning and Upgrading. A total of six review panelists were selected to review the project portfolio under Thermochemical platform, while a subset of reviewers – at least three – were assigned to review each project depending on their area of expertise. The review panel evaluated 41 projects at the review meeting and provided written comments and scores to the project PIs and the Thermochemical platform management team. Additionally, the panel evaluated the overall platform management and direction based on the strength and coverage of the quality and nature of the evaluated projects. Detailed platform evaluation is presented in Section II of this report, and individual project evaluations in Section III of this report.

Platform and Project Evaluation Results

The Thermochemical Conversion platform management actively uses the qualitative and quantitative information resulting from the review process to consider the future direction of the platform RD&D activities, and project and platform goals, approach, and targets and milestones. The numerical rating scale used for this review was a whole number scale, where 5=Excellent, 4=Good, 3=Satisfactory, 2=Fair, and 1=Poor.

Overall, the platform activities were evaluated positively. The overall average score given to the platform was a 4.29. The average of the 41-project score was 3.35. Copies of the platform and project evaluation forms can be found in Attachments 1 and 2 at the end of this report.

Platform Evaluation

At the conclusion of the project review, the review panel evaluated the overall platform management on the basis of the four evaluation criteria, listed below.

Platform Evaluation Criteria and Rating System

Goals *– Are platform goals, technical targets and barriers clearly articulated? Are platform goals realistic and logical? Do the platform goals and planned activities support the goals and objectives of the Biomass Program as outlined in the MYPP? How could the platform change to better support the Biomass Program's goals?*

Approach *– How well does the platform approach (platform milestones and organization, RD&D portfolio, strategic direction) facilitate reaching the Program Performance Goals for each platform as outlined in the MYPP? What changes would increase the effectiveness of the platform?*

RD&D Portfolio *– The degree to which the platform RD&D is focused and balanced to achieve Biomass Program and platform goals? (WBS, unit operations, pathway prioritization)*

Progress *– Based on the presentations given, how well is the platform progressing toward achieving Biomass Program and platform goals? Are we meeting our performance targets? Is it on track to meet the goals presented? Please provide recommendations on improvements for tracking progress in the future.*

A summary of the reviewer evaluation scores of the Thermochemical Conversion platform is presented in Exhibit 4. The average score represents an equally weighted average of the four scored platform evaluation criteria. In addition to the platform evaluation scores, an evaluation of the subplatform areas was performed by aggregating individual project scores.

Exhibit 4 – Average Evaluation Scores of the Biomass Program Thermochemical Conversion Platform for Each of the Four Scored Criteria

Evaluation Criteria	Average Score*	StdDev
Platform Goals	4.67	0.52
Platform Approach	4.33	0.52
Platform RD&D Portfolio	4.33	0.52
Platform Progress	3.83	0.75

** Average represents mean of individual reviewer scores. Review panels did not develop consensus scores.*

Please see the detailed responses to each evaluation criteria throughout Section IIB as well as Section IIC for the full summary response.

Project Evaluations

The review panel evaluated individual RD&D projects in eight technology focus areas (Modeling and Analysis, Feedstock Interface, Fuel Synthesis, Pyrolysis, Gasification, Co-products and Biopower, Gas Stream Clean-up and Conditioning, and Bio-Oil Conditioning and Upgrading). This breakdown of work mirrors the platform management for the current review period. Each project was evaluated on both the strength of the work and the relevance of the work to the platform objectives. Five scored evaluation criteria were used, applying the same 1–5 whole-number rating system used for the platform evaluations.

Project Evaluation Criteria

***Relevance** – The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program MYPP. Market application of the expected project outputs has been considered.*

***Approach** – The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.*

***Technical Progress** – The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the Biomass Program MYPP and overcoming technical barriers outlined in the MYPP.*

***Success Factors** – The degree to which the project has identified critical success factors (technical, business, and market factors) that will impact technical and commercial viability of the project and the degree to which the project has identified potential show-stoppers (technical, market, regulatory, legal) that will impact technical and commercial viability.*

***Future Research** – 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,* *or identified other opportunities to build upon current research to further meet Biomass Program goals and objectives.*

The evaluation scores were aggregated at the technology focus area level. Overall, the strength of work of the individual projects was clear—as, on average, the RD&D work in the eight focus areas was evaluated as highly relevant to platform objectives, of sound technical approach, making good technical progress, aware of challenges and success factors, and generally on track for the future. The project presentations are available in PDF format at http://www.obpreview2009.govtools.us/thermochem/. Each project was reviewed by 3–6 reviewers in five scored review criteria. The overall average scores for projects in each technology focus area are given in Exhibit 5.

Exhibit 5 – Review Panel Average Scores* for Thermochemical Conversion Sub-Platform Areas for Each Project Evaluation Criteria

Technology Area	Relevance	Approach	Technical Progress	Success Factors	Future Research	Overall
Bio-Oil Conditioning and Upgrading	4.22	3.57	3.28	3.43	3.55	3.60
Co- Products and Bio-Power	2.12	2.42	2.70	2.22	2.28	2.33
Feedstock Interface	3.77	3.52	3.32	3.35	3.32	3.43
Fuel Synthesis	4.22	3.72	3.36	3.48	3.52	3.66
Gas Stream Clean-Up and Conditioning	4.28	3.86	3.33	3.50	3.57	3.70
Gasification	3.14	3.24	3.26	3.24	3.23	3.23
Modeling and Analysis	4.30	4.00	3.80	3.70	4.20	4.00
Pyrolysis	3.93	3.30	3.30	3.10	3.18	3.35

** Average scores represent the mean of individual reviewer scores. Review panels did not develop consensus scores.*
Detailed explanations of the project evaluation criteria can be found in Section IIIA with the individual project evaluations. The scores presented below are the mean scores of all the projects evaluated in the Thermochemical platform.

Summary Platform Management Response

The platform management team appreciated the comments and recommendations provided by the reviewers through this review process and will consider and utilize this information to shape platform activities in the future.

Platform goals will continue to be evaluated regularly to ensure that the Thermochemical platform responds appropriately to changing feedstock types and availability.

Exhibit 6 lists each project that was presented at the review with a summary of next steps determined by the platform management.

Exhibit 6 – Summary of Evaluation Scores of Projects in the Thermochemical Platform Portfolio

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps: Continue Project	Next Steps: Continue w/ possible adjustments to Scope	Next Steps: Other	Technology Manager Summary Comment
3.6.1.1, 3.6.1.3	Thermochemical Platform Analysis: Gasification and Pyrolysis; NREL, PNNL; Abhijit Dutta	4.0	X			This project provides analytical information that the program will use to monitor progress on thermochemical processes on a quantitative basis.
3.1.2.1, 3.1.2.2, 3.1.2.3	Feed Improvement Task, Feed Processing & Handling Task & Feedstock Interface (combined); INL, NREL, PNNL; Judy Partin	3.2	X			The feedstock interface helps in optimizing the efficiency and control of the subsequent thermochemical conversion process.
3.1.1.1	Evaluation of the Relative Merits of Herbaceous and Woody Crops for Use in Tuneable Thermochemical Processing; Ceres; Bonnie Hames	3.7	X			The project garners information to guide the development of high yield, dedicated energy crops tailored for thermochemical conversion.
3.2.1.1, 3.2.1.3	Gasification Process Modeling and Optimization; NREL, PNNL; Mark Nimlos	3.8	X			This project develops understanding and models to optimize and predict gasifier performance. Uses modern scientific tools: computational modeling, analytical tools (i.e. laser spectroscopy), statistical modeling, microscopy
3.2.1.4	Integrated Biomass Gasification with Catalytic Partial Oxidation (CPO) for Selective Tar Conversion; GE Global Research; Ke Liu	3.9	X			This project develops a novel method for selective tar CPO conversion via a highly reliable and economically effective process for syngas clean-up and is an important barrier for the platform.

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps: Continue Project	Next Steps: Continue w/ possible adjustments to Scope	Next Steps: Other	Technology Manager Summary Comment
7.3.1.1	Southeast Bioenergy Initiative - Auburn University - Systems based Products and Energy; Southeast Bioenergy Initiative; Steven Taylor	2.7			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program, but we will work with the performing organization to consider and address reviewer comments.
3.2.4.2, 3.2.4.6	Catalytic Hydrothermal Gasification; PNNL, Antares group Inc.; Doug Elliott	3.4			X	The projects 3.2.4.6 and 3.2.4.2 are wrapping up.
7.4.1.3	Center for Producer-Owned Energy; Agricultural Utilization Research Institute; Teresa Spaeth	1.7			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program, but we will work with the performing organization to consider and address reviewer comments.
3.2.1.5	Development of New Gasification Processes for Biomass Residues: Gasification Kinetics at Pressurized Conditions; NREL, Georgia Tech Research Corporation; Kristina Lisa	4.0	X			This project strives to obtain experimental data on the rates of carbon gasification and tar formation during pressurized gasification of biomass leading to a kinetic model of the gasification. This addresses an important barrier for the platform.
3.2.2.8	Dual Layer Monolith ATR of Pyrolysis Oil for Distributed Synthesis Gas Production; Stevens Institute of Technology; Adeniyi Lawal	3.1	X			The project will demonstrate dual layer monolith reactor technology for distributed production of H_2/CO-rich synthesis gas via autothermal reforming of pyrolysis oil with the possibility of improved heat management and syngas quality.

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps			Technology Manager Summary Comment
			Continue Project	Continue w/ possible adjustments to Scope	Other	
3.2.5.6, 3.2.5.8	Catalyst Fundamentals Integration; NREL, PNNL; Kim Magrini	4.2	X			This project will develop and understand catalyst and sorbent performance to clean/condition biomass-derived syngas through rational materials design for use at laboratory through pilot scales. This is a project that enables the platform a deeper understanding of entities with catalytic/absorbent surfaces.
3.2.5.7	Integrated Gasification and Fuel Synthesis; NREL, Calvin Feik	4.1	X			Demonstrates integrated production of cost-competitive ethanol from mixed alcohols produced from biomass derived syngas at pilot scale.
7.7.4.2	Agricultural Mixed Waste Biorefinery Using the Thermo-Depolymerization (TDP) Technology; Gas Technology Institute; Larry Felix	3.3			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program, but we will work with the performing organization to consider and address reviewer comments.
3.2.5.5	Engineering New Catalysts for In-Process Elimination of Tars; Gas Technology Institute; Larry Felix	4.0	X			This project will demonstrate integrated production of cost-competitive ethanol from mixed alcohols produced from biomass-derived syngas at pilot scale.
3.2.5.3	Biomass Gas Cleanup Using a Therminator; Research Triangle Institute; David Dayton	3.9	X			This project will develop advanced integrated system designs for clean gas production using membranes and circulating beds of catalyst/adsorbent.

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps: Continue Project	Next Steps: Continue w/ possible adjustments to Scope	Next Steps: Other	Technology Manager Summary Comment
3.2.5.12	Validation of the RTI Therminator Syngas Cleanup Technology in an Integrated Biomass Gasification/Fuel Synthesis Process; Research Triangle Institute; David Dayton	4.1	X			This project will validate integrated biomass gasification, syngas cleanup and conditioning and catalytic fuel synthesis to be demonstrated for 500 hours (at least 100 hours continuous).
3.2.5.9	Novel Approach for Biomass Syngas Cleaning and Conditioning for Liquid Fuel Synthesis Applications; Emery Energy; Ben Phillips	3.5	X			This project will validate the capability of a novel tar reformer to effectively reform tar and oil species into additional usable syngas constituents (H_2 and CO). Subsequently, it will identify overall system integration opportunities from gasifier feeding to final liquid products for scale up design.
3.2.5.10	Biomass Synthesis Gas to Liquid Fuels Evaluation; Gas Technology Institute; Dennis Leppin	2.6			X	This project would validate syngas (from wood gasification at a scale equiv. to min. 20 kg/hr wood) cleanup processing for 100 continuous and 300 total hours to stringent specifications suitable for Fischer-Tropsch (FT). This project is not continuing due missing the phase I stage review work targets while consuming the budget.

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps			Technology Manager Summary Comment
			Continue Project	Continue w/ possible adjustments to Scope	Other	
3.2.5.1 1	Syngas to Synfuels Process Development Unit; Iowa State University; Robert Brown	3.5	X			This project will test an integrated biomass to liquids system that uses gas cleaning through oil scrubbing rather than water scrubbing in order to minimize waste water treatment. The gas-oil scrubbing liquid will then be sent to a coker in existing petroleum refining operations to be used as a feedstock.
3.2.5.1 3	Pilot-Scale Demonstration of a Fully Integrated Commercial Processes for Converting Woody Biomass into Clean Biomass Diesel Fuel; Southern Research Institute; Steven Piccot	3.6	X			This project will develop and operate syngas cleaning system with TRI Unit and subsequently integrate this first step with a commercial FT diesel line.
3.3.2.7, 3.3.2.8	Fuel Synthesis Catalyst - CRADA with DOW; NREL, PNNL; Tom Foust	4.0	X			This project will develop and demonstrate a Mixed Alcohol Synthesis (MAS) Catalyst that achieves the 2012 performance targets for cost-competitive mixed alcohol production.
3.3.2.1, 3.2.2.2	Syngas Quality for Mixed Alcohols; PNNL, NREL; Jim White	4.2	X			This project will improve the performance of mixed alcohol catalysts (productivity and selectivity) to meet or exceed DOE cost targets.
3.3.2.6	Catalytic Production of Ethanol from Biomass-Derived Synthesis Gas; Iowa State University; Victor Lin	3.4	X			This project will work to produce liquid fuels, such as ethanol and other high-energy content alcohols from biomass via pyrolysis of biomass and subsequent gasification of bio oil and fuel synthesis.

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps			Technology Manager Summary Comment
			Continue Project	Continue w/ possible adjustments to Scope	Other	
3.3.2.5	Thermochemical Conversion of Corn Stover; Bioengineering Resources, Inc.; James Gaddy	3.7	X			This project will develop an economical gasification/fermentation process to produce ethanol from corn stover. Initially, corn stover will be gasified and the syngas subsequently fermented to ethanol.
7.7.4.8	Mississippi State University Sustainable Energy Center – Syngas to Fuels Projects; Mississippi State University; Mark White	3.0			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program, but we will work with the performing organization to consider and address reviewer comments.
3.2.2.1 0	Fast Pyrolysis Oil Stabilization: An Integrated Catalytic and Membrane Approach for Improved Bio-oils; University of Massachusetts at Amherst; George Huber	3.5	X			This project will develop innovative catalytic and membrane technologies to stabilize bio-oils. Furthermore it will research the fundamental causes of bio-oil instability.
3.2.2.4, 3.2.2.5	Pyrolysis Oil R&D; PNNL, NREL; Doug Elliott	4.2	X			This project will develop the basic science and engineering for production of liquid fuels needed for fast pyrolysis of biomass through improved pyrolysis methods and upgrading of bio-oils and the development of standards for bio-oil applications.
3.2.2.6	Hydrothermal Liquefaction of Agricultural and Biorefinery Residues; Archer Daniels Midland, PNNL; Scott MacDonald	3.3			X	This project is finishing up and has made progress toward hydrothermal processing of biomass to liquid fuels. Progress was made with regard to expanded process development to enable application of the technology to industrial-scale demonstration.

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps: Continue Project	Next Steps: Continue w/ possible adjustments to Scope	Next Steps: Other	Technology Manager Summary Comment
3.2.2.7	A Low-cost High-yield Process for the Direct Production of High Energy Density Liquid Fuel from Biomass; Purdue University; Rakesh Agrawal	2.3	X			This project develops a low-cost process for high yield of liquid hydrocarbon fuels from biomass via fast hydropyrolysis and hydrodeoxygenation enabled by the synergistic use of solar H_2 with biomass.
7.4.5.8	Vermont BioFuels Initiative; Vermont Sustainable Jobs Fund, Inc.; Ellen Kahler	2.0			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program, but we will work with the performing organization to consider and address reviewer comments.
3.2.2.11	Stabilization of Fast Pyrolysis Oils; UOP; Tim Brandvold	3.9	X			This project will develop an innovative system solution (combination of technologies) for the stabilization of biomass pyrolysis oil, a high-performance, commercializable system design suitable for distributed or stand-alone operation.
3.2.2.9	Catalytic Deoxygenation of Biomass Pyrolysis Vapors to Improve Bio-Oil Stability; Research Triangle Institute; David Dayton	3.7	X			This project will develop and utilize catalysts to improve the properties of bio-oil or upgrade it into a more useful intermediate. The intermediate will have more desirable physical and chemical properties to facilitate upgrading to liquid transportation fuels in existing petroleum refineries or in stand-alone, centralized upgrading facilities.
3.2.2.13	A Systems Approach to Bio-Oil Stabilization; Iowa State University; Robert Brown	3.9	X			This project will develop practical cost-effective methods for stabilizing biomass-derived fast pyrolysis oil for a minimum of six months of storage under ambient conditions.

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps			Technology Manager Summary Comment
			Continue Project	Continue w/ possible adjustments to Scope	Other	
3.2.2.1, 3.2.2.2	Pyrolysis Oil to Gasoline (PNNL, NREL CRADA with UOP); UOP, NREL, PNNL; Richard Marinangelli	4.2	X			The objective of this project is to upgrade biomass pyrolysis oils (bio-oil) to petroleum refinery feedstock in a cost-effective manner. This project is targeted to be completed in or before June 2010.
7.7.4.8	Mississippi State University Sustainable Energy Center – Bio-oils; Mississippi State University; Philip Steele	3.0			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program, but we will work with the performing organization to consider and address reviewer comments.
7.3.4.1	University of Oklahoma Biofuels Refining; University of Oklahoma; Lance Lobban	2.9			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program
7.3.2.4	Bio-Renewable Ethanol and Co-Generation Plant, Biomass; Raceland Raw Sugar Corporation; Neville Dolan	3.0			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program
7.3.2.5	Plasma Gasification Waste-to-Energy Project; Koochiching County; John Howard	2.3			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program
7.4.3.1 1	SUNY Cobleskill Bio-Waste to Bio-Energy Project; SUNY Cobleskill – The Research Foundation; Doug Goodale	1.8			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program

WBS #	Project Title; Presenting Organ ization; PI Name	Final Average Score*	Next Steps			Technology Manager Summary Comment
			Continue Project	Continue w/ possible adjustments to Scope	Other	
7.3.6.2	Alternative Fuel Source Study - An Energy Efficient and Environmentally-Friendly Approach for Research on Alternative Fuels for Cement Processing; Auburn University; Steve Duke	2.5			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program
7.3.2.3	University of Kentucky Biofuels Research Laboratory; University of Kentucky; Mark Crocker	2.4			X	This is a congressionally directed project. The tasks associated with this project are not defined by the program

* *Average represents mean of individual reviewer scores. Review panels did not develop consensus scores.*

Each project is identified by a unique code (WBS Number), as well as the project title, presenting organization, and PI name. Projects are listed in the chronological order by which they presented at the review meeting. The average overall score is the mean of the five evaluation criteria scores. The Next Steps column is a summary of the management response to the evaluation.

I. Introduction

On April 8–10, 2009, the U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Biomass Program held a peer review of its Thermochemical Conversion platform. The platform review was part of the overall 2009 program peer review implemented by the Biomass Program. The peer review is a biennial requirement for all EERE programs to ensure:

> *"A rigorous, formal, and documented evaluation process using objective criteria and qualified and independent reviewers to make a judgment of the technical/scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects."*

The results of the peer review are used by Biomass Program Technology Managers in the generation of future work plans and in the development of Annual Operating Plans, Multiyear Program Plans (MYPPs), and potentially in the redirection of individual projects.

Paul Grabowski, the Thermochemical Platform Technology Manager, was the lead for the Thermochemical Platform Peer Review Process. He was responsible for all aspects of the planning and implementation including coordinating the review panel, coordinating with principal investigators, and overall planning for the platform review.

Approximately 210 people attended the Conversion platform review meeting, which included separate breakouts for the Thermochemical and Biochemical Conversion platform reviews. The project and platform review forms that were used to collect information from the reviewers are presented in Attachments 1 and 2 of this report. An agenda for the meeting is provided in Attachment 3. A list of attendees is provided in Attachment 4. Presentations given during each of the platform review meetings as well as other background information are posted on the registration website at www.obpreview2009.govtools.us.

The remainder of this section provides a brief description of the implementation process for the platform review meetings, identifies the Thermochemical platform review panel, and describes the role of the steering committee appointed.

A. Biomass Program Peer Review Process

The 2009 Biomass Program peer review process consisted first of a series of six platform peer review meetings followed by the overall program review meeting. The six platforms that were peer reviewed matched the manner in which the Biomass Program organizes its research and analysis activities. The platforms are Integrated Biorefinery, Infrastructure, Analysis, Feedstocks and Sustainability, Biochemical Conversion, and Thermochemical Conversion. The platform review meetings were held during the February–April timeframe.

The six platform review meetings consisted of technical project-level reviews of the research projects funded in each of the six Biomass technology platform areas. The overall structure and direction of the platform was also reviewed. A separate review panel and review panel chair were formed for each platform review. Review panels were comprised of independent, external technical reviewers with subject matter expertise related to the platform being reviewed.

The overall program review was held in July 2009 following each of the six platform reviews. During the program peer review, an independent external panel evaluated the strategic organization and direction of the Biomass Program, using the results of the platform reviews and presentations from each of the platform review chairs as input. The panel for the Biomass Program review consisted of a steering committee formed to provide overall oversight of the program peer review process. The program review panel also included the chair from each platform review panel.

This report represents the results of the Thermochemical Conversion platform review and evaluation of the platform and the individual projects in its research portfolio. A separate program review report has been prepared for each platform review and the program review meeting. The program review report may also include additional comments related to the Thermochemical Conversion platform.

The Biomass Program followed guidelines provided in the EERE *Peer Review Guide* in the design and implementation of the platform reviews and program peer review. An outside steering committee was established to provide recommendations and help ensure an independent and transparent review process. A description of the general steps implemented in each of the program peer review process is provided in Exhibit 8.

Neil Rossmeissl of the Biomass Program was assigned by the Biomass Program Manager as the peer review leader. Mr. Rossmeissl managed all aspects of planning and implementation. He was supported by a planning team comprised of staff from the Biomass Program, DOE Golden Office, National Renewable Energy Laboratory (NREL) Systems Integrator and contractor support. BCS, Incorporated was the lead contractor responsible for organizing each of the peer review. The team held weekly planning meetings beginning September 2008 to outline the review procedures and processes, to plan each of the individual platform reviews and subsequent program review and to ensure that the process followed EERE peer review guidance.

B. Thermochemical Conversion Platform Review Panel

Each platform portfolio was reviewed by a review panel of experts from outside the program. The purpose of the review panel is to provide an objective, unbiased and independent review of the individual research, development, and deployment (RD&D) or analysis projects as well as the overall structure and direction of the platform. One member from each review panel also served as the panel chairperson and was responsible for coordinating review panel activities—ensuring independence of the panel, overseeing the production of the platform review report, and representing the panel at the program peer review in July.

In forming its review panel, the Thermochemical Conversion platform evaluated 16 candidates. Candidates were evaluated based on their subject matter knowledge in the technology platform area, willingness to commit the time and energy needed to serve on the panel, and lack of a conflict of interest (COI), as represented by receipt of their COI form. An outside, objective steering committee—established to help ensure the independence and transparency of the overall peer review process—reviewed available biographies for review panel candidates during the planning process and provided feedback. Platform review planning teams considered the steering committee feedback in making final decisions on its review panel. Exhibit 7 lists review panel members for the Thermochemical platform. Per steering committee guidance, at least three of the Thermochemical Conversion platform reviewers were assigned to review each project. Reviewer assignments were based on reviewer expertise and to avoid conflict of interest.

Exhibit 7 – Thermochemical Conversion Review Panel

Name	Affiliation/ Title	Expertise
Mark Jones*	Dow Chemical	Fuel Synthesis, Product Development, Commercialization
John McDermott	General Electric	Gasification, Technical Commercialization
Charles Kinoshita	University of Hawaii	Bioremediation, Heat and Mass Transport
Robert Fireovid	USDA	Feedstocks, Gasification
Curtis Krause	Chevron	Gasification, Fuel Synthesis
Craig Brown	Weyerhauser	Gasification, Syngas Cleanup

**Review Chair*

Exhibit 8 – Basic Steps in Implementing the Biomass Program Peer Review

1. The program's RD&D and Analysis project portfolio was organized by the six platform areas.

2. A lead was designated for each platform review. The platform review lead was responsible for all aspects of planning and implementation including coordinating the review panel, coordinating with principal investigators, and overall planning for the platform review.

3. Each platform identified projects for review. Target: review at least 80% of program budget.

4. A steering committee of external, independent experts was formed to provide recommendations for designing and implementing the review and the scope, criteria and content of the evaluation.

5. Draft project-level, platform-level and program-level evaluation forms were developed for the 2009 platform review meetings. Similarly, a draft presentation template and instructions were developed. EERE *Peer Review Guidelines* and previous forms were evaluated in developing the drafts. Separate forms were used for RD&D and Analysis projects. The forms were reviewed and modified by the steering committee before being finalized.

6. Each platform lead identified candidate members for the platform review panel. The peer review lead requested steering committee feedback of candidate reviewers. Biographies that were available were provided to the steering committee for review. Committee provided *Yes/No* recommendations on candidates and recommended other candidates for the platforms to consider. Results were provided to platform leads for consideration in final selection of review panels.

7. Upon confirmation, each review panel member was provided background information on the review, instructions, evaluation forms, presentation templates and other information needed to perform his or her duties. Project lists and COI forms were provided to each reviewer in advance of the review meeting and COI forms were collected. At least one conference call was held for each review panel to provide instructions, discuss panel member responsibilities and to address any questions. To the extent possible, steering committee members participated in those calls.

8. The Biomass Program performed outreach to encourage participation in each of its platform review meetings by sending announcements to over 3,000 program stakeholders, principal investigators, and attendees at previous program events. The program reviews were also announced on the Biomass Program Web site.

9. Platforms invited PIs to present their projects at the platform review. PIs were provided with presentation templates and instructions, reviewer evaluation forms, and background information on the review process. Follow-up calls were held with PIs to address questions. If PIs chose not to present they were requested to submit a form stating such.

10. Platform review meetings were held according to guidelines developed by the peer review lead and planning team, platform lead, and steering committee. Members of the steering committee participated in each review to ensure consistency and adherence to guidelines.

11. Review panel evaluations were collected during each platform review meeting using an automated tool. These evaluations were posted to a password-protected Web site following each review and review panelists were provided approximately 10 working days to update and edit their comments. PIs were then provided approximately 10 working days to go to the same password-protected Web site and see comments on their projects. PIs were given the opportunity to respond to review panel evaluations.

12. Results of review panel evaluations and PI responses were provided to each platform review lead for overall evaluation and response. The compilation of these inputs was then used to develop this report.

C. Organization of This Report

The remainder of this document provides the results of the Thermochemical Conversion platform review meeting, including the following:

- Results of review panel comments on the overall Thermochemical Conversion platform
- Results of review panel comments on projects evaluated during the platform review and Principal Invetigator (PI) responses to reviewer evaluations for their projects
- The Biomass Program Thermochemical Conversion platform Technology Manager response to review panel comments and discussion of next steps for each project

II. Platform Overview and Evaluation Results

A. Platform Overview

i. Platform Goals and Objectives

The Thermochemical Conversion platform develops technology to convert biomass to fuels, chemicals and power via thermal and chemical processes such as gasification, pyrolysis and other nonbiochemical processes. Intermediate products include clean synthesis gas or syngas (a mixture of primarily hydrogen and carbon monoxide, resulting from gasification), bio-oil (liquid product from pyrolysis), and gases rich in methane or hydrogen. These intermediate products can then be upgraded to products such as ethanol, other alcohols, green-gasoline, green-diesel, ethers, synthetic natural gas, chemical products, high-purity hydrogen, or they may be used directly for heat and power generation. It is important to recognize that some of these products are direct substitutes for fossil-fuel-based intermediates and products and therefore, can likely use portions of the existing fossil fuel processing and distribution infrastructure.

Based on the current stage of development of thermochemical conversion technologies, gasification provides higher potential for near-term deployment, while pyrolysis will be important in meeting longer-term biofuels goals. The Program prioritizes gasification R&D in its near-term efforts. Pyrolysis technologies are being evaluated by the Program and efforts may increase in the future. Pyrolysis presents the additional benefit of leveraging investments in the petroleum industry since its intermediate product of bio-oil can be potentially used as a petroleum refinery feedstock once it is stabilized. Thermochemical conversion technology options can maximize biomass resource utilization to produce biofuels because they can more easily convert low-carbohydrate biomass materials such as forest and wood resources than biochemical conversion options. In addition, they can convert the lignin-rich non-fermentable residues from biochemical conversion processes. Advanced conversion technology scenarios rely on considerable yield enhancements achievable by combining the two conversion technologies into an integrated biorefinery; such integration would maximize the liquid fuel yield per ton of biomass and enable higher overall energy efficiencies by allowing integration of high-efficiency heat and power production systems, such as combined cycle gas turbines or fuel cells.

The Thermochemical platform's strategic goal is to develop technologies for converting feedstocks into cost-competitive commodity liquid fuels, such as ethanol, as well as bioproducts and biopower.

The Thermochemical platform directly addresses and supports production of fuels in the Agricultural Residues Processing, Energy Crops Processing, and Forest Resources Processing pathways. It also indirectly supports the production of bioproducts from these pathways. Thermochemical conversion technologies provide options for improving the economic viability of the developing bioenergy industry by their ability to convert whole biomass as well as the fractions of the biomass resources that are not amenable to biochemical conversion technologies (e.g. lignin-rich process residues and other low-carbohydrate feedstocks or process intermediates).

ii. Platform Work Breakdown and Major Milestones:

The overall performance goal of the Thermochemical platform is to reduce the estimated mature technology processing cost for converting cellulosic feedstocks to ethanol to $0.82 per gallon by 2012 and $0.60 per gallon by 2017 (2007$s) based on integrated pilot-scale data. The overall performance goal is the same for the pyrolysis route based on the energy output. The performance goals for the pathways under investigation are as follows:

Agricultural Residues Pathway:

- By 2009 (Q4), validate integrated gasification of lignin derived from corn stover and wheat straw to produce clean syngas at pilot scale.
- By 2010 (Q4), validate integrated gasification of corn stover and wheat straw to produce clean syngas at pilot scale.
- By 2012, validate integrated production of ethanol from mixed alcohols produced from corn-stover- and wheat-straw-based (lignin or biomass) syngas at pilot scale.
- By 2015, validate integrated production of biomass to gasoline and diesel via pyrolysis routes at pilot scale.

Energy Crops Pathway:

- By 2009 (Q4), validate integrated gasification of hybrid poplar- and switchgrass-derived lignin to produce clean syngas at pilot scale
- By 2010 (Q4), validate integrated gasification of hybrid poplar and switchgrass to produce clean syngas at pilot scale
- By 2012, validate integrated production of ethanol from mixed alcohols produced from hybrid poplar- and switchgrass-based (lignin or biomass) syngas at pilot scale
- By 2012, validate integrated production of biomass to gasoline and diesel via pyrolysis routes at pilot plant scale for woody biomass.

Thermochemical Platform Unit Operations

Gasification Process

Feed Processing and Handling: The feedstock interface addresses the main biomass properties that affect the long-term technical and economic success of a thermochemical conversion process: moisture content, fixed carbon and volatiles content, impurity concentrations, and ash content. High moisture and ash content reduce the usable fraction of delivered biomass. Therefore, maximum gasification system efficiencies are possible with dry, low-ash biomass; however, effective technologies for conversion of wet residues are also possible.

Gasification: Biomass gasification is a complex thermochemical process that begins with the thermal decomposition of a lignocellulosic fuel. This is followed by partial oxidation or reforming of the fuel with a gasifying agent—usually air, oxygen, or steam—to yield raw syngas. The raw gas composition and quality are dependent on a range of factors, including feedstock composition, feedstock water content, type of gasification reactor, gasification agents, stoichiometry, temperature, pressure, and the presence or lack of catalysts.

Gas Cleanup: Gas cleanup is the removal of contaminants from biomass gasification product gas. It generally involves an integrated multi-step approach which varies depending on the intended end use of the product gas. However, gas cleanup normally entails removing or reforming tars and acid gas, ammonia scrubbing, capturing alkali metal, and removing particulates.

Gas Conditioning: Typical gas conditioning steps include sulfur polishing (to reduce levels of hydrogen sulfide to acceptable amounts for fuel synthesis) and water-gas shift (to adjust the final hydrogen-carbon monoxide ratio for optimized fuel synthesis).

Fuel Synthesis: Comprehensive cleanup and conditioning of the raw biomass gasification product gas yields a ―clean” syngas composed of carbon monoxide and hydrogen in a given ratio. This gas can be converted to mixed alcohols or Fischer-Tropsch hydrocarbons. The production of fungible liquid transportation fuels from these intermediates also yields value-added bio-based byproducts and chemicals. The fuel synthesis step is exothermic, so heat recovery is essential to maximize process efficiency.

Pyrolysis Process

Feed Processing and Handling: Similar to gasification, the feedstock interface for pyrolysis addresses the main biomass properties that affect the long-term technical and economic success of a thermochemical conversion process: moisture content, elemental composition, impurity concentrations, and ash content. High moisture and ash content reduce the usable fraction of delivered biomass. So-called ―fast” pyrolysis processes require dry feedstocks, while hydrothermal approaches can use moist biomass.

Pyrolysis: Pyrolysis is the thermal decomposition of biomass in the absence of oxygen to produce a bio-oil intermediate that superficially resembles No. 4 fuel oil. These reactions occur at lower reaction temperatures than gasification and produce primarily liquid products instead of gases. Several types of fast pyrolysis or hydrothermal processes can be used to produce the bio-oil, and its characteristics such as oxygen content or viscosity depend on the processing conditions.

Bio-Oil Cleanup and Stabilization: Cleanup and conditioning of the bio-oil converts it into a product suitable for feeding to a petroleum refinery. Cleanup consists of removing water, particulates, and ash by filtration and similar methods. Stabilization involves hydrotreating and similar thermal processing to reduce the total oxygen content of the intermediate and its acid number.

Fuel Processing: The cleaning and stabilization of the bio-oil yields a feedstock suitable for use in a petroleum refinery. Hydrocracking processes convert the feedstock to gasoline and diesel hydrocarbon fuels using marginally modified technologies employed by existing refiners. This processing leverages the economies of scale and the investments of the petroleum industry and provides biofuel alternatives to ethanol.

Thermochemical Platform Interfaces

Feedstock Logistics Interface: The Feedstock Logistics platform provides preprocessed feedstock that meets the requirements (composition, quality, size, etc.) as defined by the specific biochemical conversion process configuration. Close coordination between the Feedstock Logistics and Thermochemical Conversion platforms is required to supply adequate feedstock in an appropriate form to the biorefinery.

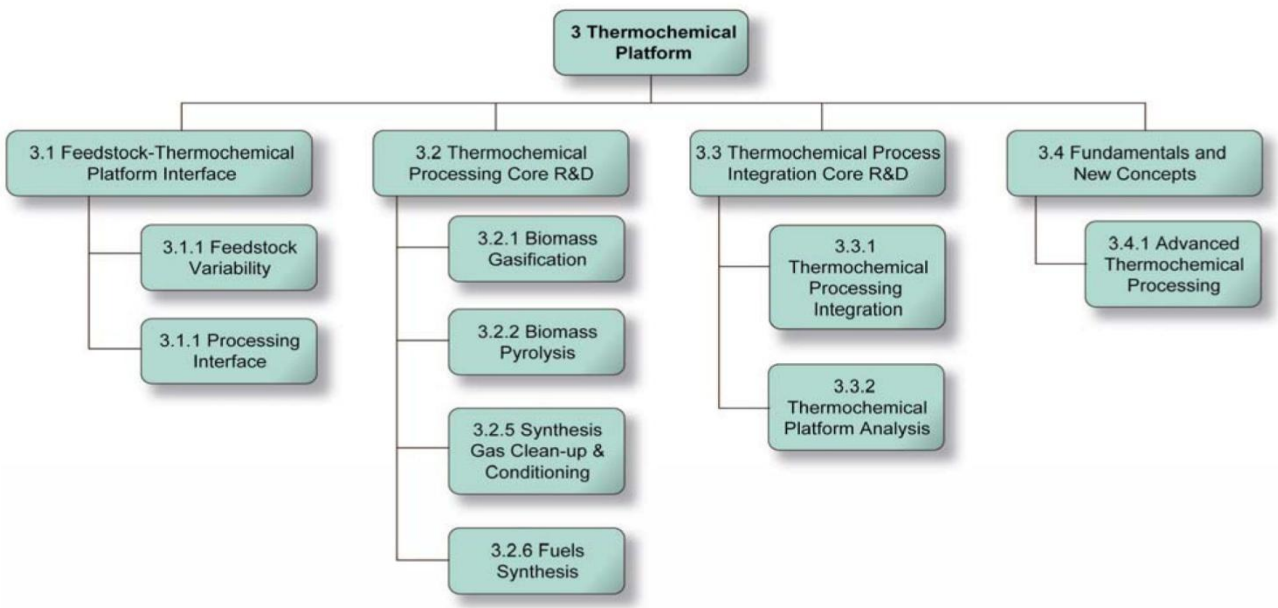
Biochemical Conversion Process Interface: Lignin and other byproducts/residues of the biochemical conversion process can be used to produce the electricity required for the production process. Lignin can also be thermochemically converted to fuels and chemicals.

Biofuels Distribution Interface: The next step in the biomass-to-biofuels supply chain is the distribution of the biofuels produced.

Thermochemical Platform Work Breakdown Structure

The approach for overcoming biomass thermochemical conversion technical challenges and barriers is outlined in the Thermochemical platform's work breakdown structure (WBS). The platform WBS is organized around four key tasks, as shown in Exhibit 3. The current efforts are focused on gasification of woody biomass, low-quality agricultural residues, and lignin-rich biorefinery residues. These R&D activities include fundamental kinetic measurements, micro-activity catalyst testing, bench-scale thermochemical conversion studies, pilot-scale validation of tar-reforming catalyst performance, mixed alcohol catalyst development, and pilot-scale demonstration of integrated biomass gasification mixed alcohol synthesis. A lower level of effort is directed at pyrolysis of similar feedstocks including basic studies of catalytic and chemical mechanisms for improving yields and quality of bio-oils and catalysis for stabilizing the intermediate. Core research, which addresses the key technical barriers, is performed by national laboratories, industry, and universities. The R&D approach of each Thermochemical WBS task element is described below in Exhibit 9.

Exhibit 9 – Work Breakdown Structure for Thermochemical Platform Core R&D



WBS 3.1. Feedstock-Thermochemical Platform Interface

For biorefineries, it is important that feedstock requirements be met while preparation requirements are minimized to reduce costs. This requires balancing the cost of plant-gate feedstock with the handling and processing required for reliable operation. The Thermochemical platform is collaborating with the Feedstock platform to overcome the challenges and barriers associated with the interface between feedstock logistics and thermochemical conversion systems. Research activities are also focused on handling, processing, and feeding that occurs within the biorefinery plant boundaries.

WBS 3.2. Thermochemical Processing Core R&D

In order to fully realize the benefits of an integrated biorefinery, robust and cost-effective biomass thermal conversion processes are under development that can convert a variety of biomass materials to suitable clean intermediates for subsequent conversion to fuels. Activities are focused on developing cost-effective thermochemical conversion technologies that can produce clean syngas, stable pyrolysis oils and downstream fuels and/or products synthesis catalysts.

WBS 3.3 Thermochemical Processing Integration Core R&D

Investigating thermochemical conversion technologies together with downstream fuel synthesis identifies the issues and opportunities of integration. In addition, the effect of feed and process variations throughout the process must be understood to ensure robust, efficient biorefineries. One immediate goal is to demonstrate that the improved tar cracking and reforming catalysts have the potential to consolidate high-temperature chemical transformations, thereby increasing thermodynamic efficiency as well as reducing the cost and risk of gasification-based process technology. Fundamental research is focused on developing advanced consolidated processes that maximize the conversion of biomass to fuels by optimizing biomass deconstruction into pretreated/preconditioned fractions to maximize yields of highly selective thermal transformations. Process intensification and consolidation drive the economics that significantly reduce capital and operating costs to minimize production costs.

WBS 3.4 Fundamentals and New Concepts

A fundamental understanding of the factors controlling thermochemical conversion is needed to be able to develop new or improved technologies that increase efficiency and reduce cost. As feedstock prices increase due to supply and demand, decreased conversion costs will allow the industry to utilize the higher priced feedstocks.

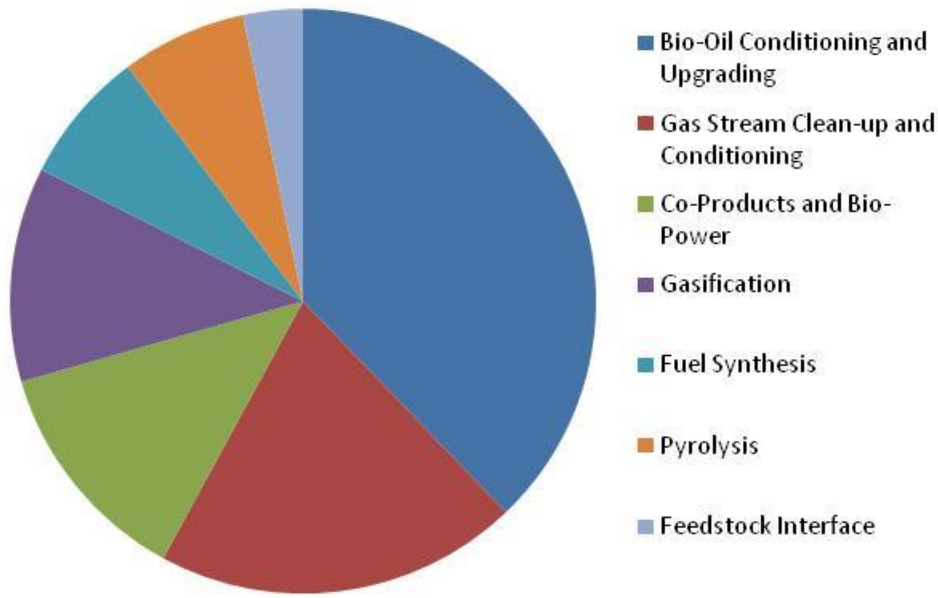
iii. FY08 and FY09 Budget by Technology Area

The Thermochemical platform R&D portfolio was presented in seven Technology Area groupings. The total spend plan allocation of projects in each area is given in Exhibits 10 and 11.

Exhibit 10 – Total Spend Plan Allocations by Technology Area, Peer Reviewed Thermochemical Conversion Project Portfolio, FY2008 & 2009

Technology	Total Spend Plan Allocation FY08 & FY09
Bio-Oil Conditioning and Upgrading	$26,642,125
Gas Stream Clean-up and Conditioning	$14,182,718
Co-Products and Bio-Power	$8,907,725
Gasification	$8,343,552
Fuel Synthesis	$5,189,735
Pyrolysis	$4,876,338
Feedstock Interface	$2,325,290
Total	**$70,467,483**

Exhibit 11 – Distribution of Total Spend Plan Allocations by Technology Area, Peer Reviewed Thermochemical Conversion Project Portfolio, FY2008 & 2009



iv. Platform Direction for FY10

In FY 2010, the Thermochemical Conversion Platform will continue its research and development activities with heavy focus on meeting the 2012 ethanol cost targets. This will include activities involving catalyst lifetime studies and improved process integration steps (i.e., syngas clean-up and mixed alcohol catalyst). In FY 2010, the thermochemical conversion pathway will also begin to transition its activities toward the pursuit of infrastructure-compatible biofuels using gasification and pyrolysis.

B. Results of 2009 Thermochemical Conversion Platform Evaluation

The review panel evaluated the platform on criteria such as goals, approach, RD&D portfolio, and progress, and also provided comments on the strengths and weaknesses of each. The following are questions posed to each of the reviewers followed by average scores, reviewer comments, and the Thermochemical Conversion platform Technology Manager responses to those comments. The scores on six independent evaluations of the Thermochemical Conversion platform as a whole are summarized in Exhibit 12. In addition to the numerical scores, each reviewer provided written comments, which have been reproduced below, followed by verbatim results of the review panel evaluation of the Thermochemical Conversion platform.

Exhibit 12 – Average Reviewer Platform Evaluation Scores

Evaluation Criteria	Average Score	Standard Deviation
Goals - Are platform goals, technical targets and barriers clearly articulated? Are platform goals realistic and logical? Do the platform goals and planned activities support the goals and objectives of the Biomass Program as outlined in the MYPP? How could the platform change to better support the Biomass Program's goals?	4.67	0.52
Approach - How well does the platform approach (platform milestones and organization, RD&D portfolio, strategic direction) facilitate reaching the Program Performance Goals for each platform as outlined in the MYPP? What changes would increase the effectiveness of the Platform?	4.33	0.52
RD&D Portfolio - The degree to which the Platform RD&D is focused and balanced to achieve Biomass Program and Platform goals? (WBS, unit operations, pathway prioritization)	4.33	0.52
Progress - Based on the presentations given, how well is the platform progressing towards achieving Biomass Program and Platform goals? Are we meeting our performance targets? Is it on track to meet the goals presented? Please provide recommendations on improvements for tracking progress in the future.	3.83	0.75

Rating System: 5=Excellent; 4=Good; 3=Satisfactory; 2=Fair; 1=Poor

The following sections provide the full written comments of the review panelists for each of the five evaluation criteria.

i. Platform Goals

Are platform goals, technical targets and barriers clearly articulated? Are platform goals realistic and logical? Do the platform goals and planned activities support the goals and objectives of the Biomass Program as outlined in the MYPP? How could the platform change to better support the Biomass Program's goals?

Exhibit 13 – Platform Goals: Strengths and Weaknesses

Strengths	Weaknesses
Platform goals and objectives are well articulated and understandable to this reviewer. Attainment of the platform goals will significantly advance the state of the art for biomass to fuel conversion.	The economic goals are very aggressive, but that is not necessarily a negative.
I believe that the Thermochemical Conversion platform has the best chance of producing fuels efficiently from biomass while being completely agnostic to the source and characteristics of that biomass. It is, therefore, the most important platform within the OBP. Its goals are completely aligned within the MYPP. The changes made over the last two years have widened the scope of research to include fuels other than ethanol, correcting a major deficiency in the program. Continued refinement of the portfolio appears to be happening, and projects have now been placed on the threshold of commercial deployment. I believe that the platform must develop clear guidelines for graduation of projects and thrust areas. Programs can matriculate into commercial opportunities or can be replaced by better options.	
	Technical and cost targets need to be developed for pyrolysis as has been done for gasification (Table B-5 in the MYPP). These targets should be developed for other technologies (hydrothermal, densification/ torrefication, etc.) as projects in these areas become of interest to the thermochem platform.
The TC platform goals, targets and barriers are clearly articulated; the TC Platform goal is concise and logical.	Though probably falling on deaf ears, this reviewer feels that the cost targets in the TC platform goal are unrealistic. The goals mention only the biofuels ethanol and pyrolysis products; perhaps it is time to expand those products.

Technology Manager Response

In general, the Thermochemical platform agrees with the comments. This year, there have been refinements on modeled costs to arrive at more realistic but still aggressive cost targets; these are reflected by the new higher cost targets in the Multi-Year Program Plan. The TC platform will be developing cost, quality and yield goals for both pyrolysis and gasification processes to non-ethanol fuels (e.g. green-gasoline, green-jet fuel, green-diesel and other hydrocarbon fuels)

The TC platform believes that implementation of the proposed transition strategy (via R&D planning and budget requests) and the aggressiveness of program goals will push the technology, and US industry, to commercial success in a shorter time frame.

A reviewer mentioned that ―… cost targets in the TC Platform goal are unrealistic…" We would welcome more detail on what is unrealistic about the goals. Are they too aggressive, not aggressive enough, focusing on the wrong fuel, focusing on the wrong parameters (e.g., cost of ethanol)? More specificity from the reviewers is sought.

ii. Platform Approach

How well does the platform approach (platform milestones and organization, RD&D portfolio, strategic direction) facilitate reaching the Program Performance Goals for each platform as outlined in the MYPP? What changes would increase the effectiveness of the Platform?

Exhibit 14 – Platform Approach: Strengths and Weaknesses

Strengths	Weaknesses
Very good breadth to the portfolio covering many of the risks and challenges.	The gasification programs are primarily centered on the NREL gasifier design which has both strengths and weaknesses. The propensity to make tar, a key weakness, necessitates a significant amount of platform effort on tar reforming. Other gasifier designs with lower tar formation, such as higher temperature slagging gasifiers, should be added to the portfolio of programs to offer a different solution to tar formation.
Exceptional is high praise. I believe the platform would benefit from more management of the portfolio to ensure that appropriate resources are deployed in exploratory research and demonstrations. Furthermore, I believe that graduation of projects could be both better defined and encouraged. While out of scope for the platform, coordination of incentives within the DOE seems warranted. Incentives could be in the form of encouragement to apply for funds in other, more development oriented platforms or as grants / tax breaks / loans to spur private sector advancement of area vetted through the program. The development of an industry is a requirement for meeting the program vision. Development of technology may not alone be sufficient.	
In the gasification area, there has been good progress towards the targets.	In areas other than gasification within the platform, the targets have not been developed.

Milestones, decision points are logical and provide sufficient specificity (without being overly prescriptive) to achieve the broader goals of the TC platform. In concert with the MYPP, they provide a systematic and stable pathway to US DOE's goals (the likelihood of achieving the lofty goals being a separate issue).	

Technology Manager Response

The platform agrees that a more appropriate level of resources (e.g. higher) is needed for exploratory research. The TC platform also believes that an increased level of resources is needed to adequately address the research barrier currently identified.

The platform will soon be developing cost, yield, and quality targets in for a petroleum blending stock biofuel derived from pyrolysis of biomass.

iii. Platform RD&D Portfolio

The degree to which the Platform RD&D is focused and balanced to achieve Biomass Program and Platform goals? (WBS, unit operations, pathway prioritization)

Exhibit 15 – Platform R&D Portfolio: Strengths and Weaknesses

Strengths	Weaknesses
The work breakdown structure is an excellent way to organize and communicate the platform work scope. The portfolio of program is reasonably balanced and is addressing most challenges.	There needs to be more exploratory process chemistry programs added to the portfolio to generate new options for mitigating technical and economic risk. Much of the work presented was optimization and integration of known technologies (e.g., catalytic tar reforming, system analysis for gas cleanup...) and the potential for breakthrough improvements is low, just incremental improvements are likely for many of these approaches. Also, broadening the definition of biomass to include coal/biomass blends and MSW will open up new process options, scale and economics.
Several congressionally directed projects are not aligned with platform goals. Need a state of technology assessment for catalyic tar reforming area (e.g. update 1998 Milne report) - What progress has been made in last decade? Are we beating a dead horse or is there light at the end of the tunnel? Shifting emphasis from gasification to pyrolysis is consistent with direction given in prior	

reviews and workshops. Recommend increased focus on more direct conversion of biomass to hydrocarbon fuels.	
The program is clearly focused and is well balanced across the technology areas. Furthermore, the recent shifts toward development projects are necessary and important. Balancing within the program areas to achieve a consistent balance of early and late stage projects needs to continue.	All programs suffer from inertia and have difficulty in decelerating particular program areas. This is evident in several areas of the Platform. One is the close interaction with NREL and its particular flavor gasifier used as the basis for one version of thermochemical conversion. The choice of gasifier used is *an* option, not the only option, yet the NREL gasifier and its characteristics have influenced the Platform, potentially unduly. The tar issue is significant in fluidized bed gasifiers, like the one used at NREL. This prompted considerable efforts on tar remediation. The tar reforming efforts spawned to handle tar today command a lesser fraction of the total budget than they did even two years ago. The program must continue these refinements and not be unduly influenced by those technologies held in hand by organizations within its sphere. At the risk of belaboring a point made earlier in this evaluation, I believe that the program must do some high level planning for what to do with technology that meets development targets. In particular, determining how the DOE can influence the success of fledgling efforts aimed at commercializing technologies. The platform has a stable of promising technologies in development. Nurture of technologies that escape the metaphorical nest can take many forms and these should be contemplated and planned for as the portfolio realizes its potential. Following the avian analogy, there comes a time when nurture is no longer required. Truly commercial technologies may no longer require Platform assistance or further government funded R&D. I believe determining how technology areas wind down should be discussed and planned for. It must be remembered that success means no longer needing the Platform and the R&D it performs.
	A commonality between several projects is the feeding of biomass into high pressure systems in both dry and slurry forms. Several Pis are having difficulties solving this problem even though it is not a focus of their project, i.e. the

	project focus on the chemistry at high pressure not the feeding of the biomass. A project or FOA in this area could aid multiple areas of the TC platform.
The TC Platform R&D is generally balanced, though perhaps the end products are a little too narrowly defined as mentioned in 1, above.	It appears that USDOE's R&D resources are weighted somewhat in favor of process integration. These types of projects typically are (1) costly, (2) long in duration, (3) rather modest permutations of a myriad of unit operations that represent alternative pathways that are not dramatically different from each other in cost or performance. Though the integration is very important, perhaps the TC Platform doesn't need to investigate so many permutations, particularly if the integration projects come at the expense of more exploratory research, which is also important. To maintain balance, USDOE needs to provide sufficient support to exploratory research.

Technology Manager Response

The TC platform in fact looks at a wide range of gasifier systems, but the platform understands how the reviewers may reach a point of view that the platform is focused on a single gasifer/gas cleanup/fuel synthesis system. The primary documents provided to the reviewers are the Design Cases/SOT analyses and MYPPs that all refer to one type of approach. The platform has in fact done extensive analyses on a variety of approaches, gasifiers, etc. Both NREL and PNNL have done extensive studies on other alternatives to determine if there is something significantly better (for instance oxygen blown, pressurized, etc). The platform has never claimed the design case systems are the "best", and we state that explicitly in the pyrolysis study. The platform is not developing gasifiers and as such the units in the platform are ―gas generating appliances" to produce raw syngas and are not in the gasifier development business. The research in the platform is relevant to a wide range of gasifier systems, not just the particular design case layout.

The platform agrees that more exploratory research is needed to fully understand and improve upon the process chemistry in gasification, pyrolysis, upgrading/improving intermediates (syngas and pyoil) and fuel synthesis catalysts. This is needed for all various ―levels of quality" of product from these process steps.

Two other large needs are research on: (1) the different requirements for thermochemical processing a matrix of additional feedstocks, and (2) the characteristics of the intermediate products (syngas, pyoil) that result from altering the feedstock and process parameters. Unfortunately the size (funding and manpower) of the current platform and management inertia are limiting factors.

iv. Platform Progress

Based on the presentations given, how well is the platform progressing towards achieving Biomass Program and Platform goals? Are we meeting our performance targets? Is it on track to meet the goals presented? Please provide recommendations on improvements for tracking progress in the future.

Exhibit 16 – Platform Progress: Strengths and Weaknesses

Strengths	Weaknesses
Good progress is being made toward meeting technical goals.	There still remain significant challenges to achieving the economic targets with the biggest risks being capital costs (platform is underestimating them), feedstock costs (platform is underestimating them) and operational reliability (impacting opex and maintenance).
	Program should insist that every project perform early-stage techno-economic analyses. Back-of-the-envelope calculations are fine, but the quantitative assumptions that underlie the analyses must be specified. In turn, the project plan must specify which assumptions the research will address (to reduce the uncertainties associated with those assumptions). In addition, DOE should require all projects to report techno-economic estimates for critical steps (e.g., cost of gas cleanup for gasification projects) in uniform terms (e.g., \$/gal, \$/BTU, gal/DT, net-BTU/DT). In addition, by specifying the assumptions, the efforts under the Thermochemical Program can be better coordinated with other DOE Biomass Programs (especially, Feedstock Logistics). For instance, assumptions associated with feedstock quality (MC, particle size, ash content, composition) can affect better cross-talk between the Thermochemical and Feedstock Logistics Programs.
Advances over the last two years has resulted in vetting pyrolysis processing as an attractive means to cost-effectively and efficiently converting biomass into liquid transportation fuels. This is so compelling that a major	

technology provider of petroleum processing technologies has formed a business around the area. This shows the adaptability of the platform and that is reaching goals leading to commercial development.	
	While there is generally recognition of the projects against the TC platform targets, there is not enough focus on cost targets.
The TC Platform is progressing reasonably well toward increasing the penetration of biofuels into the energy mix. One way to better track progress (within the Platform review process) would be to require contractors to clearly define (versus the proposal/plan for the present contract): (1) deliverables actually attained with USDOE funding; (2) $ of USDOE funding expended; status of project.	However, the TC Platform Goals are very lofty (in this reviewer's opinion unrealistic); so no program short of one whose investment approaches that of the Manhattan Project, will be able to reach the Platform Goals.

Technology Manager Response

Thank you for your vote of confidence, the TC platform has endeavored to adapt to its new political environment (a restrictive focus on ethanol production) and that it is progressing well toward a goal of increasing the penetration of biofuels into the market (both ethanol and fully fungible hydrocarbon fuels).

The platform also agrees that good progress is being made toward meeting technical goals.

The platform would like to be more accurate in determining success toward economic targets. Specifically if, as the reviewer asserts, the biggest risks are: capital costs (platform is underestimating them), feedstock costs (platform is underestimating them) and operational reliability (impacting opex and maintenance); then, the platform would always welcome a more accurate estimate from the review panel and industrial partners or at least a method of more accurately estimating them.

As suggested, the platform would like to develop and implement a technique to better track progress (within the platform review process, and will work closely with our project management team (Golden Office) to do so. This new practice will include a way for contractors (and labs) to clearly define (versus their proposal/plan): (1) deliverables actually attained with USDOE funding; (2) $ of USDOE funding expended; status of project.

In future, lab and industry-based work, the platform will begin to require that projects report techno-economic estimates for critical steps (e.g., cost of gas cleanup for gasification projects) in uniform terms ($/gal, and $/BTU). In several of the current projects, these type of analyses are already required; in the future, we will strive to make it more clear to the review panel.

v. Portfolio Gaps

Are there any gaps in the Platform RD&D Portfolio? Do you agree with the RD&D gaps presented by the Platform Manager?

Exhibit 17 – Platform Gaps: Reviewer Comments

Reviewer Comments
As noted above, there needs to be more exploratory process chemistry options being investigated to provide risk and cost mitigation options; optimization and integration of existing process options may not reach targets.
Recommend that DOE address three other gaps: focus specifically on technology development that will help to enable distributed (& possibly mobile) energy-densification/preprocessing systems; the production of liquid fuels from char intermediates (via pyrolysis or gasification); and technical and commercial demonstration of aqueous phase reforming
There are two potential gap areas that I can see. It is certainly possible to argue that neither warrants additional R&D efforts. The first is triglyceride processing, either for seed oils or algal oils. Algae are experiencing a robust, private sector funded renaissance. It is my belief that conversion technologies are still wanting and would fit nicely in the Thermochemical Platform. Steering toward efforts to process these fuels more effectively than conventional esterification (which produces a fuel inferior in many ways to petroleum diesel) and the now commercial catalytic hydrogenolysis are what I have in mind. Technologies broached at this review, such as catalytic decarboxylation, exemplify what may be possible. This would lead to a pure hydrocarbon fuel without requiring near the amount of hydrogen required by catalytic hydrogenolysis. The second is the methanol chain, including both methanol and dimethyl ether. Small-scale production, as might be required by biomass feeds, is still a challenge. Fostering developments in smaller-scale processes and recognition that DME is a perfectly viable liquid transportation fuel should be considered. Methanol also is a portal to pure hydrocarbon fuels from biomass using already developed methanol-to-gasoline technology.
More projects in 3.4 (Fundamentals and New Concepts) focus area are needed.
Unlike several of the other reviewers, this reviewer believes that the portfolio presently is quite appropriate. I don't believe that making the portfolio more prescriptive would make the R&D program or the solicitation process any better nor fill gaps any better than presently. USDOE's solicitations should be appropriately prescriptive.

Technology Manager Response

While the platform believes that there is a lot of potential for this particular platform in processing a variety of carbon resources (biomass, MSW, etc), the limits faced in the budget will make it difficult to explore all the possibilities.

Regarding the other recommendations for expanded RD&D, in multiple areas, the platform wholeheartedly agrees. The TC Platform will first develop a strategy to transition into non-ethanol fuels, and then RD&D plans to develop technology and systems to produce these other bio-fuels. These plans will most likely focus on liquid transport fuels, and will seek industry partners for guiding the technologies to the market place. Again, implementation of those plans will be wholly dependent upon available appropriations.

Regarding algal-oil-based fuels, the program is developing an algal strategy and R&D plan that will most likely include RD&D in conversion of both the algal oil and the –spent" algal bodies.

Regarding Methanol and MTG, the aforementioned transition strategy and RD&D plans will encompass all conversion technology that has the potential to produce liquid transport fuel.

Regarding modular and small-scale systems, current economic analyses are not favorable for small-scale production systems. However, recent industry input has suggested that this type of systems has high potential for commercial viability, in certain business spaces. The program will include various scale systems in the implementation of its Transition Strategy and RD&D plans.

vi. Additional Recommendations, Comments, and Observations

Exhibit 18 – Other Reviewer Comments

Reviewer Comments
Overall, an impressive portfolio of programs addressing many of the risks. The number of programs approaching scale-up and demonstration scale is encouraging, but more options will be needed to mitigate risk. There were a few projects that were progressing well toward their stated project goals, but were not relevant to the overall Thermochemical Platform goals. These programs are pulling resources and attention away from the programs that are critical to achieving the Thermochemical platform goals. The level of cross program interaction and information flow was very high. It was very apparent that most of the investigators were having frequent communications with their peers - very little evidence of operating in silos.
I believe the greatest strength of the platform is that the technologies it contains hold the greatest promise for meeting the MYPP. The technical breadth and ability to handle wide varieties of biomass are clear strengths.
A tool should be developed for cost estimating the price of ethanol and other liquid fuels. Within the Hydrogen program, an Excel-based tool (H2A) was developed for this purpose.
Some of the congressionally mandated projects are very sound and important to increasing the penetration of bioenergy into the energy mix; though several don't support the goals of the TC Platform. A few have questionable technical basis or merit. All projects, to one extent or another, should require at the very least, a back-of-the-envelope techno-economic analysis.
Overall, an impressive portfolio of programs addressing many of the risks. The number of programs approaching scale-up and demonstration scale is encouraging, but more options will be needed to mitigate risk. There were a few projects that were progressing well toward their stated project goals, but were not relevant to the overall Thermochemical Platform goals. These programs are pulling resources and attention away from the programs that are critical to achieving the Thermochemical platform goals. The level of cross program interaction and information flow was very high. It was very apparent that most of the investigators were having frequent communications with their peers - very little evidence of operating in silos.

Technology Manager Response

Regarding the ―tool for cost-estimating the price of ethanol and other liquid fuels": this recommendation will be provided to the Analysis function of OBP, as a critical need identified by this review panel.

DOE agrees with all the comments provided above and will continue to try to perpetuate an environment that is achieving the current program goals, developing new goals and transitioning to those goals. Further the platform and the GO project office will continue to work with and manage all projects (including congressionally mandated) so that they are focused on those goals.

C. Overall Technology Manager Response

The Thermochemical Conversion platform thanks the peer reviewers for their valuable comments, time, and expertise. The concerns and opinions express to us throughout the platform and program review proceedings will be considered as the program reviews its strategic plan and planning activities, and assist in guiding the program and program accomplishments. Since each successive review looks at previous peer review platform and project results for improvements and adjusts, the platform manager hopes that the PIs take the peer reviewers' comments seriously and work to incorporate this information to improve project performance and results.

III. Project Review

The Thermochemical Conversion platform supports research and development projects with the national labs, university and industry partners, non-governmental organizations, and other entities. Projects funded through the Conversion platform align their activities with the Biomass Program Multi-Year Program Plan (MYPP) goals. At the February 19, 2009 Review, 41 projects were presented, each in a 20-30 minute presentation that focused on showing how project results would help achieve the Biomass program objectives. Projects were evaluated by a subset of reviewers from the Thermochemical platform review panel, assigned according to their area of expertise.

A. Evaluation Criteria

Each project was evaluated systematically using a set of criteria developed in conjunction with the Biomass Program peer review steering committee. The evaluation criteria were provided to the project PIs ahead of time. These five criteria are as below:

Relevance - *The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.*

Approach - *The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.*

Technical Progress - *The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.*

Success Factors - *The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.*

Future Research - *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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.*

Rating System – 5=Excellent; 4=Good; 3=Satisfactory; 2=Fair; 1=Poor

B. *Project Scoring*

Exhibit 19 – Project Scoring Summary Table

Technology Area	WBS	Title and Project Information	Relevance	Approach	Technical Progress	Success Factors	Future Research	Overall
Modeling & Analysis	3.6.1.1, 3.6.1.3	Thermochemical Platform Analysis: Gasification and Pyrolysis	4.3	4.0	3.8	3.7	4.2	4.0
Feedstock Interface	3.1.1.1	Evaluation of the Relative Merits of Herbaceous and Woody Crops for Use in Tuneable Thermochemical Processing	3.83	3.83	3.33	3.5	3.83	3.66
	3.1.2.1, 2.1.2.2, 3.1.2.3	Feed Improvement Task, Feed Processing & Handling Task & Feedstock Interface (combined)	3.7	3.2	3.3	3.2	2.8	3.2
Gasification	3.2.1.1, 3.2.1.3	Gasification of Biorefinery Residues – Modeling and Optimization	4.3	3.5	3.8	3.7	3.8	3.8
	3.2.1.4	Integrated Biomass Gasification with Catalytic Partial Oxidation for Selective Tar Conversion	3.0	4.5	4.3	3.8	3.8	3.9
	3.2.1.5	Development of New Gasification Processes for Biomass Residues: Gasification Kinetics at Pressurized Conditions	4.4	4.0	3.6	4.0	3.8	4.0
	3.2.2.8	Dual Layer Monolith ATR of Pyrolysis Oil for Distributed Synthesis Gas Production	3.3	2.8	3.2	3.0	3.0	3.1
	3.2.4.2	Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical	3.0	3.8	3.2	3.5	3.7	3.4
	7.3.1.1	Southeast Bioenergy Initiative - Auburn University - Systems based Products and Energy	2.8	2.3	2.5	3.0	2.7	2.7
	7.4.1.3	Center for Producer-Owned Energy	1.2	1.8	2.2	1.7	1.8	1.7

Technology Area	WBS	Title and Project Information	Relevance	Approach	Technical Progress	Success Factors	Future Research	Overall
Gas Stream Clean-Up & Conditioning	3.2.5.10	Biomass Synthesis Gas to Liquid Fuels Evaluation	3.8	3.0	2.0	2.2	1.8	2.6
	3.2.5.11	Syngas to Synfuels Process Development Unit	4.0	3.5	3.0	3.5	3.5	3.5
	3.2.5.3, 3.2.5.12	Validation of the RTI Therminator Syngas Cleanup Technology in an Integrated Biomass Gasification/Fuel Synthesis Process	4.5	4.5	3.3	3.8	4.2	4.1
	3.2.5.13	Pilot-Scale Demonstration of a Fully Integrated Commercial Processes for Converting Woody Biomass into Clean Biomass Diesel Fuel	4.2	3.8	3.2	3.5	3.5	3.6
	3.2.5.3, 3.2.5.12	Biomass Gas Cleanup Using a Therminator	4.2	4.2	3.5	3.7	3.8	3.9
	7.7.4.2, 3.2.5.5	Engineering New Catalysts for In-Process Elimination of Tars	4.2	4.3	3.8	4.2	3.7	4.0
	7.7.4.2, 3.2.5.5	Agricultural Mixed Waste Biorefinery Using the Thermo-Depolymerization (TDP) Technology	4.2	3.3	3.0	3.0	3.2	3.3
	3.2.5.6, 3.2.5.8	Catalyst Fundamentals Integration	4.7	4.3	4.0	3.8	4.2	4.2
	3.2.5.9	Novel Approach for Biomass Syngas Cleaning and Conditioning for Liquid Fuel Synthesis Applications	4.0	3.6	2.8	3.2	3.8	3.5
	3.2.5.7	Integrated Gasification and Fuel Synthesis	4.7	3.8	4.2	3.8	4.2	4.1
Fuel Synthesis	3.3.2.1, 3.2.2.2	Syngas Quality for Mixed Alcohols	4.5	4.5	4.0	4.0	4.0	4.2
	3.3.2.5	Thermochemical Conversion of Corn Stover	4.5	3.5	3.7	3.3	3.5	3.7
	3.3.2.6	Catalytic Production of Ethanol from	4.0	3.3	3.2	3.2	3.3	3.4

Technology Area	WBS	Title and Project Information	Relevance	Approach	Technical Progress	Success Factors	Future Research	Overall
		Biomass-Derived Synthesis Gas						
	3.3.2.7, 3.3.2.8	Fuel Synthesis Catalyst - CRADA with DOW	4.4	4.0	3.2	4.2	4.0	4.0
	7.7.4.8	Mississippi State University Sustainable Energy Center – Syngas to Fuels Projects	3.7	3.3	2.7	2.7	2.8	3.0
Pyrolysis	7.4.5.8	Vermont BioFuels Initiative	1.5	2.2	2.3	2.0	2.0	2.0
	3.2.2.10	Fast Pyrolysis Oil Stabilization: An Integrated Catalytic and Membrane Approach for Improved Bio-oils	4.2	3.5	3.2	3.2	3.7	3.5
	3.2.2.4, 3.2.2.5	Pyrolysis Oil R&D	4.8	4.2	4.2	4.2	4.0	4.3
	3.2.2.6	Hydrothermal Liquefaction of Agricultural and Biorefinery Residues	3.7	3.5	3.0	3.2	3.2	3.3
	3.2.2.7	A Low-cost High-yield Process for the Direct Production of High Energy Density Liquid Fuel from Biomass	3.0	2.0	2.8	1.8	1.8	2.3
Bio-Oil Conditioning & Upgrading	3.2.2.1, 3.2.2.2	Pyrolysis Oil to Gasoline (PNNL, NREL CRADA with UOP)	4.7	4.2	4.2	4.2	3.8	4.2
	3.2.2.11	Stabilization of Fast Pyrolysis Oils	4.7	4.0	3.2	3.7	4.2	3.9
	3.2.2.13	A Systems Approach to Bio-Oil Stabilization	4.5	4.0	3.3	3.8	4.0	3.9
	3.2.2.9	Catalytic Deoxygenation of Biomass Pyrolysis Vapors to Improve Bio-Oil Stability	4.2	3.7	3.2	3.7	3.8	3.7
	7.3.4.1	University of Oklahoma Biofuels Refining	3.5	2.8	2.8	2.5	2.7	2.9
	7.7.4.8	Mississippi State University Sustainable Energy Center – bio-oil	3.7	2.7	3.0	2.7	2.8	3.0
Co-Products	7.3.2.3	University of Kentucky Biofuels Research Laboratory	2.4	2.6	3.0	2.0	2.2	2.4

Technology Area	WBS	Title and Project Information	Relevance	Approach	Technical Progress	Success Factors	Future Research	Overall
and Biopower	7.3.2.4	Bio-Renewable Ethanol and Co-Generation Plant, Biomass	2.8	3.0	3.2	2.8	3.2	3.0
	7.3.2.5	Plasma Gasification Waste-to-Energy Project	2.5	2.2	2.2	2.5	2.2	2.3
	7.3.6.2	Alternative Fuel Source Study - An Energy Efficient and Environmentally-Friendly Approach for research on alternative fuels for cement processing	1.7	2.8	3.0	2.7	2.3	2.5
	7.4.3.11	SUNY Cobleskill Bio-Waste to Bio-Energy Project	1.8	1.7	2.5	1.3	1.8	1.8

C. Thermochemical Conversion Platform Individual Project Reviews

The following 41 projects were evaluated by three to six reviewers. The number of reviewers for the project is listed for each project. Each evaluation provides a summary table of the evaluation scores provided by the review panel followed by a verbatim reproduction of the full written comments provided by the review panel. The written comments do not in any way reflect an official opinion of DOE. Following the review, each project Principal Investigator (PI) was given an opportunity to review and respond to the written evaluation provided by the review panel. These responses are provided in full below. The PI responses do not reflect an official opinion of DOE.

B. Individual Project Reviews by Technology Area

This section will provide review results for each project categorized by the technology area and the PI response to it.

i. Modeling and Analysis

Thermochemical Platform Analysis: Gasification and Pyr olysis

Technology Area: Biomass Program
Project Number: 3.6.1.1, 3.6.1.3
Performing Organization: NREL, PNNL
Number of Reviewers: 7

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.29	0.76
Approach	4.00	0.58
Technical Progress	3.86	0.69
Success Factors	3.71	0.49
Future Research	4.14	0.38

Overall Principal Investigator Response(s)
The comments from all the reviewers are addressed under four broad topics. **(1) Cost Estimates** A combination of literature, costing software and data from engineering firms will continue to be used as sources of cost information. Ideally all data should be obtained and updated on a regular basis through engineering firms for greater credibility. Unfortunately, subcontracts to such firms are expensive and cannot be supported on a regular basis. However, we will continue to use their services for data to the extent that we can afford it. In deference to some reviewers' comments, efforts will be made to get

updated costs for various gasifier types in the near term.
It should be noted that much of the cost information for similar equipment used in the direct O2 blown gasifier and indirect gasifier reports were based on data from common sources and similar assumptions. The relative cost comparisons are unlikely to change with updated quotes because the differences in the final ethanol costs are greater than the usual 30% margin of error associated with such analysis. This analysis does not rule out the use of O2 blown gasifiers for all biomass conversion processes. It points out the economic disadvantages of using it in the specific process for the production of mixed alcohols. Please note that many of the process and cost assumptions in the indirect gasification report (and inherited in the direct gasifier report) are based on studies by Nexant (subcontracts to the engineering firm in 2006).

(2) Assumptions
Presentation time constraints limited the data presented. Assumption details for the pyrolysis report can be found in the report at http://www.pnl.gov/main/publications/external/technical_reports/PNNL-18284rev1.pdf. The uncertainty regarding the specific assumption of hydrogen being available from a refinery at $0.56/lb in the base case (based on a 2007 literature source) was recognized and reflected in the sensitivity analysis.

The gasification data for the direct O2 blown dry ash gasifier was based on data from pilot plant runs (Evans et al., 1988, PNL-6518). We agree that the information is dated, but it was used in the absence of newer and better information that is available publicly.
In response to the comment from a reviewer about the use of false assumptions, we would like to say that we do our best to go through the assumptions and correct any apparent falsities and do not knowingly introduce them. The checks may not be foolproof given the resources and the amount of work that needs to be done. In the future we will try to get more outside eyes to critique our work prior to publication of our reports.

(3) External Input
We have tried to get external input in the past, within our resource and time constraints. We will make greater efforts to increase outside involvement, per the comments of the reviewers. We still will have to work within our means. There are financial constraints for employing engineering firms for too many tasks. With respect to industry, the constraint is the lack of willingness to share proprietary information (which is to be expected).
For pyrolysis work we will leverage findings from a study for a different task being conducted by the Global Energy Management Institute based out of the University of Houston. They bring in significant experience from the petroleum refining industry. We will leverage the work done by the ConocoPhillips/Iowa State/NREL collaboration for our pyrolysis and gasification analysis. We will also publish more of our work in peer-reviewed journals in order to get external feedback.

(4) Alternate Studies/Technologies
Some of the reviewers mentioned the necessity to prioritize modeling efforts because the options are many and resources are limited. In light of the shifting focus (from DOE) towards advanced fuels, the analysis work will very likely move in that direction in the coming years.

Many reviewers commented on the importance of considering many gasifier options for the conversion processes that are modeled. The analysis so far has covered an indirect gasifier and dry ash oxygen blown gasifier. We will be creating a model using an oxygen blown slagging gasifier this year and weigh the cost savings from eliminating the tar reformer in such a process. Also, we will show the reasons for selecting specific gasifiers when we do the techno-economic analysis for advanced fuels.

We are aware of new O2 technologies that claim to be more cost-effective, in particular ITM

(membranes) developed by Air Products and NETL. We will include scenarios with such technologies in future studies using direct gasifiers. We recognize that more can be done to analyze many other process variations and other research options. Sometimes quick studies are done to determine feasibilities of novel approaches. We will continue this approach, recognizing that it will be difficult to do all that we wish with available resources.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Good method for integrating the separate pieces of technical information from the other programs. Ability to update and quantify based upon new findings will enable the platform to monitor progress on a quantitative manner.	All cost estimates are difficult to validate until you actually build one. Extra effort needs to be paid to validating the capital estimates since that is likely where the largest uncertainties reside.
PI Response: Please see overall response.	
Key analysis necessary for setting program direction	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Extremely important to have on-going techno-economic analyses	Reviewers need to see details about assumptions in the cost models. Otherwise, it's impossible to know whether the conclusions presented are realistic.
PI Response: Assumptions are presented in detail in the design reports. The time was too short (15 minutes) to go through assumptions for the work done. Please see section on Assumptions in the overall response.	

Examination of the process economics and there use in guiding research is critical. Capital is critically important in getting processes commercialized. I feel that the approach is completely valid and necessary.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Valuable to identify priorities, gaps, progress, and costs.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
High relevance; very important area of work.	Need more external input (most of the eyes presently are internal, from federal labs).
PI Response: Please see section on External Input in the overall response.	
Enter Strengths here	Enter Weaknesses here
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Sound methodology for determining cost contributions for various technology options.	Basing estimates on literature information is risky. When literature cost estimates are compared to internal known cases, the literature is often significantly low.
PI Response: Please see section on Cost Estimates in the overall response.	
NREL and PNNL have proven the value of this	Need to emphasize basis for assumptions

approach	regarding capital and operating cost. Careful not to rule out options based on old or misleading data; e.g. capex and opex data on O2 blown gasification is very old. Has partial oxidation been considered as a lower cost option to catalytic tar reforming for O2 blown case?
PI Response: Please see the sections on Cost Estimates and Alternate Studies/Technologies in the overall response.	
	Presentation should have presented cost economics for the various processing steps in pyrolysis.
PI Response: Time allocated for presentation was short. The details are available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-18284rev1.pdf	
This is a logical and measured approach to the issue of quantifying the projects.	None - a completely reasonable approach.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Covers both gasification and pyrolysis. Provides a cost per gal of various technologies. Coordination with research, i.e. data from research is input to improve model.	Since there are no demonstrated solutions to tar cracking, the modeling of these processes and costs cannot be accurate. Updating the model with tar cracking and comparing to refreshed estimates of other competing technologies. Method for monitoring/revisiting gasification technologies that have not been selected or deselected. These technologies are evolving. Data should be consistent, i.e. some of the cost data is old.
PI Response: These are very good suggestions. Please see overall response for the steps we plan to take to address some of these concerns in the coming years.	
Strong, competent, and diverse team. Very good plan of work. NREL et al. are picking winners in alternative technologies (though I'm not convinced they picked the correct winners) instead of trying to please all technologies, which is good.	Additional external eyes on the project, particularly options being considered and pursued would be very helpful. Unclear where performance data came from (some of the gasification technologies being analyzed are quite old).
PI Response: The gasifier performance data came from pilot plant runs. The indirect gasifier data came from the BCL gasifier 9 tonne/day test facility (Feldman et al. 1988 referenced in Appendix I of the report). The direct gasifier data came from the IGT gasifier 12 ton/day test facility (Evans et al., 1988, PNL-6518). Also, please see overall response for responses to other comments.	
Enter Strengths here	Enter Weaknesses here

PI Response: No response to this comment has been provided by the Principal Investigator.

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
On track to meet the stated objectives.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Pyrolysis design report Preliminary MTG analysis	Consider potential of biomass pre-process (e.g. hydrothermal depolymerization, torrefaction) as option to reduce downstream tar mitigation costs for O2 blown gasification.
PI Response: Thank you for the suggestion. We will keep this in mind, although we cannot promise that we will be able to look at some or all of these options given our available resources.	
	Again, how useful are these analyses if the conclusions are based on false assumptions?
PI Response: Please see response in the Assumptions section of the overall response.	
Tools used are best available, are being used in the fashion intended and the output is being used to shape R&D efforts.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Publishing design reports on gasification and pyrolysis. Progress on SOT.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Progress seems to be on track (this is helped by the project being a decade-long endeavor).	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Enter Strengths here	Enter Weaknesses here
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Most of the critical success factors are identified.	Some challenges were identified, but clear paths to overcome them were not presented.

PI Response: Challenges identified (in presentation) and how to overcome them:

- Better incorporate scientific data
    - Conceptual designs, especially ones that set research targets have inherent uncertainties. As the research progresses we become more aware of the validity of initial assumptions and replace incorrect assumptions with experimental results. Experimental results (part of other tasks) continue to provide information for our models and make them more robust. However, the research has to take its due course and time and it is to be expected that we will continue to have uncertainties in some models until we receive the experimental results.
- Cost data
    - Please see overall comments
- Dependencies on non-commercial technologies (e.g. alcohol synthesis catalysts)
    - This is an issue for the overall program, not just the analysis task. Again, this has to go through due legal process before we can use data for such proprietary technologies which are not well documented in literature. Sometimes there are reports such as PEP reports from SRI that compile and give a good picture of such technologies based on extensive reviews of patents. We leverage such reports for

our studies.	
	Need to update input on key capital and operating cost data for O2 blown gasification. Ref literature values are from very old references.
PI Response: We will address your concern about cost data (please see overall response).	
	Need more details about pyrolysis process costs.
PI Response: The details are available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-18284rev1.pdf	
I like the interaction with the researchers. The feedback loop from model to lab is robust. Keeping an eye on cost targets is critical to reach economic reality.	An advantage of the ability to model is its ability to be anticipatory and to lead the researchers to take bold steps. While the research/model interaction is critical, it cannot be the sole goal and at the expense of reaching toward new options. "What if" studies are important and must not be lost as a goal in the hunt for accuracy in models of existing lab data.
PI Response: We appreciate the importance of your comment. We will continue to look for opportunities beyond what has already been identified (we have done some of this in the past).	
Incorporating data from research. Availability of cost data. Good understanding of the challenges of the program. Recognition of dependency on conceptual data.	Lack of current cost data.
PI Response: Please see overall response.	
Has identified critical areas that need further work.	Need to get additional data from gasifier developers (performance and cost).
PI Response: Please see overall response.	
Enter Strengths here	Enter Weaknesses here
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*
- *3-Satisfactory. Future work plans are loosely built on past progress and could address*

OBP MYPP barriers in a reasonable period.

- *2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key OBP MYPP barriers in a reasonable timeframe.*
- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
The proposed work is a logical extension of the processes already investigated.	The program should investigate a broader array of potential technologies and processes. The program should look at hypothetical processes (or modified processes) to quantify potential benefit and drive new research.
PI Response: Please see overall response. We do look at alternate processes but are sometimes resource limited to do all that we want.	
Clearly builds on previous work and adapts to program goals	
PI Response: No response to this comment has been provided by the Principal Investigator.	
List of future studies is reasonable and appropriately complete. .	The challenge in these exercises is balancing the here-and-now with what may be possible. For example, I would have liked to see more discussions about different - even mythical - gasifiers and how they would alter the flow sheet. The impression I took away is that everything leverages on the performance of the Ferco/Battelle gasifier and its operating issues.
PI Response: As mentioned in the overall response, we will be looking at a direct slagging gasifier this year. We have already looked at the BCL indirect and GTI direct (dry ash) gasifiers. We will continue to look at alternate gasifiers as time and resources permit.	
Recognition of need to model high temp (slagging) gasification. Develop SOT for pyrolysis.	Need of method to prioritize modeling efforts. There are many things to be modeled.
PI Response: Please see overall response.	
Carefully thought-out plan for future analyses, which considers non-linear options and builds upon prior work.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Enter Strengths here	Enter Weaknesses here
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) <u>Technology Transfer/Collaborations</u>

Does the project adequately interact, interface, or coordinate with other institutions and projects,

providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Looks like there is adequate input and interaction with stakeholders.	
Need to get better, more up to data on capital and operating cost. Ideally closer linkage with from commercial experience if available or perhaps DOE need to develop a more rigorous and consistent set of guidelines. Linkage to oil refiner in case of pyrolysis.	Please see overall response.
Nexant: improved method for acid gas removal	
Work with outside consultant is a good approach. Collaboration with an engineering company would add additional credibility in determining capital targets.	
ISU/ConocoPhillips/NREL study was identified.	
Most of collaboration appears to be internal to USDOE (though some external partners were mentioned). This project would benefit from greater interaction with engineering and energy companies, and, possibly, gasifier developers.	We will increase our efforts to get more diverse external input. Please see overall response.
Enter Response here	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
The program should develop cases based upon potential improvements in unit operation performance (yield, throughput, etc..),and other equipment configurations. Also, the analysis of pyrolysis process options should be continued, although funding for that task is fully spent.	
Consider engaging an engineering firm to assist in capital cost estimates Need to look at emerging O2 technology and cost reductions in context of O2 blown gasification Need to check assumption on H2 for hydrotreating in integrated case ($0.56/lb H2). Most refineries don't have excess H2 capacity and would have	Please see overall response.

to add this.	
Balance of accuracy of existing technologies and what is possible is a challenge.	We will do our best to prioritize our resources and strike a balance.
Form a steering team to guide the project and set priorities. Team should be composed of a diverse group covering NL, university and industry participants.	We plan on getting more external input (please see overall response). The logistics of a formal external steering committee may be difficult to handle with the funding available for this individual task. However we will address your concern in a more informal manner.
Seek additional external collaboration; seek additional operational and cost data (though this reviewer understands the difficulty and danger of using data from technology developers).	Please see overall response.
Enter Response here	

ii. Feedstock Interface

Feed Improvement Task, Feed Processing & Handling Task & Feedstock Interface (combined)

Technology Area: Biomass Program
Project Number: 3.1.2.1, 3.1.2.2, 3.1.2.3
Performing Organization: INL
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.67	0.82
Approach	3.17	0.75
Technical Progress	3.33	0.52
Success Factors	3.17	1.17
Future Research	2.83	0.75

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Very relevant to the other goals and critical to driving scale in the conversion process.	Potentially over ambitious regarding the feasibility of providing uniform feedstocks on spec.
PI Response: We agree that this is an ambitious goal; however, it is unlikely that the current feedstock supply systems can sustainably deliver sufficient quantities of biomass for scaling and/or replicating plant operations to meet national needs. It is also important to note that as an ―interface task” this work is augmented by other activities within the Analysis, Feedstock, and Conversion Platforms. So, it is not the sole responsibility of this task to efficiently engineer and produce this material. It is the function of this task to establish the attributes and attribute ranges of this material that would make it a better feedstock for thermochemical conversion.	
Feedstock characterization and understanding the impact of variability on conversion is worthy goal.	Hard to put a value on feedstock characteristics with limited scale experience in conversion processes.
PI Response: This is certainly true and was cited as one of the project challenges in the summary.	
Feedstock quality and variability is a critical consideration in biorefining.	$850 K budget is too low.
PI Response: The level of funding does limit the ability to fully investigate all of the feedstock characteristics as a function of conversion parameters at the level of detail we would like to pursue for this project.	
You can't have fuels if you can't get the biomass into the conversion process. This is critically important.	The connection between the stated goals and the activities is lacking (or at least not explained)
PI Response: The presenter freely admits that she did not do the best job of adequately describing the project scope within the time allocated. The main focus of the interface task is to engineer feedstock to enhance downstream system performance by avoiding problems in the process equipment. The project scope includes cataloguing feedstock characteristics into a database to help understand the property ranges that exist for various preparations and their relevance for improving and quantifying the impact on conversion performance. The work includes testing and data mining by the various laboratory partners to fill information gaps. Analytical methods and tools are used to measure feedstock characteristics as a function of various supply system operations to fill the database.	
Enable a commodity-scale supply system that can deliver on spec materials to conversion processes in a cost-effective, sustainable manner	The focus on creating standard feedstocks.

is a worthy goal. Fundamental understanding of feedstock properties on thermochemical processes is a valuable tool.	
PI Response: The overall goal of the Feedstock Platform that is one leg of this interface project is to develop feedstock formats that are stable in storage and can be efficiently handled and transported in existing low-cost infrastructure. The overall goal of the Conversion Platform leg of this project is to obtain low cost feedstock with property attributes that will minimize conversion problems, such as improper feeding, entraining, agglomerating, or corroding within systems. The concept of the standard feedstock is simply to identify what the physical and chemical properties and property ranges of this material should be to avoid these problems while allowing the use of a wide range of biomass feedstock.	
Feedstock is the major driver in the overall cost of biofuels and uniformity of feedstock would improve processing/conversion considerably.	The overall goal of the project, to deliver on-spec materials, is sound, but it's not clear how the work in progress supports this goal. Integration of various parts of this project into a cohesive effort is not clear. Effort appears to be important but presenter failed to articulate how the pieces fit together to reach the goal specified.
PI Response: Again the presenter apologizes for not making this more understandable. The components of the work include a literature search which is collected in the form of a database to review existing feedstock property and conversion data and put it into a format that can be easily accessed for future reference. Testing, compilation, and analysis of data are also being conducted by the laboratory partners as a function of key feedstock parameters to help fill in data gaps. The literature and laboratory data is being used to help establish the properties of the biomass that could reduce problems within conversion systems; and thereby form the basis of a specification. Biomass is also being collected processed, analyzed, and provided to researchers. These characterized materials, many of which are provided through the Feedstock Regional Partnership, also help define the variability in the characteristics of biomass materials produced under varying conditions and will be included in the database.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be* *improved significantly.*

- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Fairly complete program scope to address all aspects of feedstock management.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Biomass relational database is a good idea, but limited scale experience with conversion process may be a barrier to collecting relevant data.	Concept for commodity scale biomass collection and blending not very well explained. Rather than assuming end game is commodity scale biomass consolidation and blending, take a step back and do systems integrated modeling similar to that used in conversion platforms to identify most viable paths. One area to consider how upstream preprocessing (e.g. torrefaction, hydrothermal,â€¦) might reduce downstream capex and opex, enable other technology options (e.g. entrained flow gasification). What are the tradeoffs? Not clear how this get's us beyond the "50 mi" radius.
PI Response: The concept of the commodity scale biomass collection system has been developed through modeling and analysis activities supported by the Feedstock and Analysis Platforms. This concept was also reviewed within these platforms and was well received within these communities. Again the function of this work is to connect, or interface, to this work and provide property data that can feed back into these activities and allow optimization across the platforms.	
Gaining an understanding the range and variability seems to be important	The presenter seemed to stress the variability in feed quality and never confidently stated how the approach taken would lead to simplifying the determination of feed to a biofuels facility.
PI Response: As illustrated in one of the slides, biomass feedstocks are produced with a range of material properties which impact their downstream collection, handling, storage, and conversion.	

Generally, each material format requires a particular set of tools and operations for collecting, handling, and feeding into the conversion system. For example, baling involves 10 material intermediates, 3 biomass format changes, 14 process steps, and 21 different types of equipment. Hence, the concept that if the material could be processed to a ―uniform or standard" format close to the point of harvest then it could be potentially handled through existing, low cost infrastructure, such as is available for feed grains. This would reduce the number of unit operations and types of tools needed downstream, increasing efficiency and lowering costs. We know what the bulk density, moisture content, and flow property ranges of this material need to be, although not necessarily how to produce it to hit cost targets. Similarly, we know that this material contains various inorganic species that impact conversion operations in weight fractions that range from hundredths to tens of percents. Consequently, we would like to understand the impact of this composition and range on conversion systems so we could also produce materials with chemical specifications that minimize downstream issues in the conversion systems.	
Using thermochem research data from NREL testing is helpful to understand impacts of feedstock qualities.	Need data from a variety of processes and technologies to fully realize the impacts. Unfortunately, significant amounts of data will not be shared by technology providers.
PI Response: Again, this is recognized as one of the significant challenges for this effort. It is also why it is critical to have sufficient funding to conduct parametric studies using university and national laboratory assets to help fill gaps.	
	The research appears to be quite fragmented; an apples and oranges approach. Again, it's not clear that this project will reach the overall goal specified. How the web based tool being developed will improve commercialization is not clear (on surface, it should, butâ€¦ how and why?).
PI Response: As stated in a previous review comment, one issue with the project obtaining data from a variety of processes/technologies. It is hoped that the database will encourage dialogue and participation by the user community, helping fill data gaps.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP* *goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*

- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Good delineation of known issues.	Very early in program so only modest progress toward goals - limited data presented.
PI Response: The scope of work performed was clearly not well conveyed to the reviewers by the presenter. With the limited time and funding available: the program has identified the key attributes impacting conversion processes; collected conversion property data on over 100 different types of feedstock for inclusion in a database; compiled and analyzed data as function of feedstock type from laboratory activities; identified and procured a potential screening tool for inorganic species in feedstock; and obtained, archived, and provided feedstock sample materials to numerous researchers in the biofuels community.	
Inventory for biomass researchers	Interesting idea, but conclusion that "development of standardized feedstocks is key to developing more economical, â€¦" was not well supported; ie. It is just a statement at this point.
PI Response: Again, the rationale for the development of a uniform, or standard, format material has been investigated and reviewed within the Feedstock and Analysis Platforms; unfortunately there was not sufficient time to include a lot of background on these activities in this talk. Within the feedstock logistics community, it is widely accepted that conventional supply technologies will not achieve the required quantity, cost, sustainably, and energy balance targets. This information is available in presentations on the Feedstock and Analysis Platform reviews, and also in a design report at: www.inl.gov/bioenergy/uniform-feedstock.	
State of the art technologies used. Database to provide access to data is good.	Failed to draw clear connection between data gathered and the necessary data to provide usable feed to a fuels production unit.
PI Response: As mentioned in the presentation, while it is easy to name key attributes it is difficult to determine how variations in these attributes impact operations. One approach we suggested in the presentation is to design and conduct more parametric studies, like the NREL tar study reported, that systematically examine the impacts of process variables as a function of well-characterized feedstock samples	

Identification that processing can create different compositions, i.e. ash concentration in smaller particles.	Lack of focus in the program.
PI Response: The project which contains a lot of elements, including data collection and mining, analysis tool development, and the collection of pedigreed feedstocks samples into a library is easily perceived as unfocused. However, all of these elements contribute to answering key questions: (1) What are the acceptable material quality attributes for conversion processes? (2) How are they altered through the assembly operation? (3) How do we screen to establish and track quality"	
	Though progress has been made, it does not appear that the project is on track.
PI Response: The project has compiled a significant amount of data, biomass materials, and tools that can enable it to meet the goals of defining an optimized feedstock.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good delineation of high level issues.	Still too many unknowns regarding the demands of various conversion processes, performance impacts and cost targets.
PI Response: That is a recognized issue; however, we do have the ability within the national laboratory partners to obtain and prepare biomass with a range of attributes and investigate some impacts on	

performance, as a function of these attributes, within funding constraints.	
Continuing efforts to catalog feed variability is useful to the industry. Same for the library of feeds NREL keeps.	The weakness in associating activities to goals.
PI Response: Clearly, this was not well articulated in the presentation.	
	Lack of identification of success factors and showstoppers. It is very important to have the vision to identify what is needed by industry in the future. Conversion processes may not be mature enough to implement a standard feedstock.
PI Response: The project success was identified as being able to provide an on spec material with characteristics that will minimize problems in downstream processing equipment. The showstopper involves whether or not we can do this economically.	
	Critical showstoppers not identified. Future plan was not clearly articulated.
PI Response: Again, we know to a degree that we can develop material specifications that will reduce downstream problems, but what are the cost of producing this qualified material as compared to the downstream benefit?	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td></td><td>Only process impacts (at least apparent in the presentation) to be investigated are the tar formation & syngas quality as a function of feedstock and particle size. There may be other impacts related to feed rate consistency, slagging performance in a slagging gasifier, operability etc…</td></tr>
<tr><td colspan="2">PI Response:
This work was presented as an example and not meant to be all inclusive. Additional activities have included review of impacts from other researchers and NREL and PNNL research. The PNNL team members are conducting similar activities to identify key attributes of liquid fuels from their gasification and pyrolysis processes and how they are influenced by various feedstock characteristics.</td></tr>
<tr><td></td><td>Unclear of how stated directions meet stated goals.</td></tr>
<tr><td colspan="2">PI Response:
The initial effort is involved in identifying which feedstock attributes may impact operations. This was accomplished through a literature search that is being developed into a database that can be easily accessed and used to pull out various types of feedstock data as a function of conversion operational parameters. This data is augmented by data mining at the partner laboratories who have considerable experience in conversion processes and testing facilities that can be used to conduct parametric studies to fill data gaps. With this information, attributes including particle size, moisture content, and inorganic composition have been identified. Future plans are directed at testing activities and analysis that will allow the acceptable ranges of these attributes to be bounded within high to low acceptable ranges. In addition, because some inorganic species have been established to be particularly detrimental to conversion operations, a potential technique that could be used as a rapid feedstock screening tool has been proposed and procured for investigation.</td></tr>
<tr><td>Build database, inorganic screening tool, parametric test at NLs, investigating costs,</td><td></td></tr>
<tr><td colspan="2">PI Response: No response to this comment has been provided by the Principal Investigator.</td></tr>
<tr><td></td><td>No clear plan articulated.</td></tr>
<tr><td colspan="2">PI Response: Again, the plan is to use information from published data and targeted laboratory studies to establish the acceptable attribute range of a standard feedstock that would minimize problems in conversion process equipment. The work, with leverage from other platform activities, includes the production and testing of this engineered material and the development of rapid screening tools to assess quality.</td></tr>
</table>

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects,

providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
This program by its nature will require interaction with other programs and investigators. That appears to be in the plan for this team.	
Need closer collaborations with convertors and feedstock suppliers.	With more plants starting to be developed, we are starting to see more opportunities for these types of collaborations and exchanges. In fact, some of these opportunities have been facilitated by this review process. In particular, we were approached by people at the review who are having trouble finding feedstock supplies that meet their conversion requirements.
Need to work more with private sector	We agree that more input from the private sector is very important to this task. The labs do have private sector collaborations; however, in most cases the information is considered proprietary.
Good approach on making data accessible to all.	
Needs greater coordination with modeling efforts to understand impacts of different qualities.	We agree that this would be productive and will pursue greater integration with these activities. Technical impacts need to be understood and quantified and will be integrated into modeling efforts to assess economical considerations.
Taps on Feedstock Regional Partnership.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Program should look at complete supply chain logistics to get a total rolled-up cost for delivery at plant gate. In future reviews, should present vision for supply chain logisitcs and the plan to go beyond the 50 mile collection radius.	As previously stated, this is scope that is the focus of the Feedstock and Analyses Platforms. Information on the results and status of this work is available in presentations on the Feedstock and Analysis Platform reviews and also in a design report at: www.inl.gov/bioenergy/uniform-feedstock

This project needs more funding	Additional funding would allow us to conduct more parametric studies correlating feedstock properties with various conversion processes and operational parameters, as well as to more fully characterize feedstock property changes within assembly operations that impact these properties.
Focus on understanding the impacts of various qualities on TC processes. Delete the tasks on creating a standard feedstock. It is undetermined whether or not the TC industry will require a set feedstock and it is too early to tell what these standard feedstocks should be. Markets should pull for feedstocks. The market for biomass may evolve to handle a variety of feedstocks with conversion processes taking advantage of either favorable qualities and/or low cost feedstocks.	The standard feedstock is created within the Feedstock Platform. The goal of this work is to establish what the attributes of this feedstock should be to minimize problems in the thermochemical conversion process. Naturally, in order to do this we have to understand the impacts of the attributes on the process.
This project appears to be important, but the presenter did not sell the project very well. It seems quite fragmented at this point and not very well integrated. The tie between what's being done versus the stated goal is not obvious.	We are glad the reviewer recognizes the project is important even with the inadequate sells job by the presenter. We know that manipulating the properties of feedstock are very important to enabling an efficient feedstock supply system and we expect they are also important in reducing the operational costs of conversion, both of which are needed to meet national biofuels goals. What is somewhat more difficult within conversion, and probably what also makes this project seem more convoluted, is that conversion processes are complex functions feedstock properties, material handling, and experimental conditions. Hence, the effort at collecting a lot of information on relationships between feedstock materials as a function of operational parameters, that has been the initial scope of this project.

Evaluation of the Relative Merits of Herbaceous and Woody Crops for Use in Tuneable Thermochemical Processing

Technology Area:
Project Number: 3.1.1.1
Performing Organization:
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.83	0.98
Approach	3.83	1.17
Technical Progress	3.33	1.03
Success Factors	3.50	1.05
Future Research	3.83	0.98

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

Strengths	Weaknesses
This meets the needs for the characterization of a large cross-section of potential feedstocks.	It was not apparent how the cost impact of feedstock choices will be quantified.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	The biorefiner should be leading this project, not the feedstock developer (Ceres). In addition, the biorefiner should be a company focused on biorefining U.S. feedstocks, not a biorefiner focused on biorefining European feedstocks (Choren).
PI Response: No response to this comment has been provided by the Principal Investigator.	
Both companies are actual producing companies.	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Comparison of herbaceous and woody crops.	Willow is not a feedstock of significant interest in the US. Using gasifier technology (Choren) which has not been selected by NREL modeling project.
PI Response: No response to this comment has been provided by the Principal Investigator.	
This is an important area for feedstock development and selection. Even though gasification technology is predetermined (Choren technology), information being collected might have widespread applicability.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Good experimental plan should yield high quality data	Plan for two year program was adequate. The assessment of the feedstock impact limited to only the Choren process limits its utility.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Dependence on CHOREN's process model to determine impact of feedstock change and variability
PI Response: No response to this comment has been provided by the Principal Investigator.	
Companies have proven ability to commercialize technology.	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Focus on process optimization on feedstock specifications to enhance the gasification. Thorough investigation of feedstock impacts, i.e. genetics and environmental considerations.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project, though very embryonic at this point, seems sound.	The feedstock properties being collected seem more relevant to biochemical conversion than thermochemical conversion. Two statements cause a little bit of concern: (1) Sugarcane is designated as a crop needing low input, which is anything but accurate. Like most C4 crops, it needs high inputs. Future work includes "improved understanding of feedstock specification for TC processes."
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Program only started, so limited progress. Good data set for switch grass.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Just started work in Jan 2009 Analyzed >100 switchgrass samples	
PI Response: No response to this comment has been provided by the Principal Investigator.	

Clearly delivering against goal and the collaboration leverages strengths in each partner. Lots of data.	Project is just started in 2009.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Significant data for early in the project schedule. Identified ash components and variability basis different soils as well as genetics of switchgrass, i.e. both the plant and soil matter. The volume and quality of analysis is significant.	The role of Choren is not clear.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Clearly, lots of work had been done prior to the initiation of this project. Prior work is helping this project begin on a very good track.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Program is drawing on good experience base in both Choren and Ceres.	Learning may be limited to Choren process. Conclusions may not be broadly applicable.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Robust biomass analysis and operating biomass units. Liked the focus on limited feedstock slate in order to operate and test gasification.	As with all gasifiers, there are critics and proponents. This project tests only one gasifier.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Reasonable plan in place.	

PI Response: No response to this comment has been provided by the Principal Investigator.

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Characterization data will be generally useful. Plan is well constructed to hit stated objectives.	Process performance projections for only the Choren process limits usefulness.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Thoughtful and thorough approach built on a foundation of actual demonstration units.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Work to better understand impact on the gasification process as opposed to solely relying on feedstock analysis.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Appears to be on a very good track with a sound plan.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Through the partners involved in the program, the technology transfer is fairly obvious.	
Good collaboration between CERES and	

CHOREN is key to this project. Findings will be used to inform plant design and location in US.	
Choren	
Good collaboration between two companies.	
Data is being used to develop pilot plant for Choren.	
Excellent collaboration between companies.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
None.	

iii. Gasification

Gasification of Biorefinery Residues - Modeling and Optimization

Technology Area: Biomass Program
Project Number: 3.2.1.1, 3.2.1.3
Performing Organization: NREL
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.33	0.82
Approach	3.50	1.05
Technical Progress	3.83	0.98
Success Factors	3.67	1.03
Future Research	3.83	0.75

Overall Principal Investigator Response(s)
Response to DOE reviewing comments Given the recurrent nature of some of the review comments concerning the modeling approach followed in this project, the present response is organized around three main aspects: model validation, model predictability and process understanding. In each section, the comments and concerns from the reviewers are briefly summarized and addressed. Model validation The reviewers were concerned about the potential lack of validation of the models developed within this project, leading to the impression that the level of detail included in our models might be unnecessary high given the end-goal of the project, namely the undesirable products mitigation during biomass gasification. • Validation is indeed a crucial part of model development, but may represent a real challenge, especially for the complex, highly coupled physical and chemical processes considered here. To increase the degree of confidence in our models, a task-wide effort is now focusing on the incremental validation of the various processes encountered during biomass gasification in a fluidized bed. This effort includes several integrated numerical and experimental investigations of simple configurations relevant to gasification, such that biomass volatilization in a laminar flow or inert particle mixing, specifically designed to allow us to independently consider and

validate parts of our models, one at a time.

- Tar formation during gasification is a multi-scale process, from the molecular level inside the biomass, to larger-scale in the gas phase. The potential of a tar mitigation strategy can be assessed only if its effect can be tracked across the whole range of scales, which requires fairly detailed models. Coupled with a rigorous validation procedure, a detailed approach is most promising in identifying all relevant parameters for tar formation, then focusing on the most sensitive ones.

Model predictability

As the reviewers pointed out, obtaining predictive simulations of the entire reactive fluidized bed in the short term is an unrealistic goal. Instead, the focus here is to use CFD as a complement to empirical approaches to understand phenomena that cannot easily be explained experimentally. We follow a two-way process, in which numerical studies and experimental work are intimately coupled. Observations are made experimentally and guide model development. These models are validated through comparison with experimental data in simple configurations. Sensitivity analysis is then performed to get a deep understanding of how the various parameters involved influence the results. Finally, the models are integrated into larger-scale simulations. Although these large-scale simulations are currently not expected to be predictive since they do not account accurately for all the phenomena occurring simultaneously in the reactor yet, they still provide trustworthy trends, allow comparison of different alternatives for ranking purposes, help identify shortcomings, either in the models or in the reactor operating conditions, and provide valuable guidelines about what aspect or parameter should be considered next, that would have the maximum impact on tar formation. At longer term, this first-principle based incremental approach will enable predictive simulations of these reactive systems, enabling computational design and scale-up studies of biomass gasifiers.

Process understanding and tar mitigation

Some reviewers expressed doubt about how understanding a system could lead to control strategies. An important point to make here is that no optimal control strategy can be designed without at least a limited understanding of the system. Although it is possible to produce transportation fuel from biomass through gasification and fuel synthesis, this process is currently not cost nor energy-effective, and needs to be optimized, one aspect of it being tar mitigation in the gasifier. Empirical approaches are not suitable for optimization, since they are usually expensive, measurements are limited to global quantities, the range of operating conditions accessible in a given facility is very restricted and the systems involve a large number of coupled, highly non-linear phenomena. The alternative is to develop the modeling capabilities allowing us to make educated choices in terms of what parameters will have the greatest impact on our optimization goal, to reduce the time and cost needed to reach technology deployment. Understanding the underlying mechanisms of tar formation allows the formulation of models describing those mechanisms. Sensitivity analysis can be conducted to identify those formation

pathways most susceptible to be altered through the addition of catalysts or an oxidative agent. Modeling and experimental facilities can then be used synergistically to assess the potential of each option and suggest new strategies.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Focused on many technical and economic aspects of biomass gasification, including tar formation which has been identified as a critical issue.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
mitigating tar formation is extremely important	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Syngas quality is critical for most of the thermochem platform. Reducing the tars and the capital necessary for remediation is critical for the overall success of the platform.	It is still a leap of faith to believe that a fundamental understanding of tar formation will generate a path to control.
PI Response: See overall response. Some kind of understanding is needed to design and build optimized gasifiers. The better our understanding of gasification, the better built and designed the reactor.	
	No budget information was included. Without this info it is difficult to determine whether or

	not the money was well spent.
PI Response: From slide #2 in presentation: Total Funding $5.9MM (NREL), $1.5MM (PNNL) FY08 $1.6MM (NREL), $0.5MM (PNNL) FY09 $1.7MM (NREL), $0.5MM (PNNL)	
Tar formation and mitigation is important.	Modeling work, involving particle dynamics, CFD computations, reaction kinetics, is extremely complicated.
PI Response: See overall response. We agree that it is complicated and difficult, but we also believe that modeling can be useful and that it can help accelerate development and deployment.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- 5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.
- 4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.
- 3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.
- 2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.
- 1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.

Strengths	Weaknesses
	Very ambitious - will models actually be predictive enough to drive gasifier design or change of process conditions?
PI Response: See overall response.	

Yes, we think that models will be predictive enough	
Development of analytical and computational techniques. Use above to developing a fundamental understanding underlying tar formation and predictive modeling capability. Next year start on mitigation strategies, e.g catalysts, understand heating rate impact on tar formation.	No work plan outline provided (e.g. specific objectives, milestones, management plan,â€¦.) Using model compounds, but this is a practical approach. Experimental approach is limited to fluidized bed, does not include entrained flow.

PI Response: We are developing the annual operating plan for FY2010, which will include milestones. At the time of the review, we did not have a budget and could not develop specific milestones.

Here are specific objectives that we will work on during FY2010:

- Experimentally optimize partial oxidation for the reduction of tars.
- Modification of four-inch reactor for continuous feed of biomass.
- Investigate catalytic gasification for tar reduction in collaboration with Catalyst Fundamentals Task.
- Use four-inch reactor to validation of CFD models.
- Validate entrapment theories for tar formation.
- Screen feed stocks in collaboration with PNNL and Feed Processing and Handling Task.
- Development of an accurate lumped description of primary tar release during biomass gasification and coupling with the chemical mechanism for gas phase tar evolution developed in FY09.
- Validation of the gasification model will be performed in kinetically controlled environments (e.g. using data from laminar entrained flow reactor).
- Numerical and experimental investigation of biomass mixing and bed dynamics in a cold flow fluidized bed model reactor.
- Use the obtained qualitative and quantitative data will be used to develop and validate of an improved statistical representation of particle size distribution in CFD simulation of fluidized beds.
- Study tar formation kinetics of model compounds and biopolymers with focus on carbohydrates. This data will be used to improve the CFD models.
- Develop trace gas detectors for the detection of small, unwanted species formed laboratory and pilot scale gasifiers (H2S, NH3, HCl, etc).
- Investigate partial oxidation mechanisms and kinetics for tar reduction.
- Map the kinetics of tar formation from biopolymers in laminar entrained flow reactors.
- Investigate impact of gas product entrapment in biomass particle ultrastructure on tar formation during gasification.
- Correlate real-time and post reaction imaging of biomass samples with on-line chemical analysis using laser ablation REMPI-TOFMS.

understanding the mechanisms underlying tar formation is critical for identifying methods for mitigating it	
PI Response: No response to this comment has been provided by the Principal Investigator.	
State-of-the-art tools are being employed.	The complexity of the approach, coupling CFD and reaction kinetics, to optimize what is approaching trace chemistry certainly presents a challenge. Models are always interesting and only occasionally predictive. I was not left with a clear picture of the model actually describing what is observed in the real world.
PI Response: See overall response. As is typically the case, we see the predictability of the models increasing with added experimental results and validation. However, we believe that even the less predictable models can provide valuable information.	
	Emphasis is on understanding mechanisms of tar formation, but I do not see a clear path to solutions.
PI Response: See overall response. We believe that understanding will lead to more accurate models and suggest paths for improvements. We have developed a specific plan for FY10 shown in the response to the comments from reviewer 17801.	
Good integration of experimentation and theoretical modeling. Researchers appear to have good technical capacity.	This is a terribly difficult process to model. Reduction of process to few key reactions could cause shortfalls.
PI Response: See overall response. We agree that this is a complex system to model but we believe that modeling can helpful. Where mechanism reduction occurs, we will validate the limited mechanism with experimental results.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td></td><td>Data did not support any new conclusions vs. what has been known in the literature. Hypotheses were presented, such as the bubble formation and release of PAHs, but few proofs offered in presentation.</td></tr>
<tr><td colspan="2">PI Response: Much of the hypothesis and conclusions that we propose are based upon a number of experimental and theoretical observations. We did not have time to present all of this work at the review, but much of it can be found in the peer-reviewed publications listed at the end of the power point presentation.</td></tr>
<tr><td></td><td>Limited statement of objectives, milestones</td></tr>
<tr><td colspan="2">PI Response: Milestones are being prepared as part of the development of the annual operating plan for FY2010. At the time of the review, we did not have a budget and could not create milestones. Here are the specific plans for FY2010:
• Experimentally optimize partial oxidation for the reduction of tars.
• Modification of four-inch reactor for continuous feed of biomass.
• Investigate catalytic gasification for tar reduction in collaboration with Catalyst Fundamentals Task.
• Use four-inch reactor to validation of CFD models.
• Validate entrapment theories for tar formation.
• Screen feed stocks in collaboration with PNNL and Feed Processing and Handling Task.
• Development of an accurate lumped description of primary tar release during biomass gasification and coupling with the chemical mechanism for gas phase tar evolution developed in FY09.
• Validation of the gasification model will be performed in kinetically controlled environments (e.g. using data from laminar entrained flow reactor).</td></tr>
</table>

• Numerical and experimental investigation of biomass mixing and bed dynamics in a cold flow fluidized bed model reactor. • Use the obtained qualitative and quantitative data will be used to develop and validate of an improved statistical representation of particle size distribution in CFD simulation of fluidized beds. • Study tar formation kinetics of model compounds and biopolymers with focus on carbohydrates. This data will be used to improve the CFD models. • Develop trace gas detectors for the detection of small, unwanted species formed laboratory and pilot scale gasifiers (H2S, NH3, HCl, etc). • Investigate partial oxidation mechanisms and kinetics for tar reduction. • Map the kinetics of tar formation from biopolymers in laminar entrained flow reactors. • Investigate impact of gas product entrapment in biomass particle ultrastructure on tar formation during gasification. • Correlate real-time and post reaction imaging of biomass samples with on-line chemical analysis using laser ablation REMPI-TOFMS.	
Good progress against stated goals and high-quality science is being done.	Relationship to a solution to tars is still in the future.
PI Response:	
Tar formation understanding has been aided by the project.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Significant technical strides have been made.	A lot of strides remain.
PI Response: see overall response	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Modeling difficulties identified by presenter but no specific steps on how to close the gap between models and actual data. Very complicated problem that may not ultimately prove to be predictive.
PI Response: Fluidized bed gasification is our starting point. It may not be the state-of-the-art technology. We plan to start investigations of surface reactions and the effects of metals in FY2010.	
This research has determined that there may be fundamental, physical barriers to mitigating tar formaiton (small bubbles)	
PI Response: No response to this comment has been provided by the Principal Investigator.	
The showstopper term is not well applied here. The efforts are geared to explaining what happens, not in advancing a particular technology.	I am concerned by the sole focus on the fluidized bed gasifier and question the assumption that it is the state-of-the-art in gasification. I would also suggest that it includes yet another variable, the reactions on the surface of the particles.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Significant work on model components correlation to tar formation but this does not include interactions with other species and within cell walls. No evaluation of the appropriate tools/level of modeling to use. The project may be attempting to use too detailed of models for the end goal.
PI Response: Our hypothesis for PAH formation necessarily involves the interactions of the pyrolysis products from different biopolymers. The small hydrocarbon fragments and radicals from these species will react by know molecular weight growth mechanisms to produce PAHs. Our hypothesis and experimental evidence for entrapment in plant ultrastructure is an indication of an interaction with the solid material.	
	Not clear that showstoppers have been identified.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	DOE program management should be cognizant that this project may have determined that a cost-effective "solution" to mitigating tar formation may be unlikely.
PI Response: We feel that there are potential cost effective solutions to reduce tar formation. 1. Designing and operating gasifiers for minimized tar formation by reducing upset conditions, streaming, etc. . Modeling will help with this. 2. Partial oxidation may provide a cost effective strategy. We work with the analysis team to investigate this. 3. Catalytic gasification may also be cost effective.	
Logical next steps are described.	Assumption that explaining biomass gasification will tell you how to do it better is an assumption, not a proven fact.
PI Response: We agree, but as we stated before, some knowledge is needed to design gasifiers. We think that improved knowledge with help build better gasifiers.	
	No test of the model is proposed, i.e. modeling something outside of the data used to develop the models.
PI Response: We have tested the proposed chemical models with literature data and we will test the CFD models with experimental measurements in FY2010	
Clear plan for future work mapped out.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Appears to have good interaction with other researchers in the area.	
Could take a closer look a work on kinetic modeling of coal gasification - opportunity to build on this?	We have considered the literature results for coal gasification. There are important physical and chemical differences, but we have used what has been learned from coal modeling.
PNNL	
Good collaboration between government labs and university.	
Working with PNNL.	
Integration is only between two federal laboratories.	We also collaborate with two Universities.

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Should move quickly to start validating model predictions and hypotheses to assure that the modeling is sufficiently predictive to exploit in gasifier operation.	We have compared the chemical model with literature data. In FY2010 we will compare results and validate the models using experiments.
It must be remembered that models are only useful in that they can be used to make predictions. Model validation is critical.	We have compared the chemical model with literature data. In FY2010 we will compare results and validate the models using experiments.

Integrated Biomass Gasification with Catalytic Partial Oxidation for Selective Tar Conversion

Technology Area: Biomass Program
Project Number: 3.2.1.4
Performing Organization: GE Global Research
Number of Reviewers: 4

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.25	1.26
Approach	4.50	1.00

Technical Progress	4.25	0.96
Success Factors	3.75	0.96
Future Research	3.75	0.96

Overall Principal Investigator Response(s)

We appreciate the reviewers' comments. We received high remarks from them on our current accomplishments and suggestions for future directions as well.

Reviewers raised questions about the alignment between our project and the thermochemical platform objectives. In case we did not deliver our message very clearly at the review meeting in April, we want to make our points clear here.

Biomass has a much lower heating value compared with coal. In current stage, its limited supply makes large-scale operation not feasible. For small-medium scale operation, it is not economically viable to use O_2 as the gasifying agent because of extremely expensive air separation unit. Therefore, GE is researching and developing on small-medium scale air-blown biomass gasifier. The syngas produced from biomass gasification, after gas cleanup, can be used in a variety of ways. Syngas serves as the building block for biofuel or many other chemicals synthesis. Considering the technology readiness level of fuel synthesis, which still requires significant improvement to become economical at small-medium scale, GE researchers do not want to limit syngas applications to transportation biofuel only and they are in the pursuit of exploring alternative near to medium term more feasible utilization of biomass gasification product. The success of GE's CPO tar conversion technology can benefit both biomass to power as well as biomass to transportation fuels process.

Due to there is no cost effective syngas to mixed alcohols technology developed yet, GE's system and economic analysis has shown that feeding clean syngas to gas engines for heat and power generation can be economical in near future for rural and farm areas where there is no natural gas and coal nearby. This provide additional benefit and outcome for this platform.

In summary, the CPO tar conversion technology GE is working on will provide an efficient and effective method for syngas cleanup and its success will benefit both biomass to power (today) as well as biomass to fuels processes in the future.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Development of CPO is aligned with platform goal for tar mitigation/destruction	GE is developing CPO specifically for distributed power and CHP applications in short to mid term. In this respect project does not align with platform objectives for production of liquid transportation fuels. GE's economic analysis show distributed power (5-20 Mwe) via air-blown gasification is best economic proposition due to biomass at larger scale.
PI Response: As stated in the overall response of how we view the syngas application, syngas can be used for fuel synthesis upon the successful development of our CPO technology as well as economical fuel synthesis technology. At current stage, syngas can also be economically used for small-medium scale power and heat co-gen in addition to bio-fuels. Our ongoing research on CPO for tar conversion will benefit both bio-fuel synthesis and power co-gen.	
Agree that the near-term opportunity for cellulosic-based bioenergy is power generation. Consequently, this is an important project.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
GE is market leader in gasification. Catalytic partial oxidation is a solution for tars that is proven. However, the focus of this platform is NOT combined heat and power, but is production of liquid fuels.	Requires additional oxygen and associated cost to be useful for fuels.
PI Response: We only need to add small amount of secondary air (not pure oxygen) before our CPO which is easy to do. Compared with the current approach using a scrubber followed by a series of filters for syngas cleanup, our approach is much more simpler and cheaper. Our	

technology greatly simplifies the overall process and reduces cost. The small amount of air (not oxygen) addition is negligible compared with the huge cost in traditional gas cleanup units.	
Tars and particulates are important factors in gasification.	PI did not identify biofuels as the objective of this project. Is there a misalignment with USDOE's goals?
PI Response: We understand the platform objective well. Our CPO technology will benefit both biofuel synthesis as well as power co-gen. The reason we talked about the power & heat co-gen application is that in near term, the mixed alcohol synthesis technology is not developed yet, and while people are developing it, our technology provides addition application for biomass gasification in near to medium term. But, our technology is not limited to power-heat co-gen application only, it is more valuable for the bio-fuel synthesis as well if one day the downstream bio-fuel synthesis technology is available.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
GE's approach is well thought and planned	
PI Response: No response to this comment has been provided by the Principal Investigator.	
CPO has shown effectiveness for tar removal.	Did not demonstrate the CPO utility in a system that could be useful for liquid fuel production.
PI Response: See responses above.	
Interesting approach of using CPO as catalyst and ash filter reducing system components over standard gasification.	Use air feed. N2 no good for fuels. Use for distributed power. No focus on economics.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Some progress made in CPO catalysts. Has plan for system integration.	

PI Response:
At the time of program review, our project had just been for half a year. Our progress was well on target and more results will be expected later this year.

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Have built lab scale reactor and begun testing, very intriguing results	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Convincing experiments for tar elimination, albeit not for the production of liquid fuels.	
PI Response: See responses above	
Demonstrated conversion of biomass via CPO.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
CPO system shows potential.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*

- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Presented convincing arguments that the technology would not be useful for liquid fuel production.
PI Response: See responses above. In addition, we did not argue that our CPO tar removal technology is not useful for liquid fuel synthesis. In fact, our technology will be a very critical piece in generating clean syngas for fuel production whenever the cost effective down-stream bio-fuel synthesis technology is available. We just don't want to limit the application of our CPO technology to fuel synthesis only. From current technology readiness level, power generation from biomass may be a more economically viable route in near term, and bio-fuel synthesis is for the long-term solution. Again, our CPO will benefit both.	
Recognition of alkali metals as a concern and precious metal sintering.	Understanding long-term (1000s of hours) operation impact on the catalyst.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Success factors and challenges identified.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*
- *3-Satisfactory. Future work plans are loosely built on past progress and could address OBP MYPP barriers in a reasonable period.*
- *2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key OBP MYPP barriers in a reasonable timeframe.*
- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP*

MYPP barriers or advancing the program.

Strengths	Weaknesses
Plan to address impact of alkali metals. Plan to develop catalyst costs/economics.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Focus on cogen not liquid gen.
PI Response: See responses above.	
Has defined plan for next steps.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Good university / industry collaboration.	
Good partnership between GE and U of Minnesota; no other collaborations identified.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Well defined project. Intriguing results.	
Simply have to show relationship to liquid fuel production.	Sure, we will do that in the future.

Southeast Bioenergy Initiative - Auburn University - Systems based Products and Energy

Technology Area: Biomass Program
Project Number: 7.3.1.1
Performing Organization: Southeast Bioenergy Initiative
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	2.83	0.98

Approach	2.33	1.03
Technical Progress	2.50	1.05
Success Factors	3.00	0.63
Future Research	2.67	1.37

Overall Principal Investigator Response(s)
Auburn University, with assistance from the Department of Energy, is investing significant resources in a comprehensive laboratory for research on gasification, syngas conditioning, and downstream syngas utilization. There are few domestic facilities like this that contain a full complement of the equipment required to produce, clean, and utilize pressurized syngas for sustained campaigns involving the evaluation of new approaches to energy production, chemical synthesis, and catalysis. When combined with other research underway on biomass production, biomass feedstock logistics, biomass fractionation, biochemical conversion methods, and other thermochemical conversion methods, we feel that these research capabilities at Auburn University provide a significant addition to the bioenergy research infrastructure in the U.S. We would like to thank the Department of Energy for the opportunity to present the status of this project. We would also like to extend our special appreciation to the review panel for their efforts in evaluating these projects.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*

- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Integrated across the whole supply chain as part of institute. This program is only lab gasifier and gas cleanup.	Not clear what new learning will come out of the work.
PI Response: The objectives of this particular project focus on completing a gasification laboratory. After commissioning, research will focus on expanding our understanding of relationships between biomass feedstock characteristics (from a wide variety of agricultural and forest biomass types and forms) and gasification operating parameters (temperature, pressure, oxidant levels, etc.), resulting syngas quality, syngas conditioning (tar removal, sulfur removal, halide removal), and ultimate conversion to liquid fuels through Fischer-Tropsch or other gas-to-liquids processes.	
Could be useful facility for process development work.	Not clear how this facility will be used.
PI Response: The facility will be used for extensive research efforts on biomass gasification, gas conditioning, and gas-to-liquids conversion. Research will revolve around agricultural and forest biomass feedstocks and their conversion to syngas for electrical power production, or for liquid fuel production. The facility will be available for research sponsored by federal or private sponsors.	
Having a pilot research gasifier is very important	It would be most helpful if other DOE awardees would also have access to this resource
PI Response: Auburn University welcomes the opportunity to collaborate with other research groups, either within the Department of Energy, other research universities, or private industry. We are very open to discussion with any other researcher interested in using the facility.	
	Construction and commissioning as goals without mention of why.
PI Response: The primary use of the funds is for construction and commissioning of the gasifier. This facility, when completed, will allow researchers at Auburn University and other collaborating institutions to study gasification and gas conditioning processes for biomass. In the process of developing the project objectives, we were advised to focus the objectives solely on the construction activities and not to include other research objectives since there were not sufficient funds for additional research. We do have numerous plans for conducting extensive research on biomass gasification after completion of the laboratory construction.	
	No data generation. This is a build equipment project.
PI Response: At this point in the project, there are no available data to share on the performance of the gasification and gas conditioning system. After commissioning and commencement of research, we will be happy to share results of our testing efforts.	

This project is intended solely to add capacity to Auburn University.	This project might not add to the body of knowledge. This project might not add to the R&D capacity already in the U.S.

PI Response: We feel strongly that the project does add significantly to the R&D capacity in the U.S. There are no gasifiers of similar design currently operating in the southern U.S. The long term plans for the gasifier are to add feeding mechanisms for coal, which will give us the ability to conduct gasification research on biomass, coal, or combinations thereof. Moreover, when the gasification and gas conditioning facilities are integrated with other Auburn University capabilities for biomass feedstock production; feedstock harvesting and transportation; biomass fractionation; pyrolysis; gasification and power generation; Fischer-Tropsch processes; etc. we believe that this is a significant additional to the R&D capacity in the U.S. for production of renewable electrical power and liquid fuels.

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
	Redundant effort with many other small scale gasification studies. What will be new vs. GTI technology. How will this advance the art?

PI Response: Auburn's fluidized bed gasifier is quite different from other process-development-scale facilities that address individual aspects of gasification research. It is not redundant with other small-scale gasification facilities. As the presentation indicated, the Auburn facility includes:

* A 4 in. internal diameter, pressurized fluid-bed gasifier (150 psig initially, 500 psig max, including operability with enriched air and 100% oxygen), configured to initially gasify biomass, but capable of gasifying coal, biomass-coal mixtures, and other opportunistic fuels,

* A pressurized feeding system (150 psig initially, 500 psig max),
* Syngas cleaning and conditioning systems (including sorbents and catalyst-enhanced systems) capable of providing warm or hot gas that has been filtered, cleaned to ppb levels of contaminants to downstream experiments,
* Integrated instrumentation to assure process control, syngas quality and contaminant monitoring throughout operating campaigns,
* Downstream syngas processing capabilities ranging from Fischer-Tropsch synthesis reactors, mixed alcohol reactors, fuel cells and other proprietary test beds,
* A syngas compressor to provide clean syngas for supercritical conversion processes,
* A fully instrumented set of ancillary laboratories to support gasifier operation and data analysis.

There are few domestic facilities that contain a full complement of the equipment required to produce, clean, and utilize pressurized syngas for sustained campaigns involving the evaluation of new approaches to energy production, chemical synthesis, and catalysis. This is not a small-scale facility. Auburn's facility is a large, well-instrumented research platform for investigating every component of syngas utilization.

What differentiates the gasifier in this facility from GTI's RENUGAS or UGAS designs is that this is gasifier is smaller than other existing and larger RENUGAS or UGAS gasifiers and that it has been specifically designed to be a versatile research platform for syngas research. Thus, many of the internal features of the gasifier have been designed to accommodate reconfiguration for future research opportunities.

	No clear RD&D plan. This is just an equipment procurement and installation. 150 psi is too low for syngas conversion process (due to budget constraint). GTI feels 150 psi is sufficient for evaluation of gasification. Increasing pressure reduces carbon conversion rate - has this been factored into design?

PI Response: GTI's experience gasifying a broad range of biomass and coal fuels suggests that the initial 150 psig operating point may be too low for downstream chemical synthesis, but was chosen to target the first set of research programs planned for the new facility. Thus, the facility is designed to be upgraded to continuous operation at pressures near 500 psig and when fully operational will be a world-class gasification facility that can address the full range of research needs to study syngas production and utilization. With regard to the reviewer's second comment, GTI has not observed a correlation of decreased char conversion with increased pressure. In fact, GTI has seen an increase in the production of carbon compounds at increased gasifier pressures.

Well-managed construction project	What research will be performed?

PI Response: After commissioning, research will focus on expanding our understanding of relationships between biomass feedstock characteristics (from a wide variety of agricultural and forest biomass types and forms), gasification operating parameters (temperature, pressure, oxidant levels, etc.), resulting syngas quality, syngas conditioning (tar removal, sulfur removal,

halide removal), and ultimate conversion to liquid fuels through Fischer-Tropsch or other gas-to-liquids processes. Initial research projects, which are funded by other sponsors, will focus on gasification of southern pine forest residues and lignin produced by fractionation of southern pine.	
	Design, construction and shakedown are goals - again, without mention of why.
PI Response: In the process of developing the project objectives, we were advised to focus the objectives solely on the construction activities and not to include other research objectives since there were not sufficient funds for additional research. We do have numerous plans for conducting extensive research on biomass gasification after completion of the laboratory construction.	
	Approach was selected to test at high pressure FT type conditions. However, the design of the system will not permit this investigation without further modifications.
PI Response: The presentation attempted to describe a facility in several configurations: the initial configuration with operation at 150 psig, as well as a complete facility that could operate to 500 psig and accommodates all of the components described in another response, above.	
	Not clear why 150 psi maximum was selected -- it doesn't seem to match well with downstream conversion.
PI Response: This comment appears with a sufficient frequency to suggest that we did not properly address this design point in our presentation or oral remarks. As indicated in our responses above, the facility is designed to operate at up to 500 psig. For initial test campaigns, the gasifier will be operated and evaluated for operation at 150 psig. Subsequently, the feed system and downstream components will be upgraded to allow operation at higher pressures and accommodate larger volumes of syngas production.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Laboratory construction is nearing completion.	

PI Response:	
Spending and construction seems to be on target.	
PI Response:	
Goals were completely unambiguous and related only to construction.	Timeline has not been met.
PI Response: Overall goals of the research, which have been outlined in other comments, are to expand our understanding of relationships between biomass feedstock characteristics and gasification operating parameters (temperature, pressure, oxidant levels, etc.), resulting syngas quality, syngas conditioning (tar removal, sulfur removal, halide removal), and ultimate conversion to liquid fuels. During the process of developing the project objectives, we were advised to focus the objectives solely on the construction activities and not to include other research objectives since there were not sufficient funds for additional research. There are numerous research efforts planned for the laboratory that will address the goals outlined here. We are not behind schedule as defined in the PMP document submitted to DOE.	
Design and safety reviews complete.	Significant installation and fabrication needs to get done. Modest completion for place in schedule.
PI Response: Auburn University and Gas Technology Institute are working diligently to complete construction of the laboratory and the gasification systems.	
	Project appears to be behind schedule owing to late start.
PI Response: We are not behind schedule when compared to the PMP document submitted to DOE.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Fairly common success factors and challenges, nothing unique.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Not applicable.	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Goals related only to construction, not to any performance metrics.	
PI Response: Several performance metrics for the gasification facility itself were summarized in the presentation. Since this project is focused only on the construction of the facility, other factors (technical, business, and market) are not directly applicable to this project. These factors will obviously remain important as research projects are initiated in the laboratory.	
No real showstoppers.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	Redundant with other activities. Not clear what new learning will come from this effort.
PI Response: There are few domestic facilities that contain a full complement of the equipment required to produce, clean, and utilize pressurized syngas for sustained campaigns involving the evaluation of new approaches to energy production, chemical synthesis, and catalysis. This facility is not redundant with other facilities because it is quite unique as described in the comments in Section 2 above. After commissioning, research will focus on expanding our understanding of relationships between biomass feedstock characteristics (from a wide variety of agricultural and forest biomass types and forms), gasification operating parameters (temperature, pressure, oxidant levels, etc.), resulting syngas quality, syngas conditioning (tar removal, sulfur removal, halide removal), and ultimate conversion to liquid fuels through Fischer-Tropsch or other gas-to-liquids processes. Unique features of this facility will be its use of southern forest and agricultural residues along with components of fractionated biomass produced in other Auburn University laboratories.	
No program currently defined	
PI Response: A summary of future research plans has been provided in other comments here.	
	Need more information about what research will be done in this gasifier.

PI Response: A summary of future research plans has been provided in other comments here. Initial research that is scheduled for the lab includes: gasification of southern forest residues; gasification of lignin produced through biomass fractionation; tar mitigation using in-bed catalysts; and production of pure hydrogen.	
Funding for DOE program ends.	
PI Response: The presentation provided a list of future research that is planned after the gasification system fabrication is completed. All of these research topics (as outlined in previous comments) are relevant to DOE goals for conversion of biomass to liquid fuels and electrical power.	
	Future work is outside of funding. Will need a source of funding to get the work done, i.e. DOE will not receive any experimental data.
PI Response: Several research efforts are planned for the laboratory once completed, as outlined in other comments. These future research projects are highly relevant to DOE goals for production of syngas from biomass and subsequent conversion to liquid fuels and electrical power. Results from these efforts will be published and made available to DOE whenever appropriate.	
The facility, once built and shaken down, should help Auburn University conduct some useful research.	
PI Response: We agree completely. There are few domestic facilities that contain a full complement of the equipment required to produce, clean, and utilize pressurized syngas for sustained campaigns involving the evaluation of new approaches to energy production, chemical synthesis, and catalysis. This facility will provide a significant addition to the U.S. research infrastructure focused on thermochemical conversion of biomass to liquid fuels and electrical power.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Not clear what technology transfer options are.	The project involves close collaboration initially with the Gas Technology Institute. After the laboratory is completed, research is planned that will involve collaboration with other universities, US government research organizations (DOE, USDA-ARS, and USDA Forest Service), and private industry. Research results will be published as soon as projects are completed. As new intellectual property is developed during future research, technology transfer procedures are in place at Auburn University to promote the implementation and commercialization of the technology.
Good collaboration with GTI.	

Gas Technology Institute	
no collaborations stated	The presentation highlighted our collaborative relationship with the Gas Technology Institute. As discussed above, we have close ties with other universities and government agencies, as well as with private industry. Extensive research with these other groups is planned and ready to proceed as soon as the laboratory is finished.
This is a capacity building project for Auburn University. GTI is a partner.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Project is focused on installation of lab scale biomass gasification and gas conditioning system.	
Project is ending.	While this project has a limited scope (i.e. construction and commissioning of the gasification system); an extensive set of research projects will commence after completion of this project.
Downstream syngas cleanup and conversion equipment should be eliminated since this equipment is not designed for appropriate pressure and/or temperature. The gasifier alone could then be run at appropriate conditions and syngas quality could be understood.	Perhaps we were not clear in our remarks or in our slide presentation. The Auburn facility will be operated at pressures up to 500 psig, and research into downstream gas conditioning and syngas upgrading is an essential component in facility design. Assessment of raw syngas quality is an interesting task, but the cleaning and conditioning of syngas to a point where downstream conversion processes are not compromised is a research goal of the first order involving many opportunities for innovative and collaborative research.

Catalytic Hydrothermal Gasification for Eastman Kingsport Chemical

Technology Area: Biomass Program
Project Number: 3.2.4.2
Performing Organization: PNNL
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation

Relevance	3.00	1.26
Approach	3.83	0.41
Technical Progress	3.17	1.17
Success Factors	3.50	0.55
Future Research	3.67	0.82

Overall Principal Investigator Response(s)
We appreciate that the reviewers recognize this work supports the ethanol production of the bioconversion platform. Because the process produces a gas product, not a liquid fuel, there are varying opinions about the overall relevance of the work in a liquid fuels oriented program. The wide range of reviewer's scores for overall relevance is typical of past evaluations. The reviewers appreciated that we were working with real biomass feedstocks and all recognized the problems we have had in obtaining the lignocellulosic ethanol residues. We agree this critical issue of being able to obtain actual lignin-rich fermentation residues has slowed progress on this project. We have now received such residues and are making progress in testing them now.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
	Looking at the lignin residue from bioconversion. Not directly contributing to the production of liquid fuels. May impact the economics of cellulosic ethanol, but the economic case is not strong.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Process is particularly suitable to slurry biomass feeds (eg. Biorefinery lignin residues)	Fits better with biochemical conversion path. Final product is not liquid transportation fuel, although this may improve process economics of biochemical pathway.

PI Response: No response to this comment has been provided by the Principal Investigator.	
	This project has progressed to the point where preliminary economics show that the CHG technology does not offer any clear advantages.
PI Response: No response to this comment has been provided by the Principal Investigator.	
The project enables use of residues from the biochemical side of the OBP	Does not stand on its own for a pure thermochemical only system. Furthermore, the products are not liquid fuels.
PI Response: No response to this comment has been provided by the Principal Investigator.	
May aid in enabling biochem conversion processes.	Heat and power application.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Use of high moisture feedstocks is important for some thermochemical conversion scenarios.	Stated applications are "chemical use, process heat, electricity," how does this fit into the liquid fuels goals of USDOE?
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Working with real biomass samples, not model compounds.	Have not gotten a cellulosic ethanol residue.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Techno-econ analysis shows reasonable outcome.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Working with feedstock as opposed to model components is valuable.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Experiments seem to be progressing adequately on bench-scale system to the extent that	Lack of feedstocks is a concern. Obviously, PNL has not been very successful in selling the

feedstock is available.	idea to stakeholders.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Some testing of related feedstocks, but not the target feedstock. Program is behind but is conserving funding for when feedstock is available.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Technoecon comparison with direct combustion demonstrated potential savings.	Difficulty in acquiring feedstock has delayed progress.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Obviously, the delays caused by the inability to secure feedstocks is a problem.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Bench scale data obtained.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Have not received a LC derived lignin which is holding up work. Heat integration causing lower power export.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Economic analysis suggests that this could be competitive to incumbent processes for handling EtOH by-product streams.	Inability to get feedstock is a serious bottleneck. Project timeline has slipped considerably.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Economics are not clearly superior. Technical risk is high.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Use of a mobile unit to allow testing of a variety of feedstocks.	Obtaining feedstocks is an issue limiting progress.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project has identified key barriers to progress: availability of lignocellulosic ethanol residues, sulfates may be challenging, and need industrial partner for scale-up.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Need to get feedstocks.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Sound plans are in place to secure the desired feedstock.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

Algae would seem to be a reasonable target.
PI Response: No response to this comment has been provided by the Principal Investigator.
Continued testing and acquisition of feeds.
PI Response: No response to this comment has been provided by the Principal Investigator.
Bench scale testing of other materials.
PI Response: No response to this comment has been provided by the Principal Investigator.
Future plans seem sound.
PI Response: No response to this comment has been provided by the Principal Investigator.

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Difficult technology transfer since the partner Antares is not involved. Will be strongly dependent on the cellulosic ethanol industry.	
Verenium, Mascoma, Genifuel (algae)	
Nice focus on getting out of the lab, but little data presented to show that the process is able to jump to commercial scale.	
Ties into the biochem program using lignin by product. Antares backed out of technology. Needs partner for design and host facility.	
Project seems to be occurring in a vacuum; need to develop stronger partnerships.	

2) Recommendations for Additions/Deletions to Project Scope

Center for Producer-Owned Energy

Technology Area: Biomass Program
Project Number: 7.4.1.3
Performing Organization: Agricultural Utilization Research Institute
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	1.17	0.41
Approach	1.83	0.75
Technical Progress	2.17	0.75

Success Factors	1.67	0.82
Future Research	1.83	1.60

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
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- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
	Focus on electrical production, not liquid fuels. Not related to OBP liquid fuel objective.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Most projects don't fit with thermochemical conversion path. Gasification off grass residue is too small scale and not leading to synfuels.
PI Response: No response to this comment has been provided by the Principal Investigator.	
ash granulation is necessary	Why is DOE funding glycerol and DDG use in livestock rations?
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project does not make liquid fuels.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project is not concerned with making biofuels.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	No clear integration of various subprojects that make up this project. How the bulk of this project serves USDOE's biofuels objectives is not clear.
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
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- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
	A patchwork quilt approach of separate projects. Very narrow applicability for the project's technologies (specific grass residues).
PI Response: No response to this comment has been provided by the Principal Investigator.	
	This is just a collection of projects. No real work plans or project controls discussed.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Actual operation of a gasifier with PSA - unfortunately not for fuels production.	Focus on use of grass seed remnants. Limited availability and scope.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Uses ag waste as feedstock.	Feedstock is a niche feedstock, i.e. very little practical use in other geographies of the US. Other tasks are outside scope of TC. E. coli in DDGS may be a better fit for biochem pathway.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not clear that any of the R&D is sound or relevant.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

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- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Behind schedule, only 25% complete yet period of performance is 75% done.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	None identified
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Making power, not fuels.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Demonstrated ash granulation technology.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project admittedly is behind schedule.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Did not review success factors or showstoppers for any of the subtasks or the overall program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	None identified
PI Response: No response to this comment has been provided by the Principal Investigator.	
Actual operating real-world facilities.	Several projects for not much money, but few overlap with goals of the OBP.
PI Response: No response to this comment has been provided by the Principal Investigator.	

	No recognition of the these factors.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not clear that this is adding to the body of knowledge.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
	Did not present an overall program plan.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	No real plan was presented
PI Response: No response to this comment has been provided by the Principal Investigator.	
none - funding ended.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	None described.
PI Response: No response to this comment has been provided by the Principal Investigator.	

<u>1) Technology Transfer/Collaborations</u>

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Lots of collaborators receiving funding	
Many partners from within Minnesota.	
Technology transfer is largely to the biochem conv., ag and cattle industry.	
Many partners, but projects show no integration and do not contribute to solving important USDOE problems vis-Ã -vis biofuels/bioenergy production and commercialization.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
drop this project (yea, right!)	

Development of New Gasification Processes for Biomass Residues: Gasification Kinetics at Pressurized Conditions

Technology Area: Biomass Program
Project Number: 3.2.1.5
Performing Organization: NREL
Number of Reviewers: 5

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.40	0.55
Approach	4.00	1.22
Technical Progress	3.60	0.89
Success Factors	4.00	0.71
Future Research	3.80	0.84

Overall Principal Investigator Response(s)
No Overall PI Response
Thermochemical Platform Review has been very helpful in focusing on some of the things that we had not previously considered. A number of good points were made during the question/answer period which made us think of certain aspects early enough in the project. This would allow us to make revisions in our experimental matrix, without causing any real delay in the project. The questions raised about collaboration with NREL gasification fundamental projects and other commercial entities are very good ideas to think of, at the early stage of the project. I find it to be a critical yet supportive review of the work plans, basic theme, and how it ties up with other efforts supported by the DOE. .

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*

- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Entrained flow and pressurized gasifiers. Important to look at gasifier configurations beyond indirect steam gasification.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project will improve fundamental understanding of biomass gasification kinetics.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
pressurized gasification processes involving very fast heating rates - needed to model kinetics	too early in the project to judge
PI Response: No response to this comment has been provided by the Principal Investigator.	
Operation of pressurized gasifiers holds the promise of reducing the operating expense and capital. This is consistent with the goals of the OBP. Also, the reduction of tar in entrained flow gasification is a worthy target.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Finding solutions to tar and HC production is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2 . Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

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- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Pressurized entrained flow and TGA. Three diverse biomass samples. Focus on developing kinetic fundamentals. Determine carbon conversion rate and tar formation.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
PEFR test facility is unique capability. Can generate unique fundamental data for kinetic models.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Operating facility has proven track record and can clearly track kinetic parameters.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Facility has capabilities that are not found at many other institutions nationwide (1500C, 80 bars).	Project just commenced. It's not clear that the reactor (entrained flow) might impact tar formation, particularly in light of tar and char interaction.
PI Response: Entrained flow reactor (PEFR) mimics the commercial gasifier more closely than does the PTGA, both in terms of biomass particle heating rates and the biomass particle residence time. We agree with the comment that the tar-char interactions are more complex in the PEFR than in the PTGA. This is becuase of the fact that gas residence times in a PTGA are going to much smaller (0.1-0.5 sec) than in a PEFR (3-10 sec). We plan to monitor the tar constituents in our PTGA studies, but we will still measure the tar levels (total) produced in the PEFR. In any case, PEFR operation resembles the commercial gasifier operation more than PTGA does in terms of the residence times for gas and solids.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

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- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Good progress on relevant data in short amount of time.	Just started in January.
PI Response: No response to this comment has been provided by the Principal Investigator.	

Project is just getting underway	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Building on a sound foundation - project at the beginning.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is only 3 months old so is difficult to evaluate.	There has been a lot of R&D on pressurized gasification at infinitely larger scales.
PI Response: The aim of this research is to obtain fundamental reaction rate information for carbon gasification that encompasses the impact of all relevant gas species. Larger scale studies do not provide this type of information. There have also been a number of studies in laboratory reactors but to the author's knowledge, there are no studies that incorporate simultaneously the impact of H2O, CO, CO2, and H2 in a fundamental, Langmuir-Hinshelwood type kinetic rate expression at pressurized conditions.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good identification of the necessary success factors and estimation of the challenges. Difficult kinetic investigation to conduct but that was acknowledged by presenter.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Extensive experience operating PEFR facility to get and analyze this type of data	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Nice to see that other gasification options explored.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Some potential bottlenecks identified.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Straightforward plans for kinetic studies with go/no go decision at end of first year. Not clear what criteria for going forward are.	
PI Response: The go/no-go decision will be based on the ability to obtain kinetic information in a quantitative manner from the PEFR and PTGA studies.	
New project ref 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
I think this project screams for involvement in the NREL gasification fundamentals study.	
PI Response: Close collaboration with the NREL gasification fundamentals project is planned. One student from Georgia Institute of Technology is already working at the NREL facilities in Boulder on using the PTGA for biomass gasification. The PI plans to periodically visit the facilities to monitor the students' progress and to keep the communication lines open. The PI plans on meeting with the key personnel involved in the NREL gasification fundamentals project and exchange the results to help in improved interpretation of the data.	
Has plan for future work. Kinetics have not been well studied.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Not clear.	
NREL	
Limited stated, but see great promise.	
Collaborative effort between Georgia Tech and NREL; but no external collaborators identified.	We have already initiated dialogue with NewPage, and we plan to contact other

	organizations that are engaged in biomass gasification on a demonstration scale or pilot scale project. Such a dialogue/collaboration will be most helpful when we have collected enough data at least on one of the biomass so that we can begin to outline the development of a kinetic model. There are a few entities (both in the US and outside the US) that are presently pursuing high pressure biomass gasification.

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
None.	
Show how data generated will fill gap in the existing literature/work on biomass gasification fundamentals	The scope has been expanded to include an examination of the effect of heating rate on the physical structure (porosity and BET surface area) of the biomass. Thus the role of physical structure, chemical composition of the biomass (potential catalytic effects of ash components), pressure, gas-phase composition when integrated together will provide a more comprehensive picture of the biomass gasification processes, than has been available from focusing on a narrow aspect alone. It should be noted that the fundamental rate information with all relevant gases at pressurized conditions is sorely lacking. We expect that the more complete picture generated from this study will help us better understand the literature results.
Recommend close collaboration with NREL fundamentals of gasification process.	Close collaboration with the NREL gasification fundamentals project is planned. One student from Georgia Institute of Technology is already working at the NREL facilities in Boulder on using the PTGA for biomass gasification. The PI plans to periodically visit the facilities to monitor the students' progress and to keep the communication lines open. The PI plans on meeting with the key personnel involved in the NREL gasification fundamentals project and exchange the results to help in improved interpretation of the data.

Dual Layer Monolith ATR of Pyrolysis Oil for Distributed Synthesis Gas Production

Technology Area: Biomass Program
Project Number: 3.2.2.8
Performing Organization: Stevens Institute of Technology
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.33	0.52
Approach	2.83	0.98
Technical Progress	3.17	0.41
Success Factors	3.00	1.10
Future Research	3.00	0.63

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Alternate approach for making syngas from biomass.	Program based upon a supply chain model that is not likely to happen. I have serious doubts about distributed pyrolysis units and distributed syngas production.
PI Response: The integrated process we envision, involves an on-site distributed production platform for	

biomass pyrolysis to pyrolysis oil, PO. The PO from various producers within the same geographical region will then be transported using existing infrastructure to a centralized facility where the PO will undergo ATR and subsequent F-T conversion to fuel. As an example of our distributed processing concept, we envision a cluster of 10 farms each producing 5 dry tons/day (dtpd) of biomass to be processed sequentially every 10 days by a 50 dtpd ***mobile pyrolysis unit***. Ten 50 dtpd mobile pyrolysis units will process biomass from a collection of 10 such clusters (a collective of ~ 100 farmers) for a total of 500 dtpd which will provide the PO feed to the centralized ATR/FT facility to produce a few thousand gallons of liquid fuel per day (~5MMgal./yr), akin to a local filling station serving about three thousand users daily. In comparison, a typical centralized gasification plant processes about 2000 dtpd equivalent to biomass production by 400 farmers. In a detailed economic study, Boateng et al have shown that (a) the production of PO at individual farms (distributed PO) and shipping it to a central upgrading facility is more economical than (b) shipping raw biomass to a central upgrading facility. The study indicated that significant savings resulting from transportation cost reduction accrues to the distributed pyrolysis concept, option (a) compared to shipping raw biomass directly to a central processing facility, option (b). Another recent study by Henrich et al. also showed the benefit of densifying the feedstock by pyrolysis and shipping the oil by tanker trailer or rail car. In a preliminary study, we have further corroborated the importance of biomass transportation cost in a simplified model of a 16-farm cluster, using a scenario reflective of Iowa farms. The difference in transportation cost between the two options was ***$20.8M/yr*** in favor of option (a) for 15,000 farms. To further reinforce our proposed approach, ***according to Eidman, a centralized facility producing 50MM gallons of liquid fuel per year would require a truck loaded with raw biomass to arrive every six minutes around the clock.*** Wright, M.; Brown, R. C.; and Boateng, A. A.; Distributed processing of biomass to bio-oil for subsequent production of Fischer-Tropsch Liquids. *Biofuels, Bioprod. Bioref.* **2008**, 2, 229 – 238 Henrich, E.; Dahmen, N.; and Dinjus, E. Cost estimate for biosynfuel production via biosyncrude gasification. *Biofuels, Bioprod. Bioref.* **2009**, 3, 28 – 41. Rothman, D. The Price of Biofuels. *Technology Review* **2008**, January/February, 42 – 51.	
Applying dual-catalyst, monolith reactor (micro-reactor) to autotherrmal (steam) reforming of pyrolysis oil.	Too early to tell
PI Response: No response to this comment has been provided by the Principal Investigator.	
Work seeks to couple pyrolysis and gasification to improve overall economics	Vision appeared to be distributed pyoil production, but in Q&A was stated that it would be small scale through production. Air feed is not well suited for subsequent chemical production.
PI Response: Please see responses to these comments elsewhere.	
Combined pyrolysis distributed with central gasification (ATR).	Compared with other pyrolysis/gasification approaches, the char BTUs may be lost.

PI Response: In our envisioned integrated process, a significant portion of the bio-char co-product will be combusted to provide process heat for the endothermic pyrolysis reaction. The char is also valuable as a soil amendment and carbon sequestering agent, and any left-over could be used for this purpose right on the farm where it is produced.
The concept of distributed energy systems is good. Reforming of pyrolysis oil is important. There is a clear need to design cost-competitive, distributed energy systems.
PI Response: No response to this comment has been provided by the Principal Investigator.

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
	Revolatilizaition of pyrolysis oil will be very difficult - viscosity build and vitrification of the oil will present operability problems. Energy balance problem - will need air or oxygen to drive ATR conversion, despite claims to the contrary.
PI Response: We recognize re-volatilization of pyrolysis oil as one of the key challenges that need to be overcome. A number of researchers have however reported successful re-volatilization of pyrolysis oil (PO) using approaches such as, in-line steam heating, PO atomization in a triple-nozzle injection system (Nitrogen, Pyrolysis Oil and Steam), or in a temperature-controlled injection nozzle'. We have responded to the other part of the comment elsewhere. Bridgwater, A. V.; and Cottam, M. –L,; Opportunities for Biomass Pyrolyis Liquids Production and Upgrading. Energy & Fuels. **1992**, 2, 113 – 120. Wang, D.; Czernick, S.; and Chornet, E.; Production of Hydrogen from Biomass by Catalytic Steam Reforming of Fast Pyrolysis Oils. Energy & Fuels. **1998**, 12, 19 – 24. Bleeker, M. F.; Kersen, S. R. A.; and Veringa, H. J. Pure Hydrogen from Pyrolysis Oil using Steam-Iron Process. Catalysis Today. **2007**, 127, 278 – 290.	

Czernik, S.; French, R.; Feik, C.; and Chornet, E. Hydrogen by Catalytic Steam Reforming of Liquid Byproducts from Biomass Thermoconversion Processes. Ind. Eng. Chem. Res. **2002**, 41, 4209 – 4215. Czernik, S.; Evans, R.; and French, R. Hydrogen from Biomass-production by Steam Reforming of Biomass Pyrolysis Oil. Catalysis Today. **2007**, 129, 265 – 268.	
Good experimental plan	Distributed syngas does not make sense. Commercial vision is not clear. Previous studies have show higher capex with distributed pyrolysis model - not clear how this improves on this improves on that.
PI Response: Please see response elsewhere	
	I am confused by the comments about pyrolysis oil and the autothermal conversion to syngas. Pyrolysis oil must have lower oxygen content than a sugar. My understanding of thermo says that sugars will not exothermically convert to syngas.
PI Response: The H_2O/C and O_2/C ratios are two of the most important process parameters we plan to optimize during the process. This was stated in Slides 5 and 9 of our peer-review presentation. Oxygen in form of air will be added to the process. We however expect that some of the (non-molecular) oxygen in the highly oxygenated pyrolysis oil will be available for the exothermic Catalytic Partial Oxidation (CPO) thus reducing the amount of O_2 that needs to be externally added. Since dual layer ATR has never been implemented for pyrolysis oil, it's difficult a prior to predict how much additional oxygen will be required. This was explained at length by the PI in response to a comment in the same vein during the Q&A. In fact, there was a follow-on question by another reviewer on the form in which the O_2 will be supplied. In extensive tests of the BASF dual layer ATR catalyst by BASF, the O_2/C ratio for methane was about 0.4 whereas it was 0.25 for methanol, a reduction of 37.5%, which is quite significant. The H_2O/C ratios for both cases were approximately 1.	
Built in Go/No Go decision points and milestones.	Thought that no added oxygen is needed. Air feed will be expensive to compress, plus syngas will be N2 diluted. This will result in a low conversion of syngas conversion to FT/ethanol.
PI Response: Our objective is to minimize the amount of O_2 (in form of air) to be added to the process. The presence of N_2 in the feed to the F-T reactor presents a problem, and we are aware of on-going efforts by others to develop a commercially viable solution which if successful, we intend to incorporate in our envisioned integrated process. The current project only focuses on the ATR step.	
Quite straight forward project plan with appropriate Go-No Go milestones.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Program just started.
PI Response: No response to this comment has been provided by the Principal Investigator.	
New project	
PI Response: No response to this comment has been provided by the Principal Investigator.	
New project- planning looks OK	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project just started - 5% progress.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just started so no assessment can be made on technical progress.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good identification of performance metrics necessary for success.	If pyrolysis oil can not be vaporized, the program will not go forward.
PI Response: We recognize re-volatilization of pyrolysis oil as one of the key challenges that need to be overcome. A number of researchers have however reported successful re-volatilization of pyrolysis oil (PO) using approaches such as, in-line steam heating, PO atomization in a triple-nozzle injection system (Nitrogen, Pyrolysis Oil and Steam), or in a temperature-controlled injection nozzle". Bridgwater, A. V.; and Cottam, M. –L,; Opportunities for Biomass Pyrolyis Liquids Production and Upgrading. Energy & Fuels. **1992**, 2, 113 – 120. Wang, D.; Czernick, S.; and Chornet, E.; Production of Hydrogen from Biomass by Catalytic Steam Reforming of Fast Pyrolysis Oils. Energy & Fuels. **1998**, 12, 19 – 24. Bleeker, M. F.; Kersen, S. R. A.; and Veringa, H. J. Pure Hydrogen from Pyrolysis Oil using Steam-Iron Process. Catalysis Today. **2007**, 127, 278 – 290. Czernik, S.; French, R.; Feik, C.; and Chornet, E. Hydrogen by Catalytic Steam Reforming of Liquid Byproducts from Biomass Thermoconversion Processes. Ind. Eng. Chem. Res. **2002**, 41, 4209 – 4215. Bridgwater, A. V.; and Cottam, M. –L,; Opportunities for Biomass Pyrolyis Liquids Production and Upgrading. Energy & Fuels. **1992**, 2, 113 – 120.	
	Commercial vision/fit is not clear. Claim that autothermal reactions can occur for py-oil without addition of O2 is dubious. Depends upon improvements in py oil stability for intermediate product
PI Response: Please see response elsewhere.	
Recognized atomization of py-oil as critical factor, regeneration of catalyst activity,	
PI Response: No response to this comment has been provided by the Principal Investigator.	
List of technical challenges is quite logical.	Scalability of technology was not discussed.
PI Response: Adiabatic scale-up of our proposed ATR process will feature 1 ft by 1 ft monolith reactors arranged in parallel to meet desired production rate. BASF has successfully demonstrated this scale-up approach in a number of commercial processes. This was stated in the proposal.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*

- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*
- *3-Satisfactory. Future work plans are loosely built on past progress and could address OBP MYPP barriers in a reasonable period.*
- *2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key OBP MYPP barriers in a reasonable timeframe.*
- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Program plan as constructed will meet objectives assuming no major technical showstoppers materialize.	Should incorporate economics explicitly into the program to guide development. I have strong concerns about the economics of such a small scale distributed system.
PI Response: We have undertaken a preliminary economic analysis, the outcome of which was presented as part of the proposal. We will continue to refine the analysis as data become available from the project.	
New project, ref 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	No clear description or economic justification given.
PI Response: Please see responses elsewhere.	
Adequate.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
BASF (formerly Englehart)	
Working with catalyst vendor and patent holder is good.	
Collaboration between Stevens IT and BASF Catalysts, LLC	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Pathway should be modeled initially to understand the promise, i.e. is there potential to produce ethanol cheaper than biomass gasification and/or pyrolysis oil hydroprocessing.	Catalysts specific to hydrodeoxygenation or hydrocracking of pyrolysis oils are yet to be developed. Catalysts currently used have been those traditionally used to upgrade petroleum-based heavy oils. High hydrogen compression

	and consumption, poor selectivity, and rapid catalyst deactivation have prevented cost effective technologies. Our preliminary economic analysis indicates that our approach is cost-competitive when compared to these routes. We will continue to refine the analysis as data become available from the project.

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iv. Gas Stream Clean-Up and Conditioning

Catalyst Fundamentals Integration

Technology Area: Biomass Program
Project Number: 3.2.5.6, 3.2.5.8
Performing Organization: NREL
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.67	0.52
Approach	4.33	0.82
Technical Progress	4.00	0.89
Success Factors	3.83	0.75
Future Research	4.17	0.75

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of*

the project align with the needs of customers and markets; customers/markets are identified.

- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Addresses a number of the risks and concerns downstream from the gasifier. Focused on reforming catalysts.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
combi, microtesting, computational to design catalysts forâ€¦ - tar and methane reforming catalysts - sulfur sorbents - carbon dioxide sorbents	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Tar is a huge issue in much of the thermochemical conversion steps. The elimination of tars for any process that follows gasification with a catalytic reactor.	Syngas reforming has proven to be particularly challenging due to poisons, such as S, in the feeds.
PI Response: We agree that sulfur poisoning is a critical factor and are taking hte following steps to address this significant process issue: 1) examining alternative catalysts and supports that confer sulfur tolerance both singly or in combination. These comprise bimetallic catalysts (ie. SnNi, WNi), precious metal supported catalysts, and alternative support systems. 2) assessing short cycles of reforming and regenration with the current fluidizable catalysts and also with emerging sulfur tolerant catalysts to mitigate or eliminate sulfur poisoning. This is analogous to how FCC catalysts are used. Preliminary work shows that the concept is valid and a commercial partner will be using the fluidizable material to reform tars in a recirculating regenerating pilot scale reactor. Their data will be made available to us to assess catalyst performance in the presence of sulfur and use the data in our technoeconomic assessment. 3) developing high temperature sulfur sorbents and multifunctional catalysts - the combination of which may yield desired reforming performance. We are also exploring process variants that will enhance high temperature sorbent performance. 4) using computational catalytic modeling to design sulfur tolerance into new catalysts and support systems. This is longer range research but early results are promising. This approach is in combination with high throughput screening.	
Addresses a broad area of syngas cleanup, conditioning, etc. Addresses significant cost to final $/gal of ethanol. Catalysts and sorbents.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

Tars and HC reduction is important in gasification. Coking of fixed bed gasifiers has been identified as a bottleneck; fluidized beds are a solution, but attrition of catalysts is a problem, which this project addresses.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Good use of multiple tools from lab reactors, pilot reactors, combi screening of catalysts and computational modeling. Methodical and disciplined approach to screening catalysts.	Multiple step regeneration could prove to be too complicated and costly.
PI Response: We agree that multistep regeneration could be too complicated and costly though the refining industry routinely uses this approach for FCC catalysts. We are addressing this critical process issue via: 1) developing a recirculating regenerating reactor that operates with model or raw syngas to assess this mode of coupled reforming and regeneration and determine the associated economics and impact on our technoeconomic model 2) An industrial partner is evaluating the NREL fluidizable catalyst using pilot scale reforming regenerating conditions for tar reforming sulfur containing raw syngas. Obtained data will be made available to us for comparison and inclusion in our models. Samples of used catalyst will be sent to us for analysis and comparison to our used materials as well. This kind of collaboration should yield definitive data on this process approach with respect to use, cost and potential deployability.	
Combinitorial screening through pilot scale validation testing capabilities Excellent analytical capabilities	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Nice relationship between computational and experimental program. Moving from micro to pilot scale testing is a great feature.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	The project lacks a milestone structure for project management. No clear measurement of progress on goals. Develop criteria for success or failure.
PI Response: There was not time to provide the milestone structure in the presentation but there are several decision points built in with respect to catalyst and sorbent cost and performance. As well, we are working with proprietary process options that could yield significant improvement in overall reforming performance in the presence of sulfur.	
Between PNNL and NREL, there is adequate capability to span from bench-top to pilot scale. Catalyst screening process is sound and there is partnership with commercial catalyst manufacturers.	Project is costly.
PI Response: Respectfully request further details on this comment: costly compared to what?	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Have identified good candidate reforming catalysts. Have moved them through fairly comprehensive testing and characterization.	I have concerns about the level of complexity associated with a multi-step catalyst regeneration process.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Met milestone to produce catalyst	catalyst scaled up still is not likely commercially ready.
PI Response: No response to this comment has been provided by the Principal Investigator.	
A significant number of materials have been tested for catalytic activity and supports.	Methane reforming has been challenging. Catalyst requires a multi-step regeneration

Developed attrition resistant supports.	process.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good progress made to date; appears to be at roughly the 50% stage. Approach is broad and highly integrated.	Validation with biomass derived syngas mentioned several times, though data to support the validation were not shared.
PI Response: Agreed. This presenter would have liked an hour for the presentation...... Data with raw syngas was resented in the Integrated Gasification and Fuel Synthesis task.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Broad range of tools being brought to bear on this problem.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Scale-up is never a small feat and success is admirable.	Sulfur still looms large and still seems a potentially insurmountable issue.
PI Response: See above response. From a more global perspective, the petroleum industry has learned how to deal with sulfur - we think we can too: we have to....	
	Identifying business impacts of sorbent and catalyst regen approaches is lacking in the project.
PI Response: Addressed in above comments.	
Potential systems (circulating bed catalyst regeneration) have been identified.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Logical extension of good catalyst discovery and development work.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Continued highp-throughput application seems a reasonable way to look for a true breakthrough. Perfecting the skills to scale and test are valid. Move to circulating fluidized bed is a reasonable approach (but won't help captial or operability). Sulfur sorbents also seems a reasonable direction.	Catalyt production at NREL can't really be called commercial and validation of commercial scale-up should not be overlooked. I'd be remiss if I didn't point out that circulating fluidized bed as a fix is a costly option, both in capital and operating expense.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Cost impacts should be evaluated of regeneration approaches.
PI Response: As noted above, regeneration costs will be included in technoeconomic assessments as data becomes available in the next year.	
Future research is mapped out in logical manner. Challenges are identified.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Good collaboration with other programs.	
Good collaboration with commercial catalyst suppliers/developers.	
NREL, Colorado School of Mines, Colorado University, CoorsTek (alumina support)	
The program still strikes me as too inwardly focused between the two government labs. Reaching out to companies with true expertise in fluidization and catalyst synthesis.	

Working with commercial catalyst company. Catalysts are available for license.	
Project team claims collaboration with industry (though none named). Collaboration with University of Colorado, Bolder, identified.	Collaborators include WR Grace, Sud Chemie, CoorsTek, NexTech, GTI, Colorado School of Mines, CU-Boulder.

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
While it is admirable to be manufacturing 100 kg batches, it is not good use of anyone's time or money. Early involvement with a true vendor will overall reduce time and $.	
Add a economic modeling aspect to proposed approaches.	Yes. See above responses for details.
47 slides in this presentation. That's ridiculous!	

Integrated Gasification and Fuel Synthesis

Technology Area: Biomass Program
Project Number: 3.2.5.7
Performing Organization: NREL
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.67	0.52
Approach	3.83	0.75
Technical Progress	4.17	0.75
Success Factors	3.83	0.75
Future Research	4.17	0.75

Overall Principal Investigator Response(s)
The reviewer comments are generally related to the objectives of the Integrated Gasification and Fuels Synthesis (IGFS) task, and the use of the Thermochemical Process Development Unit (TCPDU) to meet those objectives. In particular, the duration of tests to evaluate catalyst lifetimes, contamination buildup, and feed stock size variations were mentioned. The OBP is tasked with demonstrating the necessary technologies for the conversion of biomass to fuel-grade ethanol by the end of fiscal year 2012 at a price competitive with starch-based (i.e. corn-based) technologies. The path towards this 2012 objective is being achieved incrementally in line with the available annual funding and to match the stage of development for each technology. The TCPDU at NREL is a small pilot scale facility designed as a research tool for multipurpose biomass conversion technologies. Depending on the research objectives for a given user, it can be configured and

operated to meet diverse process conditions. The IGFS task objectives are to validate the individual unit operations needed to convert biomass into ethanol via mixed alcohol synthesis. At the present time, the primary barrier being validated is the gas cleaning process to produce a syngas suitable to mixed alcohol synthesis – especially the catalytic reforming of tars and light hydrocarbons. So far, relatively short duration tests have been adequate for catalyst deactivation and to identify areas for catalyst and process improvements moving towards the annual Joule targets for the OBP. In FY10, process modifications to accommodate continuous catalyst regeneration will be evaluated in the TCPDU for longer durations using new operating parameters. The operating conditions were developed at the bench scale and are now ready to test at larger scale with biomass-derived syngas. The duration of the tests will depend on the results. If the catalyst performs well and maintains activity, the test duration will be increased to evaluate longer-term performance. If the results are less favorable, the test duration will be shorter and different operating parameters will be evaluated to improve performance. Doing long duration tests is a balance between limited funding and maximizing the information from the tests to further improve process performance. The need for increasingly longer duration runs is anticipated in the next three years as the conversion and synthesis technologies are fully integrated into the TCPDU. The funding levels going forward for the IGFS task will determine the length of the validation tests. Budget and time constraints are the primary reasons for using pelletized feed materials. Past studies have shown that syngas produced from the TCPDU using pelletized feeds is similar to syngas produced in other gasifiers with all biomass related contaminants at relevant levels. Pilot scale facilities often experience difficulties continuously feeding solids with the result that more effort is spent on resolving feeding issues than on the key research. When feed stock effects need to be evaluated (e.g. future TC Feedstock Interface Task plans), the TCPDU feeding system will accommodate other feed formats with minor modification.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Important to have pilot scale facility to test technology and validate models.	Seems like an extension of the prior program - Catalyst Fundamentals Integration.
PI Response: It is intended to be an extension. This task validates various unit operations performance using real	

biomass-derived syngas at a scale and space velocities that are large enough to minimize artifacts of bench-scale testing such as wall effects, heat management of exothermic reactions, reasonable space velocities, etc. The purpose of the PDU is to produce realistic, dirty syngas to verify clean up technologies through the use of comprehensive gas analysis plus validation using synthesis catalysts at typical operating conditions.
Long term validation testing in an integrated process development facility utilizing real syngas is a key to achieving 2012 targets on real syngas
PI Response: No response to this comment has been provided by the Principal Investigator.
critical project for enabling commercial BTL processes
PI Response: No response to this comment has been provided by the Principal Investigator.
Operating a real world system and addressing key components of most of the thermochem platform.
PI Response: No response to this comment has been provided by the Principal Investigator.
Demonstrating a system approach to perform testing is valuable to the program.
PI Response: No response to this comment has been provided by the Principal Investigator.
Validation and process modeling are important to commercialization. Emphasis on syngas cleanup and gas conditioning.
PI Response: No response to this comment has been provided by the Principal Investigator.

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Pilot scale research studies of gasification, cleanup, and synthesis. Good analytical capability to monitor process.	Should include longer campaigns in the facility testing to address system operability, degradation of materials, fouling of heat exchangers, build up of contaminants, etc… that can only be seen after

	extended runs.
PI Response: See general response section.	
TCPDU - Pilot scale process demonstration for each step in integrated EtOH process (currently through scrubber step). Focus on demonstrating integration with real syngas. Online MBMS and other analytical capabilities. Adding continuous flow reformer, TMBMS (Magnetic Sector Mass Spectrometer) and other key improvements in near future	Can only used pelletized feedstocks, i.e. cannot demo influence of feedstock prep on syngas quality. One week campaigns are really not pilot demonstrations - Longer term testing is planned (e.g. to demonstrate catalyst life cycle cost).
PI Response: See general response section.	
Nice pilot facility Good reflux with process model.	Pilot is but a gasification solution and not THE gasification solution.
PI Response: See general response section.	
Simulating recycle streams since syngas conversion is not available.	The project lacks a milestone structure for project management. No clear measurement of progress on goals.
PI Response: This task is tied directly to the OBP 2012 targets for validating the unit operations necessary to achieve cost competitive biomass-derived ethanol at the pilot scale. The purpose of the PDU is to validate the technologies being developed in other tasks at the bench scale and typically using model (ie. bottled) syngas. Only with "real" syngas can an integrated process be validated with relatively good confidence that no surprises will occur because of trace level contaminants and catalyst poisons.	
RDD plan is good. Main virtue of this project is the capacity to conduct gasification at a PDU scale, for sufficient durations, which balances scale and cost, though that aspect was not sold very well.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Good investigation of into reforming and beginning work on S sorbents.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is on track with State of Technology map and demonstrated 2008 targets for catalytic tar reforming.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good reporting and vetting of R&D targets. Provides validation for other tasks.	Reporting dates back to 2007 - have advances been made?
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Longer runs (100s/1000s of hours) are needed to validate catalyst performance.
PI Response: See general response section.	
Significant progress, all done for short durations.	Not clear where the niche for this PDU sits.
PI Response: See general response section.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Clear understanding of what is needed from this program for the other overall 2012 success.	Limited showstoppers identified and weak mitigations plans.
PI Response: No response to this comment has been provided by the Principal Investigator.	
PDU testing is key to indentifying critical success factors for integrated process and catalyst performance.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Key to 2012 targets for demonstration. Nothing stands out as critical or insurmountable. I think this is actually a good thing for a plant of this scale.	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Catalyst regeneration either/or sorbent injection, one needs to be successful.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Longer-duration testing is planned.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Considerable upgrades are planned to expand capacity.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Have made progressive improvements to TCPDU process and analytical capabilities to address barriers.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Careful studies and long term operation of a gasifier are great.	Uncertain of whether testing is proving operability (long term operation) and is capable of addressing capital reduction. These keep recurring as themes around gasification.
PI Response: Our purpose has not been to prove operability of gasification per se, although we could do this if it is identified as essential to the program and if adequate funding is provided. We are validating the processes necessary to clean up biomass-derived syngas to meet the quality specifications outlined in the the 2007 Thermochemical Ethanol Design report (one of many possible routes to ethanol from biomass) and the OBP targets for 2012.	
	Need to have longer term tests.
PI Response: See general response section.	
Project is intended to address the integration of the various components. Showstopper defined (catalyst deactivation).	
PI Response: No response to this comment has been provided by the Principal Investigator.	

<u>1) Technology Transfer/Collaborations</u>
Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Obvious interaction with other programs and investigators.	
Feedstock (current pellets, but looking at others)	
Collaborations are internal to NREL (TCPDU Operations Team and Catalyst Development Team). Outside partners would be useful.	We agree, outside partners would be useful. We need to decide who to involve and how to get them to participate.

2) Recommendations for Additions/Deletions to Project Scope

Agricultural Mixed Waste Biorefinery Using the Thermo-Depolymerization (TDP) Technology

Technology Area: Biomass Program
Project Number: 7.7.4.2
Performing Organization:
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.17	0.41
Approach	3.33	0.52
Technical Progress	3.00	0.63
Success Factors	3.00	0.63
Future Research	3.17	0.75

Overall Principal Investigator Response(s)
The reviewers have made a number of worthwhile comments. Some questions could have been avoided had time been provided to discuss energy and mass balance results. Understandably, given the general need to include a large number of presentations in a short time meant that the reviewers could not go back and review each presentation to pick up details that were not addressed or completely covered in the oral presentation.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass

Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Trying to address the variable feeding issues associated with biomass.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
TDP is a unique approach to biomass energy densification, could lead to overall lower syngas production costs by simplifying gasifier feed design, enabling distributed biomass supply model, and minimizing tar production in some gasifier designs.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
hydrothermal preprocessing of cellulosic biomass convert different cellulosic feedstocks into a more uniform, consistent, "universal" intermediate for thermochemical biorefining.	25% BTU loss in feedstock BTU content would appear to need a lot of energy
PI Response: As shown in slides 18 and 19, for hydrothermal pretreatment (wet torrefcation) at 260°C for 5 minutes and dry torrefaction at 300°C for 10 minutes yield the same degree of densification (1 kg wood yields 0.66 kg of solids). In terms of energy content, for this set of conditions, hydrothermal pretreatment retains 88% of the original energy available in wood while dry torrefcation retains 81% of the original energy available in wood. Thus, wet processing may require less energy expenditure than dry torrefaction which has been advocated as a viable process for densifying biomass.	
Densification of biomass and compatibility with gasification is completely consistent with program objectives. The stated goal of a truly universal device is a similarly laudable goal.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Creating a fungible feedstock.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Densification and fuel upgrading is important in economics for feedstock delivery, which is a high cost center for biofuels production.	

PI Response: No response to this comment has been provided by the Principal Investigator.

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
	Yield loss (on both mass and energy basis) may render process too expensive. Feedstock costs can dominate process costs.
PI Response: For a reason why this may not be the case, see the above comparison with dry torrefaction in a response to Reviewer 17802, in Section 1.	
	should at least provide a back-of-the-envelope calculation for material and energy balances
PI Response: Slides 18 and 19 (in the additional slides section) did provide more energy and mass balances that were compared to those available for dry torrefaction. The reviewers may not have seen this section.	
	Parr bomb studies only.
PI Response: Unfortunately, the reviewer was unspecific in his response with regard to the effacy of utilizing Parr reactors for this work. However, properly instrumented Parr reactors are quite useful for quantifying energy and mass balances in assessing the utility of hydrothermal pretreatment. Instrumented Parr reactors displacing from 125cc up to 5 gallons were used in these studies.	
	For the $5.5 MM DOE budget on project awarded, approach does not provide enough in results.
PI Response: Issues of budget were not discussed in detail, perhaps because of the press of time. Note that within the time allotted for this review (~45 minutes), three projects were reviewed, two of these focused on hydrothermal pretreatment and one dealt with catalysis.	
R&D approach seems sound.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Good data on CHO analysis pre and post- treatment	Energy balance and energy yield have not been calculated.
PI Response: See the PI's comments above regarding the energy balance information provided in slides 18 and 19.	
Prelim data suggest material produced is superior to torrefied biomass with respect to lower O2 content and higher C fraction in less than 1/10 of time for torrefaction.	Have not completed energy balances and economic analysis. Spending is behind plan, asking for no cost schedule extension. Have not addressed effluent water quality issue.
PI Response: From the perspective of the PI, the comments listed under weaknesses are not necessarily weaknesses. Spending is behind plan, and a no-cost project extension will provide sufficient time to accomplish the project plan. Preliminary analyses suggest water quality will not be an issue. Further analyses are intended that will provide more definitive results.	
	This is a development project that has yet to test pyrolysis and gasification. It seems that touting the benefits of the process for clean-up scrap may be obscuring the fact that this is a review of energy production.
PI Response: Perhaps this reviewer missed the implications of the results shown in slides 9 and 10 where the effect of hydrothermal pretreatment was to render woody biomass into a fuel with the characteristics of lignite, known to be a superior fuel for gasification as well as slides 11-13 where detailed analyses of these fuels was presented. While gasification and pyrolysis of this material awaits, analyses of these materials suggests they offer interesting substitutes for unmodified biomass.	
	Need to have an economics assessment to determine the potential of the process. Need to have H&MB prior to economics.
PI Response: See the PI's comments above regarding the energy balance information provided in slides 18 and 19. A thorough techno-economic analysis is planned, and will be carried out.	
Hydrothermally pretreated material produced;	Critical energy and mass balances have not been

properties characterized.	completed, which is critical for commercialization.
PI Response: See comments above, that directly address this issue. It would appear that the reviewers were not able to access the data shown in slides 18 and 19 of the review. Unfortunately, time was not available to present and discuss those results in the oral presentation.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good identification of critical success factors and challenges, in particular the economic challenge.	No mitigation plans presented for challenges.
PI Response: We are not certain of what comprises a "mitigation plan." However, within the limited time that was available, we presented an approach to assessing how we would meet the challenges that loom before us to successfully complete these projects, particularly with a detailed techno-economic analysis to be carried out by our Nevada partners.	
	No clear understanding of economic showstoppers; e.g. impact of 25% HV loss.
PI Response: See comments directed to Reviewer 17802, in Section 1, above, with regard to a similar comment.	
	CWT bankruptcy
PI Response: Agreed. This was specifically called out and noted in the presentation in Slide 14.	
	Doubt raised during presentation about economics and energy balance.
PI Response: Actually not. The results shown in Slides 18 and 19 were not discussed because of time considerations. See the PI's comments on the results of energy and mass balance measurements made above.	
Recognition of technical, business, and market drivers.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Partner is in Chapter 11. Project might not be able to meet deliverables.
PI Response: Correct. This will be a major concern if CWT cannot continue to perform its	

assigned roles in these projects. See the comments made to Reviewer 17802, above.

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Next steps are logical and should address remaining concerns. Decision points built in which is important.	Planning to scale-up shortly. May be premature until some other answers are determined.
PI Response: Preliminary energy and mass balances are positive. We are hopeful that more complete mass and energy balances for a variety of biomass fuels will suggest that scale-up is a reasonable approach.	
Technoecon is clearly important	Seems late in the game to be still questioning energy balance.
PI Response: We are requesting a no-cost project extension to properly address issues of techno-economic analyses and extended laboratory testing. Time did not permit discussion of the other approaches that were evaluated before a single step approach to creating a hydrothermally pretreated product was selected. This included tests to evaluate the utility of a two-step approach for producing a pretreated product of which the first step consisted of a low-temperature pretreatment to recover sugars. Thus, what was presented represented the endpoint of a variety of investigative paths.	
	Project in real danger of not meeting goals.
PI Response: See comments above to reviewer 17803's comments. A no-cost time extension will be requested to provide sufficient time to meet the goals of the project.	

<u>1) Technology Transfer/Collaborations</u>

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Not apparent how technology transfer would happen.	We are at the point where promising results need to be better defined to be able to solicit outside support. However, even at this point, we have been encouraged by the response of

	entities that need an approach such as ours to mitigate their carbon footprint.
Changing World Technologies, NREL	Note also the participation of the Desert Research Institute and their subcontractors, Renewable Energy Institute, International (REII) and the University of Nevada at Reno (UNR).
Partner, CWT, is in Chapter 11.	See comments made above with respect to CWT's business situation.

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Need to conduct integrated system economic analysis; e.g. feedstock supply through production of clean syngas. Need to answer question of whether higher upstream biomass processing capex and opex (due to 25% HV loss) offset or reduce clean syngas production costs. Does this enable application of entrained flow coal type gasifiers? Need to address effluent water quality.	Worthwhile comments. With the completion of detailed energy and mass balances for a variety of biomass fuels along with the assessment of the pretreated fuels for gasification and pyrolysis, a thorough techno-economic analysis is scheduled. A 6-month, no-cost project extension will provide the time to carry out these analyses. Water quality will be addressed. Preliminary results suggest that this will not be an issue. As indicated above, the friability and energy content of the pretreated materials render them suitable for mingling with coal to reduce the overall carbon footprint of a coal-fired gasifier.

Engineering New Catalysts for In-Process Elimination of Tars

Technology Area: Biomass Program
Project Number: 3.2.5.5
Performing Organization:
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.17	0.41
Approach	4.33	0.82
Technical Progress	3.83	0.75
Success Factors	4.17	0.98
Future Research	3.67	0.82

Overall Principal Investigator Response(s)
We appreciate the comments of the reviewers and the time spent in their review. As we have found, inventing and demonstrating novel technologies for producing robust, attrition-resistant catalysts does not insure interest in the marketplace, especially in times that demand commercializing entities be risk-averse. We continue to look for commercial partners who are willing to join us in the development of these materials into superior catalysts.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Program attempting to make a better tar reforming catalyst.	Indirectly related to the MYPP objectives to reduce tar. Program focused on a different catalyst manufacturing method. No improvement in catalyst life indicated.

PI Response: 1. Note that at least two distinct MYPP objectives were directly referenced in the presentation made to the reviewers and were inherently a part of the discussion. From Slide 3:

- WBS Element 3.2.1 – Biomass Gasification - Maximize syngas production efficiency while <u>minimizing tar and hydrocarbon contaminants</u> in raw product gas. Includes barrier Tt-C.
- WBS Element 3.2.
- 5 – Synthesis Gas Clean-up & Conditioning − Develop improved gas cleanup and conditioning catalysts <u>with improved tar reforming efficiency</u>, longer life, and higher tolerance for sulfur and chlorine. − <u>Demonstrate catalyst performance and lifetime</u>, and optimize process conditions, at pilot scale for woody feedstocks and selected agricultural and biorefinery residues. Includes barriers Tt-F and Tt-H.

2. Actually, this program resulted in the development of four novel methods of manufacturing catalysts that can be employed to improve biomass gasification:

- Supported catalysts employing direct thermal impregnation (U.S. patent 7,449,424),

covered in Slides 7, 9, 13, 14, and 15.
- Bulk catalysts made by developing new glass-ceramic formulations that contain up to 40 wt. % catalyst metal oxides that can be expressed as metallic surfaces in a reducing environment, covered in Slides 7, 11, 12, and 15.
- Bulk glass-ceramic catalysts that can be thermally impregnated with catalyst metal oxides to form a combined bulk and thermally impregnated catalytically-active material (covered in Slides 7, 14, and 15.
- Novel catalysts based on Ni-silicate structures derived from natural olivine, covered in Slides 7 and 10. Results of methane decomposition over 1000 h TOS were shown, including ~80 h of exposure to 20 ppm H2S in a simulated syngas.

3. With regard to improving catalyst life, Slides 10 and 15 directly addressed this issue. In Slide 10, test results showed with Ni-silicate catalysts, 99-100% methane decomposition could be maintained over lifetimes of at least 1000h TOS, with or without the presence of up to 20 ppnm H2S. Slide 15 showed that glass-ceramics based catalysts exhibited superior attrition resistance compared to alumina-supported catalysts prepared by incipient wetness.

Identication of ` `

PI Response: No response to this comment has been provided by the Principal Investigator.

thermally-impregnated- & incipient-wetness-
based, attrition-resistance catalysts for fluidized-need to test on biomass-derived syngas
bed gasifier

PI Response: This is a critically important point. Collaborative testing of the catalysts made on this project with the biomass gasifiers operated at Paul Scherrer Institut addresses this need.

Tar formation in a fluidized bed gasifier is a key issue in the thermochemical area.

PI Response: No response to this comment has been provided by the Principal Investigator.

Tar elimination is critical to indirect gasification technology.

PI Response: No response to this comment has been provided by the Principal Investigator.

Tar cracking is a major concern in gasification systems. Attrition of catalysts are a problem.

PI Response: No response to this comment has been provided by the Principal Investigator.

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has*

    significant weaknesses.
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Sound approach to improve attrition resistance and maintain performance.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
`	`
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good technical approach. Built in go/no go decision points.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Several samples made and tested. Did demonstrate improved attrition.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Work is nearly complete and will be published this year. Development of two new promising tar catalyst technologies.	Some planned work not completed\, but this was done (with DOE approval?) to accommodate unanticipated findings.
PI Response: As indicated in slide 7 of the presentation, and as discussed above, because of the development of four novel approaches for producing robust, attrition-resistant catalysts, the project was redirected with the express consent of the DOE project officer to address and explore the opportunities available in these new technologies. Unfortunately, we were unable to investigate other potentially promising technologies that we had originally intended to pursue. These included catalysts developed from negative-value waste materials and thorough techno-economic analyses of every type of catalytically-active material developed on this project.	
	The project is nearly complete and there are

	several unanswered questions and task to be done.
PI Response: Unfortunately, the successes of this project have presented a number of questions some of which remain unanswered . Because of limited project resources, a number of these questions cannot be addressed and, hopefully, will be thoroughly investigated in subsequent research efforts.	
Program seems to have achieved its goal, to make a non-attriting, robust catalyst. S tolerance has been demonstrated in long-term trials.	Long, costly program.
PI Response: The reviewer is correct in observing that this has been a long, costly R&D effort. However, as with all such efforts, the most important question is did the DOE, and ultimately, the taxpayer, receive a fair return on their investment. We would argue that they have, as this single program has resulted in four novel and unanticipated approaches to producing robust catalytically-active materials for improving the performance of biomass gasification. Beyond that goal. these new technologies hold the promise of reducing the costs of preparing a diverse set of catalytically-active materials by direct thermal means that can be utilized in many other processes that employ catalysis. As the 15 papers and presentations (5 of which were peer-reviewed) cited on slides 22 and 23 show, this research effort has resulted in a wealth of opportunity for technology transfer.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Biggest risks identified.	Since program is essentially done, open risks will not be addressed.
PI Response: The reviewer is correct in noting that all of the open risks will not be addressed. On the surface this could appear to be a weakness. However, we argue that the discoveries made on this project and the resulting redirection of project efforts to explore the opportunities presented by these discoveries represent a reasonable approach that has balanced the responsible use of finite project resources with the thorough investigation of risks associated with the development of these new technologies.	

Identified market pull towards commercialization, Also, recognized technical and business factors.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is nearly complete.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	Program is essentially done, so remaining open risks will not be addressed.
PI Response: See our response to a similar observation by this reviewer in Section 4, above.	
Work wraps up in Jun 09 with final reporting	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	almost over
PI Response: This is an encouraging response as the reviewer appears to suggest that it is regrettable that the project is coming to an end. We look forward to the opportunity to propose and engage in much new work in this area.	
Work is done.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is essentially complete. Next step is commercialization; though no commercial partners are obvious.	
PI Response: The reviewer addresses the important issue of commercialization. One problem presented by an invention that combines different manufacturing technologies (here glass-ceramics technology and catalysis) is that companies that offer complete lines of catalysts have a considerable capital investment in other technologies for producing supported catalysts (e.g. incipient wetness impregnation) that presently meets the needs of many who employ catalysis. Thus, we are the outsider with a new technology that requires further development to reach its full economic potential. Sadly, in the current economic climate, few manufacturers are willing to risk an investment into a technology such as we have discovered because almost any level of risk is unacceptable.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Papers are being presented. No clear commercialization path.	See the comments made above in Section 4 to reviewer 17806.
Collaboration with PSI provided additional project benefits and leverage.	We are always interested in forming international partnerships with respected researchers. This approach also serves to validate our efforts with independent analysis.
Nextech,	Interestingly, NexTech Materials is pursuing the development of Ni-silicate based catalysts through Phase 1 (successfully completed) and Phase 2 (underway) projects with NSF - a funding route that is unavailable to GTI. Like GTI, NexTech is a small company and would have to receive external funding to pursue the development of glass-based catalysts. They are also heavily involved with the development of Ni-silicate based catalysts and do not have qualified personnel available to pursue multiple developmental efforts.
Poor. Seems that no partners have been identified that would take the project forward.	It may be a fine distinction, but there are many partners we have identified that could take these discoveries into the marketplace. However, as indicated above, it is difficult to find a partner who is interested in funding a promising technology that has not yet demonstrated commercial viability. This is a difficult undertaking even in a robust business climate. In today's economic climate that task is made much more difficult because in addition to the normal risks that encumber commercialization efforts, new partnerships are needed (between glass ceramicists and catalyst manufacturers) to bring this technology to the commercial stage which multiplies perceived risk.
Challenged to find commercial partner.	See the comments made above with respect to developing these catalytically-active materials into products for the marketplace.
Good mouse trap seems to be there; but no commercial partners have been identified.	See the comments made above with respect to developing these catalytically-active materials into products for the marketplace.

2) Recommendations for Additions/Deletions to Project Scope

Biomass Gas Cleanup Using a Therminator

Technology Area: Biomass Program
Project Number: 3.2.5.3
Performing Organization:
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.17	0.41
Approach	4.17	0.75
Technical Progress	3.50	0.84
Success Factors	3.67	0.82
Future Research	3.83	0.75

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Addressing full system for syngas cleanup including testing with actual biomass syngas.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Single step cracks tars and reduces sulfur and NH3 at typical gasifier outlet temperatures. Reducing # of unit operations should reduce	May need to be adapted to high pressure O2 blown gasification

costs compared to other options. Fits well with indirect gasifier outlet temperatures and pressures	
PI Response: The current Therminator design has a maximum design pressure of 150psig to address applying this technology to pressurized O2 blown gasifiers.	
therminator: single-step bubbling-bed process for ammonia decomposition & tar cracking (using tungsten catalysts; rather than tar reforming) and desulfurization (using high-temperature sorbents)	no clear economic (cost) improvements
PI Response: Completing process modeling and technoeconomic evaluation of Therminator technology compared to other tar removal/reforming unit operations will be completed by the end of the project.	
Tar clean up is an important and relevant goal for the platform. Reducing both capital and operating cost is the right direction.	Some concern about the fact that reforming may still be required. Sulfur removal is required only for a subset of subsequent processing.
PI Response: The Therminator reactor design could be adapted for a reforming catalyst. Different materials of construction will be required for the higher temperature operation and the heat and material balance for reforming would need to be evaluated.	
Reduction of tars, NH3, sulfurâ€¦ is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Focusing on the catalyst technology challenges and the full system analysis (process modeling, balances, etc..)	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Using same approach as successfully applied by	

RTI to development of proprietary WGDS technology	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good focus on important parameters.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Approach includes not only catalyst materials development but also the process and economic modeling. Syngas cleanup targets are for FT liquids which is a challenging spec.	Project management tools need to be developed, i.e. tasks, schedule, milestones, go/no go.
PI Response: Now that cost share has been secured and a new host site identified, the project plan will be revised.	
	Long, integrated project, aimed at incremental improvements in the state of the art
PI Response: Reactor design is flexible enough for application to other tar mitigation strategies. Removing tars in the presence of sulfur that poisons reforming catalysts is a significant technical challenge.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
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- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Fairly complete data generation to allow system design. Preliminary design complete.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Tungsten catalysts look promising in micro scale testing for both NH3 and tar destruction, excellent attrition resistance Completed prelim re-design and engineering review for pilot scale Therminator	Catalyst development is lagging process development. Need lab scale validation of catalyst - gap is being filled by new project funded by BCNC. Funding interruptions and lost of cost share partner has delayed schedule.
PI Response: Now that the Biofuels Center of North Carolina grant has been secured, additional catalyst testing can be completed while the project cost share requirements are met.	
	would like to see techno-economic comparisons

	vis-a-vie other gas cleanup options
PI Response: This is will be completed by the end of the project.	
Appropriate steps are being taken for scale-up.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Techno-economic study has been done, although results not shared in presentation. This has helped validate the project.	Progress seems slow compared to funding and time into the schedule.
PI Response: Loss of cost share partner severely limited the project until additional cost share was secured. Now that the BCNC grant has been received, the cost share requirements for the project will be satisfied and the remaining funding can be spent.	
	Erratic funding has caused erratic progress. Tests, to date, have been at very small scale. Technoeconomic analysis has not been performed.
PI Response: Agreed. This has been solved and progress will be steady form now until the end of the project.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Little articulation of challenges and plans to address them.
PI Response: Technical challenges include successful circulation of solids at operating conditions. Pressure balance models are being validated with cold flow visulation tests in a separate unit. Other technical challenge is inadequate heat release during regeneration because of low carbon deposition from tars on cracking catalyst. The absorber and regeneration loop have been design to be somewhat independent so tar can be deposited on the catalyst in the absorber and catalyst can be regenerated quickly in a sinble cylce or circulated around until fresh catalyst is needed.	
Good progress is being made toward pilot testing.	

PI Response: No response to this comment has been provided by the Principal Investigator.	
	Identified technology factors but not market or business factors.
PI Response: Market factors include the economic viability of thermochemical biomass conversion technologies. Business factor is the economic competitiveness of the Therminator technology compared to traditional quench process and developing catalytic tar reforming unit operations.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Complete design and build.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Will complete design package for scalable process in FY09. Secured funding for lab scale catalyst development.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	demonstration
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good progress toward scale-up.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Recognition of activities needed to be complete.	Ambitious amount of work for little more than a year left in the schedule.
PI Response: While the remaining schedule is ambitious, we feel that we have a plan to complete the remainder of the project by June 2010 before transitioning into the validation phase.	
Plan for pilot facility completed.	Project has a long way to go.
PI Response: Agreed. We feel we have a flexible design for successfully testing the tar cracking concept. The preliminary design is complete. We feel that detailed engineering will be completed by July 1 and construction completed around November 1, 2009 leaving approximately 6 months for shakedown and operation. Catalyst testing will occur concurrently with the grant provided by the Biofuels Center of North Carolina.	

1) Technology Transfer/Collaborations
Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Univ. of Utah	
Partnering with Clemson University and Biofuels Center of NC. Lost commercial partner years ago. New partner (Biofuels Center of NC) found.	

2) Recommendations for Additions/Deletions to Project Scope

Validation of the RTI Therminator Syngas Cleanup Technology in an Integrated Biomass Gasification/Fuel Synthesis Process

Technology Area: Biomass Program
Project Number: 3.2.5.12
Performing Organization:
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.50	0.55
Approach	4.50	0.55
Technical Progress	3.33	0.82
Success Factors	3.83	0.98
Future Research	4.17	0.75

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*

- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Extension of the Therminator development program to address syngas quality and cleanup.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
1/2 tpd validation of RTI therminator is aligned with syngas cleaning and conditioning goals	
PI Response: No response to this comment has been provided by the Principal Investigator.	
straight-forward technology demonstration project	
PI Response: No response to this comment has been provided by the Principal Investigator.	
complete biomass to fuels are planned with reasonable stage gate steps.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Syngas cleanup and conditioning is important step.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

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- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Phased approach focused on syngas production &	Will only operate for 500 hours once assembled.

clean-up first and then fuel synthesis.	Relatively short time for the amount of effort to assemble. Missing out on the opportunity to get data for longer-term operation.
PI Response: 500 hours of integrated operation was specified in the RFP for the project.	
Well thought out plan. Implementation of project work plan is just starting.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Nice development plan. Well structured and thought-out	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project has a detailed schedule to manage to and determine progress throughout the project. Approach to demonstrate complete system.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Plan seems reasonable with go-no go decision point.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

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- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Just started and is a logical extension of earlier work.
PI Response: Funding just received in March 2009	
New project, funding just released in Mar 09	
PI Response: No response to this comment has been provided by the Principal Investigator.	
New - money just received.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project has just begun.
PI Response:	

Funding received in March 2009
Project just began. Subcontracts not even in place at this time.
PI Response:
At the time of this review, the sub-grant with University of Utah has been placed. A draft sub-grant has been submitted to NCSU for negotiations.

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Risks and success are essentially the same as the Therminator development program.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
has go/no-go points	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good stage gates and plan.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Identification of a Go/No Go decision point.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*
- *3-Satisfactory. Future work plans are loosely built on past progress and could address OBP MYPP barriers in a reasonable period.*
- *2-Fair. The future work plan may lead to improvements, but should be better focused on*

removing/diminishing key OBP MYPP barriers in a reasonable timeframe.

- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Builds on prior work and will address many of the full system questions - from feeding to fuel synthesis.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
ref 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Good alliance between RTI, UoU, and NCSU.	
Univ. of Utah	
Collaborations with University of Utah, NC State University, Golden Leaf Foundation. Tests will take place at University of Utah.	

2) Recommendations for Additions/Deletions to Project Scope

Novel Approach for Biomass Syngas Cleaning and Conditioning for Liquid Fuel Synthesis Applications

Technology Area: Biomass Program
Project Number: 3.2.5.9
Performing Organization: Emery Energy
Number of Reviewers: 5

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.00	0.00
Approach	3.60	0.55
Technical Progress	2.80	0.45
Success Factors	3.20	0.84
Future Research	3.80	0.45

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Addressing tar reforming using a plasma reactor.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Use of low temperature plasma for tar conversion to replace quench and/or catalytic approaches for tar reforming (NTPR) - lower capex and opex is goal - Emery projects 50% capex and 70% opex reductions vs catalytic approach. Technology is based on Ceramatec work on previous DoD contracts.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Novel tar solution	Application to a low tar, oxygen fed gasifier is an issue.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Syngas cleanup and conditioning is important. Reducing number of downstream unit operations could help economics.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and* *implemented effective project management practices. Difficult for the approach to be improved significantly.*

- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Staged approach focusing on the gasification and reformer, ultimately alcohol synthesis.	Modifying direct gasifier performance to match indirect tar formation - a somewhat artificial situation.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project work plan is consistent with syngas validation solicitation requirements.	Not clear what benefits vs partial oxidation, especially for O2 blown gasifier where just incremental O2 required. Plasma only addresses tar issue. Sulfur, halides, NH3,â€¦ need to be addressed by separate downstream processes.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Novel, non-catalytic solution.	Unproven and non-commercial option.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Plasma reforming of tars is a novel approach adding a diversity to the tar reforming portfolio. Go/No Go decision is part of project. Gasifier is direct O2 fed, but will be run to produce extra tar to demonstrate plasma reforming.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not clear evidence that the plasma reactor is a better mousetrap. Very little information shared in presentation.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives,*

OBP goals and objectives and contributes to overcoming technical barriers.

- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	No real technical work to date, though not under their control as a result of funding issues. Did not present any data to support the optimism related to the reduction of capex and opex vs. catalytic reforming.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Funding just released in March, further delay due to problem with DOE allocation. Expect to start in May.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is just in infancy.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project has not started due to award was done recently.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	New project, subcontracts only being drawn now.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Focusing on capex and opex (reduce number of unit operations).	Did not speak to any specific mitigation plans related to the plasma reactor risks.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Plan shows good understanding	

PI Response: No response to this comment has been provided by the Principal Investigator.	
This is proof of concept for the plasma reforming option.	The plasma may not work or may not
PI Response: No response to this comment has been provided by the Principal Investigator.	
Identified several success factors.	Did not identify power consumption of plasma generator as an issue.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Basically the overall program plan is to demonstrate plasma reforming. Plan should provide data to support comparison to catalytic reforming.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
ref 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Very reasonable approach.	Timeline seems expanded.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Design, fabrication, and testing planned to be completed within one year.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Emory has shorter term need for this technology in an energy application so may facilitate commercialization.	
Western Research Institute will host facility Ceramatec - low temperature tar reformer	

design and fabrication	
Partners include Ceramatec, Western Research Institute (host facility), INL.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Include economic comparison with Pox for O2 blown application	

Biomass Synthesis Gas to Liquid Fuels Evaluation

Technology Area: Biomass Program
Project Number: 3.2.5.10
Performing Organization: Gas Technology Institute
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.83	0.75
Approach	3.00	0.89
Technical Progress	2.00	0.89
Success Factors	2.17	1.17
Future Research	1.83	0.75

Overall Principal Investigator Response(s)
This project has a very promising and novel technical approach. The test location, in conjunction with an elevated pressure gasifier, imposes a large cost burden due to safety and high-pressure operation requirements. The delayed start of the program required procurement of equipment in parallel with engineering design, which can and did result in overruns against planned budget. Normally, one would do the engineering and costing and if the funds were sufficient, then enter into procurement and construction activities. To do so on this project would have ensured that the equipment could not be built in time to piggyback on the test runs on an existing industry-funded project at a large scale pilot facility that is going along independently and could not be delayed. There were large cost sharing opportunities as a result, as such tests are in the multi-million dollar range. No other biomass tests in our facility were on the horizon, so it was decided to go ahead at risk to try to accomplish the intended project objectives. The estimated cost of completion, after all detailed engineering has been completed, is far over the budget so there is no choice but to stop the work at this point. GTI is exploring, at its own cost, various alternative options that may result in the completion of the project at some

future point. We are in discussion with DOE as this develops.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
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- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Another program directed at syngas cleanup.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Advanced tar reforming catalysts Hot stage S removal eliminates acid gas removal process Filter reactor approach is proven in coal applications	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Phase I - achieve gasification and syngas-cleanup to FT-useable specs - monolith catalyst for tar reforming Phase II - validate FT synthesis of liquid fuels	It's very difficult to assess this project. Very little information was provided about the innovative technologies (e.g., monolith catalyst for tar reforming) that are to be employed. Under-estimated Phase I costs
PI Response: It was stated that a separate report was prepared for each series of catalyst tests performed in our laboratory. The catalysts are from Sud Chemie and Haldor Topsoe, the details of which are proprietary to the respective manufacturers. We provided laboratory testing representative of what we anticipated to be the conditions for the gasification testing in the project. The following statements were presented: Very positive results: F-35 noble metal catalyst was determined to be more effective for reforming both tars and methane than F-37 Ni-based catalyst Both F-35 and F-37 catalysts had slightly higher tar reforming capability than RKS-3 catalyst, and achieved > 93% tar reforming even at the lower temperature of 850°C High methane reforming activity	

It was not possible to present more details than this in a 15 min. presentation.	
Making good use of technologies for conventional coal gasification	Inadequate justification for reasons for approach.
PI Response: I provided, Slide 7, Technical Merits of the Approach v. SOA • Advanced tar reforming catalysts – high yields at moderate temperatures • Eliminate S during hot stage – minimize problems in downstream separations • Filter Reactor effective way to use absorbents (proven in coal gasification program) • No need for complex selective acid gas removal process or additional S recovery steps • Use advanced solvent (Morphysorb) with order of magnitude lower H2 and CO solubility for CO2 removal (only) • Scheme minimizes cool down/reheat steps	
Gas cleanup and conditioning is an important aspect of thermochemical production of biofuels.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Staged approach - demonstrate cleaning of syngas and then validate with FT. Leveraging the gasification infrastructure of another program. Did articulate potential advantages vs. more common reformer approaches.	The demonstration including validation with FT is at risk. Approach of throw-away sorbents may not be practical at larger scale. Underestimated costs for Phase 1.
PI Response: Generally, the amount of S in biomass is not large, and practical maximums of biomass gasfication are also small compared to coal gasification - 100 -500 TPD vs. multiples of 1,000s of TPD (2,000 TPD per gasifier). Although the cost of throwaway materials might be high per unit of S removed, at the typical scale it might be well worth it vs. the added complexities of continuous processes at small-scale such as selective acid gas removal plus liquid redox (LO-CAT, e.g.). LO-CAT is known to have costs of \$500 to \$1,000 per ton of S removed. Further, advances in absorbents are being made that will reduce the cost. Also, the	

material can be sent to a smelter or recovery plant offsite to recoup some of the cost. Should a continuous high temperature process be developed such as RTI's, that can be substituted. Detailed evaluation of performance and cost and then comparison with alternatives was the objective of this project. Costs were underestimated in Phase I. These costs were developed from conceptual information. Detailed engineering is needed to develop accurate costs - this was done as soon as possible.	
Integration with existing facility. Piggy-backing on existing test program	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not at all clear from presentation what is being done or what defines the project.
PI Response: A table of project objectives, project schedule, simplified process flowsheet, detailed flowsheet, equipment drawings, equipment plot layouts and 3Ds were all shown. This was the last in a series of presentations of similar projects in the same FOA which all had the same objectives to run a gas cleanup scheme for a set number of hours in Phase I and then continue with a FT or similar unit in Phase II. This was not reiterated for the sake of brevity. The 15 minute time limit did not afford the opportunity to repeat information or dwell on anything in detail. I would have been happy to address such questions in the question time but none were proffered.	
Approach includes runs of 100 hours continuous. Has a Go/No Go decision point. Use of a filter reactor to remove S simplifying downstream cleanup of syngas.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Filter-reactor is novel aspect of GTI project.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
To date focused on physical infrastructure and plans	Behind on program schedule. Little detail on

<table>
<tr><td>for construction of experimental rig.</td><td>advanced tar reformer catalyst and filter-reactor. Ran out of funds to complete phase 1.</td></tr>
<tr><td colspan="2">PI Response: It was stated that a separate report was prepared for each series of catalyst tests performed in our laboratory. The catalysts are from Sud Chemie and Haldor Topsoe, the details of which are proprietary to the respective manufacturers. We provided laboratory testing representative of what we anticipated to be the conditions for the gasification testing in the project. The following statements were presented:

Very positive results:
F-35 noble metal catalyst was determined to be more effective for reforming both tars and methane than F-37 Ni-based catalyst
Both F-35 and F-37 catalysts had slightly higher tar reforming capability than RKS-3 catalyst, and achieved > 93% tar reforming even at the lower temperature of 850°C
High methane reforming activity

The filter reactor was stated to have been developed in a separate coal gasification project for DOE and that public reports were available. Photographs and a brief description of the concept were discussed in my presentation.

It was not possible to present more details than this in a 15 min. presentation.</td></tr>
<tr><td>Project started in Jul08 "at risk" without funding release. Process design completed and major equipment ordered</td><td>Have consumed all of phase I funding. Greatly underestimated engineering effort and cost for Phase I. Under DOE "Stop Work" order. Have not met Phase I goals including construction of facility and 300 hrs operation in proposed facility.</td></tr>
<tr><td colspan="2">PI Response: Haver not underestimated the cost of the engineering effort - the cost of the equipment and installation exceeded our estimates for Phase I. See further comments on budget and future plans elsewhere (Overall Response of PI, Section 5 below)</td></tr>
<tr><td></td><td>Unclear what has actually been accomplished and what is being tested. Presenting slides that are purposely stated to be unreadable does not help in transformation to the review panel</td></tr>
<tr><td colspan="2">PI Response:
Slide 8 was presented summarizing actual progress

8.Technical Accomplishments/ Progress/Results
Process Design efforts completed
Obtained gasification data from earlier testing, laboratory tar reformer advanced catalyst screening results
Simulated entire process in HYSYS
Selected specific catalysts and processes
Screened tar reforming catalysts in bench-scale unit
Initial design approach modified for higher efficiency
Mechanical design completed, preliminary equipment layouts developed
Analytical techniques and sampling plans developed
Major equipment ordered</td></tr>
</table>

<table>
<tr><td colspan="2">

- HAZOP review performed
- Developed more accurate estimate of cost to complete based on detailed process and mechanical design and vendor estimates of equipment and fabrication costs

Slides that were unreadable per se were not presented to obfuscate but rather to provide some indication of the level of detail that was undertaken in the project to date. These slides were presented with the following caution:

"The following slides, which for the most part will not be discussed in detail, are intended to provide an appreciation for the level of effort undertaken to this point – it will not be necessary that every detail be legible"

My apologies if they did not accomplish that purpose.
</td></tr>
<tr><td>Performed work "at risk" prior to contract.
Syngas quality specs suitable for FT liquids.</td><td>Task 1 money is spent, but Task 1 activity is incomplete.</td></tr>
<tr><td colspan="2">PI Response: No response to this comment has been provided by the Principal Investigator.</td></tr>
<tr><td></td><td>Phase 1 progress is falling far short of plan.</td></tr>
<tr><td colspan="2">PI Response: No response to this comment has been provided by the Principal Investigator.</td></tr>
</table>

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td>A key technology piece has been demonstrated with coal (filter-reactor). Targets for cleanup were clear.</td><td>Did not manage budget risk to meet deliverables.</td></tr>
<tr><td colspan="2">PI Response: See comments on budget and future plans elsewhere (Overall Response of PI, Section 5 below)</td></tr>
<tr><td></td><td>No information given for the project.</td></tr>
<tr><td colspan="2">

PI Response: Showstoppers/Critical Success Factors were identified in Slide 39, Future Work as:

- At this time the project is under ―Stop Work” order
- GTI and partners developing alternative approach – relocate the gas cleanup slipstream to Auburn University where a suitable scale gasifier is being built by GTI on a separate project, get commitment from a BTL technology provider for the revised program
</td></tr>
</table>

(several have been contacted) • Approval from DOE needed to pursue this alternate approach in more detail • Propose that the Project would re-start with a Task to define costs to complete at new site before proceeding any further (Decision Point) – (budget adjustment for Phase 1 required	
	Failed to realize the increase in fabrication costs and manage this accordingly which ultimately may terminate the project without producing results.
PI Response: The increase in fabrication costs was determined as soon as the detailed engineering and quoted fabrication and installation costs were in hand. We could not get good quotes without RFQs for which we needed the engineering done first. We failed to "anticipate" these costs in our proposal, but did not fail to realize them once they were in hand. However, due to the testing schedule we had to risk procuring equipment as soon as partial information and quotes were in hand due to long delivery times.	
	Stop work order issued.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	Project is under a Stop Work order. Needs to be repurposed.
PI Response: We are looking at possible alternative opportunities for repurposing the work. These have been discussed with John Scahill.	
Project work plan is consistent with solicitation requirements	Project is requesting DOE release a portion of Ph II funding to address Ph I shortfall. Not clear this will leave sufficient funding for Ph II plan Have not identified replacement fuel synthesis partner for Ph II.
PI Response: The premise was that in Phase II we could reduce cost by sending samples of cleaned gas to a test laboratory. DOE was not in favor of this approach and deemed it inconsistent with the FOA. The stop work order has decided the question as without the Phase II funds to continue the construction and procurement; we are guaranteed to miss the test	

opportunity at the gasifier in conjunction with the UPM-funded testing. GTI is looking for an alternate opportunity that will enable the completion of the project. A third party that could contribute funds for the liquid synthesis aspects of the work in Phase II would provide a solution to the potential shortfall in Phase II. We are also looking at the potential of piggybacking on a future pilot unit biomass gasification test program at GTI which is now in the proposal development stage with partners. This would require a hiatus of 7 months or so until the status of that proposal was known, and this has been discussed with DOE.	
	Absolutely opaque as to what is desired, planned and underway.
PI Response: It should be clear that since the project is under a stop work order there is no work underway. It was stated that we are looking at alternative plans for completing the work, in discussion with Auburn University which also made a presentation at this Platform Review. Additional options are in various stages of planning. Details of such discussions cannot be released without clearance from all parties involved. No costs are being charged to DOE for such planning activities.	
	Work is proposed, but is unfunded.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Has proposed a Plan B.	Stop work order issued by USDOE.
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
UPM, Carbona, Andritz collaboration Need to identify fuel synthesis partner to replace Velocys	Discussions were had with two major oil companies (subsequent to the meeting). One has a FT test unit but it was determined the scale was not adequate for DOE's requirements under this FOA. A second one is interested but subject to specific details of the project that were not worked out yet. We are cooperating with them on another solicitation that may afford, if awarded, the opportunity to resume this project at GTI but without any constraints as to the time schedule and with additional monies available. It may not be worked out until early next year. DOE is aware of this and is deciding whether to hold that option open for us.
UPM - Finnish wood products company	
Collaboration with industry partners UPM, Carbona, and Andritz.	
Partnered with UPM, Carbona, Andritz.	

2) Recommendations for Additions/Deletions to Project Scope

Syngas to Synfuels Process Development Unit

Technology Area: Biomass Program
Project Number: 3.2.5.11
Performing Organization: Iowa State University
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.00	0.63
Approach	3.50	1.05
Technical Progress	3.00	0.63
Success Factors	3.50	0.84
Future Research	3.50	1.05

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Demonstration of FT from switchgrass.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

Cold gas cleaning approach	Scrubbing approach generates waste stream that requires integration with oil refinery. Ammonia Chloride will present materials challenge for stainless steel Multi-stage approach to syngas conditioning may have high capex and opex.
PI Response: No response to this comment has been provided by the Principal Investigator.	
- cold gas cleaning: wet oil scrubber to remove tars & char - Conoco sorbent (regenerateable) for sulfur removal - water scrubbing to remove ammonia - if water scrubber doesn't remove chlorides and alkalies, will remove with catalytic scrubbers	too early in the project
PI Response: No response to this comment has been provided by the Principal Investigator.	
Key strength is the fact that the process takes largely proven technologies and attempts to link them in an integrated facility for the production of FT liquids. Good linkage with industrial partner.	Unit operations seem to proliferate - even mention of trace ammonia recovery.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Demonstrate production of FT liquids from switchgrass.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Syngas cleanup and condition is important step.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Staged approach contingent upon meeting gas cleanup targets, then to validate with FT for 500 hours continuous operation. Building new reactor to	Waste oil stream requires integration with an oil refinery (coker).

get syngas volumes needed. Using oil tar scrubbing instead of catalytic reforming - an interesting alternative worth investigating.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Emphasis on analytical techniques for gas phase analysis Tar analysis done offline	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Reasonable approach.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Unique in the portfolio of cold gas cleanup. Optimized between a low capex scrubber and producing a waste stream which COP has a way to process. Good leverage of existing research.	Wet oil scrubber requires integration with a petroleum refinery to obtain the gas oil and then process it in the coker. This limits the location and collection radius to be near a refinery.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project still in very early stage (only 5% of funding expended).	It's not clear how this project advances the state of the art in syngas cleanup and conditioning. There's a bit of tail wagging the dog aspect to this project -- the use of Conoco Phillips technology is driving the approach being pursued.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Beginning design of equipment for construction activities. Also analytical capability is in place.	Early in program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just getting started. Constructed Aspen model of gas cleanup	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is very early.	Project is really early.

PI Response: No response to this comment has been provided by the Principal Investigator.	
	Early in project schedule.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	This project appears to be more an effort to advance analytical methods and capacity than to advance the state of the art in syngas cleanup and conditioning.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Focused on the appropriate economic issues. Good understanding and explanation of choice for tar scrubbing. Fall back plans available if cleanup performance is not met.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Like the focus on capital.	Lots of analytical effort that seems more academic than practical. Just because something can be measured doesn't mean there is benefit in making the measurement. Tar seems the key, but the analytical focus was not on tar.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Technical and economic factors have been identified.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Waste oil stream, waste water stream -- potential problems.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Planning is sound for meeting deliverables - build, operate and gather data before moving to next phase.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
ref 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Working with an industrial partner to prove a process while keeping capital down.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Industrial partner has capability to drive commercialization.	
ConocoPhillips is key partner due to refinery integration requirement and use of Szorb technology	
ConocoPhillips Company	
Partnership with a commercial fuels company (Conoco) is good.	
ConocoPhillips is a partner on the project.	
Collaboration between Iowa State University and Conoco Phillips.	

2) Recommendations for Additions/Deletions to Project Scope

Pilot-Scale Demonstration of a Fully Integrated Commercial Processes for Converting Woody Biomass into Clean Biomass Diesel Fuel

Technology Area: Biomass Program
Project Number: 3.2.5.13
Performing Organization: Southern Research Institute
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.17	0.41
Approach	3.83	0.41
Technical Progress	3.17	0.41
Success Factors	3.50	0.84
Future Research	3.50	0.55

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Woody biomass through to FT diesel demonstration at 0.4 TPD scale.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Multi-function hot gas conditioning approach is well aligned with platform objectives for syngas	

conditioning.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
hot catalytic gas cleanup woody biomass	too early in the project
PI Response: No response to this comment has been provided by the Principal Investigator.	
Construction of integrated facility is a good approach.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Syngas cleanup and conditioning is important. Combining unit operations could provide some cost savings.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Phased approach, gas cleanup first (300 hours) then decision point before FT. Trying to eliminate pieces of equipment to reduce capex. Catalytical hot gas/Candle filter to combine functions. Technoeconomic assessment built into Phase 1 decision.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Testing and approach are consistent with solicitation requirements 10% flow split to reduce equipment cost (4 tph TRI gasifier) Employs hot gas cleaning technique based on dry multi-contaminant sorbents and hot candle filter with upstream sorbent feed. Waiting on gas analysis from gasifier before selecting/specifying exact sorbents/catalysts.	Requires representative slipstream.
PI Response: No response to this comment has been provided by the Principal Investigator.	

Moving toward capital reduction and fully integrated facility.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Leverage of funding. Have a Go/No Go at completion of Phase 1. Project schedule developed. Plan for 300 continuous hour run.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just started; only 5% of project completed. Integration mostly of commercial technologies.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Design work and getting contracts in place.	Early on program, only 5% complete at 6 months time. Sorbent specification has not been done yet.
PI Response: No response to this comment has been provided by the Principal Investigator.	
New project,	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Early phase	Early phase
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Early in project schedule.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Did not discuss. No strategy for improving catalyst effectiveness and reactor size reduction presented.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Measured and reasonable approach to proving technology.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Pretty straightforward	Commissioning of TRI gasifier is probably the biggest hurdle.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Adequate plans going forward to confirm performance.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
ref 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Proposed path forward is completely reasonable.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations
Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
TRI steam reformer, Pall Corporation (Hot catalytic syngas cleaning), Rentech (Fe based FT)	
Rentech (FT), TRI (10% slip stream from steam-reforming gasifier), Pall Filters (commercially available equipment)	
Reasonable list of collaborators with appropriate skills.	
Partnership with industrial partners which could aid in the commercialization.	
Southern Research partnering with TRI, Pall Corporation, Rentech.	

2) Recommendations for Additions/Deletions to Project Scope

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v) Fuel Synthesis

Fuel Synthesis Catalyst - CRADA with DOW

Technology Area: Biomass Program
Project Number: 3.3.2.7, 3.3.2.8
Performing Organization: NREL
Number of Reviewers: 5

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.40	0.55
Approach	4.00	0.71
Technical Progress	3.20	0.45
Success Factors	4.20	0.84
Future Research	4.00	0.71

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Mixed alcohol synthesis - focus on catalyst productivity and selectivity.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Benchmarking of industrial Mixed alcohol catalyst is aligned with DOE targets for catalyst performance by 2012.	Oak and mixed hardwoods feedstock selection - assume this is representative of woody biomass for TC process.
PI Response: Oak and mixed hardwoods will be the starting feedstock. However, as part of the terms of the CRADA provisions exist to test the catalyst over a range of feedstocks including other woody feedstocks as well as herbaceous feedstocks.	
- mixed alcohol synthesis; high-performance catalyst from Dow - over half project funding would be available for Phase III (PNNL help with catalyst improvement) if needed	project will start in May, 2009
PI Response: No response to this comment has been provided by the Principal Investigator.	
Demonstrating a step in the mission of TC. Oak and hardwoods are feed?	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Alcohol catalyst productivity and selectivity are important. Satisfactory catalyst lifetime is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Clear performance goals for catalyst. Looking broadly at catalyst performance attributes. Focus on higher alcohols. Looking at realistic conditions and life issues. Benchmarking and characterizing the candidate DOW catalyst.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Build on DOW experience with MAS catalyst. Test plan recognizes that catalyst performance is dependent upon multiple related factors	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Phased approach with decision after phase 2. Integrates a techno-economic approach.	Lacks project management tools - schedule, milestones, etc.
PI Response: These were not presented due to the fact the CRADA has not been signed at the time of the presentation and are still under negotiation between NREL and DOW. Very specific milestones, schedules and deliverables will be an integral part of the CRADA. and the project will be managed according to the best principles of project management.	
	Main effort is to benchmark existing catalysts.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*

- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Program has not started yet.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project expected to start in May09 based on negotiation of CRADA	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project has not started.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project so far hasn't received any funding.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good understanding of successful performance requirements.	Did not discuss details of the catalyst improvement activity which is the only risk mitigation strategy.
PI Response: The terms of the CRADA would not allow a public discussion of details of the catalyst improvement activity. CRADA projects are a little more frustrating to present and to review due to the restricted nature on the amount of details that can be publicly discussed.	
Excellent recognition of required catalyst performance requirements	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Catalyst success in meeting technical and business objectives. Recognition that higher alcohols are against the law to put in fuel pool.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Since project is simply the bench marking of existing commercial products, likelihood for success is quite high.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Plan will generate good benchmarking data, which are much needed. More than 1/2 of funding is available for the catalyst improvement activities.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project hasn't started yet - good plan in place (ref 4.)	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations
Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Dow can commercialize.	
CRADA with DOW Chemical builds on industrial experience	
Dow and maybe PNNL	
NREL partnering with PNNL and DOW (50% cost share by DOW).	

2) Recommendations for Additions/Deletions to Project Scope

Syngas Quality for Mixed Alcohols

Technology Area: Biomass Program
Project Number: 3.3.2.1, 3.2.2.2
Performing Organization: PNNL
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.50	0.55
Approach	4.50	0.55
Technical Progress	4.00	0.63
Success Factors	4.00	0.63
Future Research	4.00	0.89

Overall Principal Investigator Response(s)
We would like to thank the reviewers for their comments regarding our project. We appreciate their recognition of the importance of our research, our overall approach, and progress made developing a suitable mixed alcohols synthesis catalyst. We agree with their assessment that achieving our high performance targets is a challenging undertaking. However, we believe we have research pathways that can lead us to achieving these targets. We are appreciative of the reviewers' assessment of our utilization of computational science to aid support catalyst development. We added this component to our approach at the request of reviewers at the 2007 review meeting. While we agree that computational science has not yet reached the level where it is validated as a proven method for catalyst development, we have found it to be beneficial in increasing our interpretation of experiments and for identifying new avenues for investigation that might otherwise have been overlooked. We anticipate that further refinements in the catalyst structure model and corresponding further development in the predictive powers of computation will provide even better insights. We acknowledge the reviewer's comment regarding the economics of using rhodium in our catalyst formulations. While not presented during the review, we have completed analyses that indicate that rhodium based catalyst costs are acceptable assuming reasonable catalyst lifetime and effective rhodium reclamation from spent catalysts. We have consulted with two well known commercial precious metal catalyst reclaimers both of whom have validated our assumptions regarding refining and recovery of rhodium from compositions within our family of catalysts.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
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- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Mixed alcohol synthesis process. Higher productivity and selectivity catalysts to meet economic targets.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Addressing higher productivity and selectivity MAS catalyst toward DOE 2012 targets for EtOH synthesis.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
- improved mixed alcohol catalysts - found that thermal management of exotherm is key barrier to catalyst selectivity & productivity (e.g., favors slurry system) - using computational chemistry as a tool	very high risk research
PI Response: No response to this comment has been provided by the Principal Investigator.	
Clear ethanol focus, consistent with the goals.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Developing catalysts for synthesis of alcohols is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Good performance targets and will validate with real biomass syngas. Starting with benchmark and then development of improved catalysts. Ultimately generate economic estimates. Good benchmarking to methanol. Using computation to drive new catalysts design.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Benchmarking SOA Screen and optimize - includes unique computational Monte Carlo simulation in addition to experimental Confirm in long term testing Technoeconomic modeling	
PI Response: No response to this comment has been provided by the Principal Investigator.	
good use of computational, higher throughput and conventional catalyst development techniques	Results are still only modest improvement in overall performance.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Thorough look at state of the art, theoretical (Monte-Carlo) and testing with actual syngas. Program management has a list of milestones.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Very broad, long-duration approach, integrating computational modeling with experimental screening.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*

- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
At mid-point in project, completed benchmarking and investigated range of promoters and supports to improve performance. Strong improvement in yield and selectivity.	Computational insights into new promoters and compositions have not yet been validated. Validation of catalyst in slurry reactor is just starting and is requiring some reactor modifications.
PI Response: No response to this comment has been provided by the Principal Investigator.	
SOA review shows lack of progress after 1990 Screening focused work on RhMn based catalysts Showed some supports provide 5x improvement in oxygenate STY and 3x improvement in higher alcohol selectivity. Development of and application of computational science techniques helping to explain underlying chemistry and identification of new promoters. Have developed comprehensive and disciplined approach. Project is 50% complete - on target for budget and schedule	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Nice exploratory component and expansion into the slurry phase for heat management.	Question the detailed catalyst performance evaluation if catalysts are inadequate.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Computational methods are being updated basis data. Milestones are on track.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Significant progress claimed in computational modeling. Some progress in experimental screening. Major improvements seen in space time yield (3-4 x) for alcohols. Fundamental mechanisms/processes better understood.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- 5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.
- 4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.
- 3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.
- 2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.
- 1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.

Strengths	Weaknesses
Acknowledged technical difficulty of hitting performance targets.	Minimal mitigation plans to address risks.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Excellent understanding success factors and potential pitfalls.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Really an exploratory effort and is somewhat open ended.	Impossible to state or say that better catalysts don't exist.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Catalyst costs (precious metals) not recognized in presentation.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Continued effort on improving Rh catalysts and considering other systems. Plans in place to get more validation data.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Measured and thoughtful approach. Necessary research.	There is no recipe for innovation in catalyst performance. Use of computational methods

	have not yet proven as a method for development of new catalysts.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Future work is will cover a broad perspective on the catalyst development and address the MYPP.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Mostly continuation of long-duration project.
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
NREL - slurry reactor testing	
Need to indentify commercial path forward.	
Collaboration between federal labs with some interaction with catalyst companies.	

2) Recommendations for Additions/Deletions to Project Scope

Catalytic Production of Ethanol from Biomass-Derived Synthesis Gas

Technology Area: Biomass Program
Project Number: 3.3.2.6
Performing Organization: Iowa State University
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.00	1.10
Approach	3.33	0.82
Technical Progress	3.17	0.41
Success Factors	3.17	0.98
Future Research	3.33	0.82

Overall Principal Investigator Response(s)
We thank the reviewers for their comments. Our responses to the specific comments of

reviewers are outlined in the following sections.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Ultimately produce mixed alcohols via pyrolysis oil and gasification.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Development of Mesoporous mixed oxide material for MAS is aligned with fuel synthesis goal	Focus on fast pyrolysis followed by gasification
PI Response: The present project focuses on two primary tasks: Task 1: Production of synthesis gas (syngas) from biomass via fast pyrolysis and gasification, and Task 2: Synthesis of highly selective and reactive novel mesoporous catalyst for converting syngas to ethanol and the demonstration of ethanol production from syngas by using the synthesized catalyst. Indicated by the distribution of the research budget, both Tasks are given equal importance. While Task 2 is performed by researchers at ISU's Center for Catalysis, led by the PI, Task 1 is performed by researchers at ISU's Center for Sustainable Environmental Technologies (CSET), lead by Co-PI Dr. Robert Brown and Dr. Justinus Satrio. In Task 2, the work will include the following sub-tasks: (1.1) Demonstration of the production of bio-oil from fast pyrolysis of biomass by using newly built 8-kg/hr fast pyrolysis system which is equipped with a fractionated bio-oil condenser system, which allows the collection of bio-oil in five different fractions. (1. 2) Characterize the physicochemical properties of bio-oil produced in sub-task 1.1. (1.3.) Design and construct a bench-scale high pressure bio-oil gasification system. 4) Demonstrate the production of syngas by gasifying selected bio-oil fractions produced in 1.1. (1.4) Characterize the quality of syngas streams produced from different bio-oil fractions by using different gasication operating conditions. As these subtasks are described above, we have begun to investigate the fast pyrolysis. We are	

focusing a fair amount of time and effort to the fast pyrolysis aspect of this project. We have recovered five bio-oil sample fractions from one single fast pyrolysis step and are now actively analyzing the fractions to determine which one will form the optimal synthesis gas in the gasifier.	
gasifying particular fractions of pyrolysis oil which are low in sulfur, nitrogen, inorganics	project just started
PI Response: See the explanation for syngas production work on the response to Reviewer 17801. Although the project was officially started in January 2009, the actual work has not started until late March 2009, due to the delay in the funding availability. As of the end of the first quarter (March 31, 2009), studies have been initiated for the production and characterization of bio-oil samples by using CSET's's 8kg/hr new fast pyrolysis system. The bio-oil samples will be used for the gasification study at atmospheric pressure by using an existing bio-oil reforming system in CSET lab. The data will be used for designing and constructing a high pressure bio-oil gasification system. For the design and construction task, a new Mechanical Engineering graduate student has been employed. He will be assisted by one of CSET's research engineers who is experienced in designing and constructing gasification system. As stated in the response to reviewer 17801, both task A and B are starting simultaneously to maintain continual progress on this project. The PI, Victor Lin, is overseeing the synthesis, characterization, and scale-up of the selective catalyst. We have initiated the testing of our first generation catalyst on our laboratory scale fixed bed reactor and have begun synthesizing and characterizing higher generation catalysts. Progress is continuing on all aspects of this project and we remain on task and on schedule.	
Goal of all steps from biomass to alcohols. Fast pyrolysis for bio-oil coupled to high pressure gasifier.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
R&D supports distributed feedstock concept. Broad, linear approach: fast pyrolysis of biomass to bio-oil; gasification of bio-oil; catalytic conversion of gas into EtOH.	Not clear that this will produce enough product fuel to make this a strong option.
PI Response: A technoeconomic analysis on the overall process, i.e. from biomass to ethanol, will be performed as part of the project. From the technoeconomic study, the feasibility of the process can be assessed. The technoeconomic analysis on fast pyrolysis and gasification of biomass have been reported in several open literatures. The data from literature indicate the technologies are feasible technically. The performance of the novel syngas-to-ethanol catalyst developed in this project will determine the feasibility of the syngas-to-ethanol conversion step, which will be reported as the outcome of this project. Preliminary results for the selective syngas-to-ethanol catalyst shows good recyclability, with varying product yield. One of the main objectives of this project is to realize if mesoporous based catalysts will increase the fuel production from current state-of-the-art catalysts. We continue to adjust the properties of both the catalyst and syngas-to-ethanol reaction conditions to optimize the product yield and selectivity.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Trying to improve pyrolysis unit performance. A small entrained flow gasifier has yet to be designed and built. Templated catalyst support method - does it yield a superior catalyst?	Production of pyrolysis oil before gasification presents serious economic challenges - both capex and fuel yield loss. Investigators are hopeful that pyrolysis oil fractionation will remove most impurities (catalyst impurities), could be a risk if not successful.
PI Response: Technoeconomic analysis comparisons will be made between two scenarios for making clean high pressure syngas. The first scenario is the conventional approach where biomass is gasified, followed by cleaning and then pressurized. The second scenario, which is the proposed process, involves liquefying biomass into bio-oil (in fractions) by using fast pyrolysis, followed by gasifying selected bio-oil fractions to make high pressure, high quality, clean syngas. It is expected that the proposed syngas producing process has an advantage over the conventional process (the first scenario) in terms of reducing the cost of syngas compression and of reducing the intensity of syngas cleaning. From this technoeconomic analysis, the capex, opex, and fuel yield of the two scenarios will be compared and reported.	
Building on ISU CCAT experience with development of mesoporous catalysts (funded under DOE BES)	Unclear economic proposition for application of three thermochemical platform operations. This appears to increase rather than decrease capital intensive nature of thermochemical processing.
PI Response: A technoeconomic analysis work on the overall process, i.e. from biomass to ethanol, will be performed as part of the project. From the technoeconomic study, the feasibility of the process will be assessed. The technoeconomic analysis on fast pyrolysis and gasification of biomass has been reported in several open literatures. The data from literature indicate the technologies are feasible technically. Technoeconomic analysis comparison will be made between two scenarios for making clean	

high pressure syngas. The first scenario is the conventional approach where biomass is gasified and then cleaned and pressurized. The second scenario, which is the proposed process, involves liquefying biomass into bio-oil (in fractions) by using fast pyrolysis, followed by gasifying selected bio-oil fractions to make high pressure syngas. It is expected that the proposed syngas producing process has an advantages over the conventional process (the first scenario) in term of reducing the cost of syngas compression and of reducing the intensity of syngas cleaning. The performance of the novel syngas-to-ethanol catalyst developed in this project will determine the feasibility of the syngas-to-ethanol conversion step, which will be reported as the outcome of this project.	
Very thoughtful and complete program. Integration is good.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
A unique technical approach for pyrolysis oil fractions and catalyst development.	Milestones and schedule have not been presented.
PI Response: As stated in part 1, Relevance to overall project goals, we did not start this project until the funding was available, about 2 weeks before the end of the first quarter. Milestones and a schedule was part of the initial program management plan (PMP) that was written last summer. We underestimated the time that it would take to submit the proper paperwork to release project funding. New, detailed milestones and schedules will be reported in the second quarterly report after we work with the Golden Field office to make those adjustments on the PMP.	
Project just underway; results reported were done at risk.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Just started program.
PI Response: On paper this project was officially started in January 2009, the actual work has not started until late March 2009, due to the delay in the availability of funding.	

Revised schedule will be presented in the second quarterly report of Year 1. We have begun conversations with the Golden Field office to make these adjustments to the PMP.	
Project just starting,	
PI Response: No response to this comment has been provided by the Principal Investigator.	
early in program	early in program
PI Response: On paper this project was officially started in January 2009, the actual work has not started until late March 2009, due to the delay in the availability of funding. Revised schedule will be presented in the second quarterly report of Year 1. We have begun conversations with the Golden Field office to make these adjustments to the PMP.	
	Project has just started.
PI Response: On paper this project was officially started in January 2009, the actual work has not started until late March 2009, due to the delay in the availability of funding. Revised schedule will be presented in the second quarterly report of Year 1. We have begun conversations with the Golden Field office to make these adjustments to the PMP.	
Project just underway.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	There is no fall back plan if syngas purity does not meet catalyst requirements.
PI Response: The objective of this project are twofold: 1) to produce clean syngas that does not need rigorous cleaning, and 2) to produce a series of high performance syngas-to-ethanol catalysts that do not require ultraclean syngas. The output of the project is also 2-fold (1) will be to report what quality of syngas can be produced from the unique combination of fast pyrolysis-gasification process for producing syngas, and (2) what level of syngas pretreatment, if any, is	

necessary for the selective syngas-to-ethanol catalysts. The information regarding the quality of the produced syngas from the upstream process and the required syngas quality for the downstream process will determine whether auxiliary gas cleaning/upgrading steps are needed in order to connect both upstream (syngas production) and the downstream (syngas to synfuel) processes.	
	Benefits of overall process concept is poorly defined.
PI Response: A technoeconomic analysis work on the overall process, i.e. from biomass to ethanol, will be performed as part of the project. From the technoeconomic study, the feasibility of the process can be assessed and the benefits of overall process will be addressed. Technoeconomic analysis comparisons will be made between two scenarios for making clean high pressure syngas. The first scenario is the conventional approach where biomass is gasified, cleaned, and pressurized. The second scenario, which is the proposed process, involves liquefying biomass into bio-oil (in fractions) by using fast pyrolysis, followed by gasifying selected bio-oil fractions to make high pressure syngas. It is expected that the proposed syngas producing process has an advantage over the conventional process (the first scenario) in terms of reducing the cost of syngas compression and reducing the intensity of syngas cleaning. The technoeconomic analysis will show whether this expectation holds true for our proposed system. The performance of the novel syngas-to-ethanol catalysts developed in this project will determine the feasibility of the syngas-to-ethanol conversion step, which will be reported as the outcome of this project. There are several benefits of incorporating the metal catalyst on mesoporous support. The novel 3D porous structure will protect the metal catalyst from sintering and the surface of the support and metal catalyst has sites that can intercept sulfur-based impurities and carbon dioxide to minimize poisoning issues seen in other syngas-to-ethanol systems. These are just a few specific benefits of parts of the overall process.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Fairly standard catalyst improvement plans.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
ref 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Future work should focus in part on the success factors and challenges.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project just underway. A lot of work, including fabricating new test systems, remains.
PI Response: On paper this project was officially started in January 2009, the actual work has not started until late March 2009, due to the delay in the availability of funding. Revised schedule will be presented in the second quarterly report of Year 1. We have begun conversations with the Golden Field office to make these adjustments to the PMP. As of the end of the first quarter, initial studies have been started on the production and characterization of bio-oil samples by using CSET's's 8kg/hr new fast pyrolysis system. The bio-oil samples will be used for gasification study at atmospheric pressure by using an existing bio-oil reforming system in CSET lab. The data will be used for designing and constructing a high pressure bio-oil gasification system. For executing the task of designing and constructing a bench-scale high pressure bio-oil gasifier, a new Mechanical Engineering graduate student has been employed. He will be assisted by one of CSET's research engineers who is experienced in designing and constructing gasification system. Progress on the syngas production via fast pyrolysis and gasification work will be reported in the second quarterly report by the end of July 2009. As new generations of syngas-to-ethanol catalysts are synthesized and characterized, their reactivity is tested on a laboratory scale fixed bed reactor we have dedicated to this project. Initially, we are using artificially mixed syngas, but will begin testing the syngas produced by CSET soon. We are working on syngas-to-ethanol catalyst design and synthesis concurrently with the fast pyrolysis and gasification processes to keep this project on schedule.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Views other work PNNL/NREL as complimentary work.	

2) Recommendations for Additions/Deletions to Project Scope

Thermochemical Conversion of Corn Stover

Technology Area: Biomass Program
Project Number: 3.3.2.5
Performing Organization: Bioengineering Resources, Inc.
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.50	0.84
Approach	3.50	0.55
Technical Progress	3.67	1.03
Success Factors	3.33	0.82
Future Research	3.50	0.55

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Demonstration of a novel approach for turning syngas into ethanol.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Unique syngas fermentation approach is well	

aligned with platform goals for EtOH production	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	project almost done still not economical ($35/ton feedstock cost is extremely unrealistic)
PI Response: No response to this comment has been provided by the Principal Investigator.	
All steps needed are being demonstrated and the approach is a significant departure from other syngas conversion technologies. Specifically, the low pressure of operation, 100% selectivity to ethanol, and ability to handle syngas of any ratio differentiate this technology from other alcohol synthesis.	This technology has now transitioned to private funding and is moving rapidly to demonstration by at least two companies.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Interesting hybrid cross between pure thermochemical versus pure biological conversion processes. Might be able to fully utilize syngas compositions that are different from other thermochemical processes.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
A different method for making ethanol from syngas that eleviates some of the selectivity challenges of catalytic conversion. Claimed 80 to 100 gallons ethanol/dry ton of stover but presented not data to support.	Only 70% conversion, rest of syngas going to steam and electrical power, which have much lower value than ethanol.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Have not addressed potential waste water tar

	issue
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good approach to demonstration. Operation on real bio derived syngas removes all doubts about the ability of the technology to deliver.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Has demonstrated gasification of stover and fermentation of syngas. Hit fermentation performance targets.	Gasification configuration would be difficult to scale to large commercial capacities (multi 1000 TPD). Some difficulties with gasification operation (feeding and heat loss). At 90% completion, there is still important work remaining - emissions and economics. Some preliminary economics should have been done and presented.
PI Response: No response to this comment has been provided by the Principal Investigator.	
90% complete - started in FY05 Completed successful pilot development and test program Have demonstrated long term viability/tolerance and conversion efficiency of biological system.	Not clear that system can be scaled up to large scale, e.g. >1000 tpd feed. Have not addressed potential environmental problem with tars in waste water.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Nice demonstration of an approach that only makes ethanol.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Appears to be on schedule for delivering as planned.	Requires wood chips to feed the corn stover. This may cause significant cost and/or logistic challenges.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project milestones mostly completed.	Technoeconomic evaluation still forthcoming; this is a very critical part of the project.

PI Response: No response to this comment has been provided by the Principal Investigator.

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Many of the technical challenges have been met.	Economic targets have not been confirmed. Some preliminary estimates should have been done and presented to justify the hypothesis of lower cost vs. catalytic production.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not willing to discuss process economics
PI Response: No response to this comment has been provided by the Principal Investigator.	
All that seems to remain is meeting economic hurdles.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Identified challenges in environmental permitting as well as technology and business/market.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Economics still not addressed even though project is many years old.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*

- *3-Satisfactory. Future work plans are loosely built on past progress and could address OBP MYPP barriers in a reasonable period.*
- *2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key OBP MYPP barriers in a reasonable timeframe.*
- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Future work should answer remaining questions.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is nearly complete	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Economics are hazy.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project almost completed.	Economics need to be evaluated.
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Process design and integration by AdvanceBio	
Allusions to "sold the company" left impression that technology transfer had already occurred.	
Integrated with biochem (corn ethanol).	
Partner with AdvanceBio.	

2) Recommendations for Additions/Deletions to Project Scope

Mississippi State University Sustainable Energy Center - Syngas to Fuels Projects

Technology Area: Biomass Program
Project Number: 7.7.4.8.b
Performing Organization:
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.67	0.82
Approach	3.33	0.52
Technical	2.67	0.52

Progress		
Success Factors	2.67	0.52
Future Research	2.83	0.41

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Production of liquid hydrocarbons from syngas.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Aligns with goal for development of catalysts for "other fuels" HC fuels via higher alcohols (not FT chemistry)	
PI Response: No response to this comment has been provided by the Principal Investigator.	
syngas to hydrocarbon fuels via dual catalyst that operates through higher alcohol intermediates	only 31 mole-% yield to liquid HC fuels (31% to C1-C3 and 39% to CO2) and low
PI Response: No response to this comment has been provided by the Principal Investigator.	
Interesting approach to use bifunctional catalyst.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	This is duplicative work.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Development of catalyst for production of transportation biomass-derived fuels is important.	Process goes via alcohols -- seems more complicated than necessary.
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Make hydrocarbons from syngas via higher alcohols - use bifunctional catalysts.	Uphill battle for yield improvement.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Management of overall academic research program	RDD approach and plans for specific projects not discussed
PI Response: No response to this comment has been provided by the Principal Investigator.	
	no techno-economic evaluation
PI Response: No response to this comment has been provided by the Principal Investigator.	
Building on observations and exceeding expectations is good.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project milestones and schedule need to be developed. Testing should be validated with produced syngas rather than solely relying on bottled gas.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives,*

OBP goals and objectives and contributes to overcoming technical barriers.

- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Second generation of catalyst for HC yield improvement. Making good quality liquid product.	Low CO conversion and low yield of liquid vs. light gases.
PI Response: No response to this comment has been provided by the Principal Investigator.	
2nd generation Molyb catalyst - improved C yield to liquid HC Selection of H-Y acid catalyst - reduced aromaticity Produced high octane, low aromatic blend stock	Not clear how this work is distinguished from decades old MTG catalyst development. Was a literature and patent search done?
PI Response: The previous literature was thoroughly examined for converting synthesis gas to methanol first in one catalytic converted followed by the dehydration/oligiomerization etc in a second converter containing an acid catalyst. That concept proved uneconomical because of several factors one being the equilibrium limited reaction. The new concept is a one bed, multifunctional catalyst that seeks to build on the new data showing that higher alcohols produce much higher liquid yields than the old concept. Moreover, a comparison of our data with the latest work using the MTG approach shows that our catalyst makes much less CO2 than the MTG concept (39% versus 50%). Finally, the Mo/Y system makes a liquid almost devoid of aromatics where the old MTG system makes significant amounts of aromatics, especially durene.	
	Some confusion of valuable mixture with mixture of valuable chemicals. What is needed is clarity on the economics.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Low conversion of CO to liquids appears to make the process uncommercial.
PI Response: No response to this comment has been provided by the Principal Investigator.	
USDOE funded project is phasing down; all deliverables have been largely completed.	There is no strong argument that this process is superior. Project needs economic feasibility analysis.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*

- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Challenges and targets are known and documented.	No mitigation strategy for addressing catalyst performance risks (life and selectivity) - need strategy for developing next generation catalysts.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Have not done process economics to establish success factors (particularly comparison with FT)
PI Response: No response to this comment has been provided by the Principal Investigator.	
	no techno-economic evaluation
PI Response: No response to this comment has been provided by the Principal Investigator.	
Engine testing is a plus for such an early stage project.	Disregard for energy content and economics is difficult to handle.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Recognized a business concern: industry acceptance.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Has developed a surrogate gasoline with good octane number and low aromatics.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Future work will demonstrate performance with current catalyst in piloting.	Unclear on strategy to improve catalyst. Need to demonstrate economics and energy balances.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	no techno-economic evaluation
PI Response: No response to this comment has been provided by the Principal Investigator.	

Lack of economic basis compromises weight of conclusions.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Pilot scale testing is scheduled for future months (as separate work).	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations
Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Collaboration with PNNL in next phase.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Need to compare process economics with F-T alternative. Address compatibility of oxygenated components with fuel system components.	

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vi) Pyrolysis

Fast Pyrolysis Oil Stabilization: An Integrated Catalytic and Membrane Approach for Improved Bio-oils

Technology Area: Biomass Program
Project Number: 3.2.2.10
Performing Organization: University of Massachusetts at Amherst
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.17	0.75
Approach	3.50	0.55
Technical Progress	3.17	0.41
Success Factors	3.17	0.75
Future Research	3.67	0.52

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Stabilization of pyrolysis oils on route to liquid fuels.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Aligned with DOE goal to address bio-oil instability	
PI Response: No response to this comment has been provided by the Principal Investigator.	
- get a better understanding of the chemical mechanisms underlying the instability of pyrolysis oils - stabilize pyrolysis oils by utilizing microfiltration to remove char and ultrafiltration, hydrogenation or ion exchange to remove organic acids, aldehydes & ketones	project just started (Feb'09)
PI Response: No response to this comment has been provided by the Principal Investigator.	
Seems to be	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Stability and quality of bio-oils is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2 Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Understanding of sources of instability as first step.	Trial and error method to acid and char removal. Very empirical approach to understanding source of viscosity build. A bit of a shotgun approach.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good approach to characterize and understand causes of instability followed by development of techniques to target removal functionality.	Broad brush approach requires discipline to stay on track and not chase too many leads.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project has a task structure.	No schedule, milestones, nor go/no go associated with tasks. Goal lacks an oxygen reduction. Hydrogenation in a distributed pyrolysis plant location will occur a hydrogen cost.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
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- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Only two months into the program. Only limited

	characterization of oil to date. No new insights.
PI Response: No response to this comment has been provided by the Principal Investigator.	
New project, < 4% complete Preliminary membrane work on model fluids Preliminary on characterizing bio-oil fractions	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Reasonable approach	Early stage of both project and understanding.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project has recently started.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just underway.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	No mitigation plans to address challenges.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Very observational research. Characterization is mentioned without really talking about what chemistry is hypothesized to lead to the issues.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Identified a market driver and potential high cost of hydrogen.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Challenges mentioned, but solutions not identified.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Plan is sound to assess viability of proposed technologies.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
red 4.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Fairly broad list of tasks in research plan, including economic analysis.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Program does have commercial partners to aid commercialization.	
Not clear what role for Renewable Oil International (Phil Badger) industrial partner	
Renewable Oil Int'l (Phil Badger)	
Partnership with Renewable Oils International.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
The membrane approach should be quickly assessed for viability with some jugular experiments. If they prove to be not viable, shift effort and resources to other strategies.	

Technology Area: Biomass Program
Project Number: 3.2.2.4, 3.2.2.5
Performing Organization: PNNL
Number of Reviewers: 5

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.80	0.45
Approach	4.20	0.84
Technical Progress	4.20	0.84
Success Factors	4.00	0.71
Future Research	4.00	0.71

Overall Principal Investigator Response(s)
We appreciate the overall strong endorsement from the review panel for this project and its recognition of the value of the program of research included. There are some selected comments that can also be found below.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
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- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Broad scope of pyrolysis process flow from pyrolysis oil to hydrocarbon fuel.	Effort directed at developing standards for burner fuel is not directly relevant to MYPP.
PI Response: We recognize that the burner fuel ASTM standard for bio-oil does not directly support the MYPP and the emphasis on transportation fuels, but it is the first step in setting	

standards for use of bio-oil. We fully expect to move on to turbine and diesel standards as well as developing standards for use of hydrotreated bio-oil products as fuels. A driver for this first step is the world-wide interest in direct use of bio-oil for heat and power and is therefore included in the IEA Pyrolysis Task 34, to which this project contributes.	
- catalytic fast pyrolysis (to lower oxygen content) - stabilizing bio-oils (determined that hydrotreating is uneconomical) - standards for bio-oils - techno-economic analyses	
PI Response: Stabilizing of bio-oil is a key step in utilization -- either directly or in hydrotreating. The UOP assessment (project 3.2.2.1) suggests that hydroprocessing of bio-oil is a very reasonable option for producing transportation fuels.	
Bio-oil stability is important to DOE and this project touches many, if not all, of the key steps and issues. Project is building on a strong foundation and has outlined reasonable directions with results indicating success is possible.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Optimization of pyrolysis and stabilization and quality of bio-oils are important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

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- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Program does focus on each of the steps plus an economic evaluation. Pyrolysis at a scale to make sufficient volume of oil. Including investigation into catalytic pyrolysis.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Developed facilities to produce, treat, and	

analyze bio-oils Collaboration with other research institutes (VTT), standards organizations (ASTM and REACH), technology developers (Ensyn, Dynamotive, UOP), UH/GEMI	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Nice variety of options and at reasonable scale.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Broad coverage of pyrolysis research areas. Has a milestone structure with dates.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Long-term, broad R&D on bio-oil characterization and treatment.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Initial yield performance of pyrolysis with different feedstocks. Some initial stabilization results. Broad perspective and approach to addressing commercial risks.	Not a lot of data presented considering the program is 40% complete and is a fairly large program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
60% complete - started in Fall 2006 Design case study completed and published	
PI Response: No response to this comment has been provided by the Principal Investigator.	
good range of effort	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Seems to be on track, schedule-wise.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good assembly of risks and success factors for commercialization of technology.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Economics should be more prominent in the analyses.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Future plans address most of the open issues.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Catalytic pyrolysis and improved catalytic treatment of bio-oil	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Development of standards is OK - important,	

but not sexy. Nice to see documentation complete for this type of work. Great to see work with armored refinery.
PI Response: No response to this comment has been provided by the Principal Investigator.

1) Technology Transfer/Collaborations
Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Collaboration with VTT is very desirable. Recently published report on economics.	
VTT collaboration - comparison of results Ensyn commercial fast pyrolysis technology developer UH/GEMI technoeconomic assessment of pathways	
NREL, Finnish Technical Research Center (VTT), Ensyn	
Reasonable collaboration partners.	
Partnership between PNNL and NREL; collaboration with VTT (Finland), Gemi/University of Houston, Ensyn.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Would recommend that less effort be put on the catalytic pyrolysis and more effort to address the refinery compatibility of treated pyrolysis oil.	Refinery compatibility is the near-term focus of the project including both experimentation and assessments. Less effort is already planned on the catalytic pyrolysis. Catalytic pyrolysis is viewed as a long-term option which will be investigated in this project to try to determine the extent of the long-term opportunity.

Hydrothermal Liquefaction of Agricultural and Biorefinery Residues

Technology Area: Biomass Program
Project Number: 3.2.2.6
Performing Organization: Archer Daniels Midland,
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.67	0.52
Approach	3.50	1.22
Technical Progress	3.00	0.63
Success Factors	3.17	0.75
Future Research	3.17	0.41

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Hydrothermal liquefaction of biomass to produce intermediate oils.	Performance objectives and product attribute targets for commercial viability are not clear.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Hydrothermal liquefaction aligned with pyrolysis pathway	Use of biorefinery residues suggests fit with biochemical platform
PI Response: No response to this comment has been provided by the Principal Investigator.	
	should have had a preliminary techno-economic analysis by this point
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is addressing real engineering concerns.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Ability to convert biorefinery residues and agricultural residues into biofuels is valuable.	

Upgrading of liquefaction oils is important.
PI Response: No response to this comment has been provided by the Principal Investigator.

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Use of continuous microscale products to evaluate feedstock performance in hydrothermal treatment. Assessment of product quality by ConocoPhillips should provide high quality feedback.	Overall process vision and implementation strategy is not clear.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Excellent project management and controls processes - one of very few projects that showed this	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good use of economic evaluation to keep project on reasonable course.	Approach is is described as very observational.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project has a task structure with project management plan.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	The project goals appear to be overly ambitious in light of the proposed 1.5 year duration of the project.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Listed tasks completed but no quantitative data presented. Difficult to assess progress. Not clear what has been learned or insights generated. A little behind schedule.
PI Response: No response to this comment has been provided by the Principal Investigator.	
50% complete, started in Mar08, finish in Sep09	Slightly behind schedule, but on budget against progress.
PI Response: No response to this comment has been provided by the Principal Investigator.	
A bit behind on timing.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Testing and analysis are underway (50% complete). Signficant accomplishments over a relatively short time period, albeit on small reactor system.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Identified some very specific equipment challenges	Presenter only minimally addressed new equipment

and feedstock variability challenges.	design to meet challenges.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Cost effective and reliability of HP feeding of biomass slurries is a key challenge.	Commercial vision is somewhat vague.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Steps outlined to take material to product and addressing issues necessary for ultimate fuel production.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Recognition of factors outside the scope of the project.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Continuing on path to complete the assessment of hydrothermal process and product capabilities plus economic evaluation.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Nice balance of reasonable steps across the breadth of the project.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Extensive list of tasks presented, including economic analysis.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Involvement of ConocoPhillips will help with	

technology transfer and commercialization.	
Good collaboration between ADM, ConocoPhillips, and PNNL	
Conoco Phillips, PNNL	
Good industry collaboration.	
Collaboration between ADM, PNNL, and Conoco Phillips.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Not clear how scale requirement of 4000 TPD matches with stated application for biorefinery residues.	

A Low-cost High-yield Process for the Direct Production of High Energy Density Liquid Fuel from Biomass

Technology Area: Biomass Program
Project Number: 3.2.2.7
Performing Organization: Purdue University
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.00	1.26
Approach	2.00	0.63
Technical Progress	2.83	0.41
Success Factors	1.83	0.41
Future Research	1.83	0.41

Overall Principal Investigator Response(s)
The central theme of this study involves designing a novel process to produce high yields of high energy density liquid fuel for transportation. The novelty of this work does not lie in the fact that hydrogen from solar energy is being used. The novelty of this work lies in the fast hydropyrolysis process, which has the potential to generate higher yields of liquid fuel than any other process using biomass. Until a carbon-free source, such as solar, is available for the production of cheap hydrogen, the process will use hydrogen derived from coal or natural gas. Our H_2Bioil process is quite synergistic when the source of H_2 is natural gas or coal. For example, our modeling results show

that 1 billion ton of biomass using 198 billion m^3 of natural gas will be able to provide 3.24 billion bbl of oil. If 1 billion ton of biomass is converted to oil by any of the known processes, it will produce roughly 1.2 billion bbl of oil. Similarly, 198 billion m^3 of natural gas through steam methane reforming/FT will produce 0.79 billion bbl of oil. Therefore, when individually used, the same quantities of biomass and natural gas will produce roughly 2 billion bbl of oil. The proposed H_2Bioil on the other hand has a potential to provide 3.24 billion bbl of oil – which is 1.6 times more! Once a carbon-free source is readily accessible, the transition will be seamless as the lessons learned and techniques developed will remain the same regardless of the source of hydrogen.

Realizing the advantage of this process over other existing processes to convert biomass to liquid fuels is the driving force for this study. While traditional biomass gasification/Fischer-Tropsch processes can produce 86 ege/ton biomass (ege is ethanol gallon equivalent), and biomass fast pyrolysis processes can produce 163 ege/ton biomass, the proposed fast hydropyrolysis/hydrodeoxygenation process shows significant improvement in yield at 230 ege/ton biomass (1). In addition, it is able to overcome the challenges associated with the stability of the oil formed during fast pyrolysis of biomass since the use of hydrogen is expected to dramatically lower to oxygen content of the product and thus increase its stability and processibility and utility.

While the advantages of this process approach rest on thermodynamically sound detailed process calculations, achieving the full potential is not without challenges. Neither fast hydropyrolysis nor catalytic hydrodeoxygenation has a rich literature. Their experience in process and reaction engineering, chemical kinetics, and catalyst design, however, positions this research team to meet those challenges. The potential for a process that can generate a significant portion of the Nation's need for fuel from sustainably available biomass is the source of the team's passion for success.

1. Agrawal, R., N. R. Singh. (2009). "Synergistic routes to liquid fuel for a petroleum deprived future." Accepted for Publication, AIChe J.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*

- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td></td><td>Reliance on solar hydrogen is unrealistic and makes this program of marginal relevance.</td></tr>
<tr><td colspan="2">PI Response:
The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being used but in the use of hydrogen to improve carbon and energy efficiency and produce a useful product while taking maximum advantage of the chemical structure already provided by nature. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available. The relevance of the project is linked to the possibility of producing low-cost, high-yield, high energy density liquid fuels in a sustainable manner to satisfy the needs of the entire light-duty transportation sector of the country.</td></tr>
<tr><td>One step hydropyrolysis+hydrodeoxygenation is an intriguing new approach for direct conversion of biomass to HC</td><td>Unclear fit with current platform priorities
Requires external supply of H2, preferably for "carbon-free" source (e.g. Solar)</td></tr>
<tr><td colspan="2">PI Response:
The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being utilized. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available. Calculations using hydrogen from natural gas highlighted the impact of such synergistic integration, producing 1.6 times more liquid fuel from the combination than when produced from each source separately (1). Additionally, in the future, if hydrogen is available from solar energy, it is evident that this process becomes even more attractive. The lessons learned from this experiment will remain unchanged when hydrogen is available from carbon free sources.

2. Agrawal, R., N. R. Singh. (2009). "Synergistic routes to liquid fuel for a petroleum deprived future." Accepted for Publication, AIChe J.</td></tr>
<tr><td>- one-step hydro-pyrolysis and hydro-deoxygenation (envision hydrogen from renewable energy sources - photovoltaics, wind)
- would require less than 1/3 the hydrogen than what would be required to convert all of the carbon to liquid fuels via BTL.</td><td>- will use very expensive (solar-generated) hydrogen - very high pressure (50 bar, 500 deg-C) - no breakthrough ideas for catalysts - extremely high exotherm, so controlling the reaction(s) would be very difficult</td></tr>
<tr><td colspan="2">PI Response:
The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being used. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available. While the ―silver bullet” catalyst is not in hand, the team has extensive catalytic experience and a plan for screening acid/base, redox, and hydrogen activation functions in the rational design of HDO catalysts for the specific oxygen functionalities present in biomass.

In order to understand the enthalpy changes of hydrodeoxygenation (HDO) reactions, calculations were made for HDO of model compounds, which are representative of the cellulose,</td></tr>
</table>

hemicelluloses and lignin components in biomass. Thus, our calculations do not account for the energy needed to break biomass into these smaller molecules, which would consume a portion of the heat generated due to reaction. The heat of reaction of the HDO of glucose (representative of cellulose) is -377.8 kJ/mol which is 14.8% of its heat of combustion; the heat of reaction of the HDO of xylose (representative of hemicellulose) is -541.7 kJ/mol which is 23.2% of its heat of combustion; and the heat of reaction of the HDO of coniferyl alcohol (representative of lignin) is -650 kJ/mol which is 13% of its heat of combustion (1). Thus, it is evident that that heat of reaction for the HDO of biomass is small in comparison with gasification/Fischer-Tropsch based processes, contributing to better overall energy efficiencies for the proposed process (1). In conclusion, the commercial FT process releases much more heat than this process ever would, and thus the heat released is not an engineering challenge to control.

3. Agrawal, R., N. R. Singh. (2009). "Synergistic routes to liquid fuel for a petroleum deprived future." Accepted for Publication, AIChe J.

Real weakness is that too many miracles - you need biomass AND renewable hydrogen.

PI Response:
We do not understand the word –miracle” used by the reviewer. The amount of sustainable waste biomass generated in the US, amounting to 1.366 billion tons (2), has been shown to be sufficient for producing liquid fuel to supply the entire US transportation sector (3). As explained previously, hydrogen need not be renewable and the success of this project is independent of the availability of solar, or other carbon-free, hydrogen. The rewards of this approach are high. The process holds the promise to a produce large quantity of liquid fuel from a given quantity of biomass that is greater than any current biomass to liquid fuel process. The team is well prepared to meet the challenges.

4. Perlack, R. D., L. L. Wright, et al. (2005). Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply.

5. Agrawal, R., N. R. Singh, et al. (2007). "Sustainable fuel for the transportation sector." PNAS **104**(12): 4828-4833.

Simple (conceptually) and efficient process to produce biofuels would be very valuable.

PI Response: No response to this comment has been provided by the Principal Investigator.

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*

- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td></td><td>Relying on solar hydrogen renders this a very unattractive process. Catalysts plans are ill-defined.</td></tr>
<tr><td colspan="2">PI Response:
The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being utilized. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available.

The catalysts investigation will begin with the use of hydrodesulfurization (HDS) and hydrodenitrogenation (HDN) catalysts as a starting point due to the large amount of literature available for these catalysts. In general, these HDS and HDN catalysts are also active HDO catalysts but because they are sulfides, they lack stability in a non-sulfur environment. The work with these catalysts will begin elucidation of reaction networks and give us a working system while we develop the next generation catalysts. To develop the next generation catalysts we will use model compounds and examine the catalytic effects of solid acid (both zeolites and more open structures), redox, and metal functionality. Once we understand these effects and their dependence on process conditions, we expect to be in a position to combine functionality to optimize catalysts for specific biomass constituents. We acknowledge that this is not a trivial undertaking, but the team brings significant catalytic experience to the problem.</td></tr>
<tr><td></td><td>Project work plan and management plans not well defined</td></tr>
<tr><td colspan="2">PI Response:
The study, being an exploratory research project, involves significant challenges which we aim to overcome by approaching it according to the following broad project plan which will first be carried out at ambient pressure, allowing time for construction of the high pressure setup:

6. Build the equipment required to perform hydropyrolysis/HDO.
7. Address the issue of analysis of the products being produced from the above mentioned reactors.
8. Run the HDO of model compounds to get a fundamental understanding of the nature of reactions that are taking place.
9. Finally, with the help of information attained from the previous step, feed cellulose and lignin to the hydropyrolysis/HDO reactor.</td></tr>
<tr><td></td><td>The project needs a breakdown of the tasks with schedule, milestones and go/no go decision points.</td></tr>
<tr><td colspan="2">PI Response:
The exact breakdown of tasks with schedule, milestones and other information has been uploaded. (3.2.2.7_GO18087_Purdue_PMP_FY09.xlsm).</td></tr>
<tr><td></td><td>This project really needs a detailed thermodynamic (1st and 2nd law) analysis and a</td></tr>
</table>

	life cycle analysis.

PI Response:
Based on the earlier mentioned analysis of HDO of molecules representing the various components of biomass, we have been able to calculate the hydrogen requirement for the process as 7 mole H_2/mol glucose, 6 mol H_2/mol xylose and 8 mol H_2/mol coniferyl alcohol (1). In addition, the overall process energy efficiency of the proposed process is 81%, while that for gasification/Fischer-Tropsch processes is 40.6% and that of fast pyrolysis processes is 77% (1). This comparative advantage in efficiency along with the significant improvements in yield mentioned earlier, make this process thermodynamically feasible to produce high energy density liquid fuel. Since the individual steps of the proposed process are not unlike the existing ones, a life cycle analysis for the proposed process should be no different from that done for other biomass related projects.

1. Agrawal, R., N. R. Singh. (2009). "Synergistic routes to liquid fuel for a petroleum deprived future." Accepted for Publication, AIChe J.

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Constructed equipment.	Only 10% complete. No data to date.

PI Response:
The study, being an exploratory research project involves significant challenges that need to be addressed. For example, feeding solid biomass at low flow rates to the reactor at moderate pressures was one challenge that prior to our work had not been solved. However, over time we have made considerable progress in addressing this issue. Another challenge involves providing fast heating rates inside the reactor keeping in line with the short residence times desired for maximum yield. We are currently in the process of addressing this and other similar issues. These challenges have required more time to overcome than originally anticipated.

3 yr project started in Jun08, 10% complete
Completed design for lab scale reactor

PI Response: No response to this comment has been provided by the Principal Investigator.

Strengths	Weaknesses
Still early stage. Model compounds don't really	No addressing of intermittent hydrogen feed

address the issues of feeding real biomass.	from renewables.
PI Response: The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being used. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available. We think that understanding model compounds will be essential to the understanding and optimization of the process for the full biomass. As discussed above, these efforts are going on simultaneously and capability for direct feeding of biomass and analysis of products is in progress.	
Project just underway; only 10% complete so far.	High-pressure reactor still being fabricated.
PI Response: It was necessary to fabricate a high pressure reactor, since it was not available commercially. Therefore, it was necessary to custom design each component of the reactor to unique specifications. At every step, we are learning new facets which we are incorporating in the design accordingly.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Missing the obvious challenge of renewable source of H2.
PI Response: The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being utilized. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available.	
	Not well defined
PI Response: From the broad project plan mentioned in an earlier section above, we feel that every step is a critical success factor, since we cannot move ahead without successfully accomplishing an earlier step.	

	Hydrogen needed.
PI Response: The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being utilized. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available. Reviewer 17804: We agree with the reviewer that feeding biomass at high pressures is indeed a critical success factor. As we have mentioned in an earlier section, we have made considerable progress towards feeding biomass at low flow rates at low pressures and are currently working on upgrading the system to work at high pressures.	
	Need to address feeding biomass to high pressures required. The economics of the technology including the cost of hydrogen.
PI Response: The source of hydrogen is irrelevant for the success of this project. The novelty of this process does not lie in the fact that hydrogen from solar energy is being utilized. At present, hydrogen could be supplied from coal or natural gas until an economical carbon-free hydrogen source is available. Reviewer 17804: We agree with the reviewer that feeding biomass at high pressures is indeed a critical success factor. As we have mentioned in an earlier section, we have made considerable progress towards feeding biomass at low flow rates at low pressures and are currently working on upgrading the system to work at high pressures.	
	The practicality and soundness of this project was not well articulated.
PI Response: The practicality and applicability of the project is vast, as successful completion of the goals stated will result in a relatively low-cost, high yield way to make high energy density liquid fuels. Enough fuel can be produced in this manner from the amount of renewable biomass available every year to satisfy the needs of the entire light duty transportation sector of the United States. As for the reviewer’s concern regarding the soundness of the project, we believe that systematic completion of successive steps will reinforce the findings to date.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*
- *3-Satisfactory. Future work plans are loosely built on past progress and could address OBP MYPP barriers in a reasonable period.*
- *2-Fair. The future work plan may lead to improvements, but should be better focused on*

removing/diminishing key OBP MYPP barriers in a reasonable timeframe.

- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
	Need to justify economics before doing any other work. Using solar H2 is very expensive and impractical. Virtually any CO2-free route to H2 via electricity (wind, solar or nuclear) would have greater CO2 reduction benefit by putting the electricity directly onto the grid and displacing some coal derived electricity capacity. Making H2 to make fuel in this manner is inefficient.
PI Response: We are in complete agreement with the reviewer on the point made. However, we are working to produce high yield, high energy density liquid fuels. Therefore, the goals of our study are vastly different from what the reviewer is addressing, which is the issue of efficient utilization of electricity. On the contrary, we are looking to cover for the inefficiencies of biomass in capturing solar energy by supplementing with additional hydrogen via electricity. Overall, we are looking to integrate efficiencies in order to produce high energy density liquid fuels.	
	This project has an uphill climb.
PI Response: We respectfully agree that the challenges involved in this project are significant. However, we believe strongly that the rewards from the success of this project will be of even greater significance in terms of being able to produce high yields of high energy density liquid fuels for the transportation sector. Therefore, we have decided to pursue our studies in this direction despite the risks involved.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Economics need to be added to the project including preliminary economics to prioritize future work on the biggest impact items to reduce costs.	We have calculated preliminary numbers and they look attractive.

Vermont BioFuels Initiative

Technology Area: Biomass Program
Project Number: 7.4.5.8
Performing Organization: Vermont Sustainable Jobs Fund, Inc.
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	1.50	0.55
Approach	2.17	0.75
Technical Progress	2.33	1.03
Success Factors	2.00	0.89
Future Research	2.00	0.89

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Addressing the supply chain for feedstock.	Not thermochemical conversion to liquid fuels - does not support OBP objectives.
PI Response: No response to this comment has been provided by the Principal Investigator.	
VBI goals are aligned with key priorities of	Emphasis on small/farm scale oil seed based

EERE OBP strategic plan.	biodiesel and manure based CH4/power production does not support is not aligned with thermochemical pathway.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	this should be a USDA project, NOT a DOE project
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not relevant to the thermochemical platform.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Little done to reach goals of the thermochemical pathway. Projects are largely on biodiesel and biopower.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good outreach program with positive outcomes.	Scattered, non-integrated projects supported by this project.
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Market develolpment approach to funding grants. Appropriate for VSJF objectives.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
VBI objective of supporting development of a rural biofuels industry is a nobel objective.	This is not a TC project per se but rather a collection of projects. Some aspects of some VBI funded projects may lead to progress in development of a rural biofuels industry, but this will not contribute to TC platform.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	R&D not described. This is a funding option.
PI Response: No response to this comment has been provided by the Principal Investigator.	

	This is not an R&D program, though some of the projects funded might be development and demonstration projects.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Development of biodiesel projects for captive farm production of their fuel needs. Also biogas projects. Program appears to meeting its objective of implementing regional projects.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is 100% complete, writing final report	Have not demonstrated long term economic viability'/potential of any supported work.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not thermochemical
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Activities are not supporting the Thermochemical program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Though program does not seem to align well with USDOE objectives under the TC R&D program, some of the outcomes are quite valuable to Vermont and help to increase public awareness and support of biofuels/bioenergy.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good understanding of barriers to implementation and public acceptance. Successfully developing a network of resources.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	None identified
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Doesn't fit in this framework.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Failed to recognize external threats such as low petroleum prices, loss of grants/incentives.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is completed.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Focus on triglycerides and biodiesel. Once again, consistent with objectives.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

Have received additional congressional mandated funding.	No future work plans for funding identified. Need to demonstrate how funding for specific projects will be used to address OBP MYPP barriers.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	None. Funding done.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Future work does not address thermochemical pathway objectives.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Future work not being funded by USDOE.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
High degree of collaboration with local community.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
This is an interesting program that simply doesn't fit in the thermochemical conversion program. It is being done well and by thoughtful folks.	
While this doesn't fit USDOE's vision under the TC R&D program, the outreach aspects of this project seems valuable.	

vii. Bio-Oil Conditioning and Upgrading

Stabilization of Fast Pyrolysis Oils

Technology Area: Biomass Program
Project Number: 3.2.2.11
Performing Organization: UOP
Number of Reviewers: 5

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.60	0.55
Approach	4.00	0.71
Technical Progress	3.20	0.45
Success Factors	3.60	0.55
Future Research	4.20	0.84

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Development of a combination of technologies to stabilize pyrolysis oils for subsequent processing in a refinery. Focus on commercializable technologies.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
lower acidity, lower particulate matter (char content)	project just started
PI Response: No response to this comment has been provided by the Principal Investigator.	
Program takes a holistic, integrated approach to investigate a wide range of options.	It attempts to cover all options
PI Response: No response to this comment has been provided by the Principal Investigator.	
Stabilization of bio-oils is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Very broad look at options for stabilization, potentially impacting the product all along the process path. Very disciplined project management plans.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Systems approach and broad expertise of project team. Clear management plan and practices	Experimental plan not defined or at least presented Wide array of approaches being assessed for down selection
PI Response: No response to this comment has been provided by the Principal Investigator.	
Multi player project team with goals aligned with commercial interests of companies involved.	The early stage and wide interest area leads to nebulous descriptions. The time frame for stage gates is aggressive and leads to uncertainty in how selection will be made with such a wide range of options.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just underway.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*

- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Program just started.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just starting, but builds on previous work.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Planning looks good	Very early stage and nebulous description of how the down selects will happen given the breadth of the investigation area.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just underway.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good capture of success factors, both technical and commercial.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Expect commercially available by 2012	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Team covers a breadth of technologies	Critical parameters are still somewhat unceratin. The option to move multiple projects through is both good and bad.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Team agreements still not finalized.

PI Response: No response to this comment has been provided by the Principal Investigator.

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	Would like to see more specifics on the down select criteria and management of trade-offs.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just starting	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Large multi-organizational team with expertise in many technology aspects.	
Strong team addresses "systems" approach	
Ensyn, Pall, ERRC, NREL, PNNL	
Excellent mixture of collaborators with a good mixture of public and private entities.	
Collaboration with NREL, PNNL, USDA/ARS, ENSYN, Pall (strong team).	

2) Recommendations for Additions/Deletions to Project Scope

Catalytic Deoxygenation of Biomass Pyrolysis Vapors to Improve Bio-Oil Stability

Technology Area: Biomass Program
Project Number: 3.2.2.9
Performing Organization: Research Triangle Institute
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.17	0.98
Approach	3.67	0.52
Technical Progress	3.17	0.41
Success Factors	3.67	0.82
Future Research	3.83	0.75

Overall Principal Investigator Response(s)
I would like to re-iterate that this project has been selected for a ward but as of the time of this review, no funding has been received to date. What little that has been made has been done at risk.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Addresses the high oxygen content of pyrolysis oil.	Only pursuing one option for pyrolysis oil stabilization (vapor phase catalysis).
PI Response:	

Lessons learned by developing catalysts for acting on the pyrolysis vapors can be sued to develop materials that may be able to be used in the pyrolysis reactor for catalytic pyrolysis.	
Directly linked to platform objective to remove O2 from raw bio-oil	
PI Response: No response to this comment has been provided by the Principal Investigator.	
- screening existing catalysts followed by new catalyst development	project just started
PI Response: Actually proejct ahs nt yet started because although the project has been selected, no funding ahs been received to date.	
Project	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Deoxygenation of condensables is important to producing high quality bio-oils.	It is not clear what impact oxygen concentration has on bio-oil stabilization.
PI Response: That is one of the correlations that will be investigated in the project.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Looking at the vapor phase deoxygenation in the context of the full pyrolysis system, not in isolation.	Trial and error approach to catalyst development. Implicit assumption that reducing oxygen content will improve stability and reduce TAN, a reasonable assumption, but will need to be validated.
PI Response: Catalyst development is not strictly trial and error. We have identified 3 classes of catalysts that have potnetial for deoxygenation of pyrolysis vapors. These 3 classes will be explored. The assumption that reducing oxygen content will lead to lower TAN and improved stability is the hypothesis to be proven in the project.	
Focus on catalytic vapor-phase upgrading to remove O2 rather than broad brush approach used by others.	Plan for down selecting/screening catalysts not well defined. No clear plan for addressing catalyst deactivation.

PI Response: Point taken. Catalyst down selection will be evaluated in terms of maximum oxygen removal while maintaining carbon efficiency. The initial screening in packed beds will require post mortem catalyst analysis to evaluate fouling and deactivation mechanisms.	
	relatively weak regarding how project will handle tar-fouling catalyst and catalyst re-generation
PI Response: We expect that coke formation will be a likely deactivation mechanism however, the reducing gases present and the water vapor content may help minimize coke formation. Regeneration will be done off line in the proposed experiments however, a larger scale systems would involve a circulating reactor with a regeneration loop. That is outside the scope of this project.	
Building on existing infrastructure at RTI. Focus on NREL standard material gives credibility if the	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project has a task and schedule structure.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Three alternatives being evaluated.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
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- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Program has not started yet.
PI Response: Funding not yet received from DOE.	
Project just getting started	
PI Response: No response to this comment has been provided by the Principal Investigator.	
program has not yet stated, but planning is OK. Good to see that it builds on foundation of being able to produce bio-oils.	R&D on the stabilization is in infancy.

PI Response: Stabilize bio-oil is not particularly new. Past studies have focused on removing char from bio-oil to improve long term stability. However, the stabilization of bio-oil for fuel production is relatively new.	
	Project has just started.
PI Response: Project has not officially started because funding has not been received.	
New project; not even officially underway. Some at-risk work already performed, e.g., bio-oil already produced and analyzed.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Fairly comprehesive look at system requirements.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Still early.	Regeneration an issue.
PI Response: Regeneration can be done off line ut continuous catalyst regeneration is outside the scope of this exploratory R&D project.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*
- *3-Satisfactory. Future work plans are loosely built on past progress and could address OBP MYPP barriers in a reasonable period.*

- *2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key OBP MYPP barriers in a reasonable timeframe.*
- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Approach will determine feasibility and effectiveness of vapor phase treatment.	Only one path to stabilization being investigated.
PI Response: Based on RFP requirements and project scope, a single option for bio-oil stabilization is justified. Lessons learned from this research can be applied to developing materials for catalytic pyrolysis.	
Project just getting started (refer to 4.)	
PI Response: No response to this comment has been provided by the Principal Investigator.	
The approach of de-oxygenating is worthy of investigation mainly because it increases the BTU content and oil quality.	The assumptions that de-oxygenating will improve stability of the finished oil are, in fact, assumptions that must be proven.
PI Response: Agreed. That is the primary hypothesis of the project that is to be validated.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Will be very important to get input from refineries regarding the acceptability of minimally treated pyrolysis.	
Role of ADM is not clear, what expertise the bring to this focused project.	
ADM (has partners in the refinery industry)	
Partnership with ADM.	

2) Recommendations for Additions/Deletions to Project Scope

A Systems Approach to Bio-Oil Stabilization

Technology Area: Biomass Program
Project Number: 3.2.2.13
Performing Organization: Iowa State University
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.50	0.55
Approach	4.00	0.63
Technical Progress	3.33	0.82
Success Factors	3.83	0.75
Future Research	4.00	0.63

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Stabilization of pyrolysis oil is clearly a MYPP objective. This should address many process options.	Not focusing as strongly on oxygen content reduction as other programs, leaving that to other programs.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Focus on understanding underlying fundamentals. Recognition that aerosols will behave different than vapors.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Understanding the controlling, fundamental mechanisms in pyrolysis chemistry Develop practical, cost effective methods for stabilizing biomass derived fast pyrolysis oil for a minimum of six months of storage under	

ambient conditions. - reduce oxygen content of organic compounds in bio-oil - remove carboxylic acid groups - reduce charcoal content (key since more charcoal - more water and more low-molecular weight organics)	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good range of technologies all aimed at key issues	Just getting started.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Stabilization of bio-oils is important for downstream conversion or use.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
A full scope investigation across the whole process system. Many technology options in scope. Standardized characterization of pyrolysis oil may lead to treatment insights, possibly not.	Fractionation of pyrolysis oil may not be practical due to negative yield impact. Possibly too much focus on analytical methods - resource prioritization challenge.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Biomass pretreatments (e.g remove alkali) Moving bed granular hot filtration Fractionating bio-oil Developing bi-functional catalysts Developing Characterization/analytical methods	
PI Response: No response to this comment has been provided by the Principal Investigator.	
- biomass pretreatment - hot vapor filtering - fractionating condenser - bi-functional catalysts for post-condensation treatment (create alcohols and esterify acids) - improving, standardizing analyticals	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Focus on real materials and determining the complexity therein. Goal for stability enhancement is completely aligned with objectives.	The presentation failed to focus on hypothesis testing and simplification. Repeated stating that a problem is hard doesn't clarify the steps that must be taken to solve it.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	PM
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project only 5% complete. Use of granular filter is interesting approach.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Some anecdotal data for preliminary investigations.	Only 5% into the program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project only 5% complete.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Working on real world solutions - real feeds, reasonable processing. Builds on existing foundation and capabilities nicely.	Multiplicity of approaches makes management and stage gating difficult. Almost no work under this program has been completed.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project has just started.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Broad look at system needs.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Fractionation is an interesting approach as is focus on the char filtration.	Breadth is a challenge for an exploratory project. Analytical may prove to be important, but it remains a statement unsupported by data.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Fractionation approach creates small scale streams. The economics may become more challenging. Industry is challenged to reach significant capacities. Fractionation must create higher value products.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Very strong emphasis on analytical methods - will progress be made that will impact treatment? There is a risk that effort may prove unproductive but a worthy effort.	A multiplicity of approaches. There is a risk that program will lack focus and not advance the state of the art for treatment. Program will need to gain focus as early data are generated.
PI Response: No response to this comment has been provided by the Principal Investigator. refer to 4.	

PI Response: No response to this comment has been provided by the Principal Investigator.	
Focus on analytical and simoultaneous development was somewhat confusing in the presentation.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
ConocoPhillips role not defined	
Conoco Phillips - excellent	
Presence of a fuels company collaborator is good.	
Parterned with Conoco Phillips.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
This project direction and the NREL Nimlos project (3.2.1.1, 3.2.1.3) actually share some common attributes not highlighted. I would hope that collaboration between the two might be fostered to further enhance the program and solidifying the observation that the first step in gasification is a pyrolysis.	

Pyrolysis Oil to Gasoline (PNNL, NREL CRADA with UOP)

Technology Area: Biomass Program
Project Number: 3.2.2.1, 3.2.2.2
Performing Organization: UOP
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	4.67	0.52
Approach	4.17	0.75
Technical Progress	4.17	0.75
Success Factors	4.17	0.75
Future Research	3.83	0.41

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
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- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Focus on the production of a useful intermediate for a petroleum refinery from pyrolysis oil.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Addressed DOE objectives under CRADA	
PI Response: No response to this comment has been provided by the Principal Investigator.	
upgrading bio-oil to gasoline (hydrotreating, hydrocracking)	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Proving that pyrolysis oil can fit in a refinery is key.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Producing a high-quality bio-oil is important. Upgrading of bio-oils for downstream conversion or use is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be* *improved significantly.*

- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Proof of concept investigation for hydrotreatment of bio-oils.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Very applied and convincing conclusions on key operability parameters.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
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- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Understanding of impact of pyrolysis conditions on bio-oil quality. Issues found with catalyst deactivation and reactor plugging. Presented updated economic estimates reflecting more realistic feedstock costs.	Several issues remain unresolved. Issues found with catalyst deactivation and reactor plugging.
PI Response: No response to this comment has been provided by the Principal Investigator.	
97% complete. Jun09 end. Identified catalyst deactivation leading to reactor plugging as key technical challenge Showed >50% of oil yield as high quality gasoline component. Techno-economic analysis demonstrated potentially	

competitive process Demonstrated yield of 120 gal/ton EtOH equiv.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	hydroconversion catalyst deactivation remains the major technical challenge
PI Response: No response to this comment has been provided by the Principal Investigator.	
Program is ahead of schedule and met goals.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Producing cuts (gasoline, diesel) from testing.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
This project is winding down; future tasks will be funded internally.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Focus is on fungible products. Strong understanding of market and commercial risks. Have identified operability risks as future focus.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Program has met goals	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Recognized a comprehensive technical, business and market challenges and success factors.	Did not list catalyst stability as a key challenge. The presentation highlighted this as a potential show stopper.
PI Response: No response to this comment has been provided by the Principal Investigator.	
This project is winding down.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Essentially complete. Work to continue internally to UOP with focus on process stability.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project is complete UOP intend to continue development with internal funding	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Suggests key areas for future research with economic justification.	Successful project that appears to be heading toward commercialization - now in stealth with respect to the DOE. Success means that the knowledge will no longer flow to the broader community.
PI Response: No response to this comment has been provided by the Principal Investigator.	
This project is winding down.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Leverage DARPA funding to show 50% of final product potential as Jet Fuel blend stock Announced JV with Ensyn, Envergent Technologies	
NREL, PNNL	
Formation of a new company is, I believe, the ultimate proof of a good and successful collaboration.	
Collaboration with NREL, PNNL; UOP has	

announced joint venture with Ensyn.	

2) Recommendations for Additions/Deletions to Project Scope

Mississippi State University Sustainable Energy Center – Bio-Oil

Technology Area: Biomass Program
Project Number: 7.7.4.8.a
Performing Organization:
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.67	1.03
Approach	2.67	0.52
Technical Progress	3.00	0.89
Success Factors	2.67	0.82
Future Research	2.83	0.98

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
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- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses

Bio-oil to liquid fuels - on the MYPP objectives.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Aligned with feedstock specific pathways to improve bio-oil quality and develop catalytic processes to improve bio-oil yields and quality	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	work appears to duplicate what is being done by other DOE projects, but this project has less-capable resources
PI Response: No response to this comment has been provided by the Principal Investigator.	
real feeds are being handled	the premises that the research on a feedstock has to be proximate to the feedstock was not supported by data.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Feedstock are pine and red oak wood and bark, southern pine and cottonwood (wood and pieces), i.e. do not align with TC MYPP.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Biomass pyrolysis and bio-oil upgrading are important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Investigation of pyrolysis of southern feedstocks and the investigation of unique catalysts for fuel production.	Not explicitly addressing stabilization of bio-oil. Catalyst development approach was not clear.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Strategy for managing/facilitating academic R&D	

	Barriers and problems identified with no clear discussion of how these lead to testable hypotheses that address the problems.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Did not consider ash content in original work, but will be incorporated in future work.
PI Response: No response to this comment has been provided by the Principal Investigator.	

(Table begins with: **PI Response:** No response to this comment has been provided by the Principal Investigator.)

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

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- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Determined that bark and leaves reduces pyrolysis yield (mass but not energy) and increases viscosity. Trying to use whole tree to reduce feedstock costs. Screened both commercial and unique catalysts for hydrotreating and hydrocracking.	Not many details about the performance of catalyst, only final product quality.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Identified role of wood components (clear wood, bark, needles, leaves, and species) on bio-oil yield and viscosity.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Undifferentiated program that is not hypothesis driven. Statement in supplemental materials indicate an attempt to fit within OBP program without showing data to support the statement.
PI Response: No response to this comment has been provided by the Principal Investigator.	
HDO tests were promising.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Four feedstocks pyrolyzed. Batch scale testing performed on catalysts so far.	Not clear that pyrolysis yields and bio-oil quality were better than other processes. Not much progress on pyrolysis or hydrotreating

	over last two years.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

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- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Good consideration of feedstock cost interaction with pyrolysis yield and quality. Recognized the need to fully characterize catalyst performance.	No plans to mitigate risks.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	No clear representation of direction or path forward.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Key success factors and potential road blocks were not identified.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Plans will address open issues of pyrolysis of whole trees and further characterization of catalyst performance.	No explicit economic analysis plans.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Moving toward agriculture feedstocks	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not described well.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Future work will in part focus on feedstocks of interest to the TC platform.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Quite a bit of work remaining in project.
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Many partners and interactions with other researchers and companies in the field.	
INL, PNNL, refiners, various universities	
Work is feeding into the INL work on feedstock impacts on TC.	
Partnering with INL, PNNL, Entergy Mississippi, Ergon Refinrey Bunge-Ergon Vicksburg, OSU, U Mass, U Wisconsin.	

2) Recommendations for Additions/Deletions to Project Scope

University of Oklahoma Biofuels Refining

Technology Area: Biomass Program
Project Number: 7.3.4.1
Performing Organization: University of Oklahoma
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	3.50	1.22
Approach	2.83	1.17

Technical Progress	2.83	0.41
Success Factors	2.50	0.84
Future Research	2.67	1.03

Overall Principal Investigator Response(s)
Our results largely reflect research activities prior to the DoE funding. These research activities have been an important first step in understanding the processes and catalytic reactions involved in stabilization and upgrading of pyrolysis oil. By the time of the next review, our project will involve conversion of complex mixtures and actual pyrolysis oil, and we expect that the specific relevance of our work to DoE goals and priorities will be very clear.

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	**Weaknesses**
Catalytic conversion of biomass derived oil to fungible fuels.	Learning from model compounds and structure property relationships may not provide commercially and technically exploitable insights.

PI Response:
The model compound studies are a first step in the selection of the most promising catalysts and have the important objective of enhancing our understanding of the fundamental chemistry involved in the stabilization/upgrading reactions. This understanding aids in linking the specific catalytic process (hydrodeoxygenation, decarboxylation, decarbonylation, condensation) to the desired properties of the resulting molecules. Many important fuel molecule properties (octane and cetane numbers, sooting tendency, water solubility to name several) will be affected by the catalytic process used for the stabilization/upgrading. In designing the catalytic conversion strategy, we must know how a given catalytic conversion will affect these properties for the molecules present in the feedstock. This method has been applied to petroleum catalytic refining processes and the results implemented commercially by one of the largest US refiners, so we have confidence the approach works. However, we do understand the importance of moving to actual oils, and as noted later we will be producing and

processing/stabilizing our own, and hopefully other's, bio-oils and their fractions as part of the work.	
Aligned with goals for stabilizing bio-oils and improved hydrotreating catalysts	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	project just began using model compounds - with 100's of compounds in bio-oil, how realistic is this approach?
PI Response: We realize the bio-oil is very complex, but as noted in a previous response, the model compound studies are a first step in the selection of the most promising catalysts and have the important objective of enhancing the understanding of the fundamental chemistry involved in the different stabilization/upgrading reactions. Our plan is to carry out reactions on molecules representing the important oxygen moieties -- acids, ketones, aldehydes, heterocycles, alcohols -- in order to understand the reactions of each. We have carried out reactions with simple mixtures, and will work towards more complex mixtures. We believe the best approach to molecular engineering of biofuels is not the simple deoxygenation by severe hydrotreating, but rather the controlled conversion of the oxygen functionality and how this conversion most effectively stabilizes the bio-oil and beneficially affects the fuel properties of the resulting molecules.	
	Virtually no focus on market. Instead, focus is on basic catalysis research.
PI Response: Our research activities have been catalytic research, but the goal of the research has been to develop both understanding and catalysts to enable improved pyrolysis processes, which result most directly and efficiently in fungible fuels. Severe hydrotreating will stabilize the bio-oil, but we believe that selective catalysts can be used to capture more of the bio-oil as usable feedstock for refining into fuels, with less hydrogen consumption. So the eventual market for the process and product does drive the research. As mentioned above, we have reason to believe the approach works, but agree and plan the work to include the use of actual bio-oils.	
Focus on switchgrass as a feedstock.	
PI Response: Switchgrass has been identified as a good candidate for dedicated energy crop, and is the primary focus of the Oklahoma Bioenergy Center.	
Having effective catalytic processes defined is important.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some*

milestones are developed. Improvements in approach would improve project quality.

- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Reactions of individual chemical types separately (e.g., furfurals) to develop insights for catalyst design. Develop structure property relationships from model compounds.	Will the insights and predictions derived from the individual constituents be accurate for the whole oil? Approach is not appropriate for a Commercialization Stage: Detailed investigation program. More appropriate for Research: Exploratory/Development stage.
PI Response: The research has given insight into possible commercial processes, but Exploratory or Development Research is probably more accurate for the work completed. These studies are very valuable in providing guidance for development of rational bio-oil stabilization and upgrading strategies rather than depending on purely empirical approaches. We plan to use more complex mixtures and the oils to develop the relationships between them. As mentioned above, we know this approach works in finding the relationship between model compound results and petroleum refinery streams	
Application of molecular engineering approach to understand catalyst chemistry and to synthesize new catalysts.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Typical, proven approach.	Approach not being used to solve problems identified by the program. The research may be high quality catalysis work, but it is not being applied to identified problem areas. Instead of adapting the research to fit the problem, the problem is being shaped to fit the desired research. If a hammer is the only tool you have, everything begins to look like a nail comes to mind.
PI Response: The particular problem this work addresses is how best to remove oxygen to stabilize the bio-oil and produce molecules that are most suitable for upgrading to fungible transportation fuels. We believe the model compound studies are the best first step in the selection of the most promising catalysts to carry out this process. (see above responses) The alternative of empirical studies on complex mixtures would not yield the fundamental understanding to guide the upgrading strategy. The approach of initially carrying out more fundamental studies followed by more applied and complex investigations has been widely applied, e.g., in the development of petroleum refining strategies, and has been proven highly effective, by one of our PIs. We expect it to be the most effective approach in developing a strategy for stabilizing and upgrading pyrolysis oil. We think the analogy would be more attuned to using a scalpel instead of a hammer.	
Plan seems sound.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Presented some background information from past work.	Program just started.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Early stage	Planning doesn't appear to reflect focus on issues identified by the Thermochemical program.
PI Response: The primary issue this research addresses is the stabilization/upgrading of the bio-oil. We will work to make sure that focus is clear and that our research activities reflect that focus.	
	Project has recently started.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just begun. Testing model compounds for catalytic activity.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*

- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Focused primarily on technical challenges, not business/commercial challenges - If program is in a commercialization stage, should also focus on those challenges.
PI Response: As noted above, our program more appropriately classified as development research. We do plan to carry out technoeconomic analyses as soon as possible.	
	Data presented are fundamental studies that have been described as being completely unrelated to fitting pyrolysis oils into the fuel pool.
PI Response: We believe that description is not accurate. For the reasons described in previous responses, these studies are highly relevant to the development of catalytic processes to stabilize and upgrade pyrolysis oils. While severe hydrotreating of pyrolysis oil will stabilize the pyrolysis oil, such a process will consume large quantities of hydrogen and will not be the most effective at capturing as much of the carbon as possible into fuel molecules. By understanding, from model compound studies, the relationships between model compounds and their resulting fuel properties, and by understanding the linkage between the nature of catalyst active sites and types of reactions (and the chemical functions converted) they will catalyze, we are guided in the development of specific catalysts and reaction conditions. The single compound studies are only a first step (most of the results presented as examples occurred before the project recently started), but nevertheless an important and very relevant step.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	Validation of model compound predictions was not apparent in the future plans.
PI Response: We do plan validation of some predictions related to fuel properties -- studies of sooting and NOx tendencies, measurement of cetane or octane number, measurement of combustion efficiency. In the examples shown, the first step in doign this has been started and	

acts to guide the research. A key element is looking at the improvement of properties with the cost (such as hydrogen consumed, loss of carbon, etc.). This will be continued as we work with the oils.	
Completing 1-2 kg/h fluidized bed pyrolyzer (separate state funded) for future work is synergistic with ongoing detailed investigations.	
PI Response: We expect this pyrolysis reactor to be operational this summer.	
	Unrelated to NREL testing of common pyoil feeds.
PI Response: While we believe our research is related to work at NREL, we have not yet developed a relationship with those researchers -- We agree that we should include the standard samples in our program and this is something for us to work on in the ensuing year.	
Logical transitioning from testing with model compounds to testing with real bio-oil or pyrolysis gas. Pyrolyzer being fabricated at this time to real bio-oil testing.	
PI Response: We expect this pyrolysis unit to be operational this summer and a micropyrolysis unit is already undergoing testing.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Collaboration with Oklahoma Bioenergy Center.	This is an already strong and growing collaboration, particularly w.r.t. the properties of switchgrass and how those properties will affect pyrolysis and subsequent stabilization/upgrading. We are getting advice from a major refiner and are discussing ways of collaboration.

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
The description is of a project that is a basic catalysis study with only limited connection to the immediate task of producing transportaion fuels. This is a good project for training catalyst researchers, but is not well related to the goal of biofuel production.	As noted in above responses, we believe the research is directly related to the development of a pyrolysis-based process for production of liquid fuels.

viii) Co-products and Biopower

Bio-Renewable Ethanol and Co-Generation Plant, Biomass

Technology Area: Biomass Program
Project Number: 7.3.2.4
Performing Organization: Raceland Raw Sugar Corporation
Number of Reviewers: 5

Evaluation Criteria	Average Score	Standard Deviation
Relevance	2.80	0.84
Approach	3.00	0.71
Technical Progress	3.20	0.45
Success Factors	2.80	0.45
Future Research	3.20	0.45

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Development of bagasse and cane briquettes for economical deliverable transportation of density feed to biorefinery.	Not broadly applicable to MYPP objectives, only narrowly supports objectives on feedstock interface challenges.

PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not aligned with TC pathway objectives, rather biomass handling
PI Response: No response to this comment has been provided by the Principal Investigator.	
Feedstock program	Not a thermochemical program
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Project is aligned with feedstock logistics but not necessarily with TC.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Use of presently unused bioresidues provides a good opportunity for increasing feedstock base and new markets for farmers.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Focus on simple and practical field implementation - minimal impact on the farmer.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Transform bagasse and leafy matter into briquette for transport to other conversion process.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Going for real commercial application, with focus on simplicity and acceptance by suppliers.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Looking at complete chain from farming	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Research aspects of project were not well articulated.

PI Response: No response to this comment has been provided by the Principal Investigator.

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Program to date has been very equipment focused and delivery is on schedule. On track to use in next harvest season.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Installing commercial scale facility this fall.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Approaching the problem in a practical and reasonable way. Purchasing equipment with a high probability of success.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project milestones, very substantial, are being met.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to*

overcome showstoppers are not well developed.

- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Understands importance of farmer buy-in and meeting the seasonal demands.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	The purpose is to prove operation of purchased equipment. No contingencies described.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Identify other market pulls for bagasse (combustion for power?)
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Items such as: 1. Loss of recycled nutrients by not leaving cane trash (leaves) in the field have not been addressed. 2. Potential problems such as high inorganic content in leafy trash were not discussed.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Complete operation of briquetting plant and dryer.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Implement and produce briquettes	
PI Response: No response to this comment has been provided by the Principal Investigator.	
This is a construction, shakedown, and operation project.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects,

providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Good collaborations with several stakeholders.	
Collaboration with LA cane farmers, USDA, American Sugar cane League, Bioenergy	

2) Recommendations for Additions/Deletions to Project Scope

Plasma Gasification Waste-to-Energy Project

Technology Area: Biomass Program
Project Number: 7.3.2.5
Performing Organization: Koochiching County
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	2.50	0.55
Approach	2.17	1.17
Technical Progress	2.17	0.75
Success Factors	2.50	1.38
Future Research	2.17	0.75

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are*

identified.

- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
Does address some issues with cellulosic feedstock gasification.	Feed is segregated MSW, so not broadly applicable to all biomass concerns. Ultimate target and scope are not clear.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Aligned with TC platform goals for biomass gasification, maybe clean syngas production but depends upon still undetermined end use.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
MSW feedstocks (negative cost - landfill) - relatively small market Minnesota is trying to avoid more incinerators	should have at least preliminary economic and energy balance estimations 1/3 of the energy produced is consumed by the plasma torch
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Instructions from OBP were to exclude MSW.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Feedstock used (MSW) is not a primary focus of TC. End product (biofuel, steam, heat, syngas) has not been determined.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Being able to gasify a wide array of feedstocks is useful.	Targeting only feedstocks with tipping fees.
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Build a facility to convert MSW to syngas using plasma to be more tolerant of highly variable feedstocks.	Not touching on the challenges of syngas cleanup and conversion to fuel needed to make liquid fuels. Not clear in presentation what the full project scope is and the status of the project relative to completion.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Have not identified use for produced syngas - this will drive selection of gas clean-up technology/requirements
PI Response: No response to this comment has been provided by the Principal Investigator.	
	I don't know what is being done or proposed.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project management has stage gate process. Milestones are defined and progress tracked against.	Undetermined what to do with the product syngas.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Project just underway. Engineering design beginning.	No clear plan presented.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Not clear regarding status of the technology or construction project.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Currently in feasibility study Have identified host site	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	A plant tour as a key accomplishment!? I can't tell what this project is about from the information given.

PI Response: No response to this comment has been provided by the Principal Investigator.	
New project.	No clear plan.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Understands the importance of local government support and community buy-in.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Recognition of need for local government support	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	I have no idea having listened carefully to the presentation; I don't know what they are trying to do, so I can't evaluate what is critical.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Identified a variety of success factors.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Tipping fee required.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

- *5-Excellent. The future work plan clearly builds on past progress and is sharply focused to address one or more key technical barriers in the OBP MYPP in a timely manner.*
- *4-Good. Future work plans build on past progress and generally address removing or diminishing OBP MYPP barriers in a reasonable period.*
- *3-Satisfactory. Future work plans are loosely built on past progress and could address*

OBP MYPP barriers in a reasonable period.

- *2-Fair. The future work plan may lead to improvements, but should be better focused on removing/diminishing key OBP MYPP barriers in a reasonable timeframe.*
- *1-Poor. Future work plans have little relevance or benefit toward eliminating OBP MYPP barriers or advancing the program.*

Strengths	Weaknesses
Work will result in an operating facility.	Not clear what additional work remains before facility scope can be completed.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Nothing was described! I don't know what the technology is or what impediments are being circumvented.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Plan not well defined.
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Coronal teaming with MN, et al.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Need to fix on project and construction scope soon. Very difficult to evaluate at this current state.	
Program doesn't fit with rest of platform reviewed.	
Economics of this demonstration project are based on receiving tipping fees for MSW. Additionally, economics should be done on a break even tipping fee/cost of MSW, i.e. today's trash is tomorrow's treasure. Syngas quality should be analyzed for suitability for liquid fuels conversion. This would expand the useful of the project	

SUNY Cobleskill Bio-Waste to Bio-Energy Project

Technology Area: Biomass Program
Project Number: 7.4.3.11
Performing Organization: SUNY Cobleskill-The Research Foundation
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	1.83	0.75
Approach	1.67	0.52
Technical Progress	2.50	0.55
Success Factors	1.33	0.52
Future Research	1.83	0.41

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
	Not targeting liquid fuels. Using a unqiue gasifer design (rotary kiln) that has limited applicability resulting from external heating requirements. Using cafeteria waste and animal waste as feedstock.

PI Response:
The original presentation guidelines as forwarded from the OBP did not identify that only projects on the

<table>
<tr><td colspan="2">production of liquid fuel were to be presented. In point of fact, the guidelines called for reflections on the biomass conversion into an alternative form of energy (be it steam to electricity) capable of substituting for fossil fuel. Feedstock focal point for this project includes the conversion of animal and cafeteria waste into electricity through an innovative rotary kiln technology. To this PI, SUNY Cobleskill's Biowaste to Bioenergy project is in lock step with the MYPP for the thermal conversion platform as reference in slide 3, 4, and 9 or 11 in my power point presentation. Furthermore, the PI recognizes this research for its potential to revolutionize biowaste thermal conversion technology on a global scale.</td></tr>
<tr><td>Aligns with very broad OBP goals, i.e. reducing dependence on foreign oil and carbon emission reduction.</td><td>Did not show linkage to specific MYPP barriers CHP project - not liquid fuels Small scale 2-stage "prototypic" rotary kiln gasification technology not suitable of large scale liquid fuels production</td></tr>
<tr><td colspan="2">PI Response:
As displayed in slide 11 of 11 in my power point presentation ... since this project includes the preliminary steps of research leading to scale up to a larger system ... I do believe reviewer #2 did not make the connection presented (both by slide and orally) by the PI, for scale up leading to electricity and eventually liquid fuel production. The scope of work for the current funding does clearly align (as noted by the reviewer #2) with OBP goals.</td></tr>
<tr><td>CHP for SUNY-Cobbeskill from rotary kiln gasification of MSW (animal & cafeteria waste) - more of a commercial project than a research project DOD funding the cost of the kiln and gas cleanup</td><td>project just underway</td></tr>
<tr><td colspan="2">PI Response:
This project is probably a minimum of two years away from preliminary commercialization as the research is just about ready to commence. Being a "one-of-a-kind rotary kiln, the research must be done before the scale up to a larger system can be undertaken. Municipal Solid Waste (MSW) is not yet part of the feedstock evaluation stream but will likely follow as soon as the animal and cafeteria waste is assessed. Reviewer #3 is accurate that DoD is funding the research on fuel gas production and cleanup but this DOE funded project is essential link for conducting the actual research on the innovative rotary kiln system. DOE funding will lead to system refinement so that syngas can be converted in an effacious manner into electricity. The milestones identified for this portion of the project are displayed on slides #5 and 6 of 11.</td></tr>
<tr><td></td><td>Feedstock doesn't fit with thermochemical program. Power and electricity not in scope.</td></tr>
<tr><td colspan="2">PI Response:
As to the reflection of Reviewer #4 - I have reread the YPPP items again and do not find an restrictions as to feedstock to be utilizes in referenced to the thermochemical platform. As noted in my oral presentation, the ultimate goal is convert biowaste into bioenergy. This point is also displayed in the scope slide #3, second bullet and second point within the bullet.</td></tr>
<tr><td></td><td>Biowaste feedstock (animal and food waste) and product electricity is not aligned with the TC MYPP. In the future, hydrogen production will be looked at but this is inconsistent with a low pressure gasifier.</td></tr>
<tr><td colspan="2">PI Response:
Agreeing with Reviewer #5's responses is difficult since the production of electricity by converting biomass seems in lock step with OBP's goals of fossil fuel substitution and carbon emission control</td></tr>
</table>

leading to power generation. Hydrogen production is, as stated by this reviewer, part of DOE's future look. However, there is no place in the presentation guidelines or the MYPP to identify what is considered low or high pressure regime. In the Q and A following my presentation, I commented on this innovative rotary kiln as operable in "low pressure depending on what is considered low." It would seem that DOE would happily note an "even better" situation if H can be produced in a lower pressure environment. This is also part of the proposed research.	
	Goal is steam and electricity production.
PI Response: Reviewer #6 is right on target with the PI's power point slide #11 of 11 and his oral presentation. However, it is puzzling why this reviewer listed this point under weakness. Producing electricity from biomass as a form of renewable and sustainable alternative energy directly aligns with DOE's OBP goals. Producing steam and then electricity is outside the funding zone of this research but is the longer range target of the technology as stated in my oral presentation. As additional funding is procured, the electricity generation components will be squarely addressed.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
	Unrealistic expectations on gasifier performance and syngas purity. Build and operate plan presented with little backup data to support feasibility.
PI Response: Perhaps I am overly optimistic with my expectations on gasifier performance and syngas purity. However, this reviewer is inaccurate to claim the expectations are unrealistic. All research starts with hypotheticals and then sets to the task of proving (or disproving) the hypotheses. The uniquiness of this innovative gasification system places its possibilities well above current gasification performance and syngas cleanliness. As for build and operational plans ... these are also part of the research and will lead conclusively to support of the technology feasibility.	
	Not clear how DOE funding is being used as part of larger project funding. Project scope is not defined

PI Response: To note the scope or work hence how the DOE funding is being utilized, review slide 7 of 11 in my power point presentation. As stated on slide 7, the funds are planned for: 1. cold testing the gasification system 2. operation of the gasification system 3. data analysis 4. developing a deployment plan 5. project management and reporting	
	the presentation had no details about what research will be done
PI Response: I suggest reviewer #3 take another look at slide 5 of the presentation where 5 clearly stated structural approaches to project scope are listed. During the oral presentation, I provided details on achieving each of the 5 on-slide milestones.	
	No description of R&D efforts provided.
PI Response: I am finding myself rebutting reviewer comments including these of reviewer #4 because the information listed as a weakness is presented on (one or more) the power point presentation slides. The proposed research claimed to be missing by reviewer #5is stated as 5 points on slide 5 of 11 in the presentation. Then, each of the 5 points received additional comment from me, as the PI, during the oral presentation. Each of the research points align with OBP goals and the results match to the MYPP.	
	The plan doesn't seem well thought out.
PI Response: As to the reflection from Reviewer #6 ... I am once again referring you to slide #5 of my power point presentation. The funding for this project allows me to conduct cold testing of this innovative gasification system, then to actually conduct the research followed by data analysis and then plans for deployment. To me, the sequence seems very logical as a first this and then that.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
	Just started.
PI Response:	

I am puzzled as to why "just started" is considered a weakness in reference to technical progress and accomplishments. I am every bit confident that your next review will be full of data results and translations.	
Project just received funding	
PI Response: So true ... research finding to follow in near future	
Project not yet started.	
PI Response: So true ... the research will soon be underway and data will be collected.	
	Project just started.
PI Response: Why do you considered just getting started as a weakness? The data will come and be presentable in time for the next DOE review.	
Project just began.	There are some major obstacles in this project.
PI Response: Since obstacles anticipated by reviewer #6 were not identified, it remains impossible for this PI to know if he has already anticipated them. The barriers to the project were limited to 3 and they are stated in slide 2 with how they will be addressed in slide 8. It would be helpful if the presentation guidelines allowed a listing of more than 3 barriers.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
	Technical barriers are grossly underestimated as presented and plans to address risks were not obvious.
PI Response: Plans to address risk / overcome barriers are displayed on slide 8 of 11 from my power point. Per the presentation development guidelines, the PI was limited to identifying three barriers. For consistency, the barriers state on slide 1 are the same three addressed on slide 8. Will there be additional barriers ... of course. Are they visible at this time ... yes, at least several more than space to present them. This very point was referenced in my oral presentation. The fact that the barriers were addressed should have generated more than a poor ranking. Like the hypotheses, the barriers will be accepted as true and overcome or they will be rejected as false and the project will proceed as planned.	

	None described.
PI Response: Reviewer #4 is inaccurate ... critical success factors (barriers) were displayed on slide 1 and addressed on slide 8 of the 11 presented. The PI reflected on each during his oral presentation and again in one of the response during the Q and A period. Additionally, the critical success factors are noted as a list of deliverables/milestones on slide 5,10 and 11 of the 11 presented. As the PI, I realize each of these milestones could be a show stopper if not achieved. What more can I say ... the critical success components were listed straight out in the presentation.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	Plans beyond the construction and operation of the prototype bench-scale kiln are unclear.
PI Response: There is good reason for the lack of clarity beyond the project ... the presentation template and subsequent guidelines did not call for them. No slide in my power point carries this information. My oral presentation however, did carry my plans to move this prototypic gasification system through project funding to the scale up to a 1 MW system. Then I reflected on electricity generation plans with a steam turbine and liquid H development through Fischer - Tropsch technology plans. I would have developed a separate slide with this information had it been called for in the specifications.	
	Poorly or not defined
PI Response: As to the comment from reviewer #2 ... I must disagree. Even though future research was not called for in the guidelines for presentation preparation, my plans to be convert syngas into steam and submit to a steam turbine for generating electricity ... and ... my intentions to produce liquid H via Fischer - Tropsch Technology, were both mentioned in my oral presentation. Likewise both points were reiterated in the Q and A period. Details were not provided because they were not called for in the guidelines.	
	No description of technology employed / to be employed given.
PI Response: Like for my response to Reviewer 1 and 2 ... my same reflections are in order here. The guidelines did not call for plans for future research therefore a slide was not presented. However, I did share my future plans in an oral presentation via plans to generate electricity and produce liquid H.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
W2E (Waste-to-Energy)	Waste to Energy (W2E USA, Inc.) has its corporate headquarters in Princeton, New Jersey with its technical headquarters in Chicago, Illinois. This is project partner holding the rights to the innovative rotary kiln gasification system. They are working with SUNY Cobleskill to develop the technology. Preliminary collaboration plans are also underway with the United States Military Academy at West Point for joint research.
Partnered with W2E USA, Inc.	Waste to Energy (W2E USA, Inc.) is headquartered in Princeton, New Jersey with the technical side of their incorporation housed in Chicago, Illinois. This relationship is established as a research facility with future plans to conduct related rotary kiln gasification research through the SUNY Cobleskill Bioenergy center.

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
This project doesn't fit within the framework we've been asked to evaluate. It is not specific or even loosely focused on liquid fuel production or steps required for liquid fuel production.	What can I say as project PI to Reviewer 3's reflection when the SUNY Cobleskill Biowaste to Bioenergy Project was directed to this platform for presentation reviewers? The reviewer reflection is as puzzling as to the opening to this review document when the title frame indicated this project had not been reviewed.

Alternative Fuel Source Study - An Energy Efficient and Environmentally-Friendly Approach for research on alternative fuels for cement processing

Technology Area: Biomass Program
Project Number: 7.3.6.2
Performing Organization: Auburn University
Number of Reviewers: 6

Evaluation Criteria	Average Score	Standard Deviation
Relevance	1.67	0.82
Approach	2.83	0.98

Technical Progress	3.00	0.63
Success Factors	2.67	0.82
Future Research	2.33	1.03

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
	Primarily combustion (not gasification) of alternate fuels and not producing liquids fuels renders this project not very relevant to MYPP.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Aligns with DOE goals for reducing fossil fuel use - Goal is 50% displacement of fossil fuels.	No alignment with thermochemical platform objectives
PI Response: No response to this comment has been provided by the Principal Investigator.	
heat for cement kilns from direct combustion and gasification of scrap tires, waste plastics, broiler litter, woodchips, switchgrass, etc. (replacing coal)	bulk of the "alternative fuel" that can replace coal is composed of scrap tires or waste plastic
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Tires aren't biomass and cement is not a liquid fuel. This does not fit into the OBP / thermochemical program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Focus is on combustion for cement kilns to replace coal. Gasification is included.

PI Response: No response to this comment has been provided by the Principal Investigator.	
Sound, very useful project, technically.	Does not obviously meet USDOE objectives.
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
Some gasification work scope is in the project. Focus is on the substitution of coal with alternate solid fuels.	Major effort on combustion.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Collaboration with Lafarge	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	just starting to look at gasification, but project is almost over
PI Response: No response to this comment has been provided by the Principal Investigator.	
	The goals of gasification - virtually irrespective of feed source - are commercially practiced. There is limited R&D need. Demonstrating that cleaned fuels can be applied in a new way has not been convincingly described as a necessary target.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to* *date suggests that the barrier(s) will be overcome.*

- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Have evaluated several alternate fuels in trial burns in kilns.	Primarily combustion work scope, very little gasification or other process that could produce a liquid fuel.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Demonstrated up to 20% replacement (energy basis) without negative impact on product cement quality or environmental emissions.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Program is working in an actual cement plant, effectively proving the technical viability.	
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Limitations and challenges for fuel replacement are understood and listed.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Majority of work, while environmentally interesting, don't fit in the program we're evaluating.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
	Limited future work plan presented other than the continuation of a small lab and pilot gasification scope.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Majority of work, while environmentally interesting, don't fit in the program we're evaluating.
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations
Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Collaboration with Lafarge is important for this project	
LaFarge (cement manufacturer)	
Impressive list of collaborators with skill sets that should lead to a successful project.	
Collaboration with Lafarge, Systech, Compton Consulting, ASF.	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
Does not fit into the biomass program. The production of cement and reducing waste tires are both laudable goals, but these do not fit into the framework for evaluation that we've been	

given.	

University of Kentucky Biofuels Research Laboratory

Technology Area: Biomass Program
Project Number: 7.3.2.3
Performing Organization: University of Kentucky
Number of Reviewers: 5

Evaluation Criteria	Average Score	Standard Deviation
Relevance	2.40	1.14
Approach	2.60	0.89
Technical Progress	3.00	0.71
Success Factors	2.00	0.71
Future Research	2.20	0.45

Overall Principal Investigator Response(s)
No Overall PI Response

1. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

- *5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.*
- *4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.*
- *3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.*
- *2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.*
- *1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.*

Strengths	Weaknesses
	Indirectly support goals by establishing research infrastructure and equipment at University of Kentucky. Scope does not directly support MYPP objectives.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Goal is to establish biofuels laboratory (i.e. analytical capabilities) at UK to support biofuels industry.	No specific alignment with thermochemical platform objectives
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Much of the work is inconsistent with the Thermochemical program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Some aspects of this project supports distributed feedstock pretreatment (e.g., extruded reactor system).	Capacity building only.
PI Response: No response to this comment has been provided by the Principal Investigator.	

2. Approach to performing the Research, Development and Demonstration (RD&&D)

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

- *5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.*
- *4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.*
- *3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.*
- *2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.*
- *1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.*

Strengths	Weaknesses
	Not focused on any one particular technological approach. Seems to be a collection of equipment that is only related by biomass. It will be quite some time before these efforts contribute to the advancement of the state of the art.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Good capabilities being developed	Poor overlap with the goals of the Thermochemical program. Exception may be the extruder reactor.
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Capacity building project.
PI Response: No response to this comment has been provided by the Principal Investigator.	

3. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

- *5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.*
- *4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.*
- *3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.*
- *2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.*
- *1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.*

Strengths	Weaknesses
Have obtained the desired equipment.	Limited data generated to date. Data were from disparate, unconnected projects.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Aquired and installed lab equipment	
PI Response: No response to this comment has been provided by the Principal Investigator.	
Extruder reactor is an interesting approach	Much of program doesn't fit with thermochemical program.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Some good research being conducted, though not necessarily in line with USDOE goals.	Capacity building only.
PI Response: No response to this comment has been provided by the Principal Investigator.	

4. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

- *5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.*
- *4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.*
- *3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.*
- *2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.*
- *1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.*

Strengths	Weaknesses
Adequate list of performance targets for the process technologies.	
PI Response: No response to this comment has been provided by the Principal Investigator.	
	Not a well defined program.
PI Response: No response to this comment has been provided by the Principal Investigator.	

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

Strengths	Weaknesses
Next logical steps for the process technologies being investigated in plan.	Work only loosely supports the OBP MYPP objectives.
PI Response: No response to this comment has been provided by the Principal Investigator.	
Continuing the extruder reactor work is consistent with the program and appears to show promise.	Most of efforts don't fit within the Thermochemical program.
PI Response: No response to this comment has been provided by the Principal Investigator.	

1) Technology Transfer/Collaborations

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

Reviewer Comment	PI Response
Good range of collaborations	
Partnered with KY DEDI, ORNL, NETL, â€¦	

2) Recommendations for Additions/Deletions to Project Scope

Reviewer Comment	PI Response
This program doesn't fit within the Thermochemical review parameters.	

Attachment One: Conversion Project Review Form

Project Evaluation Form

Session: **R&D**

Reviewer Name: ____

Title of Project: ____

Presenter Name: ____

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

1. **Project Stage of Development** as Identified by PI ______________________

2. **Project Stage of Development** as Recommended by Reviewer ______________________

3. Relevance to overall Program objectives and market need.

The degree to which the project continues to be relevant to the goals and objectives of the Biomass Program Multi-Year Program Plan. Market application of the expected project outputs have been considered.

Project Relevance to OBP Objectives and Market		
5-Excellent. The project is critical to and fully supports Multi-Year Program Plan objectives. The project is critical to and fully supports the needs of target customer(s) and market(s); customers and markets are fully identified.		Specific Comments:
4-Good. Most aspects of the project align with the plan objectives. Most aspects of the project align with the needs of customers and markets; customers/markets are identified and important.		

3- Satisfactory. Many aspects of the project align with plan objectives. Many aspects of the project align with the needs of customers and markets; customers/markets are identified.		
2-Fair. The project partially supports the plan objectives. The project partially supports the needs of customers and markets identified.		
1-Poor. The project provides little support to the plan objectives. The project does not meet the needs of customers and markets; customers/markets not identified.		

4. Approach to performing the Research, Development and Demonstration (RD&D).

The degree to which the project uses a sound, well-designed RD&D approach and clear project management plan, which incorporates well-defined milestones for monitoring the progress of the project and methods for addressing potential risks.

5-Excellent. The project has a sound, well-designed approach and has developed and implemented effective project management practices. Difficult for the approach to be improved significantly.		Specific Comments:
4-Good. The approach is generally well thought out and effective but could be improved in a few areas. The project has developed adequate milestones and potential risks have been identified but management approaches may not be fully developed.		
3-Satisfactory. The approach is satisfactory to meet project objectives and some milestones are developed. Improvements in approach would improve project quality.		
2-Fair. Some aspects of the project may lead to progress, but the approach has significant weaknesses.		
1-Poor. The approach is not responsive to project objectives and unlikely to make significant contributions progress.		

5. Technical Progress and Accomplishments

The degree to which the project has made progress in its stated objectives, achieving milestones as planned and contributing to OBP goals and objectives as outlined in the OBP MYPP and overcoming technical barriers outlined in the MYPP.

5-Excellent. The project has made excellent progress towards project objectives, OBP goals and objectives and overcoming one or more key technical barriers. Progress to date suggests that the barrier(s) will be overcome.		Specific Comments:
4-Good. The project has shown significant progress toward project objectives, OBP goals and objectives and to overcoming one or more technical barriers.		
3-Satisfactory. The project has shown satisfactory progress toward project objectives, OBP goals and objectives and contributes to overcoming technical barriers.		
2-Fair. The project has shown modest progress towards stated project goals and OBP objectives and may contribute to overcoming technical barriers.		
1-Poor. The project has demonstrated little or no progress towards stated project goals, or OBP objectives and technical barriers.		

6. Critical Success Factors and Showstoppers

The degree to which the project has identified critical success factors (technical, business, and market factors) which will impact technical and commercial viability of the project; and the degree to which the project has identified potential show stoppers (technical, market, regulatory, legal) which will impact technical and commercial viability.

5-Excellent. A comprehensive list of critical success factors and showstoppers are identified and strong strategies to overcome possible showstoppers are identified.		Specific Comments:
4-Good. Key critical success factors and showstoppers are identified and there are clear strategies developed to overcome showstoppers.		
3-Satisfactory. Many critical success factors and showstoppers are identified and strategies to overcome showstoppers have been proposed.		
2-Fair. Some critical success factors and showstoppers are identified. Strategies to overcome showstoppers are not well developed.		

1-Poor. Little to no identification of critical success factors or showstoppers. Little to no recognition of relative importance or prioritization of activities.		

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

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, or identified other opportunities to build upon current research to further meet OBP goals and objectives.

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

8. **Technology Transfer/Collaborations**

Does the project adequately interact, interface, or coordinate with other institutions and projects, providing additional benefits to the Program? Have Project Performers Presented or Published on the Progress or Results of the Project?

9. **Provide Comments on Overall Strengths and Weaknesses**

Strengths:

Weaknesses:

10. **Recommendations for Additions/Deletions to Project Scope**

Attachment Two: Platform Review Form

Platform Review Form

Reviewer Name:____

Platform:____

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

1) Are platform goals, technical targets and barriers clearly articulated? Are platform goals realistic and logical? Do the platform goals and planned activities support the goals and objectives of the Biomass Program as outlined in the MYPP? How could the platform change to better support the Biomass Program's goals?

Platform Goals		
5-Excellent. The platform goals are critical and fully support achieving OBP goals. The platform goals are clear, realistic and logical.		Specific Comments:
4-Good. The platform goals are important and support achieving almost all OBP goals. The platform goals are clear and logical.		
3-Satisfactory. The platform goals support achieving the majority of OBP goals. The platform goals are defined, but could be improved.		
2-Fair. The platform goals support achieving some OBP goals. The platform goals need better definition.		
1-Poor. The platform goals support achieving few OBP goals. The platform goals are not well defined.		

2) How well does the platform approach (platform milestones and organization, RD&D portfolio, strategic direction) facilitate reaching the Program Performance Goals for each platform as outlined in the MYPP? What changes would increase the effectiveness of the Platform?

Platform Approach		
5-Excellent. The quality of this platform approach is exceptional and fully supports achieving Program Performance Goals.		Specific Comments:
4-Good. The quality of this platform approach is above average and supports achieving almost all Program Performance Goals		
3-Satisfactory. The quality of this platform approach is sufficient to support achieving the majority of Program Performance Goals		
2-Fair. The quality of this platform approach supports achieving some Program Performance Goals		
1-Poor. The quality of this platform approach supports achieving few Program Performance Goals		

3) The degree to which the Platform RD&D is focused and balanced to achieve Biomass Program and Platform goals? (WBS, unit operations, pathway prioritization)

Platform R&D Portfolio		
5-Excellent. The platform R&D is focused and balanced and fully supports achieving OBP and Platform goals.		Specific Comments:
4-Good. The platform R&D is focused and balanced and supports achieving almost all OBP and Platform goals.		
3-Satisfactory. The platform R&D is balanced and supports achieving the majority of OBP and Platform goals.		
2-Fair. The platform R&D supports achieving some OBP and Platform goals.		
1-Poor. The platform R&D supports achieving few OBP and Platform goals.		

4) Based on the presentations given, how well is the platform progressing towards achieving Biomass Program and Platform goals? Are we meeting our performance targets? Is it on track to meet the goals presented? Please provide recommendations on improvements for tracking progress in the future.

Platform Progress		
5-Excellent. The platform is making exceptional progress towards achieving OBP and Platform goals.		Specific Comments:
4-Good. The platform is making above average progress towards achieving almost all OBP and platform goals.		
3-Satisfactory. The platform is making sufficient progress towards achieving the majority of OBP and platform goals.		
2-Fair. The platform is making progress towards achieving some OBP and platform goals.		
1-Poor. The platform is making little progress towards achieving OBP and platform goals.		

5) Please note any specific platform strengths.

6) Please note any specific platform weaknesses.

7) Are there any gaps in the Platform RD&D Portfolio? Do you agree with the RD&D gaps presented by the Platform Manager?

8) Additional Recommendations, Comments and Observations

Attachment Three: Thermochemical Platform Review Agenda

Thermochemical Platform Peer Review Agenda
Vail Ballroom, Sheraton Denver Downtown
Denver, Colorado
April 14-16, 2009

Day 1-April 14					
7:30-8:30 AM	**Continental Breakfast**				
8:30-9:00 AM			Welcome and Overview of Peer Review Structure and Thermochemical Platform	Department of Energy, Office of the Biomass Program	Paul Grabowski
9:00-9:30 AM			Welcome and Overview of Peer Review Structure and Thermochemical Platform	Golden Field Office	John Scahill
	Presentation /Q&A	**WBS #**	**Project Title**	**Performing Organization**	**Presenter/Recipient**
Modeling and Analysis					
9:30 – 10:00 AM			Modeling and Analysis Session Overview	GFO	John Scahill
10:00 – 10:25 AM	*15/10*	3.6.1.1, 3.6.1.3	Thermochemical Platform Analysis: Gasification and Pyrolysis	NREL, PNNL	Abhijit Dutta, Sue Jones
20 Minute Break					
Feedstock Interface					
10:45 – 10:55 AM			Feedstock Interface Session Overview	GFO	John Scahill
10:55 –11:20 AM	*15/10*	3.1.2.1, 3.1.2.2, 3.1.2.3	Feed Improvement Task, Feed Processing & Handling Task & Feedstock Interface (combined)	INL, NREL, PNNL	Judy Partin, Kim Magrini, David Eakin
11:20 – 11:45 AM	*15/10*	3.1.1.1	Evaluation of the Relative Merits of Herbaceous and Woody Crops for Use in Tuneable Thermochemical Processing	Ceres	Bonnie Hames

Lunch**					
Gasification					
12:45 – 12:50 PM			Gasification Session Overview	GFO	John Scahill
12:50- 1:25 PM	*25/10*	3.2.1.1, 3.2.1.3	Gasification Process Modeling and Optimization	NREL, PNNL	Mark Nimlos, Don Stevens
1:25 – 1:50 PM	*15/10*	3.2.1.4	*Integrated Biomass Gasification with Catalytic Partial Oxidation for Selective Tar Conversion	GE Global Research	Ke Liu,
1:50 – 2:15 PM	*15/10*	7.3.1.1	Southeast Bioenergy Initiative - Auburn University - Systems based Products and Energy	Southeast Bioenergy Initiative	Steven Taylor
2:15 – 2:40 PM	*15/10*	3.2.4.2	Catalytic Hydrothermal Gasification	PNNL, Antares Group, Inc.	Doug Elliott, Ed Gray
2:40 – 3:05 PM	*15/10*	7.4.1.3	*Center for Producer-Owned Energy	Agricultural Utilization Research Institute	Teresa Spaeth
20 Minute Break					
3:25 – 3:50 PM	*15/10*	3.2.1.5	*Development of New Gasification Processes for Biomass Residues: Gasification Kinetics at Pressurized Conditions	NREL, Georgia Tech Research Corporation	Kristiina Iisa, Pradeep Agrawal
3:50 – 4:15 PM	*15/10*	3.2.2.8	Dual Layer Monolith ATR of Pyrolysis Oil for Distributed Synthesis Gas Production	Stevens Institute of Technology	Adeniyi Lawal
Gas Stream Clean-up and Conditioning					
4:15 – 4:20 PM			Gas Stream Clean-up and Conditioning Session Overview	GFO	John Scahill
4:20 – 4:55 PM	*25/10*	3.2.5.6, 3.2.5.8	Catalyst Fundamentals Integration	NREL, PNNL	Kim Magrini, Mark Gerber
4:55 – 5:30 PM	*25/10*	3.2.5.7	Integrated Gasification and Fuel Synthesis	NREL	Calvin Feik
End Day 1					

Day 2-April 15					
7:00-8:00 AM	**Continental Breakfast**				
Gas Stream Clean-up and Conditioning					
8:00 – 8:45 AM	*30/15*	7.7.4.2, 3.2.5.5	1- Agricultural Mixed Waste Biorefinery Using the Thermo-Depolymerization (TDP) Technology 2 - Engineering New Catalysts for In-Process Elimination of Tars	Gas Technology Institute	Larry G. Felix
8:45 – 9:30 AM	*30/15*	3.2.5.3, 3.2.5.12	1- Biomass Gas Cleanup Using a Therminator 2- Validation of the RTI Therminator Syngas Cleanup Technology in an Integrated Biomass Gasification/Fuel Synthesis Process	Research Triangle Institute	David C. Dayton
9:30 – 9:55 AM	*15/10*	3.2.5.9	Novel Approach for Biomass Syngas Cleaning and Conditioning for Liquid Fuel Synthesis Applications	Emery Energy	Ben Phillips
20 Minute Break					
10:15 – 10:40 AM	*15/10*	3.2.5.10	Biomass Synthesis Gas to Liquid Fuels Evaluation	Gas Technology Institute	Dennis Leppin
10:40 – 11:05 AM	*15/10*	3.2.5.11	*Syngas to Synfuels Process Development Unit	Iowa State University	Robert C. Brown
11:05 – 11:30 AM	*15/10*	3.2.5.13	*Pilot-Scale Demonstration of a Fully Integrated Commercial Processes for Converting Woody Biomass into Clean Biomass Diesel Fuel	Southern Research Institute	Steven Piccot

Fuel Synthesis					
11:30 – 11:35 AM			Fuel Synthesis Session Overview	GFO	John Scahill
11:35 – 12:00 PM	*15/10*	3.3.2.7, 3.3.2.8	Fuel synthesis catalyst - CRADA with DOW	NREL, PNNL	Tom Foust Mark A. Gerber
Lunch**					
12:55 – 1:30 PM	*25/10*	3.3.2.1, 3.2.2.2	Syngas Quality for Mixed Alcohols	PNNL, NREL	Jim White, Steve Phillips
1:30 – 1:55 PM	*15/10*	3.3.2.6	*Catalytic Production of Ethanol from Biomass-Derived Synthesis Gas	Iowa State University	Victor Lin
1:55 – 2:20 PM	*15/10*	3.3.2.5	*Thermochemical Conversion of Corn Stover	Bioengineering Resources, Inc.	James L. Gaddy
2:20 – 2:55 PM	*25/10*	7.7.4.8	*Mississippi State University Sustainable Energy Center – Syngas to Fuels Projects	Mississippi State University	Mark White
20 Minute Break					
Pyrolysis					
3:15 – 3:20 PM			Pyrolysis Session Overview	GFO	John Scahill
3:20 – 3:45 PM	*15/10*	3.2.2.10	Fast Pyrolysis Oil Stabilization: An Integrated Catalytic and Membrane Approach for Improved Bio-oils	University of Massachusetts at Amherst	George W. Huber
3:45 – 4:20 PM	*25/10*	3.2.2.4, 3.2.2.5	Core Pyrolysis R&D	PNNL, NREL	Doug Elliott Jim Frederick
4:20 – 4:45 PM	*15/10*	3.2.2.6	Hydrothermal Liquefaction of Agricultural and Biorefinery Residues	Archer Daniels Midland, PNNL	Scott MacDonald Doug Elliott
4:45 – 5:10 PM	*15/10*	3.2.2.7	A Low-cost High-yield Process for the Direct Production of High Energy Density Liquid Fuel from Biomass	Purdue University	Rakesh Agrawal
5:10 –5:35 PM	*15/10*	7.4.5.8	***Vermont BioFuels Initiative	Vermont Sustainable Jobs Fund, Inc.	Ellen Kahler
End Day 2					

Day 3-April 16					
7:00-7:55 AM	Continental Breakfast				
Bio-Oil Conditioning and Upgrading					
7:55- 8:00 AM			Bio-Oil Conditioning and Upgrading Session Overview	GFO	John Scahill
8:00 – 8:25 AM	*15/10*	3.2.2.11	Stabilization of Fast Pyrolysis Oils	UOP Ensyn/NREL/PNNL/PALL filter Corp	Tim Brandvold
8:25 – 8:50 AM	*15/10*	3.2.2.9	Catalytic Deoxygenation of Biomass Pyrolysis Vapors to Improve Bio-Oil Stability	Research Triangle Institute	David Dayton
8:50 – 9:15 AM	*15/10*	3.2.2.12	Novel Fast Pyrolysis/Catalytic Technology for the Production of Stable Upgraded Liquids	Virginia Polytechnic Institute & State University	Foster Agblevor
9:15 – 9:40 AM	*15/10*	3.2.2.13	A Systems Approach to Bio-Oil Stabilization	Iowa State University	Robert Brown
9:40 – 10:05 AM	*15/10*	3.2.2.1, 3.2.2.2	Pyrolysis Oil to Gasoline (PNNL, NREL CRADA with UOP)	UOP NREL PNNL	Richard Marinangelli Rich Bain Doug Elliott
20 Minute Break					
10:25 – 11:00 AM	*25/10*	7.7.4.8	* Development of Fuels from Bio-oils	Mississippi State University	Philip Steele
11:00 – 11:25 AM	*15/10*	7.3.4.1	University of Oklahoma Biofuels Refining	University of Oklahoma	Lance Lobban
Co-Products and Bio-Power					
11:25 – 11:30 AM			Co-Products and Bio-Power Session Overview	GFO	John Scahill
11:30 – 11:55 AM	*15/10*	7.3.2.4	*Bio-Renewable Ethanol and Co-Generation Plant, Biomass	Raceland Raw Sugar Corporation	Neville Dolan
Lunch**					
12:55 – 1:20 PM	*15/10*	7.4.5.3	*Kona Carbon Biomass Project	KonaCarbon, LLC	Bennett Miller
1:20 – 1:45 PM	*15/10*	7.3.2.5	Plasma Gasification Waste-to-Energy Project	Koochiching County	John D. Howard

1:45 – 2:10 PM	*15/10*	7.4.3.11	SUNY Cobleskill Bio-Waste to Bio-Energy Project	SUNY Cobleskill-The Research Foundation	Doug Goodale
2:10 – 2:35 PM	*15/10*	7.3.6.2	Alternative Fuel Source Study - An Energy Efficient and Environmentally-Friendly Approach for research on alternative fuels for cement processing	Auburn University	Steve Duke
2:35 – 3:00 PM	*15/10*	7.3.2.3	*University of Kentucky Biofuels Research Laboratory	University of Kentucky	Mark Crocker
3:00 – 3:15 PM	Conclude and Adjourn				Paul Grabowski, DOE

*Projects that combine more than one technology section within them.
** Lunch will not be provided for this meeting. A list of local eateries will be included in your registration materials.
***Originally in Co-Products and Bio-Power technology area.

Attachment Four: Thermochemical Conversion Platform Review Attendees

First Name	Last Name	Organization
Andy	Aden	National Renewable Energy Laboratory
Pradeep	Agrawal	Georgia Tech Research Corporation
Carl	Anderson	Brookhaven National Laboratory
Michael	Arbige	Genencor, A Danisco Division
Suzanne	Atkinson	Navarro Research and Engineering, DOE Golden Field Office
Richard	Bain	National Renewable Energy Laboratory
Scott	Baker	Pacific Northwest National Laboratory
Robert	Bartek	KiOR Inc
William	Batchelor	Mississippi State University
Linda	Belte	Weyerhaeuser
Bryna	Berendzen	U.S. DOE
David	Berry	Flagship Ventures
Lindsay	Bixby	BCS, Incoprorated
Michael	Blaylock	Edenspace Systems Corporation
Peter	Bluford	Consultant to the Life Science Industry
Paul	Blum	University of Nebraska
Jim	Brainard	National Renewable Energy Laboratory
Tim	Brandvold	UOP LLC A Honeywell Company
Adam	Bratis	National Renewable Energy Laboratory
Craig	Brown	Catchlight Energy, LLC
Robert	Brown	Iowa State University
Alexander	Brown	Sandia National Labs
Daniel	Burciaga	ThermoChem Recovery Int'l, Inc.
Doug	Burdette	IBC Tech
Tom	Butcher	Brookhaven National Laboratory
Stewart	Campbell	Canadian Bioenergy Corporatoin
Cole	Carveth	Colorado School of Mines
Deanna	Carveth	Snohomish County Public Works
Chris	Cassidy	USDA
Jean-Marie	Chauvet	USDA Office of Energy Policy & New Uses
Singfoong	Cheah	National Renewable Energy Laboratory
Shulin	Chen	Washington State Univeristy
Senthil	Chinnasamy	University of Georgia
Mike	Cleary	National Renewable Energy Laboratory

Eric	Connor	ThermoChem Recovery Int'l, Inc.
Mike	Cotta	USDA-ARS
Kurt	Creamer	Novozymes
Stefan	Czernik	National Renewable Energy Laboratory
Keshav	Das	University of Georgia
Ryan	Davis	National Renewable Energy Laboratory
Mark	Davis	National Renewable Energy Laboratory
David	Dayton	RTI International
Roxanne	Dempsey	U.S. DOE
Neville	Dolan	Raceland Raw Sugar Corporation
Nancy	Dowe-Farmer	National Renewable Energy Laboratory
Steve	Duke	Auburn University
Abhijit	Dutta	National Renewable Energy Laboratory
David	Eakin	Pacific Northwest National Laboratory
Jane	Earley	Consulting
Rick	Elander	National Renewable Energy Laboratory
Douglas	Elliott	Pacific Northwest National Laboratory
Noureen	Faizee	Red Lion Bio-Energy
Calvin	Feik	National Renewable Energy Laboratory
Larry	Felix	Gas Technology Institute
Robert	Fireovid	USDA/Agricultural Research Service
Daniel	Fishman	BCS, Incoprorated
Gretchen	Fitzgerald	Navarro Research and Engineering, DOE Golden Field Office
Gary	Folkert	Cargill
Thomas	Foust	National Renewable Energy Laboratory
Nick	Frasier	Navarro Research and Engineering, DOE Golden Field Office
Jim	Frederick	National Renewable Energy Laboratory
Hiroyuki	Fukui	Toyota
Stephen	Gatto	BioEnergy International, LLC
Mark	Gerber	Pacific Northwest National Laboratory
Cindy	Gerk	National Renewable Energy Laboratory
Dr. Douglas	Goodale	SUNY Cobleskill
John	Gordon	Los Alamos National Laboratory
Johan Willem	Gosselink	Shell Global Solutions International
Paul	Grabowski	U.S. DOE
Garold	Gresham	Idaho National Laboratory
Raghubir	Gupta	RTI International
Neal	Gutterson	Mendel Biotechnology
Bonnie	Hames	Ceres, Inc
Molly	Hames	Navarro Research and Engineering, DOE Golden Field Office

Paul	Harris	Novozymes, Incorporated
J. Michael	Henson	Clemson University
Richard	Hess	Idaho National Laboratory
Mike	Himmel	National Renewable Energy Laboratory
William	Hitz	DuPont Company
Nancy	Ho	Purdue University
David	Hogsett	Mascoma
Elizabeth	Hood	Arkansas State University
John D.	Howard, III	Coronal, LLC
David	Hsu	National Renewable Energy Laboratory
Ryan	Hubbart	Power Ecalene Fuels, Inc.
George	Huber	University of Massachusetts at Amherst
Kristiina	Iisa	National Renewable Energy Laboratory
Whitney	Jablonski	National Renewable Energy Laboratory
Gene	Jackson	Power Ecalene Fuels, Inc.
Gene	Jackson	Power Ecalene Fuels, Inc.
Alisha	Jarnagin	Genencor, A Danisco Division
Edward	Jennings	National Renewable Energy Laboratory
Samuel	Jones	Iowa State University
Bruce	Jones	Minnesota State University
Susanne	Jones	Pacific Northwest National Laboratory
Mark	Jones	The Dow Chemical Company
Jay	Keller	Sandia National Laboratories
Ellyn	Kerr	Industrial Biotechnology / Mary Ann Liebert
George	Kervitsky	BCS, Incoprorated
Charles	Kinoshita	University of Hawaii
Susanne	Kleff	MBI International
Rick	Kleiner	PALL
Brian	Kneale	BP
Michael	Knotek	Knotek Scientific Consulting
Stephen	Korstad	Coronal, LLC
Curt	Krause	Chevron
Manoj	Kumar	DSM White Biotechnology
Mike	Lanahan	Agrivida Inc
Paul	Larsen	Power Ecalene Fuels, Inc.
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