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

BIOMASS PROGRAM

THERMOCHEMICAL

2011 Platform Review Report

An Independent Evaluation of Platform Activities for FY 2010 and FY 2011

Review Date

February 16–18, 2011

February 2012

Department of Energy

Washington, D.C. 20585

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 February 16–18, 2011, at the Crowne Plaza Hotel in Downtown Denver, Colorado.

All programs in the Department of Energy's Office of Energy Efficiency and Renewable Energy are required to conduct a formal peer review of their project portfolios as a means for enhancing the management, relevance, effectiveness, and productivity of the activities. This report documents the process utilized by the Biomass Program in conducting its fiscal year 2011 Peer Review, the resulting opinions and recommendation from the Review Panel who was tasked with evaluating the Thermochemical Conversion Platform, and the Program's response to the results and recommendations. Additional information on the 2011 Biomass Program Peer Review Process—including all presentations and a full compilation of reviewer comments for each of the individual platform review meetings and Program Review meeting—are available on the Program Review website at http://obpreview2011.govtools.us.

The Biomass Program peer review process involves a systematic review of the project portfolios of eight separate technology platforms managed by the Program and a separate meeting where the entire Program was comprehensively reviewed. The Biomass platform reviews were conducted from February through April 2011 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 June 2011, was conducted to evaluate the Program's overall strategic planning, management approach, priorities across research areas, and resource allocation.

The recommendations and evaluations provided by the expert peer review panels 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 considered in combination with other critical project information to result in a complete systematic evaluation of the progress and accomplishments achieved by the individual projects, the platforms, and the Program toward programmatic milestones, project goals, and objectives.

I would like to express my sincere appreciation to the reviewers. They make this report possible, and we rely on their comments to help make project and programmatic decisions for the new fiscal year. Thank you for participating in the 2011 Thermochemical Conversion Platform Peer Review meeting.

Paul E. Grabowski
Technology Manager
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U.S. Department of Energy

EXECUTIVE SUMMARY

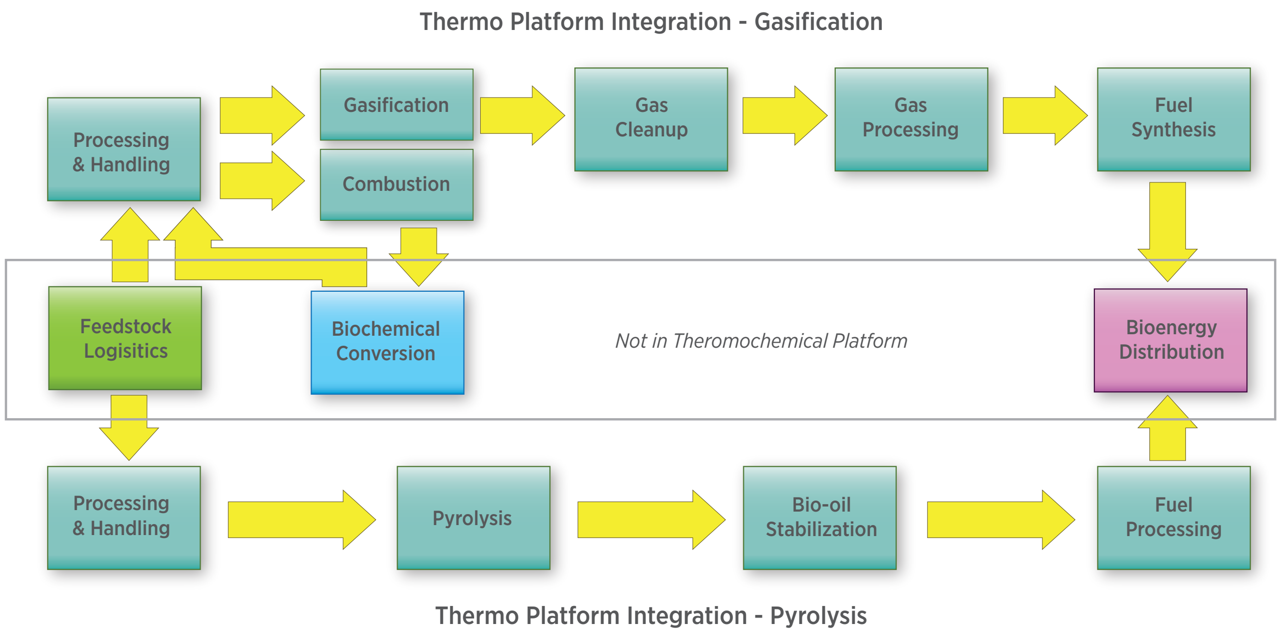
Summary from Review Panel

Platform Review Summary – Impressions and Observations:

Thermochemical conversion technologies for the sustainable, cost-effective conversion of biomass to liquid transportation fuels continue to show great promise. The Thermochemical Conversion Platform offers a flexible route for "replacing the entire barrel of oil." Processes being developed by the Thermochemical Conversion Platform can be used to replace gasoline or diesel fuels, and, as needed, jet fuels and chemicals. Thermochemical conversion technologies are much less sensitive to the type and amount of sugars present in a particular biomass feedstock stream. Thermochemical conversion technologies can be used to produce ethanol, or other alcohols, or convert biomass directly to infrastructure compatible hydrocarbons.

Thermochemical conversion technologies can be divided into two foundational pathways, gasification and pyrolysis, each with a number of process specific subcomponents, as shown in Figure 1.

Figure 1 | Biomass processing options within the Thermochemical Platform.



The gasification pathway allows for the production of synthesis gas (e.g., carbon monoxide and hydrogen), or 'syngas,' and the subsequent production of alcohols, hydrocarbons, chemicals, and process heat and power. The technology needed for the production of hydrocarbons and many chemicals from clean synthesis gas streams is well-developed and commercial around the world. The scale of many of these current commercial processes is quite large, and may be inconsistent with sustainable biomass growth and collection. Biomass gasification forms a number of process impurities, tars, water, carbon dioxide, that must be removed prior to the production of fuels or chemicals, and this technology challenge has been a major focus of the Program.

Pyrolysis is the rapid, high-temperature decomposition of biomass feedstocks in a reductive (oxygen lean) atmosphere. The pyrolytic process generates three product streams, a viscous pyrolysis oil (py-oil), light gases, and a carbon-rich char. The yield of each stream is sensitive to the feedstock and the specifics of the pyrolysis process. The py-oil is a very complex suite of hundreds of individual chemicals, and its value is limited by its complexity, acidity, and tendency to increase in viscosity over time. However, with suitable treatments the py-oil can provide a stream that can be co-fed into a petroleum refinery or used as a replacement for diesel fuels in some processes. Co-processing of pretreated py-oil in a petroleum refinery should allow for production of the full range of hydrocarbon fuels, which are compatible with existing processing and distribution.

In addition to the two foundational pathways, the Thermochemical Conversion Platform also includes technical and economic process evaluations, evaluations of feedstock supply and logistics, and, most recently, consideration of the life-cycle impacts of the integrated cradle-to-‘wheels’ processes. All three of these supporting activities are critical for evaluation of the potential of the overall Thermochemical Platform, and the careful, uniform evaluation of individual projects.

Project Reviews: Overall the Thermochemical Platform Review Panel evaluated 37 of the 38 Thermochemical Platform projects. (The University of Kentucky Biofuels Research Laboratory did not provide any materials for the review.) The projects were evaluated and scored for their technical approach and progress over the past two years, relevance to the Biomass Program goals, and their critical success factors. All of the projects were ranked by Review Panel members, and the average score in each category is reported below. All the projects were also evaluated, but not scored for their technology transfer and collaborations, and overall impressions of the project.

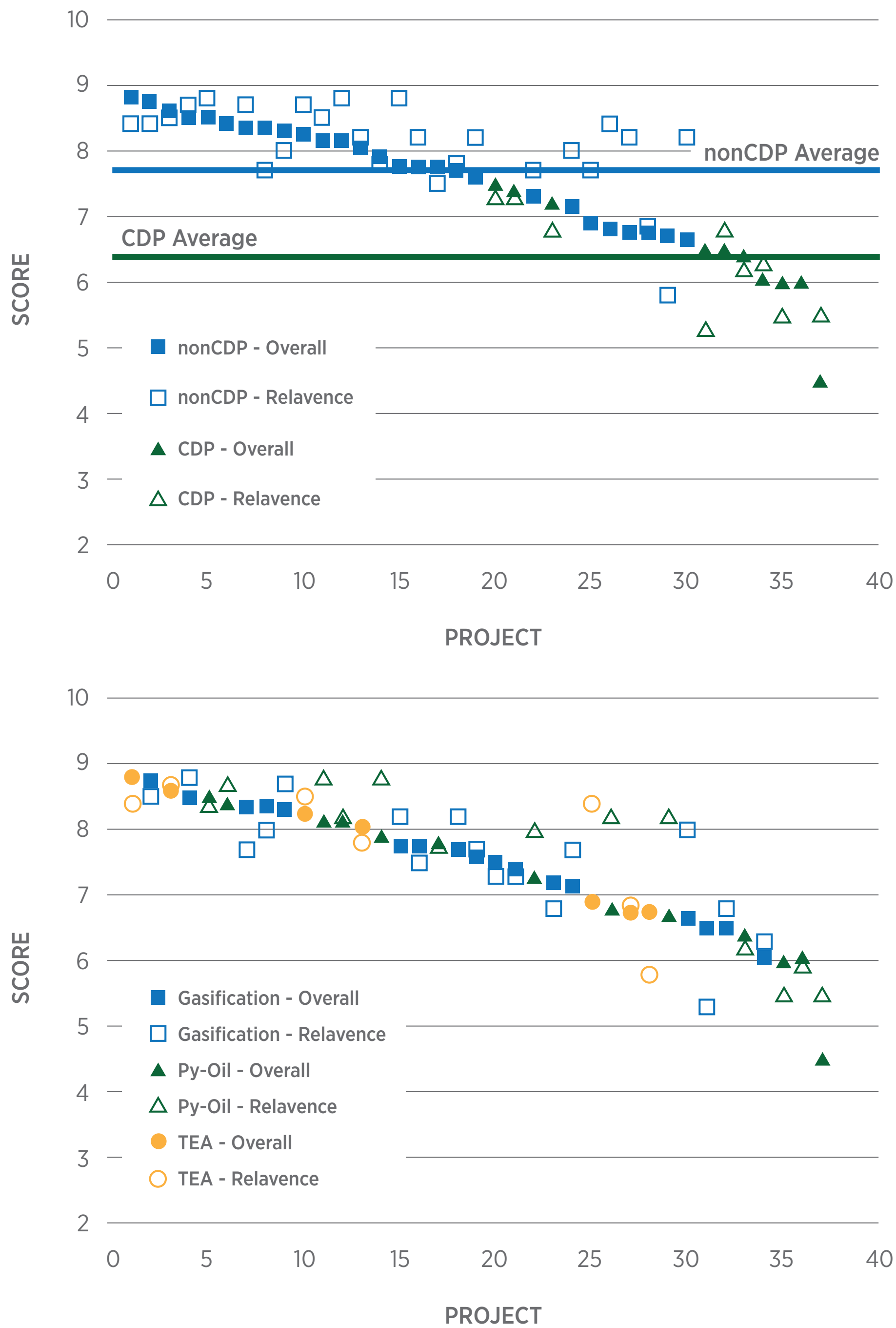
The numerical scores can be used to gain an overall view of the Thermochemical Platform portfolio. To gain insight into the overall impact of an individual project the numerical score for the “technical approach” and “progress” were averaged into a single numerical score and used to evaluate the portfolio.

Two views of the entire Thermochemical Platform portfolio are shown in Figures 2a and 2b. Figure 2a shows a rank order of the projects, the average score from the “technical approach” and “progress,” along with their associated relevance scores. This presentation also identifies the congressionally directed projects. Figure 2b shows the same results, but three topical areas (Gasification; Pyrolysis; Techno-economics and Analysis; and Feedstocks Interface) are highlighted.

Figure 2a shows a clear differentiation between the congressionally directed projects, and the projects that are selected through formal, competitive solicitations or through Biomass Program internal competitive evaluated processes. There is also a less clear trend that suggests the weaker projects are less clearly aligned with Biomass Program goals and priorities. This presentation also shows that there is a suite of non-congressionally directed projects that are highly relevant, but below average in some other way. It is likely that this suite of projects would benefit from some additional attention from Biomass Program management.

Figure 2b is the same data, but the projects are now identified by their main topical area. (Several projects cover more than one topical area, so this presentation tries to identify the major topical area.)
This presentation highlights that the Platform has high-performing and highly relevant projects in all three of the major topical areas: gasification, pyrolysis, and techno-economic analysis (TEA), as well as feedstocks interface.

Figure 2a and 2b | Thermochemical Platform Project Scoring Charts



Technical R&D Area Discussion

- **How is the focus area of projects performing collectively?**
  - The Thermochemical Platform has a good balance between the two foundation pathways. This balance between the two conversion pathways provides the Platform with opportunities to produce alcohols or hydrocarbons. The ability to produce fuels from highly variable biomass is a fundamental strength of the Platform.
  - In response to the 2009 Review, the Thermochemical Platform has added several techno-economic and feedstock tasks. These additions provide the Platform with the ability to uniformly evaluate the impacts of technical progress for both the gasification and pyrolysis technology routes.
  - For the pyrolysis projects, there is a good balance between all crucial areas: stabilization, (upgrading) and core research and development (R&D). The feedstock interface is being established and should be beneficial. The pyrolysis TEA, and the feedstock and sustainability projects are all important additions.
  - Gasification work appears to be well organized, and there is a good balance between all crucial process steps. Tar reforming has been a major thrust for more than five years. In addition, there needs to be a firm stage gate with a significant level of industrial review. The 2012 mixed alcohol catalysts tests need to be done with enough run time with real syngas to be meaningful. The Range Fuels/PNNL project highlights the risks associated with extrapolation from short run times to longer run times. The outcomes of the four integrated syngas to fuels projects need to be captured and compared with a constant set of metrics. Overall, there is good engagement by commercial catalyst companies.
  - The presence of sound, robust TEA models will also allow the Program to evaluate the congressionally directed projects on a consistent basis. These projects may have useful attributes, but the principal investigators from universities or companies with a narrow focus, do not have the experience to fully or objectively evaluate the impact of their technologies. Without a strong review role from the Biomass Program, these projects are not likely to provide the desired value.

- **What synergies exist between the projects in each technical R&D area?**
  - With the addition of robust TEA, feedstock, and life-cycle assessment (LCA) tasks, there is a great deal of potential for a systematic evaluation of the integrated systems. For example, there is a great deal of concern about the large size of potential thermochemical conversion plants, and the sustainable supply of biomass feedstocks. The robust TEA models, feedstock delivery studies, and LCA can begin to address this and other issues.
  - There is an opportunity for greater collaboration between the university teams and the national laboratories. Many of the university projects are focused on more fundamental reaction mechanisms, development of analytical tools, or exploratory work, and these projects could benefit from collaboration. The PNNL-Range Fuels project appears to be a good example of how the tremendous array of analytical tools can be used to provide insight into the very complex changes in catalysis properties.

- **Are there topics that are not being adequately researched?**
  - There is a need for additional planning for some of the extended pilot plant runs designed to evaluate the long-term performance of catalysts. This holds for tar cracking, fuels synthesis, and py-oil upgrading processes.
  - There is an opportunity for some bench-marking work, similar to the CAFI study sponsored by the Biomass Program several years ago. For example, universities should be making some runs with a standardized biomass and developing a common basis for energy balance/carbon balance assessments. Potentially overlapping work on catalyst synthesis and testing needs to be better coordinated so they can learn from one another. It is also important that they accurately track or model the hydrogen consumption for their individual processes.
  - The life-cycle work is under-represented. Because the Thermochemical Platform can consider commercialization pathways, such as distributed py-oil production and very large-scale gasification, the LCA and supply chain impacts will be large. The Review Panel recognized that the LCA efforts are a growing focus and that additional work is being convened at the Program level. It is important to carefully evaluate and update the engineering process models to allow for robust LCA. The LCA needs to include more than simple gate-to-gate analysis. There needs to be a careful evaluation of the carbon and energy impacts of biomass production, harvesting and storage, and the impacts of biomass variation on the product quality. There also needs to be a connection to landowners to understand the regional differences in sustainability criteria.
  - Consideration needs to be given to breakthrough/out-of-the-box thermochemical conversion technologies. There has been a great deal of fundamental work at both thenational laboratories and universities, but it is not well connected to the specific research needs. An industrial/international advisory group might be useful to help provide direction.
  - The py-oil stabilization funding opportunity announcement (FOA) projects are wrapping up; what's the next step? There is a need to make sure that the Biomass Program captures the successes generated by the different projects. There may also an opportunity for benchmarking the py-oil FOA projects with the National Advanced Biofuels Consortium (NABC) projects.
  - In spite of the many challenges, there continues to be interest in deriving chemicals from pyrolysis oils. Some of the technology progress in py-oil stabilization or the use of new catalysts could open up new routes for value-added chemical products.

Platform Discussion

- **How is the Platform performing collectively?**
  - Overall the Thermochemical Platform goals and activities are well-aligned with the Multi-Year Program Plan (MYPP). The inclusion of additional TEA, feedstock interface, and LCA work is valuable.
  - There appears to be a need for a regular forum for researchers to discuss results and activities. Many of the projects are relatively 'siloed.' One option might be fewer, larger projects with bigger teams, which include (require) partners from industry, national laboratories and universities. Another option would be a Biomass Program-sponsored forum where all the projects present technical progress and where there is ample time for discussions.

- **What are the gaps in the portfolio? Are there other research areas that DOE should consider funding?**
  - As suggested in the 2009 Review the Thermochemical Platform should seriously consider linking with biopower-related efforts. Power applications could potentially use either gasification or pyrolysis technology that may still have technical risks for liquid fuel production. This may include work on combining biomass and fossil feedstocks. There may also be opportunities for starting with a power application to demonstrate the effective, reliable operation of a gasifer, prior to addition of a fuel synthesis reactor. This approach could reduce the initial capital and technical risks. Several of the Integrated Biorefinery projects have elements of this approach.
  - As the Thermochemical Platform moves from mixed alcohols production, it should also consider biomass gasification for methane/synthetic natural gas that could be added to pipelines in the near term and later used for liquid fuels production.

- **What single thing would strengthen the portfolio in the coming 12 months?**
  - Forcing all projects to work with DOE to perform a consistent TEA, including a sensitivity analysis. Tornado plots and sensitivity analysis are helpful to highlight risks.
  - Create an opportunity for project crosstalk (e.g., an intermediate 'science' meeting to foster additional understanding) and reduce unintended duplicating.
  - More work on upgrading of stabilized py-oil. This should include the involvement of oil companies to help verify additional 'performance' targets. Maybe the NABC could help foster the discussions.
  - Consider picking up NABC projects that do not move forward or other breakthrough thermochemical technologies with a new solicitation.

- **What changes in the portfolio are required to better meet the goals of the Biomass Program?**
  - Require a consistent TEA of all applied/demonstration projects and annual science review of all fundamental projects. Require common assumptions for the TEA.
  - Consider biomass gasification for methane/synthetic natural gas for heat and power applications that can reduce risk of a fully integrated gasification/liquid fuels production system.

Summary of Results: Platform

Evaluation Criteria	Average	Range	Std. Dev.
1. Relevance	9.0	-	4.87
2. Approach	8.7	-	3.54
3. Progress	8.5	-	3.55

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

Summary of Results: Project Portfolio

WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps: Continue Project	Next Steps: Change	Next Steps: Other	Technology Manager Summary Comments
3.1.2.1/2/3	Feed Improvement Task Feed Processing & Handling Task Idaho National Laboratory (INL)	INL & National Renewable Energy Laboratory (NREL); Richard Boardman	7.9	X	-	-	This interface task will continue to support optimization of the feedstock supply system, including collection, preprocessing, and storage operations, related to bioconversion optimization. Meeting the milestones in this task is imperative to realizing the overall Platform's FY 2012 targets.
3.1.2.4	Sustainability Interface	Pacific Northwest National Laboratory (PNNL); Lesley Snowden-Swan	7.5	X	-	-	This project will continute to determine, prioritize, and quantify environmental sustainability metrics for thermochemical conversion processes.
3.6.1.3	Thermochemical Platform Analysis: Pyrolysis Route	PNNL; Lesley Snowden-Swan	8.0	X	-	-	This project will continue to perform detailed TEA for pyrolysis and upgrading cases.
3.2.2.4/5	Pyrolysis Oil R&D - PNNL	PNNL; Lesley Snowden-Swan	8.5	X	-	-	This project will continute to develop the basic science and engineering for production of liquid fuels needed for fast pyrolysis of biomass and for production of improved bio-oil intermediates for petroleum refinery insertion.

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WBS Number	Project Title	Recipient / PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
3.2.2.16	Effects of Bio-Oil on Reactor and Tank Materials	Oakridge National Laboratory (ORNL); Jim Keiser	7.3	X	-	-	This project will continue to determine the compatibility of potential containment materials with biomass-derived pyrolysis oil and with fractions of untreated, partially treated, and fully hydrotreated bio-oil.
3.3.1.1	National Advanced Biofuels Consortium (NABC)	Alliance for Sustainable Energy, LLC; Tom Foust	8.2	X	-	-	The work of the NABC is still ongoing, and two thermochemical conversion process strategies (hydrothermal liquefaction and catalytic fast pyrolysis) are being evaluated for Stage 2 selection.
3.2.2.9	Catalytic Deoxygenation of Biomass Pyrolysis Vapors to Improve Bio-Oil Stability	Research Triangle Institute; Dave Dayton	7.2	X	-	-	This project developed and tested catalysts to selectively remove oxygen from biomass pyrolysis vapors prior to condensation to improve bio-oil stability. Project end date is 9/30/12.
3.2.2.7	A low-cost high-yield process for the direct production of high energy density liquid fuel from biomass	Purdue University; Fabio Ribeiro	5.7	X	-	-	This project is aimed at developing a low-cost, high-yielding process to produce liquid fuel from biomass using hydrogen and energy for hydroprocessing an intermediate oil from a carbon-free energy source. Project end date is 5/31/13.

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WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
3.2.2.10	Fast Pyrolysis Oil Stabilization: An Integrated Catalytic and Membrane Approach for Improved Bio-oils	University of Massacusetts, Amherst; George Huber	7.8	X	-	-	This project aimed to develop catalytic and membrane technologies to stabilize bio-oils and mitigate residual char fines from the oil to less than 0.01 weight percent. Project is finishing and will move into close out by 11/30/11.
3.2.2.11	Stabilization of Fast Pyrolysis Oils	Honeywell's UOP, LLC; Tim Brandvold	8.1	X	-	-	This project examined a systems solution (combination of technologies) for the stabilization of biomass pyrolysis oil, like in-situ py-oil stabilization, hot gas filtration, and transfer hydrogenation/ hydrothermal treatment. Project is finishing and will move into close out by 3/30/12.
3.2.2.13	Novel Fast Pyrolysis/ Catalytic Technology for the Production of Stable Upgraded Liquids	Virginia Polytechnic Institute & State University; Foster Agblevor	7.2	X	-	-	This project produced upgraded liquids from hardwood biomass by using new multifunctional catalysts in a two-stage fluidization unit. Project is finishing and will move into close out by 4/30/12.
3.2.2.12	A Systems Approach to Bio-Oil Stabilization	Iowa State University; Robert Brown	8.7	X	-	-	This project aimed to develop methods for stabilizing biomass derived fast pyrolysis oil for a minimum of six months of storage under ambient conditions. Project is finishing and will move into close out by 12/31/11.

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WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
3.2.2.17	Advanced Biomass to Gasoline Process	Excelus, Inc; Mitrajit Mukherjee	4.6	X	-	-	This work will continue to seek a low-temperature catalytic process to convert cellulosic biomass into a gasoline blend stock.
3.6.1.1	Thermochemical Platform Analysis: Gasification Route	NREL; Abhijit Dutta	8.5	X	-	-	The immediate objective of this work is to help achieve the Biomass Program's goal to demonstrate integrated conversion technologies capable of producing cost-competitive ethanol from biomass by the year 2012.
3.2.1.1/3	Gasification Process Optimization and Modeling	NREL; Mark Nimlos	7.9	x	-	-	The goal of this task is to develop an understanding of chemistry and transport that can be used to improve the performance of gasification. This work will be rolled into a liquefaction-focused R&D suite post FY 2012.
3.2.5.6/8	Catalyst Fundamentals Integration	NREL; Kim Magrini	8.5	-	-	-	This work on syngas cleanup will be closing out, and the fuel synthesis work will be focused. Some sub-tasks of this work will be rolled under a new project and altered to focus more on pyrolysis (Work Breakdown Structure 3.3.2.9).

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WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
3.2.5.9	Novel Approach for Biomass Syngas Cleaning and Conditioning for Liquid Fuel Synthesis Applications	Emery Energy; Karl Libsch	6.0	X	-	-	This project aimed to demonstrate the ability of a cold plasma reformer to destroy tars and oils in syngas produced by biomass gasification. Project end date is 8/30/12.
3.3.2.1/2	Advanced Thermochemcial Biofuels- formerly Syngas quality for fuel synthesis	NREL; Jessee Hensley	8.4	X	-	-	This project will continue to design and validate catalysts for the improved performance of mixed alcohol synthesis from biomass dervied syngas. This work will be rolled into a liquefaction focused R&D suite post FY 2012.
3.2.5.10	Biomass Synthesis Gas to Liquid Fuels Evaluation	Gas Technology Institute; Larry Felix	7.3	-	-	X	This project aimed to develop novel methods for creating and producing optimized, attrition-resistant catalysts for the reduction or elimination of the tars produced in fluid-bed biomass gasification. Project has moved into close-out.
3.2.5.15	PNNL Range Fuels Catalyst Development	PNNL; Mike Lilga	8.0	-	-	X	This project aimed to improve a proprietary set of molybdenum-based mixed alcohol synthesis catalysts to increase alcohol selectivity, improve catalyst lifetime, and increase catalytic activity. Project has moved into close-out.

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WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
3.2.5.7	Integrated Gasification and Fuel Synthesis	NREL; Stephen Phillips	8.3	X	-	-	This project will continue to demonstrate integrated production of cost-competitive ethanol from mixed alcohols produced from biomass-derived syngas at pilot scale. This work will be rolled into a liquefaction-focused R&D suite post FY 2012.
3.2.5.12	Validation of the RTI Therminator Syngas Cleanup Technology in an Integrated Biomass Gasification/ Fuel Synthesis Process	RTI; Dave Dayton	7.8	X	-	-	This project will continue to work on reducing syngas cleanup/conditioning capital and operating costs to achieve biofuel production cost goals. Project end date is 7/1/12.
3.2.5.11	Syngas to Synfuels Process Development Unit	Iowa State University; Robert Brown	8.0	X	-	-	This project aimed to demonstrate the production of Fischer-Tropsch liquids from switchgrass with a process development unit rated at 20 kilograms per hour biomass input. Project is finishing and will move into close out by 3/30/12.
3.2.5.13	Pilot-Scale Demonstration of a Fully Integrated Commercial Processes for Converting Woody Biomass into Clean Biomass Diesel Fuel	SRI; Steve Piccot	7.1	X	-	-	This project will continue to integrate and validate a commercially scalable biomass gasifier and syngas cleanup system; then integrate an existing gasification/ Fischer-Tropsch Synthesis biorefinery pilot plant with said syngas cleanup unit. Project end date is 9/30/12.

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WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
6.5.2.2	Thermochemical Collaboration with China	PNNL; Jonathan Male	7.5	X	-	-	This closed project leverages ongoing China-based research capabilities in thermochemical conversion to further the Biomass Program's mission-related R&D.
6.5.4.1	Thermochemical Collaboration with EU - Finland and Sweden	NREL; Kristiina Iisa	7.6	-	-	X	This closed project leveraged ongoing European Union-based research capabilities in thermochemical conversion to further Biomass Program mission-related R&D. This project has been closed out.
6.5.9.1	Thermochemical Collaboration with Canada	PNNL; Alan Zacher	8.0	-	-	X	This closed project leveraged ongoing Canadian-based research capabilities in thermochemical conversion to further the Biomass Program's mission-related R&D. This project has been closed out.
3.2.1.5	Development of New Gasification Processes for Biomass Residues: Gasification Kinetics at Pressurized Conditions	Georgia Tech Research Corporation; Pradeep Agrawal	6.9	X	-	-	This project aimed to obtain experimental data on the rates of carbon gasification and hydrocarbons and tar formation during pressurized gasification of biomass. Project end date is 12/31/13.
3.2.1.4	Integrated Biomass Gasification with Catalytic Partial Oxidation for Selective Tar Conversion Partial Oxidation for Selective Tar Conversion	GE Global Research; Wei Wei	7.3	-	-	X	This project aimed to research and develop an advanced catalytic system for tar removal that is of high efficiency and cost effective. This project has moved into closed out.

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WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
3.2.2.16	Feedstock Treatments for Thermal Reactors.	ORNL; Shahab Sokhansanj	6.7	X	-	-	This project will continue to develop parameters (temperature, time, particle size, power) for converting torrefied biomass to pellets for feeding pyrolyzers and gasifiers.
3.1.1.1	Evaluation of the Relative Merits of Herbacious and Woody Crops for Use in Tuneable Thermochemical Processing	Ceres; Bonnie Hames	6.4	-	-	X	This project aimed to determine how the optimum process parameters of a commercial gasification conversion process change as the feedstock material varies among multiple species. This project has been closed out.
7.7.4.8	Mississippi State University Sustainable Energy Center (MS)	Mississippi State University; Michele Anderson	6.3	X	-	-	This project aims to develop pyrolysis technology to produce high-quality bio-oils from southern feedstocks followed by upgrading of the bio-oil to liquid fuels using a patened suger system.
3.3.2.6	Catalytic Production of Ethanol from Biomass-Derived Synthesis Gas	Iowa State University; Brian Trewyn	6.2	X	-	-	This project aimed to produce liquid fuels, such as ethanol and other high-energy content alcohols, from biomass by using a mesoporous catalytic syngas conversion system. Project end date is 6/30/12.

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WBS Number	Project Title	Recipient; PI	Final Average Score	Next Steps			Technology Manager Summary Comments
				Continue Project	Change	Other	
3.2.2.8	Dual Layer Monolith ATR of Pyrolysis Oil for Distributed Synthesis Gas Production	Stevens Institute of Technology; Adeniyi Lawal	6.0	-	-	X	This project aimed to demonstration of dual-layer monolith reactor technology for distributed production of H_2/CO-rich synthesis gas via autothermal reforming of pyrolysis oil. This project has been closed out.
7.3.4.1	University of Oklahoma Biofuels Refining (OK)	University of Oklahoma Biofuels Refining; Lance Lobban	7.5	X	-	-	This project aimed to develop a fundamental catalyst and process for upgrading strategies of bio-oil (vapor and liquid phase) to achieve a stable product. Specific project objectives are to maximize carbon retention and minimize hydrogen consumption.

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INTRODUCTION

On February 16–18, 2011, 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 2011 Program Peer Review implemented by the Biomass Program. The peer review is a biennial requirement for all EERE programs to ensure the following:

> *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, multi-year program plans, and potentially in the redirection of individual projects.

Paul Grabowski was designated by the Biomass Program as the lead for the Thermochemical Conversion Platform. In this capacity, he was responsible for all aspects of planning and implementation, including coordinating the Review Panel, coordinating with principal investigators (PIs), and overall planning for the Platform Review. They were assisted in this effort with resources from a Peer Review Implementation team comprised of logistics and Peer Review implementation contractors and DOE staff from the Golden Office.

Approximately 150 people attended the Thermochemical Conversion Platform Review meeting. An agenda for the meeting is provided in Attachment 1. A list of attendees is provided in Attachment 2. Presentations given during each of the Platform Review meetings, as well as other background information are posted on the Peer Review website: http://obpreview2011.govtools.us.

The remainder of this section provides a brief description of the implementation process for the Platform Review meetings, identifies the Thermochemical Conversion Review Panel, and describes the role of the Steering Committee.

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 developed following the June Program Review meeting. The Program Review report may also include additional comments related to this Platform.

Biomass Program Peer Review Process

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 Reviews is provided in Exhibit 1.

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 Systems Integrator, and contractor support. The planning team held weekly planning meetings beginning September 2010 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. The planning activities included input from the following committees:

1. **Biomass Program Internal Peer Review Committee** – To ensure the quality of the process, exchange information efficiently, and communicate meeting and activity specifics throughout the review process all of the Platform Leads were invited to participate in weekly conference calls involving contractor and DOE Program Review Lead.
2. **Biomass Program Peer Review Steering Committee** – Following EERE Peer Review guidance, a Steering Committee was formed to help ensure an independent and transparent expert review of the Biomass Program's research, development, and deployment (RDD&D) portfolio. They serve as a working partner with the Biomass Program and are involved throughout the planning and implementation of the review process providing comment and direction to ensure the Program receives and publishes calibrated, independent, and transparent project portfolio feedback. The specific activities performed by the Steering Committee are as follows:
    - Review and comment on evaluation forms and presentation templates
    - Review and comment on overall implementation process
    - Review and comment on candidate review panelists for each platform
    - Review the summary results of the platform reviews and reviewer comments
    - Be present at the overall Program Peer Review, participate as Program Peer Reviewer, and complete required review forms for the Program Peer Review. This includes reviewing the Biomass Program structure, Program management decision making processes, selection process and portfolio balance, and progress in achieving Program mission and goals.

Twenty individuals were nominated to be considered for the Steering Committee, with a target of selecting seven members. In the end, only six Steering Commmittee members were selected to be on the Committee. Decision criteria included

- Absence of any conflict of interest (COI) as demonstrated by receipt of a signed COI form
- Balanced representation of the diversity of expertise required to support the review process such as expertise in finance, conversion technology, environmental sciences, or integrated biorefineries
- Balanced representation by type of organization including research institution, private sector, government, and non-governmental organization.

Final selection was made by the Biomass Peer Review Planning Team and Team Leader. A list of Steering Committee members is provided in Attachment 3. The Steering Committee met through biweekly conference calls that began in September/October 2010. Committee recommendations were provided to the Platform Review planning teams as they were made throughout the planning process.

Exhibit 1 | Basic Steps in Implementing the Biomass Program Peer Review

1. The Program's research, development, and demonstration (RD&D) and analysis project portfolio was organized by the eight 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 PIs, and overall planning for the Platform Review. Each Platform Lead was assigned contract support resources to assist in the implementation of the associated activities.
3. Each platform identified specific projects for review from its portfolio. Target: Review at least 80% of the Platform's total budget.
4. An internal Peer Review committee (IPRC) comprised of leads of each of the eight platforms, the DOE Program Review Lead, and the Peer Review Implementation team was formed to enhance communications, discuss relevant issues and concerns, and ensure the quality of the process. Meetings of the IPRC were held weekly.
5. 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. Meetings with Steering Committee members were held every two weeks.
6. Draft Project-level, Platform-level, and Program-level evaluation forms were developed for the 2011 Platform Review meetings. Similarly, draft presentation and project abstract templates 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 Steering Committee reviewed and modified the forms before they were finalized.
7. 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. The Committee provided yes/no recommendations on candidates, and they recommended other candidates for the platforms to consider. Results were provided to Platform Leads for consideration in the final selection of Review Panels.
8. Upon confirmation, each Review Panel member was contacted by the Golden Office and registered as an individual contractor for the purpose of the Peer Review Process. The Golden Office also communicated important information on their responsibilities, reimbursement procedures, and issues regarding COIs to the reviewers. Each reviewer received COI forms prior to the review meeting; forms were also collected prior to the meeting. A minimum of two conference calls were held for each Platform Review Panel, as well as Peer Review organizers, Golden Office and reviewers to verbally discuss background information on the review, instructions, evaluation forms, presentation templates, and other information pertaining to the Platform Review process. Project lists, abstracts, and presentations were provided to each reviewer in advance of the review meeting via a secure meeting website. To the extent possible, representatives from the Steering Committee participated in those calls.
9. The Biomass Program performed outreach to encourage participation in each of its Platform Review meetings by sending announcements to more than 3,000 Program stakeholders, PIs, and attendees at previous Program events. The Program Reviews were also announced on the Biomass Program website.
10. Platforms invited PIs to present their project(s) at the Platform Review. PIs were provided with presentation templates and instructions, reviewer evaluation forms, and background information on the review process. Conference calls were held with PIs to address questions. PIs who chose not to present received requests to submit forms stating such.
11. Platform Review meetings were held according to guidelines developed by the Steering Committee, IPRC, and the Peer Review Implementation team. Members of the Steering Committee participated in each review to ensure consistency and adherence to guidelines.
12. Review Panel evaluations were collected during each Platform Review meeting using an automated Web-based tool. These evaluations were accessible via a password-protected website following each review, and review panelists had approximately 10 working days to edit and finalize their comments. PIs then had approximately 10 working days to access the review results using the same password-protected website. PIs were also given the opportunity to respond to Review Panel evaluations via the same tool, and all comments are made publically available with the issuing of the final Platform Report.
13. 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.

Biomass Program Peer Review Meetings

The Biomass Program organizes its research and analysis activities into technology platform areas, and for the purposes of the Peer Review process, the individual Platform Review meetings are held, information is processed, Platform Review comments and scoring outputs generated, and from this rolled up information the Biomass Program is reviewed. The 2011 Biomass Program Peer Review process reviewed eight platforms in three distinct series of meetings held between February and April of 2011. The Peer Review schedule was as follows:

Series 1 Peer Review Meetings, held February 1–3, 2011:

- Integrated Biorefinery
- Infrastructure

Series 2 Peer Review Meetings, held February 14–18, 2011:

- Biochemical Conversion
- Thermochemical Conversion

Series 3 Peer Review Meetings, April 4–8, 2011:

- Analysis
- Sustainability
- Feedstock
- Algae.

The eight Platform Review meetings focused on the technical project-level reviews of the research projects funded in each of the eight Biomass Technology Platform areas. The overall structure and direction of the Platform was also reviewed. A separate Review Panel and a designated Lead Reviewer were seleted for each platform review. Review Panels were comprised of independent, external, technical reviewers with subject matter expertise related to the platform being reviewed.

The Program Review was held June 27–28, 2011. This allowed sufficient time to complete and verify the gathering of reviewer comments, and to process comments and scoring outputs for use by the Program Reviewers. At 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 the Platform Leads and Lead Reviewers as input. The Biomass Program Review Panel comprised the six members of the Steering Committee, formed to provide overall oversight of the Program Peer Review process, and the lead reviewer from each of the eight Platform Review Panels.

Thermochemical Conversion Platform Review Panel

Each Platform's portfolio was evaluated 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 RD&D or analysis projects, as well as the overall structure and direction of the Platform. Paul Grabowski, the Biomass Program lead for the Thermochemical Conversion Platform, designated Dr. Steve Kelley—a Professor at North Carolina State University and a national recognized expert in forestry and thermochemical conversion processes—as the Lead Reviewer for the Peer Review Panel. Dr. Kelley 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 June.

In forming its Review Panel, the Thermochemical Conversion Platform evaluated 15 candidates for its Review Panel. 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 absence of COI, as represented by receipt of their COI forms. 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 2 lists Review Panel members for the Thermochemical Conversion Platform.

Exhibit 2 | Thermochemical Conversion Review Panel

Name	Affiliation/Title	Expertise
Craig Brown	Senior Engineering Specialist, Catchlight Energy	Gasification technologies
Robert Fireovid, Ph.D.	Leader for Bioenergy Research, USDA, ARS National Program	Bioenergy and biobased products
Sandra Hermle, Ph.D.	Bioenergy and Combustion Program Manager, Swiss Federal Institute of Technology	Life-cycle analysis
Ryan Katofsky, Ph.D.	Navigant Consulting, Associate Director	Commercialization of bioenergy technologies
Steve Kelley, Ph.D.*	Professor, North Carolina Sate University	Pyrolysis
Curtis Krause	Thermochemical Technology Manger, Chevron	Thermochemcial conversion of biomass

* Denotes Lead Reviewer

Organization of this Report

The remainder of this document provides the results of the Thermochemical Conversion Platform Review meeting, including

- Results of Review Panel comments on the overall Thermochemical Conversion Platform
- The Biomass Program Thermochemical Conversion Platform Technology Manager response to Review Panel comments and discussion of next steps for each project
- General results information processed from Review Panel comments on projects evaluated during the Platform Review
- Additional information, including the full compilation of Review Panel comments on projects evaluated during the Platform Review and Principal Investigator responses to reviewer evaluations for their projects, can be found in a compendium document.

PLATFORM OVERVIEW AND EVALUATION

Platform Overview

Thermochemical Conversion research and development (R&D) develops technology to convert biomass to fuels, chemicals, and power via thermal and chemical processes such as gasification, pyrolysis, and other catalytic conversion processes. Intermediate products include clean synthesis gas (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, chemical products, or high-purity hydrogen, or maybe even used directly for heat and power generation. Some of these products are direct substitutes for fossil-fuel-based intermediates and products and are compatible with existing fossil fuel processing and distribution infrastructure.

Based on the current stage of development of thermochemical conversion technologies, gasification provides potential for near-term deployment, while pyrolysis will help to meet longer-term biofuels goals and in providing a route to renewable gasoline, diesel, and jet fuel. Pyrolysis presents the additional benefit of leveraging investments in the petroleum industry, as its intermediate product of bio-oil can—after stabilization and upgrading—potentially be used as a petroleum refinery feedstock.

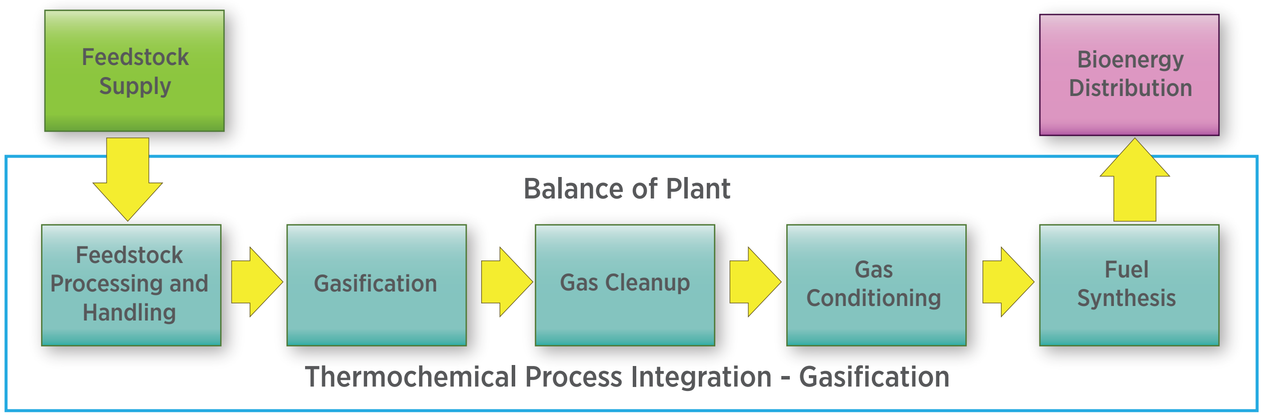
Thermochemical conversion technology options can maximize biomass resource utilization to produce biofuels because they can more easily convert low-carbohydrate biomass materials, such as forest and wood resources, than the biochemical conversion options. In addition, they can convert the lignin-rich non-fermentable residues from biochemical conversion processes. Advanced conversion technology scenarios rely on considerable liquid fuel yield per ton of biomass and enable higher overall energy efficiencies by allowing integration of high-efficiency heat and power production systems.

Thermochemical Conversion Unit Operations

(i) Gasification-to-Biofuels Conversion Process Description

A simple thermochemical gasification process flow for converting biomass to biofuels is shown in Figure 3. Process details for a gasification route to mixed alcohols are available in design reports.

Figure 3 | Thermochemical gasification route for biomass-to-biofuels thermochemical conversion



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. Maximizing gasification system efficiencies thus requires 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 feedstock. 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, 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-derived synthesis 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).

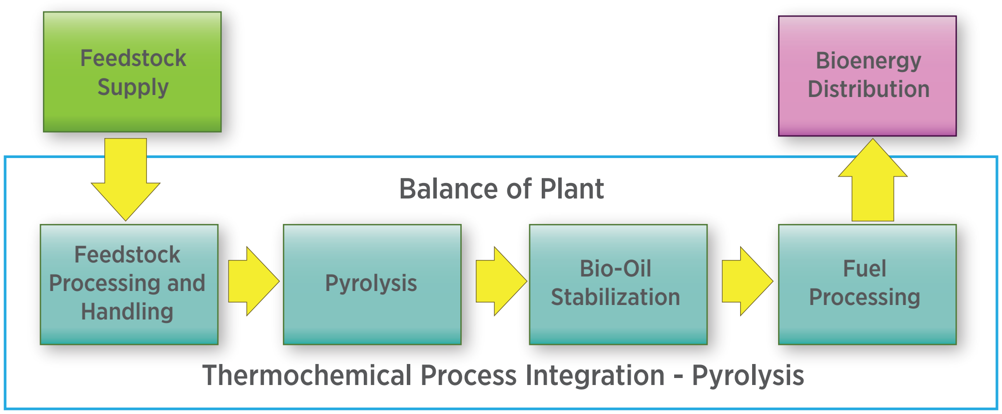
Fuel Synthesis: The cleaned and conditioned synthesis gas composed of carbon monoxide and hydrogen in a given ratio can be converted to mixed alcohols or Fischer-Tropsch hydrocarbons. The production of fungible liquid transportation fuels from these intermediates also yields value- added bio-based byproducts and chemicals. Since the fuel synthesis step is exothermic, heat recovery is essential to maximize the process efficiency.

Balance of Plant: This encompasses the entire site and its need for integrated and effective energy, heat, steam, and water usage. Pinch analysis is used to analyze the energy network of the process and optimize energy integration of the process. Cost reductions are attained through better usage of waste heat stream.

(ii) Pyrolysis and Biofuels Conversion Process Description

A simple pyrolysis process for converting biomass to renewable gasoline, jet fuel, or diesel is shown in Figure 4 below. Process details for the pyrolysis of wood chips and subsequent hydrotreating and hydrocracking to produce renewable gasoline, jet fuel, and diesel are available in a recent design report.

Figure 4 | Thermochemical pyrolysis route for biomass to biofuels



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, particle size, particle porosity, 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. Fast pyrolysis reactions occur at lower reaction temperatures than gasification and produce primarily liquid products together with some gases and bio-char. Several types of fast pyrolysis or hydrothermal processes can be used to produce bio-oils, and their characteristics such as oxygen content, water content, or viscosity depend on the processing conditions.

Bio-Oil Cleanup and Stabilization: Cleanup and stabilization of the bio-oil converts it into a liquid intermediate that can be stored for a minimum of six months. Cleanup consists of removing water, particulates, and ash by filtration and similar methods. Stabilization involves preliminary hydrotreating and similar thermal and catalytic processing to reduce the total oxygen content of the intermediate and its acid content in order to reduce reactivity.

Fuel Processing: Additional processing of the bio-oil is required to enable the bio-oil to become a feedstock suitable for use in a petroleum refinery at several entry points. Hydrocracking processes convert the feedstock to renewable gasoline, jet fuel, and diesel using modified technologies employed by existing refiners. This processing leverages the economies of scale and the investments of the petroleum industry and provides biofuel alternatives.

Balance of Plant: This encompasses the entire site, and significant contributions are derived from the hydrogen generation and air and water operation. Cost reductions are attained through more efficient hydrogen usage and better usage of power and water.

Thermochemical Conversion R&D Support of Program Performance Goals

Thermochemical Conversion R&D has two overall performance projections corresponding to the primary gasification and pyrolysis processing routes. Each process will reduce the estimated mature technology processing cost for converting cellulosic feedstocks to advanced biofuels:

By 2012, the gasification-to-ethanol process will achieve a conversion cost of $1.31 per gallon of ethanol ($1.95 per GGE, 2007 dollars).

By 2017, a biomass-based thermochemical route that produces gasoline and diesel blendstocks will achieve a conversion cost of $1.56 per gallon of total blendstock ($1.47 per GGE, 2007 dollars).

Feedstock pathway performance goals for the pathways under investigation are as follows:

- By 2012, [quarter 4 (Q4)], validate integrated conversion process to produce ethanol from syngas via gasification of woody feedstocks at a scale sufficient enough for transfer to pilot-scale operation.
- By 2015, (Q4), validate integrated conversion process for woody biomass to renewable gasoline or diesel via pyrolysis at a scale sufficient enough for transfer to pilot-scale operation.
- By 2017, (Q4), validate fully integrated conversion process for woody biomass to renewable gasoline or diesel via pyrolysis at a scale sufficient enough for transfer to pilot-scale operation.

RESULTS

Reviewers evaluated the Thermochemical Conversion Platform and scored projects on a scale of 1–10 for each applicable criterion, and they provided written comments on approved criteria. The Platform was reviewed on five criteria: Relevance (1–10), Approach (1–10), Progress (1–10), Overall Impressions (no score), and Additional Recommendations, Comments, and Observations (no score). The individual projects funded by the Platform were evaluated on six criteria: Project Approach (1-10), Technical Progress and Accomplishments (1–10), Project Relevance (1–10), Critical Success Factors (1-10), Technology Transfer and Collaborations: (no score), and Overall Impressions (no score). The two tables that follow present the Summary of Platform results and comment, as well as the detailed Project Scoring Summary information from the review of the individual projects.

The detailed scoring includes the work breakdown structure number (WBS); project reference information; recipient information; average scores and associated standard deviation information for each criterion; total average project score; and information on the projects percentile rank. Overall, total average project scores in the Thermochemical Conversion Platform ranged between 8.5 and 4.6, with a mean of 7.3. The presentation of the percentile rank shows the percentage of scores in the frequency distribution that are score exactly the same or less than the referenced project.

Results of Platform Evaluation

Evaluation Criteria	Average	Range	Std. Dev.
1. Relevance	9.0	-	4.87
2. Approach	8.7	-	3.54
3. Progress	8.5	-	3.55

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

Relevance (1-10)

Reviewer Comments
Reviewer 1 Criteria Score: 8 Very good integration of feedstock, sustainability with specific technical tasks. The work is planned and aligned with DOE priorities, the President, DOE, and Congress **Platform Response:** The Thermochemical Conversion Technology Manager thanks the Committee for their comments about the Platform's relevance within the Program. The Thermochemical Platform has evolved as a result of reviewer inputs from past review meeting, and will work to incorporate 2011 inputs to strengthen these activities in the future. TheTechnology Manager takes full responsibility for the Review Panel's scoring of the overall portfolio makeup and management.
Reviewer 2 Criteria Score: 8 The Thermochemical Conversion Platform goals are clearly defined in the Multi-Year Program Plan (MYPP) for ethanol via gasification pathway and gasoline/diesel via pyrolysis pathway. The targets are generally done on a consistent basis between the two pathways, with the assumptions documented. The Platform has developed projects that align with meeting the targets of the MYPP in each of the key processing areas. These projects are well balanced across these processing areas (i.e., there is no over concentration of projects in any one area). There are some projects that do not fit clearly into the two well-defined pathways, such as gasification with Fischer-Tropsch and hybrid thermochemical/biochemical routes. The MYPP goals and targets do not address these other than providing cost targets for the products. Additionally, there are some projects that have a significant renewable power generation portion. It is unclear how these fit into the portfolio, as the yields to fuels may not meet the targets.
Reviewer 3 Criteria Score: 10 Program effectively addresses the Platform goals/targets. Goals/targets are well-chosen.
Reviewer 4 Criteria Score: 9 Goals are clearly articulated and are in line with the policy goals. Goals are straight forward.
Reviewer 5 Criteria Score: 10 The relevance of the Thermochemical Conversion Platform was very well articulated, e.g., the four EERE strategic goals are directly addressed. I believe the Thermochemical Conversion Platform has correctly identified research areas that will increase the commercial viability of biofuels. I particularly liked the concept of replacing the entire barrel of oil (i.e., the inclusion of a broad spectrum of products and applications).
Reviewer 6 Criteria Score: 9

Platform Response

The Thermochemical Conversion Technology Manager thanks the Committee for their comments about the Platform's relevance. The Platform has evolved as a result of reviewer inputs from past review meetings, and we will work to incorporate 2011 inputs to strengthen these activities in the future. The Technology Manager takes full responsibility for the Review Panel's scoring of the overall portfolio makeup and management and will consider these comments and recommendations when considering future adjustments to the portfolio.

Approach (1–10)

Reviewer Comments
Reviewer 1 Criteria Score: 8 Integration and analysis is an important aspect of the Thermochemical Conversion Platform, and a continuing strength. There is a need to bring the non-DOE lab projects under the same level of TEA and life-cycle assessment evaluation.
Reviewer 2 Criteria Score: 9 The Thermochemical Conversion Platform is well organized covering the technology areas of the two major pathways of the Program (i.e., gasification and pyrolysis). All the processing technology areas of the two pathways have been funded and have multiple projects addressing these processing technology areas. Further, the projects are diverse in the technical approach to achieve the targets of the pathway. The Platform management has prioritized the funding of processing areas/unit operations with a sequential approach to processing order. For example, the solicitation on pyrolysis oil stabilization was initiated before the fuel processing to transportation fuels, which potentially allows the learnings from the stabilization projects to flow into the upgrading projects. One of the weaknesses of the Platform is that several of the projects lack a cost estimate and/or economic model. It is not always clear how technical success of a project will translate into an economic success. Not all projects have participants with the capability to produce a quality cost estimate/economic model nor is it expected. However, the Platform would benefit by either providing service (such as NREL) or tools for the individual projects to use to help perform this function.
Reviewer 4 Criteria Score: 9 The Platform is taking the whole process chain into account, which is really good. Two pathways are taken into account—pyrolysis and gasification. Each pathway has clear targets stated for the different process steps. Goals are put into numbers to have not just strategic goals, but real countable goals (economically driven) along a timeline. Therefore, the progress is easily measured and tracked.
Reviewer 5 Criteria Score: 9 There appears to be a good balance between pyrolysis and gasification, and the Biomass Program structure is very logical. But I do wonder if there also can/should be a place for “breakthrough” technologies. Perhaps this is better addressed by ARPA-E?
Reviewer 6 Criteria Score: 9

Platform Response

The reviewer comments on our approach are greatly appreciated. The Technology Manager agrees that integration and analysis is an important aspect of Thermochemical Platform and an area of continuing strength. DOE is working with the Golden Office staff to ensure that the non-DOE lab projects produce the same level of technoeconomic analysis (TEA) and life-cycle analysis (LCA) evaluation.

Progress (1-10)

Reviewer Comments
Reviewer 1 Criteria Score: 9 Over the past four years, there has been very impressive progress in creating a well-balanced Platform. There has been significant progress in the pyrolysis stabilization arena. The gasification clean-up has made less technical progress. This work needs more focus on testing with real syngas and longer time on-stream to really evaluate the stability of the catalysts.
Reviewer 2 Criteria Score: 7 Overall, the Platform is making progress on the targets within the MYPP. Individual projects have demonstrated meeting one or more of the targets. However, it is not clear how the Platform is making progress (i.e., understanding the state of progress against the MYPP of the collective projects). It would be helpful if the Platform developed some type of score card to document the state of technology against the goals. This would not only be a communication tool, but may help in identifying gaps, additional funding, and/or new projects. In the gasification pathway, the progress of tar reforming and fuels synthesis is unclear. For tar reforming, some of the projects have demonstrated meeting the technical targets of methane and benzene conversion. However, the capital and operating costs are uncertain due to catalyst life issues and process configurations. For the fuel synthesis, it does not appear that the technical targets (carbon conversion and selectivity to alcohols) are being met.
Reviewer 3 Criteria Score: 10 Program progress is adequate. My personal opinion is that the MYPP targets are overly optimistic, but it's better to have stretch goals, as long as shortfalls are expected.
Reviewer 4 Criteria Score: 8 Recommendations from the last review had to be taken into account for developing the Platform further on.
Reviewer 5 Criteria Score: 8 It is clear that the vast majority of the individual projects are well executed and are working successfully toward their goals. We will see within the next 1–2 years whether the overall Thermochemical Conversion Platform will fully achieve its goals. It is important to recognize that the problems being addressed are challenging and the major pilot projects within the portfolio are not yet completed. I am optimistic that we will see some very promising results.
Reviewer 6 Criteria Score: 9

Platform Response

The Platform agrees that the technical, economic, institutional, and social problems being addressed within the portfolio are challenging, and the major pilot projects funded by the Platform are not yet completed. Despite these concerns, progress is being made, and we are confident that the Thermochemical Platform will be producing some very promising results in the near future.

The Platform will work with our lab, university, and industry partners to reduce the capital and operating costs of the Gasification Pathway. Further, we will seek to improve catalyst life issues and process configurations. The Technology Manager ensures that the fuel synthesis technical targets (CO carbon conversion and selectivity to alcohols) are being met and are appropriately reported.

In the future, the Platform will focus increased attention on testing with real syngas and longer time on-stream to evaluate the stability of the catalysts.

Overall Impressions

Reviewer Comments
Reviewer 1 There has been good progress with both Program management and a well-planned increase in the breadth of the Platform.
Reviewer 2 *Platform Strengths*: The Platform has a diverse collection of projects addressing all the major processing areas. Most of the projects are of high quality. Many of the projects have demonstrated making progress on targets or meeting those targets as outlined in the MYPP. The Platform has demonstrated adaptability by adding a significant number of projects to address biomass to hydrocarbons. *Platform Weaknesses*: It is unclear how the collection of projects is performing against the MYPP targets. At the Platform level, a progress scorecard should be developed and maintained. It is unclear how targets are set for projects outside of the well-defined gasification to ethanol pathway and pyrolysis to hydrocarbon pathway. All projects should be able to demonstrate how they contribute to the MYPP targets. Generally, all the projects have a methodology to clearly show progress on technical targets. However, several of the projects do not have a methodology to demonstrate progress on cost targets. The Platform should sponsor a service organization to support these projects with cost estimating and/or develop a cost estimating tool for the projects to use. *Platform Gaps*: There are few projects in the "New Conversion Process Alternatives." For example, hydrothermal liquefaction is one element of the NABC project, but no other projects are addressing this. With the biomass-to-hydrocarbon projects, the fuel product quality will become important. Not all hydrocarbons make good transportation fuels. The Platform may need to create projects in this area to understand the quality of the fuels and potential issues to the motor pool.
Reviewer 3
Reviewer 4 Well thought out Platform. Goals are clearly expressed and stated. The review event is very helpful for seeing the projects altogether and also for inter-comparisons.

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Reviewer Comments
Reviewer 5 The Thermochemical Conversion Platform is a clear, well-structured program. Paul is very knowledgeable about the Program, the projects/participants, and the way in which the Platform fits within the Program and EERE. I like the specificity of the cost reduction goals for the different technology options. Even if they are aggressive, it sets a good target to aim for. As the current round of projects works toward completion, I think that DOE staff should increase, to the greatest extent possible, information exchange between projects and also provide some guidance to ensure that results can be compared easily across projects, especially for the pilot projects (i.e., those going from solid biomass all the way to a finished fuel).
Reviewer 6

Platform Response

The Platform appreciates the comments received by the reviewers and agrees that the Platform has demonstrated adaptability by adding a significant number of projects to address biomass to hydrocarbons. The Platform will continue to make adjustments and adapt the portfolio to maintain its relevance and meet programmatic needs, as funding appropriations allow.

Additional Recommendations, Comments, and Observations

Reviewer Comments
Reviewer 1 There are still a number of the earmark projects that have no real measures of progress. They should be required to provide data for TEA, and measurable performance targets.
Reviewer 2 The MYPP includes ethers, chemicals, hydrogen, heat, and power as potential products from thermochemical processes. However, the current slate of projects addresses these as byproducts with no MYPP targets associated with these products. The Thermochemical Platform should address these products to fulfill the MYPP.
Reviewer 3
Reviewer 4 I formulated most of my comments and recommendations within the Review Panel discussion at the last day of the meeting. I will just concentrate on a few additional comments here. Exchange with the Feedstock Platform has to be guaranteed because the feedstock has a great influence on the costs, the used technology, environmental issues, etc. For international collaborations, like the program in U.S.-European Union or U.S.-China, it might be helpful to start with a screening of foreign biomass programs for having a good match of both countries' interests. This might also give a certain "political" hold, which is especially necessary regarding the funding. In all of these collaborations, it is clear to me that within this review, the benefit for the United States should be clearly shown; however, I would like to see more mutual benefits for both countries. How fast can the Platform(s) react to new political goals? How flexible is the Platform in terms of following new political directions? To me, the analysis projects should form a base for all the experimental projects within this conversion route. They are doing good work; however, the use of these results within the experimental projects is not always clearly visible for me. Perhaps the benefit of the analysis work could be increased by a more frequent communication between the experimental and analysis side. Another suggestion would be to get more suggestions from the experimental side what they really need as data for optimizing their processes. To the review meeting: It would be desirable that the principal investigators have a time slot where they can better interact. So far, they came more or less just for having their presentation, but there is no real possibility, like a side event, to exchange new ideas or discuss results. It might also be worth to get more interaction with the Feedstock Platform because the feedstock is part of the process chain.
Reviewer 5 In addition to the specific comments above, I would like to add the following more general ones: The Biomass Program is the main EERE program that is working directly on reducing petroleum consumption by providing alternatives in the form of advanced biofuels. As important as all of EERE's work is, this focus on petroleum displacement remains a strategic imperative. The Thermochemical Conversion Platform has made good progress on a range of important barriers preventing the commercialization of a several advanced liquid biofuels. As the current Platform's portfolio of projects works toward completion, we will begin to see whether the pathways under development will be able to successfully produce finished fuels from biomass. Given the critical point that the Thermochemical Conversion Platform has reached, now would be the worst time to scale back funding. Commercial developers of advanced biofuels continue to struggle with commercialization, and the Thermochemical Conversion Platform is providing critical support to this emerging industry by tackling core technology barriers. Thus, I hope that as this Peer Review comes to its conclusion, that this issue of funding will figure prominently, and that the Thermochemical Platform will be adequately funded.

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Reviewer Comments
Reviewer 6 Paul did a good job setting the context for the review. The Platform has done a good job of responding to weaknesses identified in the 2007 review; specific examples were given. Achieved significant budget increase to meet added scope $20 million to $27 million, $30 million request.

Platform Response

The Platform appreciates the comments and recommendations recorded by the reviewers and agrees that funded projects should be required to provide data for TEA, and measurable performance targets. The Technology Manager will work with Golden Office to try to implement the gathering of this data.

Based upon appropriations, the Technology Manager will try to initiate R&D to address ethers, cchemicals, hydrogen, heat, and power as potential products to fulfill the MYPP. Tight interface with the Feedstock Platform will continue to ensure that feedstock cost and quality issues will have a great impact on the Thermochemical Conversion Platform and the conversion technologies needed, environmental issues, and other issues, including the final cost of biofuels.

The Technology Manager acknowledges that the Platform has reached a critical point, and now would not be the ideal time to scaleback funding. Provided that appropriations allow, the Platform will tackle core technology barriers and continue to provide critical support to this emerging industry and those commercial developers struggling to advance biofuels to commercialization.

Project Review

Project Scoring Summary Table

Reviewer Averaged Project Results

WBS	Project Name	Recipient; PI	Approach	Progress	Relevance	Critical Success Factors	Total Average Score	Percentile Rank %
			Average	Average	Average	Average		
3.1.2.1/2/3	Feed Improvement Task Feed Processing & Handling Task (INL)	INL & NREL; Richard Boardman	8.3	7.8	7.8	7.7	**7.9**	55%
3.1.2.4	Sustainability Interface	PNNL; Lesley Snowden-Swan	7.2	6.6	8.4	7.8	**7.5**	50%
3.6.1.3	Thermochemical Platform Analysis: Pyrolysis Route	PNNL; Lesley Snowden-Swan	8.2	8.3	8.5	7.2	**8.0**	81%
3.2.2.4/5	Pyrolysis Oil R&D - PNL	PNNL; Lesley Snowden-Swan	8.8	8.2	8.4	8.4	**8.5**	88%
3.2.2.16	Effects of Bio-Oil on Reactor and Tank Materials	ORNL; Jim Keiser	7.0	7.6	8.0	6.4	**7.3**	29%
3.3.1.1	National Advanced Biofuels Consortium (NABC)	Alliance for Sustainable Energy, LLC; Tom Foust	8.3	8.0	8.8	7.8	**8.2**	78%
3.2.2.9	Catalytic Deoxygenation of Biomass Pyrolysis Vapors to Improve Bio-Oil Stability	Research Triangle Institute; Dave Dayton	7.4	6.2	8.2	6.8	**7.2**	20%

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WBS	Project Name	Recipient; PI	Approach	Progress	Relevance	Critical Success Factors	Total Average Score	Percentile Rank %
			Average	Average	Average	Average		
3.2.2.7	A low-cost high-yield process for the direct production of high energy density liquid fuel from biomass	Purdue University; Fabio Ribeiro	6.5	5.5	5.5	5.2	**5.7**	2%
3.2.2.10	Fast Pyrolysis Oil Stabilization: An Integrated Catalytic and Membrane Approach for Improved Bio-oils	University of Massacusetts, Amherst; George Huber	7.3	8.2	7.8	8.0	**7.8**	61%
3.2.2.11	Stabilization of Fast Pyrolysis Oils	Honeywell's UOP, LLC; Tim Brandvold	7.8	8.0	8.8	8.0	**8.1**	79%
3.2.2.12	Novel Fast Pyrolysis/Catalytic Technology for the Production of Stable Upgraded Liquids	Virginia Polytechnic Institute & State University; Foster Agblevor	6.0	7.4	8.2	7.0	**7.2**	35%
3.2.2.13	A Systems Approach to Bio-Oil Stabilization	Iowa State University; Robert Brown	8.0	8.8	8.7	8.0	**8.4**	88%
3.2.2.17	Advanced Biomass to Gasoline Process	Excelus, Inc; Mitrajit Mukherjee	4.3	4.7	5.5	3.8	**4.6**	0%
3.6.1.1	Thermochemical Platform Analysis: Gasification Route	NREL; Abhijit Dutta	8.7	8.5	8.7	8.3	**8.5**	90%
3.2.1.1/3	Gasification Process Optimization and Modeling	NREL; Mark Nimlos	8.5	8.2	7.7	7.3	**7.9**	68%

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WBS	Project Name	Recipient; PI	Approach	Progress	Relevance	Critical Success Factors	Total Average Score	Percentile Rank %
			Average	Average	Average	Average		
3.2.5.6/8	Catalyst Fundamentals Integration	NREL; Kim Magrini	8.8	8.7	8.5	8.2	**8.5**	91%
3.2.5.9	Novel Approach for Biomass Syngas Cleaning and Conditioning for Liquid Fuel Synthesis Applications	Emery Energy; Karl Libsch	6.3	5.8	6.3	5.5	**6.0**	5%
3.3.2.1/2	Advanced Thermochemcial Biofuels-formerly Syngas quality for fuel synthesis	NREL; Jessee Hensley	8.3	8.3	8.7	8.3	**8.4**	85%
3.2.5.5	Biomass Synthesis Gas to Liquid Fuels Evaluation	Gas Technology Institute; Larry Felix	7.0	7.3	7.7	7.0	**7.3**	32%
3.2.5.15	PNNL Range Fuels Catalyst Development	PNNL; Mike Lilga	8.5	8.2	8.0	7.3	**8.0**	70%
3.2.5.7	Integrated Gasification and Fuel Synthesis	NREL; Stephen Phillips	8.5	8.5	8.8	7.2	**8.3**	85%
3.2.5.12	Validation of the RTI Therminator Syngas Cleanup Technology in an Integrated Biomass Gasification/Fuel Synthesis Process	RTI; Dave Dayton	7.8	7.6	8.2	7.4	**7.8**	60%
3.2.5.11	Syngas to Synfuels Process Development Unit	Iowa State University; Robert Brown	7.7	7.8	8.2	8.2	**8.0**	70%
3.2.5.13	Pilot-Scale Demonstration of a Fully Integrated Commercial Processes for Converting Woody Biomass into Clean Biomass Diesel Fuel	SRI; Steve Piccot	6.8	6.5	8.0	7.0	**7.1**	34%

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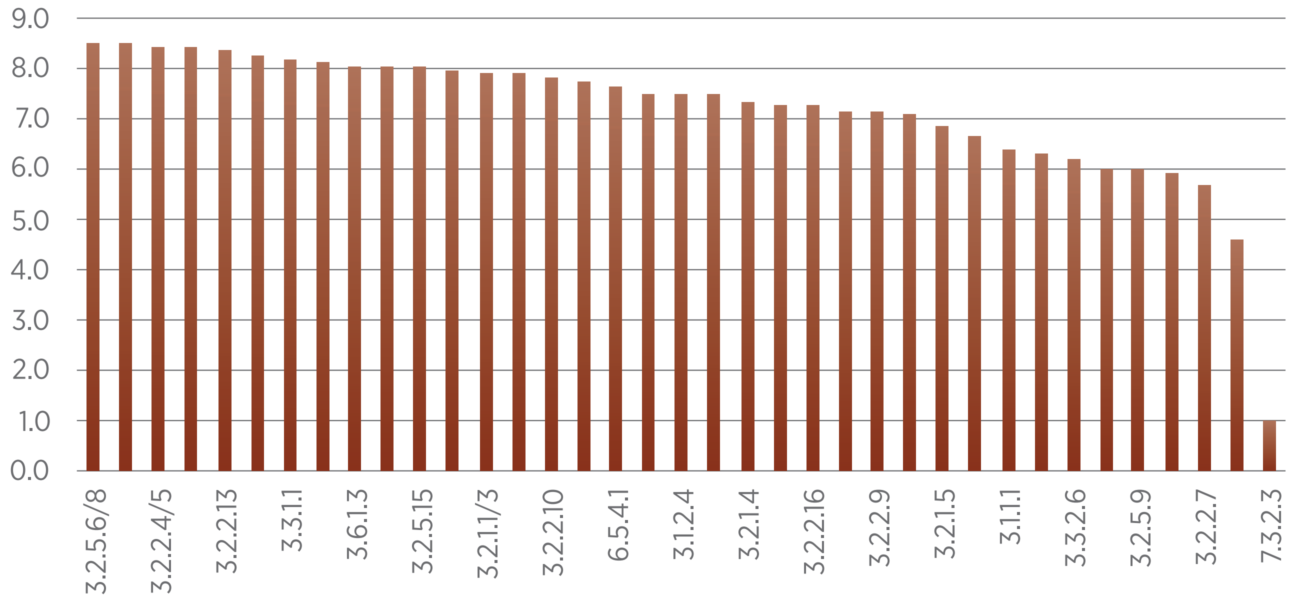
WBS	Project Name	Recipient; PI	Approach	Progress	Relevance	Critical Success Factors	Total Average Score	Percentile Rank %
			Average	Average	Average	Average		
6.5.2.2	Thermochemical Collaboration with China	PNNL; Jonathan Male	7.7	7.5	7.7	7.2	7.5	35%
6.5.4.1	Thermochemical Collaboration with EU - Finland and Sweden	NREL; Kristiina Iisa	8.0	7.5	7.5	7.5	7.6	41%
6.5.9.1	Thermochemical Collaboration with Canada	PNNL; Alan Zacher	8.3	8.0	8.2	7.5	8.0	67%
3.1.1.1	Evaluation of the Relative Merits of Herbacious and Woody Crops for Use in Tuneable Thermochemical Processing	Ceres; Bonnie Hames	6.7	6.8	5.8	6.2	6.4	55%
7.7.4.8	Mississippi State University Sustainable Energy Center (MS)	Mississippi State University; Michele Anderson	6.2	6.6	6.2	6.2	6.3	8%
7.7.2.9	University of North Dakota, Grand Forks, Center for Biomass Utilization	University of North Dakota, Grand Forks, Center for Biomass Utilization; Bruce Folkdahl	6.7	6.3	5.3	5.3	5.9	5%
3.3.2.6	Catalytic Production of Ethanol from Biomass-Derived Synthesis Gas	Iowa State University; Brian Trewyn	6.5	6.5	6.8	5.0	6.2	18%
3.2.2.8	Dual Layer Monolith ATR of Pyrolysis Oil for Distributed Synthesis Gas Production	Stevens Institute of Technology; Adeniyi Lawal	5.8	6.2	6.0	6.0	6.0	10%
7.3.4.1	University of Oklahoma Biofuels Refining (OK)	University of Oklahoma Biofuels Refining; Lance Lobban	7.2	7.8	7.3	7.5	7.5	44%

Project Rating Criteria for Reviewers

Project Scoring Chart



COMPENDIUM INFORMATION

1. Biomass Program MYPP: www.eere.energy.gov/biomass/pdfs/mypp_november_2011.pdf
   Thermochemical Platform: Page 74 (PDF)

2. Full Compilation of Reviewer Comments for the Thermochemical Platform
   Reviewer Comments are direct transcripts of commentary and material provided by the Platform's Review Panel. They have not been edited or altered by the Biomass Program.
   www.eere.energy.gov/biomass/pdfs/2011_thermochem_review_comments.pdf

3. Peer Review Portal Website Peer Review Page: http://obpreview2011.govtools.us
   Thermochemical Page: http://obpreview2011.govtools.us/thermochem/

ATTACHMENTS

1. Platform Review Meeting Agenda
2. List of Attendees
3. Biomass Program Review Steering Committee
4. Project Evaluation Form
5. Platform Evaluation Form

Thermochemical Conversion Platform Review Meeting Agenda

Time	WBS#	Project Title	Presenter/ Recipient	Performing Organization
Date: 2/16/2011				
WEDNESDAY MORNING AGENDA BRIEFING				
8:00 a.m. – 8:25 a.m.	0.0.0.4	Thermochemical Conversion Platform Overview (Presentation)	Technology Manager	U.S. Department of Energy Biomass Program
8:30 a.m. – 9:00 a.m.	3.1.2.1/2/3	Feed Improvement Task Feed Processing & Handling Task (Abstract, Presentation)	Richard Boardman	Idaho National Laboratory
9:00 a.m. – 9:30 a.m.	3.1.2.4	Sustainability Interface (Abstract, Presentation)	Lesley Snowden-Swan	Pacific Northwest National Laboratory
9:30 a.m. – 10:00 a.m.	3.6.1.3	Thermochemical Platform Analysis: Pyrolysis Route (Abstract, Presentation)	Susanne Jones	Pacific Northwest National Laboratory
10:00 a.m. – 10:30 a.m.	3.2.2.4/5	Pyrolysis Oil Research & Development (Abstract, Presentation)	Douglas Elliott	Pacific Northwest National Laboratory
BREAK				
10:45 a.m. – 11:15 a.m.	3.2.2.16	Effects of Bio-Oil on Reactor and Tank Materials (Abstract, Presentation)	James Keiser	Oak Ridge National Laboratory
11:15 a.m. – 12:00 p.m.	3.3.1.1	National Advanced Biofuels Consortium (NABC) (Abstract, Presentation)	Thomas Foust	National Renewable Energy Laboratory
LUNCH				
WEDNESDAY AFTERNOON AGENDA BRIEFING				
1:00 p.m. – 1:30 p.m.	3.2.2.9	Catalytic Deoxygenation of Biomass Pyrolysis Vapors to Improve Bio-oil Stability (Abstract, Presentation)	David Dayton	RTI International
1:30 p.m. – 2:00 p.m.	3.2.2.7	A low-cost high-yield process for the Direct Production of High Energy Density Liquid Fuel from Biomass (Abstract, Presentation)	Fabio Ribeiro	Purdue University

CONTINUES ON NEXT PAGE

Time	WBS#	Project Title	Presenter/ Recipient	Performing Organization
2:00 p.m. – 2:30 p.m.	3.2.2.10	Fast Pyrolysis Oil Stabilization: An Integrated Catalytic and Membrane Approach for Improved Bio-Oils (Presentation)	George Huber	University of Massachusetts-Amherst
2:30 p.m. – 3:00 p.m.	3.2.2.11	Stabilization of Fast Pyrolysis Oils (Presentation)	Tim Brandvold	UOP-Honeywell
Date: 2/16/2011 (Location: Poster Session)				
3:00 p.m. – 6:00 p.m.	3.2.2.8	Dual Layer Monolith ATR of Pyrolysis Oil for Distributed Synthesis Gas Production (Presentation)	Adeniyi Lawal	Stevens Institute of Technology
3:00 p.m. – 6:00 p.m.	3.3.2.6	Catalytic Production of Ethanol from Biomass-Derived Synthesis Gas (Abstract, Presentation)	Brian Trewyn	Iowa State University
3:00 p.m. – 6:00 p.m.	7.3.4.1	University of Oklahoma Biofuels Refining (Abstract, Presentation)	Lance Lobban	University of Oklahoma
3:00 p.m. – 6:00 p.m.	7.7.2.9	University of North Dakota, Grand Forks, Center for Biomass Utilization	Bruce Folkedahl	University of North Dakota, Grand Forks, Center for Biomass Utilization
3:00 p.m. – 6:00 p.m.	7.7.4.8	Mississippi State University Sustainable Energy Center (Abstract, Presentation)	Michele Anderson	Mississippi State University
3:00 p.m. – 6:00 p.m.	3.2.1.4	Integrated Biomass Gasification with Catalytic Partial Oxidation for Selective Tar Conversion (Presentation)	Wei Wei	General Electric
3:00 p.m. – 6:00 p.m.	3.2.2.16	Feedstock Treatments for Thermal Reactors (Abstract, Presentation)	Shahab Sokhansanj	Oak Ridge National Lab
3:00 p.m. – 6:00 p.m.	3.2.1.5	Development of New Gasification Processes for Biomass Residues: Gasification Kinetics at Pressurized Conditions (Abstract, Presentation)	Pradeep Agrawal	Georgia Institute of Technology

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Time	WBS#	Project Title	Presenter/ Recipient	Performing Organization
3:00 p.m. – 6:00 p.m.	3.1.1.1	Evaluation of the Relative Merits of Herbaceous and Woody Crops for Use in Tunable Thermochemical Processing (Presentation)	Steve Bobzin	Ceres, Inc.
Date: 2/17/2011 (Location: Room 1)				
THURSDAY MORNING AGENDA BRIEFING				
8:05 a.m. – 8:30 a.m.	3.2.2.12	Novel Fast Pyrolysis/ Catalytic Technology for the Production of Stable Upgraded Liquids (Abstract, Presentation)	Foster Agblevor	Virginia Tech
8:30 a.m. – 9:00 a.m.	3.2.2.13	A Systems Approach to Bio-Oil Stabilization (Abstract, Presentation)	Robert Brown	Iowa State University
9:00 a.m. – 9:30 a.m.	3.2.2.17	Advanced Biomass to Gasoline Process (Abstract, Presentation)	Mitrajit Mukherjee	Exelus, Inc.
9:30 a.m. – 10:00 a.m.	3.6.1.1	Thermochemical Platform Analysis: Gasification Route (Abstract, Presentation)	Abhijit Dutta	National Renewable Energy Laboratory
BREAK				
10:15 a.m. – 10:45 a.m.	3.2.1.1/3	Gasification Process Modeling and Optimization (Abstract, Presentation)	Mark Nimlos	National Renewable Energy Laboratory
10:45 a.m. – 11:15 a.m.	3.2.5.6/8	Catalyst Fundamentals Integration (Abstract, Presentation)	Kim Magrini	National Renewable Energy Laboratory
11:15 a.m. – 11:45 a.m.	3.2.5.9	Novel Approach for Biomass Syngas Cleaning and Conditioning for Liquid Fuel Synthesis Applications (Abstract, Presentation)	Karl Libsch	Emery Energy
11:45 a.m. – 12:15 p.m.	3.3.2.1/2	Advanced Thermochemcial Biofuels—Formerly Syngas Quality for Fuel Synthesis (Abstract, Presentation)	Jesse Hensley	National Renewable Energy Laboratory
LUNCH				
THURSDAY AFTERNOON AGENDA BRIEFING				

CONTINUES ON NEXT PAGE

Time	WBS#	Project Title	Presenter/ Recipient	Performing Organization
1:30 p.m. – 2:00 p.m.	3.2.5.5	Biomass Synthesis Gas to Liquid Fuels Evaluation (Abstract, Presentation)	Larry Felix	Gas Technology Institute
2:00 p.m. – 2:30 p.m.	3.2.5.15	PNNL Range Fuels Catalyst Development (Abstract, Presentation)	Mike Lilga	Pacific Northwest National Laboratory
2:30 p.m. – 3:00 p.m.	3.2.5.7	Integrated Gasification and Fuel Synthesis (Abstract, Presentation)	Steven Phillips	National Renewable Energy Laboratory
3:00 p.m. – 3:30 p.m.	3.2.5.12	Validation of the RTI Therminator Syngas Cleanup Technology in an Integrated Biomass Gasification/ Fuel Synthesis Process (Abstract, Presentation)	David Dayton	RTI International
		BREAK		
3:45 p.m. – 4:15 p.m.	3.2.5.11	Syngas to Synfuels Process Development Unit (Abstract, Presentation)	Robert Brown	Iowa State University
4:15 p.m. – 4:45 p.m.	3.2.5.13	Pilot-Scale Demonstration of a Fully Integrated Commercial Processes for Converting Woody Biomass into Clean Biomass Diesel Fuel (Abstract, Presentation)	Stephen Piccot	Southern Research
Date: 2/18/2011 (Location: Room 1)				
		FRIDAY MORNING AGENDA BRIEFING		
8:30 a.m. – 8:50 a.m.	6.5.2.2	Thermochemical Collaboration with China (Abstract, Presentation)	Jonathan Male	Pacific Northwest National Laboratory
8:50 a.m. – 9:10 a.m.	6.5.4.1	Thermochemical Collaboration with EU – Finland and Sweden (Abstract, Presentation)	Kristiina Iisa	National Renewable Energy Laboratory
9:10 a.m. – 9:30 a.m.	6.5.9.1	Thermochemical Collaboration with Canada (Abstract, Presentation)	Alan Zacher	Pacific Northwest National Laboratory

List of Attendees

First Name	Last Name	Organization
Andy	Aden	National Renewable Energy Laboratory
Foster	Agblevor	Virginia Tech
Ajay	Agrawal	University of Alabama
Pradeep	Agrawal	Georgia Institute of Technology
Karl	Albrecht	Pacific Northwest National Laboratory
Michele	Anderson	Mississippi State University
Rodney	Andrews	University of Kentucky Biofuels Research Laboratory (KY)
Valdeir	Arantes	University of British Columbia
Andrew	Argo	National Renewable Energy Laboratory
Richard	Bain	National Renewable Energy Laboratory
Morgan	Beck	National Renewable Energy Laboratory
David	Belcher	Pecos Valley Biomass Cooperative
Mary	Biddy	National Renewable Energy Laboratory
Lindsay	Bixby	BCS, Incorporated
Richard	Boardman	Idaho National Laboratory
Steve	Bobzin	Ceres, Inc.
Jim	Brainard	National Renewable Energy Laboratory
Tim	Brandvold	UOP-Honeywell
Adam	Bratis	National Renewable Energy Laboratory
Craig	Brown	Weyerhauser
Robert	Brown	Iowa State University
Ron	Brown	Agenda 2020 Technology Alliance AF&PA
Dan	Burciaga	ThermoChem Recovery International, Inc.
Robert	Byrne	Flambeau River BioFuels, Inc.
Yan	Cao	Institute for Combustion Science, Western Kentucky University
John	Carpenter	RTI International
Singfoong	Cheah	National Renewable Energy Laboratory
Devicharan	Chidambaram	University of Nevada Reno
Mike	Cleary	National Renewable Energy Laboratory (National Bioenergy Center)
James	Condela	Pegasus Capital Advisors
Stefan	Czernik	National Renewable Energy Laboratory
Robert	Dagle	Pacific Northwest National Laboratory
K.C.	Das	University of Georgia
Mark	Davis	National Renewable Energy Laboratory

CONTINUES ON NEXT PAGE

First Name	Last Name	Organization
Ryan	Davis	National Renewable Energy Laboratory
Brian	Davison	Oak Ridge National Laboratory
David	Dayton	RTI International
Bob	Dergay	Standard Alcohol Company of America, Inc.
Brian	Duff	U.S. Department of Energy, Biomass Program
Abhijit	Dutta	National Renewable Energy Laboratory
Tim	Eggeman	ZeaChem Inc.
Douglas	Elliott	Pacific Northwest National Laboratory
Robert	Evans	RJ Evans & Associates, LLC
Peter	Evich	Van Scoyoc Associates
Calvin	Feik	National Renewable Energy Laboratory
Larry	Felix	Gas Technology Institute
Robert	Fireovid	U.S. Department of Agriculture
Daniel	Fishman	BCS, Incorporated
Christina	Florencio	Octaform Systems, Inc.
Bruce	Folkedahl	University of North Dakota, Grand Forks, Center for Biomass Utilization
Janice	Ford	U.S. Department of Energy, Golden Office
James	Foster	Archer Daniels Midland Company
Thomas	Foust	Alliance for Sustainable Energy, LLC
Ed	Frank	Argonne National Laboratory
Rick	French	National Renewable Energy Laboratory
James	Gaddy	Bioengineering Resources, Inc.
Santosh	Gangwal	Southern Research Institute
Mark	Gerber	Pacific Northwest National Laboratory
Cindy	Gerek	National Renewable Energy Laboratory
Josh	Gesick	National Renewable Energy Laboratory
Paul	Grabowski	U.S. Department of Energy, Biomass Program
Robin	Graham	Oak Ridge National Laboratory
Garold	Gresham	Idaho National Laboratory
Ashutosh	Gupta	Brookhaven National Laboratory
Andrew	Held	Virent
Jesse	Hensley	National Renewable Energy Laboratory
Sandra	Hermle	Swiss Federal Office of Energy
J. Richard	Hess	Idaho National Laboratory
Stacey	Hesterwerth	National Renewable Energy Laboratory
John	Holladay	Pacific Northwest National Laboratory
George	Huber	University of Massachusetts-Amherst

CONTINUES ON NEXT PAGE

First Name	Last Name	Organization
Kelly	Ibsen	Lynx Engineering
Kristiina	Lisa	National Renewable Energy Laboratory
Mark	Jones	The Dow Chemical Company
Sue	Jones	Pacific Northwest National Laboratory
Iva	Jovanovic	Pacific Northwest National Laboratory
Ryan	Katofsky	Navigant Consulting
James	Keiser	Oak Ridge National Laboratory
Steve	Kelley	North Carolina State University
George	Kervitsky	BCS, Incorporated
Melissa	Klembara	U.S. Department of Energy, Biomass Program
Richard	Knight	Gas Technology Institute
Curtis	Krause	Chevron
Paul	Larsen	Power Ecalene Fuels, Inc
Adeniyi	Lawal	Stevens Institute of Technology
Dan	Lehrburger	BCS, Incorporated
Dennis	Leppin	Gas Technology Institute
Karl	Libsch	Emery Energy
Mike	Lilga	Pacific Northwest National Laboratory
Alicia	Lindauer	U.S. Department of Energy, Biomass Program
Chris	Lindeman	CNJV
Lance	Lobban	University of Oklahoma
F Stephen	Lupton	UOP, LLC
Gina	Lynch	CNJV
Kim	Magrini	National Renewable Energy Laboratory
Jonathan	Male	Pacific Northwest National Laboratory
Borys	Mar	BCS, Incorporated
Terry	Marker	Gas Technology Institute
Scott	McQueen	ConocoPhillips
Josh	Messner	CNJV
Ferman	Milster	University of Iowa
Liz	Moore	U.S. Department of Energy, Golden Office
Laura	Morgan	Van Scoyoc Associates
Sheila	Moynihan	U.S. Department of Energy, Biomass Program
Evan	Mueller	CNJV
Mitrajit	Mukherjee	Exelus, Inc.
James	Nehlsen	Excelus, Inc.
Mark	Nimlos	National Renewable Energy Laboratory
Jose	Olivares	Los Alamos National Laboratories

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First Name	Last Name	Organization
Stephen	Paul	Trenton Fuel Works, LLC
Gene	Petersen	U.S. Department of Energy, Golden Office
Leslie	Pezzullo	U.S. Department of Energy, Biomass Program
Benjamin	Phillips	Emery Energy
Jessica	Phillips	CNJV
Steven	Phillips	National Renewable Energy Laboratory
Stephen	Piccot	Southern Research Institute
Albert	Ratner	The University of Iowa
Valerie	Reed	U.S. Department of Energy, Biomass Program
Fabio	Ribeiro	Purdue University
John	Scahill	Thermal Biofuels Consulting, LLC
Will	Schrode	CNJV
Dennis	Schuetzle	Renewable Energy Institute International
Amy	Schwab	National Renewable Energy Laboratory
Ed	Sennings	National Renewable Energy Laboratory
Christopher	Shaddix	Sandia National Labs
Victor	Shang Yi Lin	Iowa State University
Reyhaneh	Shenassa	Metso Power
Lisa	Siesennop	U.S. Department of Agriculture
Trevor	Smith	CNJV
Doug	Smith	Baker Commodities Inc.
Lesley	Snowden-Swan	Pacific Northwest National Laboratory
Shahabaddine	Sokhansanj	Oak Ridge National Laboratory
Philip	Steele	Mississippi State University
W. Glenn	Steele	Mississippi State University
Kara	Stephens	CNJV
Don	Stevens	Pacific Northwest National Laboratory
Michael	Talmadge	National Renewable Energy Laboratory
Eric	Tan	National Renewable Energy Laboratory
Ling	Tao	National Renewable Energy Laboratory
Brian	Trewyn	Iowa State University
Cynthia	Tyler	CNJV
Niels	Udengaard	Haldor Topsoe, Inc.
Nicholas	Vanderborgh	Gibbs Energy
Lorrie	Vorkink	Emery Energy
Steven	Wagner	Merrick Building Quality Solution
Wei	Wei	General Electric
Kevin	Whitty	University of Utah

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First Name	Last Name	Organization
Edward	Wolfrum	National Renewable Energy Laboratory
Steve	Xiao	Savannah River National Laboratory
Fei	Yu	Mississippi State University
Matthew	Yung	National Renewable Energy Laboratory
Alan	Zacher	Pacific Northwest National Laboratory
Steffen	Zahn	Air Products & Chemicals, Inc.
Lingzhi	Zhang	General Electric Global Research

Biomass Program Review Steering Committee

Reviewer Name	Role	Professional Title and Affiliation
Neal Gutterson, Ph.D.	Co-lead	President & CEO, Mendel Biotechnology, Inc.
Mark E. Jones, Ph.D.	Co-lead	Research Fellow, Dow Chemical Company
Elizabeth Marshall, Ph.D.	-	Staff, Economic Research Service, U.S. Department of Agriculture
Janet Hawkes, Ph.D.	-	Consultant, Biobusiness, Environmental Services, and Academic Administration
Roger C. Prince, Ph.D.	-	Scientist, Biomedical Sciences Division, ExxonMobil
Robert Miller, Ph.D.	-	Consultant, Retired Air Products & Chemicals

Thermochemical Project Evaluation

Using the following criteria, reviewers are asked to rate the project work presented in the context of the Program objectives, both numerically and with specific, concise comments to support each evaluation. **Please provide both strengths and weakness to support your score**.

Superior		Good		Satisfactory		Marginal		Unsatisfactory	
10	9	8	7	6	5	4	3	2	1
All aspects of the criteria are comprehensively addressed. There are significant strengths and no more than a few weaknesses that are easily correctable.		All aspects of the criteria are adequately addressed. There are significant strengths and some weaknesses. The significance of the strengths outweighs most aspects of the weaknesses.		Most aspects of the criteria are adequately addressed. There are strengths and weaknesses. The significance of the strengths slightly outweighs aspects of the weaknesses.		Some aspects of the criteria are **not** adequately addressed. There are strengths and significant weaknesses. The significance of the weaknesses outweighs most aspects of the strengths.		Most aspects of the criteria are **not** adequately addressed. There may be strengths, but there are significant weaknesses. The PI fails to demonstrate the project's capability to meet objectives.	

1. Project Approach (1–10):
Please evaluate the degree to which

a) The project performers have implemented technically sound research, development, and deployment approaches and demonstrated necessary results to meet their targets

b) The project performers have identified a project management plan that includes well-defined milestones and adequate methods for addressing potential risks.

2. Technical Progress and Accomplishments (1–10):
Please evaluate the degree to which the project has made progress in its objectives and stated project management plan and has met its objectives in achieving milestones and overcoming technical barriers

3. Project Relevance (1–10):
Please evaluate the degree to which

a) The project both identifies with and contributes to meeting the platform goals and objectives of the Biomass Program Multi-Year Program Plan

b) The project has considered applications of the expected outputs.

4. Critical Success Factors (1–10):
Please evaluate the degree to which

a) The project has identified critical factors (including technical, business, market, regulatory, and legal factors) that impact the potential technical and commercial success of the project

b) The project has presented adequate plans to recognize, address, and overcome these factors

c) The project has the opportunity to advance the state of technology and impact the viability of the commercial conversion processes through one or more of the following focus areas:

   i. Conversion Process Parameters

   ii. Environmental Sustainability/Process Parameters.

5. Technology Transfer and Collaborations: (no score)
Please comment on the degree to which the project adequately interfaces and coordinates with other institutions and projects to provide additional benefits to the Biomass Program, such as publications, awards, or others.

6. Overall Impressions
Please provide an overall evaluation of the project, including strengths, weaknesses, and any recommendations to the project approach and scope, as well as any other overall comments.

Platform Evaluation

1. Relevance (1–10):
Please evaluate the degree to which

a) Platform goals, technical targets, and barriers are clearly articulated and logical
b) Platform goals and planned activities support the goals and objectives outlined in the MYPP
c) Achieving Platform goals will increase the commercial viability of biofuels.

How could the Platform change to better support the Biomass Program goals?

2. Approach (1–10):
Please evaluate the degree to which

a) The Platform approaches are effective, as demonstrated by the extent to which Platform milestones and organization, project portfolio, and strategic directions facilitate reaching Program Performance Goals as outlined in the MYPP
b) The Platform portfolio is focused and balanced to achieve Biomass Program and Platform goals, as demonstrated by Work Breakdown Structure; unit operations; and pathway prioritization.

Please explain your score by commenting on the strengths and weakness evaluated.

What changes would increase the effectiveness of the Platform?

3. Progress (1–10):
Please evaluate the degree to which the Platform is progressing toward achieving Biomass Program and Platform goals, specifically in reference to meeting performance targets and the likelihood of achieving the goals presented.

Please provide recommendations for improvements for tracking progress.

4. Overall Impressions (no score):
Please provide an overall evaluation of the Platform, including strengths, weaknesses, and any gaps in the Platform portfolio.

5. Additional Recommendations, Comments, and Observations (no score):
Please provide any additional recommendations, comments, and observations you have about the Platform or the Platform portfolio.

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

DOE/EE-0660 • February 2012

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post-consumer waste.