

Biomass Program

OFFICE OF THE BIOMASS PROGRAM

PEER REVIEW FY 2004

NOVEMBER 18-19, 2003

Summary of Results



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Introduction

In 2002, the U.S. Department of Energy reorganized its biomass-related research programs within the Office of Energy Efficiency and Renewable Energy (EERE) to create a consolidated Office of the Biomass Program (OBP). Since that time OBP has integrated and restructured its research activities to more effectively address the major technical barriers that must be overcome to facilitate the development of biorefineries – plants producing fuels, chemicals, and materials from renewable biomass. These biorefineries will form the foundation for creating a new bioindustry, one of EERE’s primary goals. The new structure of the program also supports the important EERE goal of reducing U.S. dependence on imported oil.

From the restructuring of OBP research activities emerged five core activities:

- Feedstock Interface
- Sugar Platform
- Thermochemical Platform
- Products
- Integrated Biorefineries

Each of the core research areas has established technical goals and objectives to go along with an essential portfolio of research, development and demonstration (RD&D) activities. The scope of these activities, levels of funding, and the overall OBP strategies are outlined in several documents, including the OBP Multiyear Year Program Plan (MYPP), OBP Multiyear Technical Plan (MYTP), and OBP Annual Operating Plan (AOP). These documents represent the most accurate information pertaining to the OBP activities currently available.

As part of the path forward, the OBP commissioned a high-level, programmatic peer review of the newly designed RD&D structure and overall strategy by industrial experts in the field of bioenergy. The Biomass Peer Review was held on November 18-19th, 2003, at the Renaissance Hotel in Washington, D.C. This report summarizes the results of the peer review, as well as the process behind it.

Objectives of the FY 2004 Peer Review

The primary objectives of the FY 2004 Biomass Peer Review were to obtain expert opinion on 1) the goals and objectives of the program as currently designed, 2) given the direction and mix of the current portfolio, the feasibility for reaching those goals, 3) the appropriateness of the technical barriers being addressed, and 4) the adequacy of funding levels. The intention was to address these questions at the programmatic, rather than project level, and to obtain more of a “corporate-level” peer review that assessed overall RD&D strategies over the next 5 years.

In addition, it was hoped that through this Peer Review, OBP could gain an outside perspective on how well the RD&D structure would contribute to meeting the overall EERE goals of fostering a new bioindustry and reducing dependence on foreign oil. The information obtained from the Peer Review will be used by OBP management to make decisions about the focus and direction of future programmatic activities to better meet these goals and gain the most from Federal expenditures in biomass research.

Peer Review Design and Process

The Peer Review was designed to develop an external perspective on programmatic strategies, goals, and the scope of the portfolio. The review process successfully integrated consistent presentation materials, a well-rounded expert review panel, and a concise evaluation form to yield an effective and relatively comprehensive assessment of the program. The agenda (provided in Appendix A) was designed to optimize the delivery of information and provide adequate time for reviewer questions.

Presentation Design

To achieve the best possible results in the time frame allowed, the Review focused on presenting high-level information about the overall program and the major technical areas, rather than project-level details. Presentations were heard from the OBP Program Manager, DOE program area managers, national laboratory managers, and in some cases, individual project managers.

The OBP Program Manager kicked off the Peer Review by presenting information on the overall review process, the history of the office, overall program strategies (as embodied in the Multiyear Technical Plan), and decision-making processes (e.g., Stage Gate). This presentation provided the context for the remainder of presentations made by DOE and R&D program managers.

Following the overview, presentations were made for the five major R&D elements of the work breakdown structure (WBS) shown in the OBP Multiyear Technical Plan – Feedstock Interface; Sugar Platform; Thermochemical Platform; Products; and Integrated Biorefineries. For each major WBS category a presentation was made on program management (DOE staff), followed by overview presentations on each R&D sub-area (R&D managers).

To ensure consistency in the level and detail of information, presenters for each of the five major technical areas were given a template to follow in developing their presentations. Each presenter was allotted 15 minutes of delivery time. Presentations for platforms/major areas included information on:

- Broad description of area and scope of R&D
- Goals, objectives, and benefits, and how they support overall Program goals
- Management strategies
- Funding history for area
- Barriers being addressed
- Investments
- Where program is now (key accomplishments, issues, impediments)
- Where program is going (major milestones, planned accomplishments, solutions to impediments)
- Impacts of external program reviews

A slightly different template was followed for projects supported under the Integrated Biorefineries area, as these are very diverse, large projects, and in some cases, Congressionally-mandated. As such, it was anticipated that reviewers would benefit from more details to fully evaluate the Integrated Biorefineries category. The Integrated Biorefineries template provided additional information on partners, technical plan, and other project-level elements that were not included in the higher-level presentations given for the other major technical areas.

Time was allotted at the end of each presentation for a question and answer (Q&A) session. Q&A periods were designed to be approximately as long as the presentations. Reviewers were asked to

refrain from Q&A until all presenters within a WBS category gave their presentations. At that time, all presenters returned to the podium to field questions as a group. This significantly reduced redundancy in questions and provided the most effective use of the time allotted.

Additional Background Materials

In addition to oral presentations, written materials were provided to the reviewer two weeks prior to the Peer Review. These included the OBP MYPP, the MYTP, and a brief historical budget document. The MYPP is a strategic overview document giving a broad perspective of the program, its goals and R&D areas. The MYTP provides a more detailed view of specific technical barriers, objectives, and R&D. The MYTP includes budgets, milestones, technical descriptions, and partners involved in the individual R&D program areas. Providing written materials beforehand was critical to the success of the Peer Review because this gave reviewers additional time to review the multiyear plans, gain an overall perspective of the direction of the Program, and formulate questions.

In addition, reviewers were provided with evaluation sheets and instructions for completion of these forms two weeks prior to the meeting. A conference call was then held with the reviewers the week prior to the meeting to answer questions, clarify how the meeting would proceed, and gain some insights on the expected roles and responsibilities of the reviewers from the DOE perspective. At the meeting reviewers were provided with a notebook including all the pertinent forms, agenda, instructions, details for travel reimbursement, and other meeting materials.

Reviewer Selection

The process for nominating and identifying reviewers employed a committee of DOE and national laboratory managers. Nominees were obtained from both internal and external sources, and the committee selected the reviewers after a group discussion of the qualifications of each. Reviewer nominees included approximately 3-5 experts in each of the five major technical areas from the WBS.

Ten experts from the private sector agreed to serve on the Peer Review panel. These experts provided excellent technical coverage in all five of the major areas, with many having expertise in more than one area. The reviewers along with their affiliation are shown in Table 1, in alphabetical order.

Table 1. Peer Review Panel

Gerard Closset, Pulp & Paper Industry Consultant	Scott Richman, Sparks Company
Robert Dorsch, E.I. DuPont de Nemours & Company	Neal Richter, Chevron Texaco
David Glassner, Cargill Dow	Pat Smith, Dow Chemical Company
Warren Johnson, Dynamotive	Lyle Stephens, John Deere Technology Center
Parry Norling, E.I. DuPont de Nemours & Company	Charles Wyman, Dartmouth

Evaluation Process

OBP RD&D activities within the five core areas are diverse, and as many as 100 projects may be funded at any one time. To facilitate the review of the core RD&D areas within a reasonable time frame, a set of key questions was developed to coincide with the presentations planned for each of the five WBS areas.

The overarching question to be answered by the Peer Review was “*Are the MYTP and the portfolio on track to achieve OBP goals?*” With this in mind, the questions were formulated to help reviewers evaluate both the overall direction of the MYTP and individual program elements. These questions were directed at some very essential factors that would be important for evaluating the direction of the program and the potential to meet stated goals. Key evaluation concepts included:

- Goals and objectives
- Technical barriers being addressed
- Scope of R&D
- Investments
- Current status and accomplishments
- R&D path forward (milestones and planned accomplishments)
- Relevance to MYTP and EERE goals and objectives

The questions were grouped on reviewer evaluation forms along with evaluation criteria and provided to reviewers beforehand. To facilitate the review process and evaluation of various elements, the oral presentations were designed to provide information in the same order as the questions on the reviewer evaluation forms.

Reviewers were asked to record scores for each set of questions using a rating guide to help ensure consistency of scoring across programmatic areas and among reviewers. Reviewers were also asked to record written comments supporting the score. The evaluation sheets and the rating criteria instructions are provided in Appendix B.

Scoring Guide Used by Reviewers

- 4 **Excellent** overall.
- 3 **Good** overall; no major and only some minor weaknesses.
- 2 **Acceptable** overall; no major and some moderate weaknesses.
- 1 **Marginal** overall; one or more significant weaknesses that cast doubt on the merit of the program in this area.
- 0 **Unacceptable** overall; clearly little or no merit in this area.

To evaluate the overall direction of the MYTP, reviewers were provided with a separate evaluation sheet asking for comments and insights. Emphasis was placed on gaining a perspective of how well the MYTP supports the overall goals and objectives, whether they appeared achievable, and the relevance of the portfolio to meeting EERE goals for reducing dependence on imported oil and fostering the creation of a new bioindustry. This evaluation sheet is included in Appendix B.

Results of the Peer Review

Peer Review Panel Ratings and Comments

Most members of the Peer Review panel have a broad range of experience and were able to provide an evaluation of all five of the WBS areas. In a few cases, members of the Peer Review panel limited their comments to those areas where they had the most specialized expertise. The results presented here represent an aggregate of all results, without differentiating the comments of individual Peer Review panel members.

A summary of ratings received by each WBS area for each question is shown in Table 2. In general, all WBS areas received acceptable or better ratings for every question that was applicable.

Question	Feedstock Interface	Sugars	Thermo-Chemical	Products	Integrated Biorefineries
Does the area have clearly stated goals?	3.30	3.89	3.30	3.33	3.33
Does R&D platform support MYTP goals?	2.70	2.78	3.00	3.22	3.33
Do goals seem achievable?	2.10	3.13	2.50	2.78	3.00
Are technology barriers identified?	2.70	3.33	3.20	2.89	3.11
Is R&D addressing the right barriers to meet R&D and MYTP goals?	2.40	3.11	3.10	2.88	na
Is R&D/technology demonstration adequate to overcome barriers in the stated time frame?	2.10	2.78	2.60	2.50	2.88
Is R&D a good fit with MYTP goals and focus?	2.56	3.33	2.60	3.00	3.56
Is funding adequate to achieve plan in proposed time frame?	2.30	2.75	3.00	2.50	3.22
Is right level of resources being directed at appropriate areas?	2.38	2.38	2.89	2.38	na
Has R&D met schedules and milestones?	3.00	3.33	2.88	2.89	na
Are potential "showstoppers" identified and being addressed?	2.50	3.11	2.56	3.00	na
Are future milestones realistic in terms of time frames and budgets?	2.33	2.50	2.75	3.00	2.78
If milestones have not been met, is there a path forward to overcome impediments?	2.50	2.50	2.67	3.00	2.50
Do outcomes of technology demonstration feed into a feasible commercialization path?	na	na	na	na	2.75
Are planned demonstration/validation activities sufficient to achieve goals?	na	na	na	na	3.08
4 – excellent 3-good 2-acceptable 1-marginal 0-unacceptable					

The aggregated rating received by each WBS area (average for all questions) is shown in Figure 1. Most areas received a rating that approached the “good” rating or better. A discussion of the ratings and reviewer comments specific to the overall MYTP as well as individual WBS areas is provided in the next section. Condensed reviewer comments are provided in Appendix C.

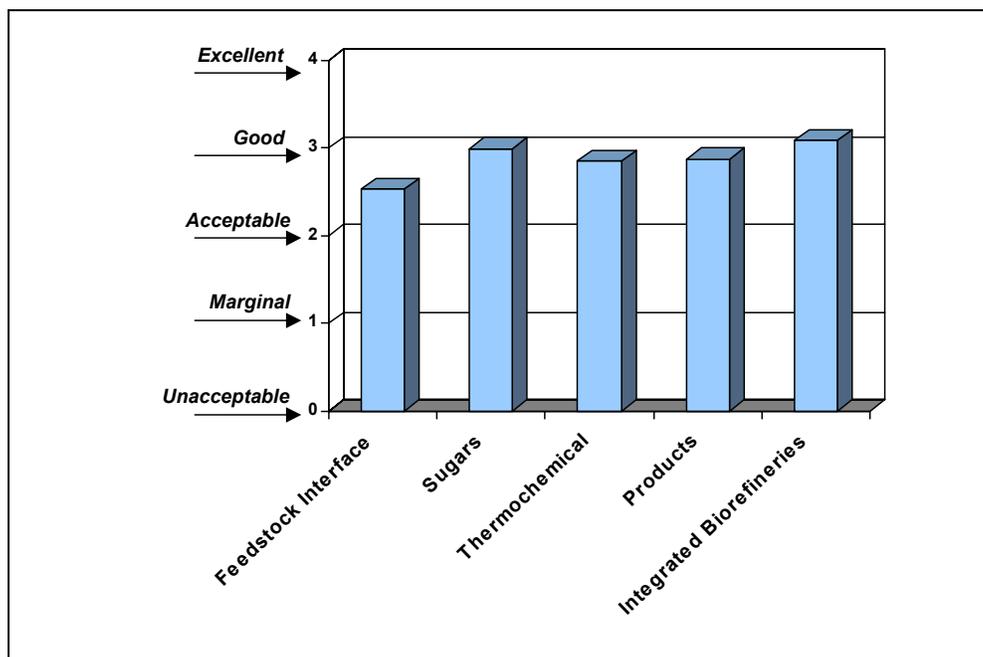


Figure 1. Average Reviewer Ratings for Individual WBS Areas

Overall Multiyear Technical Plan

Reviewers voiced a number of positive comments concerning the overall organization of the Biomass Program and the R&D portfolio. The reorganized program with key technical areas is easier to follow and understand than in the past. Reviewers felt tremendous progress had been made in designing the new structure and getting stakeholders on board with the programs. In terms of R&D management, reviewers felt that OBP’s use of the Stage Gate process and the current emphasis on analysis-based decision-making were necessary and valuable to the program.

A number of recommendations for change also emerged from reviewer evaluation of the overall direction of the MYTP. These include the following:

- The program should expand significantly into “Forestry Biorefineries” that utilize woody biomass, primarily because of the large existing feedstock infrastructure and the capability to take advantage of the existing capital resources already in place in the U.S. pulp and paper industry.
- Products R&D must be industry led; projects should involve significant industry participation in a leadership role. This ensures that R&D in the Products area is non-duplicative and valuable to industry.
- Broad stakeholder participation is needed in feedstock technology development for this area to achieve its goals. While R&D programs can be led by national laboratories, they will require the involvement of all constituencies to be successful. Conversion experts, for example, should be involved in harvest and storage activities. Collaboration is needed between producers, processors, the farm equipment industry, labs and universities.

-
- More emphasis should be placed on feedstocks and the right areas of feedstock research if cost goals are to be achieved. It was recognized that USDA has the lead in much of the feedstocks research.
 - Know your competition (fossil fuels), i.e., understand the current relative competitiveness of ethanol produced from biomass with fossil fuels.

Feedstock Interface

Reviewers voiced agreement with the value of the program's efforts on single-pass harvesting, and storage and collection activities, although they felt these could be expanded. The reviewers also indicated that the collection and coordination of "public" resource assessment data was important and valuable to the overall goals of the program.

Concerns were raised as to whether the stated cost goals for feedstocks could be achieved given the resources currently being applied to this area. Overall, the reviewers felt planned funds were inadequate for meeting the goals of the program. In addition, the issues of sustainability and "rural sociology" need to be considered along with economics and feedstock production.

Reviewers recommended some specific changes be made to the Feedstock Interface area, including:

- Expand the scope of research to include woody biomass feedstocks, along with other mixed solid wastes, as the collection and transportation infrastructure already exists and the feedstock resource is considerable.
- Pursue "creative" approaches to reduce the cost of storage, handling and transportation of biomass.
- Engage a consortia of stakeholders (lead labs, conversion labs, universities, conversion industry, producers, equipment manufacturers) to more effectively address feedstock barriers.
- Engage necessary partners to avoid stove-piping of R&D areas (e.g., involve conversion experts in storage research).

Sugar Platform

The high value of the enzyme work currently being undertaken was reinforced by positive reviews. Reviewers agreed that low cost enzymes would be critical to cost-effective conversion of feeds to sugars. The focus on fundamentals such as pretreatment and enzyme hydrolysis was deemed to be a key element of the approach, and is funded appropriately.

Concerns were raised about over-representing the accuracy of cost information (+/- 10% not real) as the "true cost" of sugars or ethanol. If costs are going to guide research and spur commercial development, then costs need to be better defined in terms of technology represented, state of development, source of data, and so forth.

Reviewers recommended some specific changes be made to the Sugar platform portfolio, including:

- Place more focus on "separations" technology (biomass fractions, not SLS)
- Efforts should be undertaken to link molecular modeling to a "test-able, relevant" experiment to verify the validity of the model
- More aggressive "breakthrough" R&D should be funded

Thermochemical Platform

Reviewers made a number of positive comments about the thermochemical platform. The focus on producing clean intermediates was considered to be appropriate, and the work on tar formation and synthesis gas cleanup was deemed to be comprehensive and well-planned. Thermochemical platform

Reviewers expressed a need for a comparison of thermochemically-produced fuels with fuels from sugar and other sources. Overall, reviewers felt that potential “showstoppers” were less clear than in other areas, and that the challenges in this area, particularly the path to commercialization, might be greater than anticipated.

Reviewers recommended that specific changes be made to the thermochemical platform, including:

- Place more emphasis on approaches other than gasification, such as pyrolysis and “catalytic” pyrolysis
- Consider different pretreatment options
- Engender more industry involvement
- Apply thermochemical processes to lignin residues and other solids obtained as byproducts of cellulose and hemicellulose hydrolysis

Products

Reviewers agreed with the value chain approach being taken for products R&D, and felt that progress in the Products area will be essential to achieving MYTP goals. They agreed that it was important to identify fuels, chemicals and products of high value as targets, with a focus on intermediates to avoid competing with individual companies and their finished products.

Concerns were raised that government-funded research could be counter-productive to industry participation. Some goals were seen as being too close to industrial goals, and funding should be limited to areas where there is a clear societal benefit and where industry is unlikely to carry out the R&D independently. One of the primary barriers will be ownership of intellectual property. Given industry reluctance to cost-share research, and concerns over intellectual property, some product research activities could be counterproductive or of limited value. A big question is whether technology push or market pull should define what products to pursue.

Changes to the Products area that were recommended by the reviewers included:

- Increase the focus on products from the thermochemical platform, not just sugar
- Products R&D should be lead by industry
- Coordinate products research with conversion platforms (sugar and thermochemical)
- Engage industry in “barriers” discussion to improve R&D focus
- Define role of government and labs (lab efforts may be counter-productive to industry participation)
- Use Life Cycle Assessment (LCA) as a criteria for identifying leading opportunities

Integrated Biorefineries

Reviewers felt that the Integrated Biorefineries area would be a large contributor to the overall goals and success of the MYTP. A good connection and leveraging with strong industrial partners has been established, facilitating the capability to deliver commercial results and foster a new bioindustry. The investments in the agricultural and food sectors appear adequate for achieving objectives in those sectors, although investments in forestry biorefineries were deemed to be insufficient.

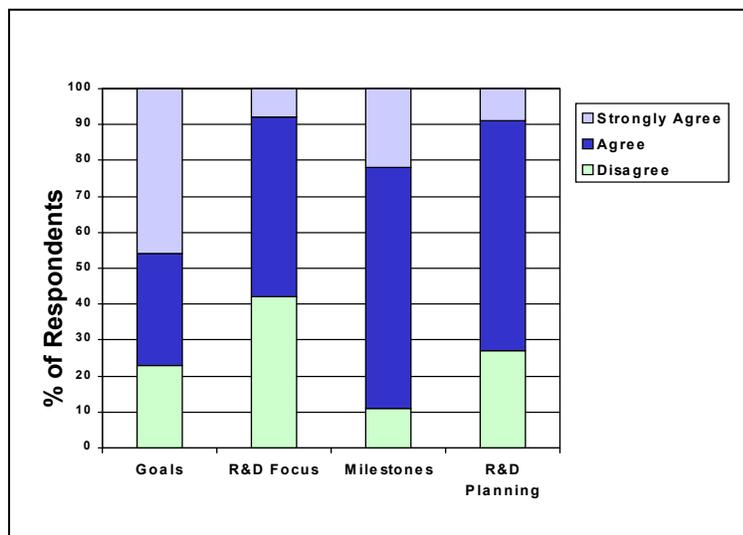
Concerns were voiced that rural investment and development (many Congressionally-mandated projects fall into this category) may be premature. A focus on rural development should follow only after science has been established behind the projects. Another concern was that goals set for demonstration of a biorefinery by 2007 might be too ambitious, but would depend on the size and complexity of the plant. In addition, the barriers as defined appeared to be more generic and applicable to engineering any novel manufacturing process. These need to be defined more specifically to the biorefinery. Perhaps most important, the success of the biorefinery will rely on the success of the feedstock and platform efforts.

Reviewers made a number of recommendations for changes that should be made to the Integrated Biorefineries area, including:

- Increase funding and emphasis on the Forest Biorefinery
- Reduce or cancel Congressional Mandates, as they don't contribute to OBP goals and reduce funding that could be applied to more valuable areas
- Include "agricultural products" and integrated animal/farm production as feedstocks for the biorefinery
- Translate financial and risk barriers into technical results
- Establish contingency plans in case goals are not met; assess the impacts of missing goals or significant delays in reaching goals

Audience Evaluation

The audience was comprised of participants from both the public and private sectors with an interest and in many cases, expertise in the field of bioenergy. To obtain additional insights on the MYTP and current portfolio, the audience was invited to participate in the Peer Review by completing a questionnaire with high-level questions concerning the overall mission and goals of the program, R&D planning and portfolio emphasis, milestones, and gaps in R&D. The audience was also asked to provide comments on the strengths and weaknesses of the program, and new approaches that might be taken to accelerate the development of a new bioindustry. For the first set of questions, the audience was asked to rank their responses according to an agree/disagree criteria. Some questions required only text responses. The questionnaire and criteria are included in Appendix D.



Responses from the audience were collated and the results are shown in Figure 2 for those questions based on agree/disagree criteria. Audience response for most of these questions indicated more than 50 percent agreed with what the direction of the program. Table 3 provides a summary of audience comments.

Figure 2 Audience Response to Selected Questions

Table 3 Summary of Audience Comments	
Question	Response
Program mission and goals are adequately defined and reflect present status of science, technology, and needs of emerging U.S. bioindustry.	Reorganization makes the program approach much clearer, more coherent; MYTP has right definition, similar effort is needed for USDA. Goals appear on target, but funding may be insufficient. Focus should be on commercially viable demonstrations and joint ventures with industry.
Identify gaps in R&D or possible additions to the R&D portfolio.	<ul style="list-style-type: none"> • Forestry feedstocks and forest biorefinery • New biocatalysts • Feedstock availability and cost • Fermentations of syngas • More emphasis on value-added products
Please suggest any new approaches the Program could pursue to accelerate the development of a new domestic bioindustry.	<ul style="list-style-type: none"> • Pursue nanobiotechnology • Engage in more long-range R&D innovations • Engage small businesses (new markets, grants) • Build partnerships that include industry, universities, federal and state governments • Adopt parallel approach for woody feedstocks
In your opinion, what are the major strengths and weaknesses of the program?	<p>Strengths:</p> <ul style="list-style-type: none"> • Excellent research lab system • Top scientists, well organized • Top 12 analysis for products • Targets for cost reductions • Biomass to liquid fuel <p>Weaknesses:</p> <ul style="list-style-type: none"> • Limited funding for R&D – no resources to explore new frontiers • Heavily earmarked for political rather than scientific merit • Not enough emphasis on small business • Limited emphasis on small modular, pretreatment • Focus on one-pass harvesting (too limited)

New Ideas and Lessons Learned

After post-meeting discussions, several ideas and “lessons learned” emerged that could improve the review process in the future.

Review Process and Meeting Design

- **The Ideal Portfolio** – As part of the reviewer evaluation process, ask panelists for a perspective on what their “ideal” portfolio would look like. This could consist of asking reviewers for comments on the whole program by posing the question “How would you spend your 100 monetary units?”
- **Reviewer Materials** – Panelists should be provide hard-copies of all presentations at the review meeting, rather than just having them available on-line or on a CD. Reviewers should also have access to the high-level results from Stage Gate reviews.
- **Conclusions** – A concluding session should be held at the end of the meeting to recap program strategies and objectives so these are fresh in the minds of reviewers.

Portfolio Management

- **Education Initiative** – Issue a biomass storage/transport “challenge” solicitation to facilitate research in this area. Reviewers indicated that more funding and effort was needed in this area.
- **Understanding of Plant Financing** – Meet with sources of departmental financing for first of a kind bioethanol plant to understand the finance requirements.

Appendix A

Agenda

FY04 BIOMASS PROGRAM REVIEW

Renaissance Washington DC Hotel
 999 9th Street, NW
 Washington, DC
 November 18-19, 2003

Agenda

NOVEMBER 18, 2003

7:30 – 8:00 am	Continental Breakfast	
8:00 – 8:15 am	Welcome and Introduction	D. Kaempf/DOE
	Framework of the Program Review	
	Instructions for Peer Reviewers	
8:15 – 9:45 am	OVERVIEW OF PROGRAM PLANNING AND MANAGEMENT	D. Kaempf/DOE
	<ul style="list-style-type: none"> • MYTP • AOP and MYAP Materials, Stage Gate 	
9:45 – 10:00 am	BREAK	
10:00 – 10:45 am	MYTP Questions and Discussion	
10:45 – 12:15 pm	FEEDSTOCK INTERFACE R&D	S. Tagore/DOE T. Foust/INEEL S. Sokhansanj/ORNL
	<ul style="list-style-type: none"> • Feedstock Interface Management • Emerging Feedstock Barrier R&D • Feedstock Supply Chain Analysis 	
12:15 – 1:00 pm	LUNCH (on your own)	
1:00 – 3:20 pm	SUGAR PLATFORM R&D	M. Ruth /NREL J. Jechura/ NREL S. Bower/NREL
	<ul style="list-style-type: none"> • Sugar Platform Management • Analysis • Pretreatment • Enzymes • Process Integration • Advanced Fractionation and Conversion 	
3:20 – 3:30 pm	BREAK	
3:30 – 5:30 pm	THERMOCHEMICAL PLATFORM RESEARCH	P. Grabowski/DOE P. Spath/NREL D. Stevens/PNNL R. Bain/NREL D. Cicero/NETL
	<ul style="list-style-type: none"> • Thermochemical Platform Management • Analysis • Thermochemical Conversion • Cleanup/Conditioning • Containment/Causticization 	
5:30 pm	Adjourn	

FY04 BIOMASS PROGRAM REVIEW

Renaissance Washington DC Hotel

999 9th Street

NW, Washington, DC

November 18-19, 2003

Agenda

NOVEMBER 19, 2003

7:30 – 8:00 am	Continental Breakfast	
8:00 – 8:10 am	Welcome and Overview of Day's Agenda	
8:10 – 10:00 am	PRODUCTS R&D <ul style="list-style-type: none"> • Products R&D Management • Current Status of Products R&D • Future Products – Chemicals and Materials • Future Products – Fuels and Energy 	D. Kaempf/DOE A. Manheim/DOE G. Petersen/NREL T. Werpy/PNNL S. Bower/NREL R. Bain/NREL
10:00 – 10:15 am	BREAK	
10:15 – 12:15 pm	INTEGRATED BIOREFINERIES <ul style="list-style-type: none"> • Integrated Biorefineries Management • Existing Sugar Biorefineries NCGA/ADM/PNNL Broin Cargill IN Corn Dry Mill – Iroquois Black Belt Bioenergy 	J. Spaeth/DOE R. Shunk/NCGA S. Lewis/Broin R. Zvosec/Cargill K. Gibson/Iroquois P. Orentas/Black Belt
12:15 – 1:15 pm	LUNCH (on your own)	
1:15 – 3:15 pm	INTEGRATED BIOREFINERIES (Continued) <ul style="list-style-type: none"> • Emerging Sugar Biorefineries Abengoa Dupont MBI Cargill Dow • Existing and Emerging Thermochemical Biorefineries Gridley Black Liquor (Big Island Demo) 	J. Spaeth/DOE Gerson Santos-Leon/ Abengoa Bob Dorsch/DuPont M. Stowers/MBI D. Glassner/Cargill-Dow T. Sanford/Gridley K. Morency/Big Island
3:15 – 3:30 pm	BREAK	
3:30 – 4:45 pm	<ul style="list-style-type: none"> • Existing and Emerging Thermochemical Biorefineries (Continued) Thermo-depolymerization projects (all) - CWT Sealaska Mississippi EtOH 	T. Adams/ Thermo- depolymerization F. Ferraro/Merrick & Co (for Sealaska) B. Prewitt/Mississippi EtOH
4:45 - 5:00 pm	Wrap Up, Next Steps, and Adjourn	D. Kaempf/DOE

Appendix B

Rating Sheet Instructions and Evaluation Questions

Rating Sheet Instructions

Please use the Rating Sheets to record scores for each set of questions. A rating guide is provided to help ensure consistency of scoring across projects and among reviewers. Based on the written materials provided beforehand, and information given in the oral presentation and Q&A, evaluate each R&D program area for each question on a scale of 0 to 4. Below the score for each area, please record written comments supporting your score. Attach additional sheets as necessary to provide a full and complete support for your score, and any additional comments or insights you can provide.

Scoring Guide

- 4 - **Excellent** overall.
- 3 - **Good** overall; no major and only some minor weaknesses.
- 2 - **Acceptable** overall; no major and some moderate weaknesses.
- 1 - **Marginal** overall; one or more significant weaknesses that cast doubt on the merit of the program in this area.
- 0 - **Unacceptable** overall; clearly little or no merit in this area.

Sample Rating Sheet

Feedstock Interface

Reviewer: _____

1. Goals and Objectives	SCORE (0-4)
<ul style="list-style-type: none">• Does the area have clearly stated goals?• Do the R&D platform/area goals adequately support the overall MYTP goals?• Do the goals seem achievable?	_____ _____ _____
<u>COMMENTS</u>	

2. Barriers	SCORE (0-4)
<ul style="list-style-type: none">• Are technology barriers identified?• Is the R&D program area addressing the right barriers to meet MYTP and R&D area goals (identify potential gaps)?• Is the R&D being conducted (or planned over the 5-year period) adequate to address and overcome the barriers in the stated time frame?	_____ _____ _____
<u>COMMENTS</u>	

3. Scope of R&D	SCORE (0-4)
<ul style="list-style-type: none">• Is the R&D or other activity a good fit with the focus and goals of the MYTP?	_____
<u>COMMENTS</u>	

4. Investments**SCORE (0-4)**

- Are the resources (funding) adequate to achieve the plan in the proposed time?
Is the right level of resources being directed at the appropriate areas?

_____COMMENTS**5. Current Status of the Program Area: Where are we now?****SCORE (0-4)**

- Has the R&D area met its prior schedules and planned accomplishments?
- Has the R&D area experienced significant “showstoppers” or impediments?

_____COMMENTS**6. Path Forward: What do we have to do to get there?****SCORE (0-4)**

- Are the major planned milestones realistic for meeting the goals of the R&D area, in terms of both time frame and budgets?
- If major milestones have not been met, is there an adequate proposed plan going forward to overcome the impediments, technical or otherwise?

_____COMMENTS**7. Improvements to the MYTP**

- What are the suggested additions/deletions to improve the portfolio (R&D, other activities) and MYTP, based on budget expenditures? (qualitative response below)

Overall Multiyear Technical Plan Comments

Please use this space (and attach additional sheets if necessary) to provide any comments, insights, or advice you may have regarding the composition of the Biomass Program's Multiyear Technical Plan, keeping the goals of the program in perspective (reducing dependence on imported oil, fostering the creation of a domestic bioindustry).

Appendix C

Condensed Reviewer Comments and Ratings

Table C-1. Condensed Reviewer Ratings and Comments: FEEDSTOCK INTERFACE

Question	Average Rating	Condensed Comments
<p>Goals and Objectives</p> <ul style="list-style-type: none"> • Does the area have clearly stated goals? • Does R&D platform support MYTP goals? • Do goals seem achievable? 	2.70	Focus on feedstock supply is appropriate; more emphasis should be placed on forestry feedstocks. Goal of \$30/ton may be optimistic for all feedstocks. Storage will continue to be an issue. Broader involvement of stakeholders is needed to reach goals.
<p>Barriers</p> <ul style="list-style-type: none"> • Are technology barriers identified? • Is R&D addressing the right barriers to meet R&D and MYTP goals? • Is R&D/technology demonstration adequate to overcome barriers in the stated time frame? 	2.40	Additional projects may be needed; USDA should collaborate to identify other barriers. Barriers to using forestry residues are not identified. Collection and storage need more emphasis. Resources may not be sufficient to address all barriers.
<p>Scope of R&D</p> <ul style="list-style-type: none"> • Is R&D a good fit with MYTP goals and focus? 	2.56	Sound approach in view of the limited resources. R&D should be broadened to include forestry resources. More creative strategies may be needed to meet cost goals.
<p>Investments</p> <ul style="list-style-type: none"> • Is funding adequate to achieve plan in proposed time frame? • Is right level of resources being directed at appropriate areas? 	2.34	Programs are under-funded; funding should be added for forestry residues. More funding should be applied toward residue collection, as well as harvesting, and storage.
<p>Current Status of the Program</p> <ul style="list-style-type: none"> • Has R&D met schedules and milestones? • Are potential "showstoppers" identified and being addressed? 	2.75	Good outcomes reported, but program is still in early phases with limited results. Sustaining soil productivity needs to be addressed.
<p>Path Forward</p> <ul style="list-style-type: none"> • Are future milestones realistic in terms of time frames and budgets? • If milestones have not been met, is there a path forward to overcome impediments? 	2.42	Need additional alternatives to storage and transportation. Forest products should be included in path forward. More creative approaches are needed to meet goals. Progress is good, but the current budget will be insufficient to meet goals.

Table C-2. Condensed Reviewer Ratings and Comments: SUGAR PLATFORM

Question	Average Rating	Condensed Comments
<p>Goals and Objectives</p> <ul style="list-style-type: none"> • Does the area have clearly stated goals? • Does R&D platform support MYTP goals? • Do goals seem achievable? 	3.27	Goals are clear and well-stated. Additional detail is needed on cost goals, as well as sensitivity analysis. Meeting goals is dependent on meeting feedstock cost goals.
<p>Barriers</p> <ul style="list-style-type: none"> • Are technology barriers identified? • Is R&D addressing the right barriers to meet R&D and MYTP goals? • Is R&D/technology demonstration adequate to overcome barriers in the stated time frame? 	3.07	Barriers are well-thought out. Need more focus on yield improvements. Limited resources make it difficult to focus on major barrier of recalcitrance. Enzymes are still a technical barrier; the enzyme cost reduction program is essential.
<p>Scope of R&D</p> <ul style="list-style-type: none"> • Is R&D a good fit with MYTP goals and focus? 	3.33	Scope is well-defined and R&D is addressing key issues. More focus should be placed on pilot and bench scale data to represent costs accurately. Sugar platform R&D is essential to overall program; should be structured to support integrated biorefineries.
<p>Investments</p> <ul style="list-style-type: none"> • Is funding adequate to achieve plan in proposed time frame? • Is right level of resources being directed at appropriate areas? 	2.57	Funding allocations appear appropriate, but programs are generally under-funded. Novel separations should be funded at greater levels. Congressional earmarks are diminishing effectiveness of program.
<p>Current Status of the Program</p> <ul style="list-style-type: none"> • Has R&D met schedules and milestones? • Are potential "showstoppers" identified and being addressed? 	3.22	Excellent outcomes, with industry involvement in enzymes and other areas. Process chemistry questions still need to be addressed. No showstoppers, but tough issues remain. Demonstration of integrated processing should be done sooner.
<p>Path Forward</p> <ul style="list-style-type: none"> • Are future milestones realistic in terms of time frames and budgets? • If milestones have not been met, is there a path forward to overcome impediments? 	2.50	Work with enzymes should continue. Pursue more aggressive R&D on leap-forward technologies to dramatically reduce costs. More understanding is needed on fundamentals to reduce costs. Develop plan for separation technologies.

Table C-3. Condensed Reviewer Ratings and Comments: THERMOCHEMICAL PLATFORM

Question	Average Rating	Condensed Comments
<p>Goals and Objectives</p> <ul style="list-style-type: none"> • Does the area have clearly stated goals? • Does R&D platform support MYTP goals? • Do goals seem achievable? 	2.90	<p>Platform is in an evolutionary mode; parts are close to commercialization (black liquor). Goals are based on feedstock cost, and sensitivity analysis should be done to refine goals. Focus on syngas for chemicals and materials is appropriate; mixed gases are familiar feedstocks. Goal for an industrial test in 2006 is optimistic given the risks.</p>
<p>Barriers</p> <ul style="list-style-type: none"> • Are technology barriers identified? • Is R&D addressing the right barriers to meet R&D and MYTP goals? • Is R&D/technology demonstration adequate to overcome barriers in the stated time frame? 	2.97	<p>Focus on clean up is appropriate. Barriers to high temperature gasification should be more explicit. Trace contaminants may be a bigger challenge than anticipated.</p>
<p>Scope of R&D</p> <ul style="list-style-type: none"> • Is R&D a good fit with MYTP goals and focus? 	2.60	<p>Gas cleanup/conditioning effort is excellent. Both high and low temperature gasification technology should be considered for black liquor. Catalytic pyrolysis should also be explored. A program for bio-oil is needed.</p>
<p>Investments</p> <ul style="list-style-type: none"> • Is funding adequate to achieve plan in proposed time frame? • Is right level of resources being directed at appropriate areas? 	2.95	<p>Some programs are under-funded, including mill integration issues, containment, and reaction kinetics of high temperature technology. More funding should go toward biomass pyrolysis.</p>
<p>Current Status of the Program</p> <ul style="list-style-type: none"> • Has R&D met schedules and milestones? • Are potential "showstoppers" identified and being addressed? 	2.72	<p>Impressive progress in gas cleanup and conditioning. Funding decrease for black liquor may limit progress toward forest biorefinery. Program is in transition and taking on new areas, so history is difficult to evaluate.</p>
<p>Path Forward</p> <ul style="list-style-type: none"> • Are future milestones realistic in terms of time frames and budgets? • If milestones have not been met, is there a path forward to overcome impediments? 	2.71	<p>Future strategy should include a path to the forest biorefinery. Good work has been done, but meeting future goals may be difficult given the challenges and funding.</p>

Table C-4. Condensed Reviewer Ratings and Comments: PRODUCTS

Question	Average Rating	Condensed Comments
<p>Goals and Objectives</p> <ul style="list-style-type: none"> • Does the area have clearly stated goals? • Does R&D platform support MYTP goals? • Do goals seem achievable? 	3.11	Complex area given the number of possible products. Goals appear achievable but could be more aggressive. Chemical targets should be ones that are difficult for industry to produce on their own. Developing products that increase economic viability of ethanol is important and appropriate.
<p>Barriers</p> <ul style="list-style-type: none"> • Are technology barriers identified? • Is R&D addressing the right barriers to meet R&D and MYTP goals? • Is R&D/technology demonstration adequate to overcome barriers in the stated time frame? 	2.76	Business process – value chain approach is excellent. Barriers are somewhat general due to multitude of possible products. IP will be a major barrier. Industry leadership is critical for overcoming barriers.
<p>Scope of R&D</p> <ul style="list-style-type: none"> • Is R&D a good fit with MYTP goals and focus? 	3.00	Products are essential to meeting goals of MYTP. Excellent effort to target products, strong emphasis on collaborating with industry. Legacy projects complicate the scope. Some overlap with sugar and thermochemical platform; should be streamlined. R&D should be limited to areas where industry is unlikely to carry out development on its own.
<p>Investments</p> <ul style="list-style-type: none"> • Is funding adequate to achieve plan in proposed time frame? • Is right level of resources being directed at appropriate areas? 	2.44	Balance between sugars, syngas and others should be driven by industry interest. Greater industry funding would be desirable. Congressional earmarks detract from the overall program.
<p>Current Status of the Program</p> <ul style="list-style-type: none"> • Has R&D met schedules and milestones? • Are potential "showstoppers" identified and being addressed? 	2.95	Although program is new, excellent progress in meeting milestones. Implementing value chain analysis is a good approach.
<p>Path Forward</p> <ul style="list-style-type: none"> • Are future milestones realistic in terms of time frames and budgets? • If milestones have not been met, is there a path forward to overcome impediments? 	3.00	Additional competitive projects should be added to achieve objectives. Narrowing of scope will allow a clear path forward.

Table C-5. Condensed Reviewer Ratings and Comments: INTEGRATED BIOREFINERIES

Question	Average Rating	Condensed Comments
Investments <ul style="list-style-type: none"> • Are resources (funding) adequate to achieve the plan in the proposed time? 	3.22	Funding levels are reasonable but may not yield a demonstration by 2007. Level of industry funding is encouraging. Funding is adequate for agricultural sector, but forestry is underfunded.
Goals and Objectives <ul style="list-style-type: none"> • Does the area have clearly stated goals? • Does project support MYTP goals? • Do goals seem achievable, given the technical plan? 	3.22	Overall, Congressional earmarks do not contribute to the goals or DOE objectives. Project goals in agriculture and food sector support MYTP goals; a goal for a forest biorefinery would add to the program. Competitively selected biorefinery project offers most potential for meeting goals.
Barriers <ul style="list-style-type: none"> • Are technology barriers identified? • Is the technology demonstration being conducted (or planned) adequate to address/overcome barriers? 	3.00	Technology barriers are well-identified. Need to translate financial and risk barriers into technical results.
Scope of R&D <ul style="list-style-type: none"> • Is R&D a good fit with MYTP goals and focus? 	3.56	This part of the program will contribute the most to MYTP goals – it is the heart of the biomass effort. Scoped well, except for earmarks, although a few were a good fit. More effort is need in the forest biorefinery area.
Milestones and Accomplishments <ul style="list-style-type: none"> • Are major milestones realistic for meeting goals, in terms of time frame and budgets? • If major milestones have not been met, is there a plan going forward to overcome impediments? 	2.64	Projects are in early stages; little history given on some.
Commercialization Path <ul style="list-style-type: none"> • Do the outcomes of technology demonstration feed into a feasible commercialization path? • Are planned demonstrations sufficient to achieve goals? 	2.92	Good connection with strong commercial players capable of delivering good results. IP ownership should be navigated cautiously. Greater management/reporting on earmarks is recommended. Demonstrations are impressive in agriculture and food sectors but lacking in the forestry sector.

Appendix D

Audience Evaluation Form

**FY 2004 BIOMASS PEER REVIEW
- AUDIENCE EVALUATION FORM -**

Participant Name/Affiliation:	
Programmatic Area	
Overall Multiyear Technical Plan and Portfolio	
Feedstock Interface	
Sugar Platform	
Thermochemical Platform	
Products R&D	
Integrated Biorefineries	

*****IMPORTANT*****

Please check the area you are reviewing in the box at left. Circle the number that represents your views on the statements and questions posed and add your reasons and supporting comments

I. MISSION/GOALS

A. The Program's research mission and goals are adequately defined and reflect the present status of science, technology, and needs of the emerging U.S. bioindustry.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

B. Comments: _____

II. R&D PLANNING

A. Key research areas are receiving sufficient emphasis and will enable the achievement of program goals.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

B. The R&D milestones are realistic and achievable.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

C. DOE has performed the proper planning for the success of the program.

<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly Agree</i>
1	2	3	4	5

D. Identify gaps in R&D or possible additions to the R&D portfolio.

E. Comments

III. NEW APPROACHES

Please suggest any new approaches the Program could pursue to accelerate the development of a new domestic bioindustry.

IV. STRENGTHS/WEAKNESSES

In your opinion, what are the major strengths and weaknesses of the program?
