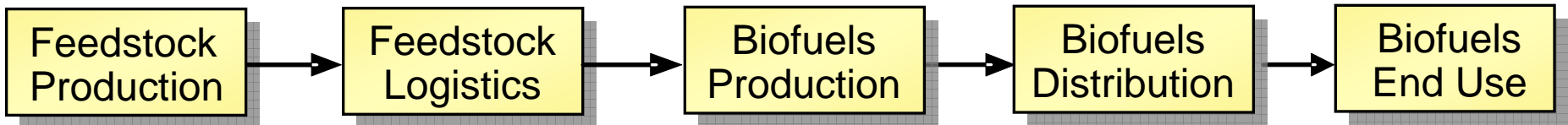


Biomass Program Activities

Technical Advisory Committee
November 27-28, 2007

Valri Lightner
Strategy and Planning

Strategic Focus: Biofuels



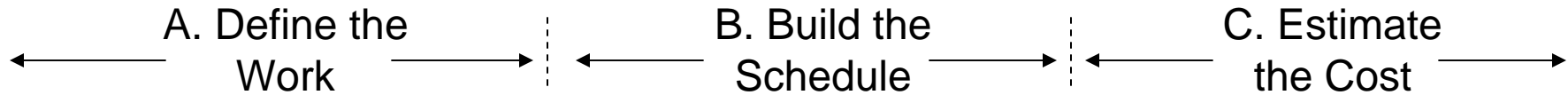
- **Cellulosic Ethanol:** Primary focus of the program.
- **Alternative Light-Duty and Diesel Replacement Fuels:** In addition to ethanol, alternative biofuels that require governmental support and can significantly contribute to achieving the President's goal may be developed. A scoping study is underway to help determine the priority for alternate fuels.

Strategic Planning

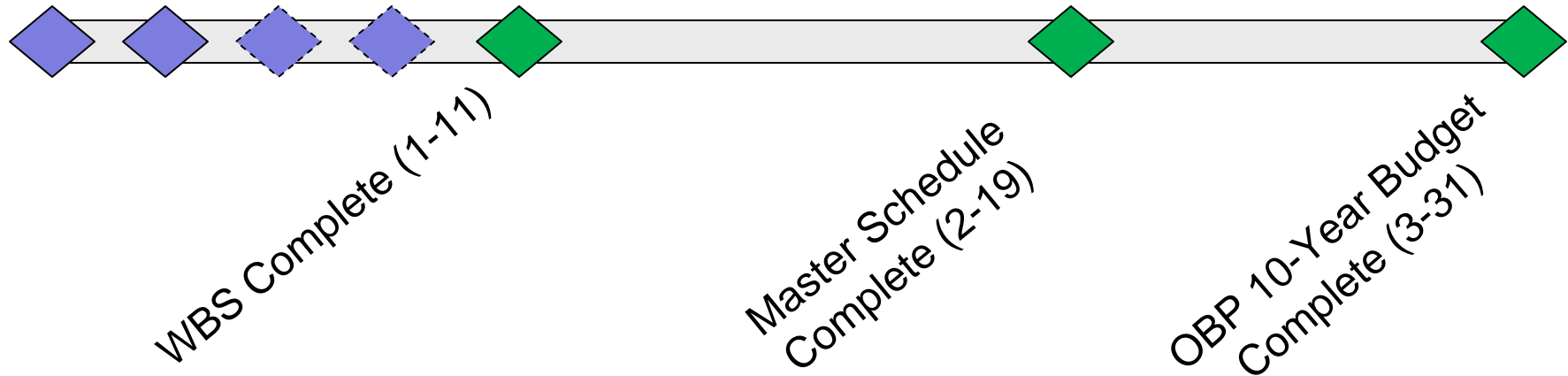


- The Biomass Program is undergoing a strategic planning process.
 - Focused on maximizing the contribution of biofuels towards the President's 20-in-10 goal
 - Defines the 10-year milestones, decision points and targets for governmental activities across the biofuels supply chain and estimates cost
 - 3-step process over 4 months

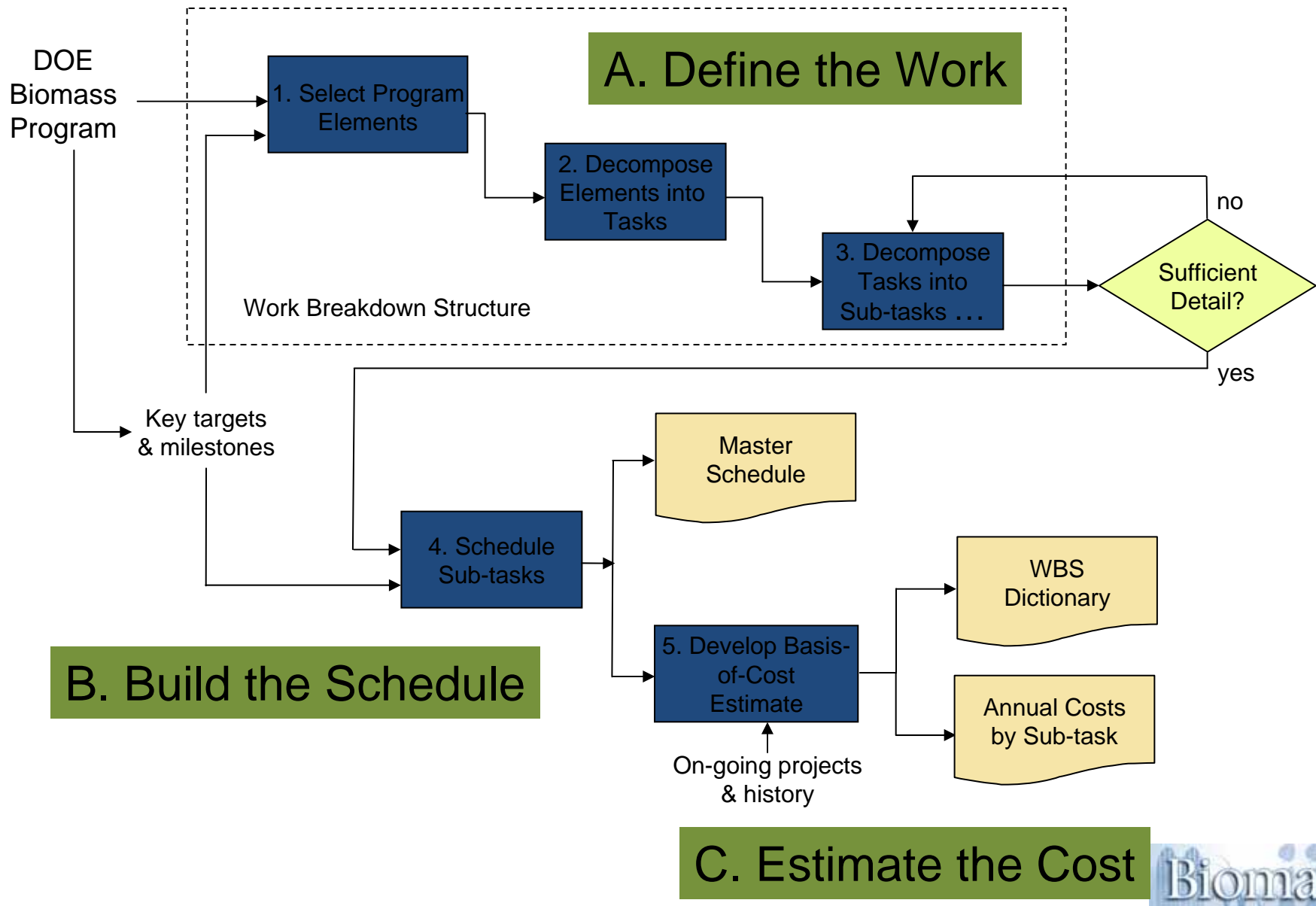
Timeline



Kickoff Meeting (11-07) Follow-Up Meetings (12-07 thru 1-11)



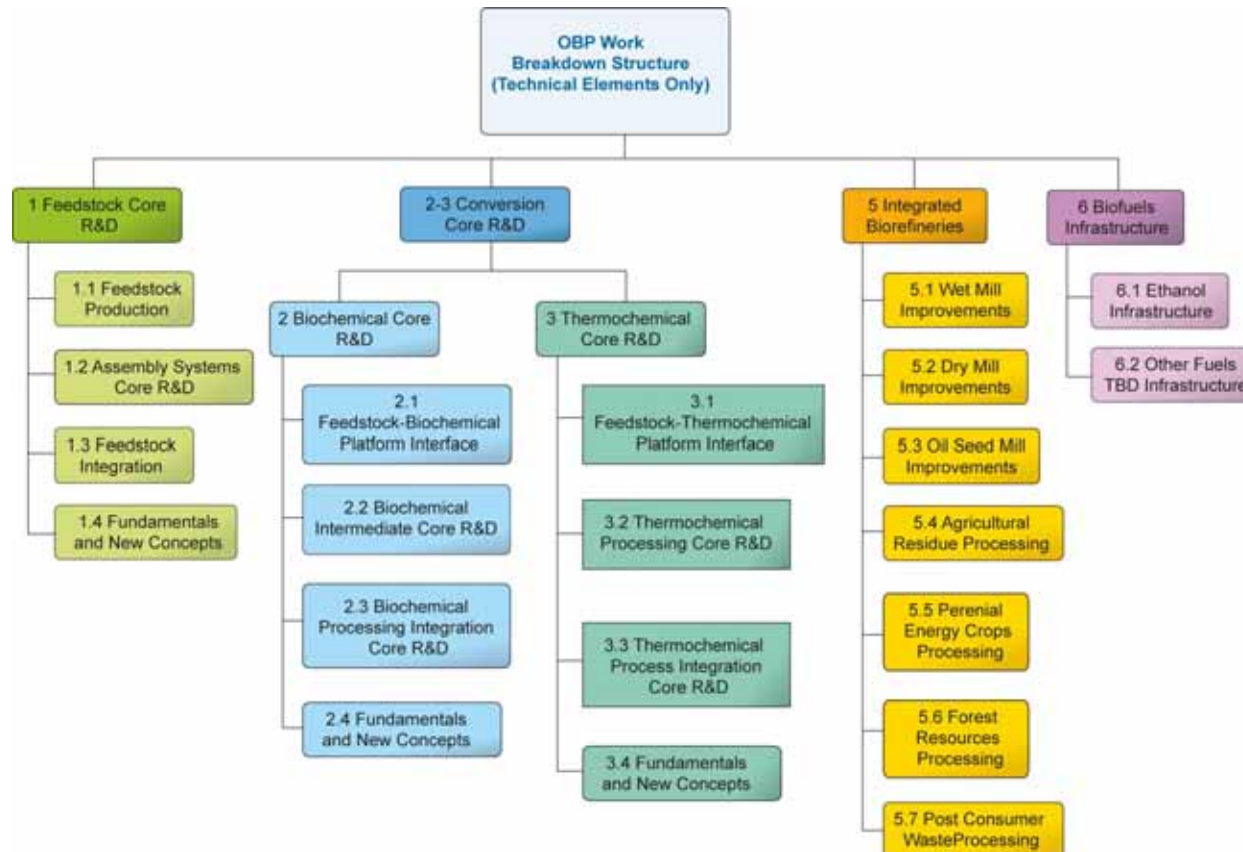
Three Key Planning Steps



A. Define the Work



- Decompose Program Elements Into Tasks
 - MYPP Work Breakdown Structure Provides the *Starting Point*



A. Define the Work



- Decompose Work into Subtasks
 - MYPP Task/Activity Tables Provide the *Starting Point*

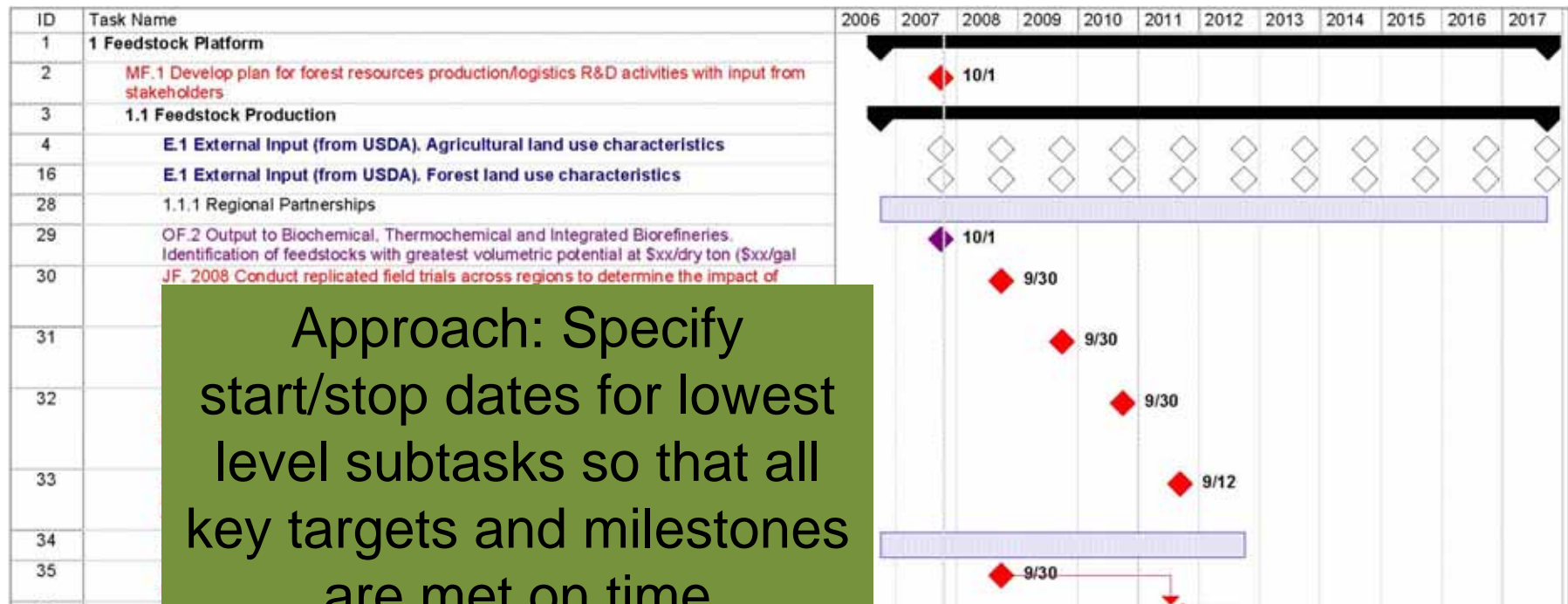
Platform WBS Element	Technical Area	Tasks	Projects/Agreements	Description	Barriers Addressed	Pathways Addressed	Goals (metrics)	Estimated FY08 Total	Basis of Estimate	Priority
2.1 Feedstock-Biochemical Platform Interface										
	2.1.1	<i>Feedstock Variability: Understanding feedstock variability and options for mitigating impacts on downstream processing</i>				ARP, ECP		\$		
	2.1.1.A	Characterize/optimize lignocellulosic biomass feedstocks				ARP, ECP		\$		
	2.1.1.B	Assess/mitigate impacts of biomass characteristics on downstream unit operations				ARP, ECP		\$		
	2.1.1.C	Determine process sensitivity to differences in feedstock type and quality				ARP, ECP		\$		
	2.1.1.D	Identify required process modifications to accommodate feedstock differences								
	2.1.1.E	Design and manipulate plant cell wall composition and structure to maximize yield of fermentable sugars								
	2.1.2	<i>Processing Interface: Defining and coordinating the interface between feedstock logistics and biochem</i>								
	2.1.2.A	Evaluate technology options and trade-offs with respect to feedstock assembly and preprocessing with biochemical conversion processes								
	2.1.2.B	Validate feedstocks as received from feedstock logistics systems at pilot scale								
	2.1.2.C	Continue efforts with new or emerging feedstocks								
2.2 Biochemical Intermediate Core R&D										
	2.2.1	<i>Pretreatment: Identifying cost-effective, feedstock-specific pretreatment options with respect to chem</i>								
	2.2.1.A	Evaluate and compare lignocellulosic biomass pretreatment options (chemistry, reactor design and pretreatment process) with respect to hemicellulose conversion, cellulose digestibility and ethanol production.				ARP, ECP		\$		
	2.2.1.B	Select and further develop most promising pretreatment options				ARP, ECP		\$		
	2.2.1.C	Validate targeted performance in pilot- scale pretreatment reactor systems				ARP, ECP		\$		
	2.2.1.D	Map structures and chemistries of native and prehydrolyzed plant cell walls to better understand cell wall deconstruction				ARP, ECP		\$		

Approach: Breakdown the scope of work to the point where the *cost of the work can be straightforwardly estimated*



B. Build the Schedule

- Schedule Tasks and Subtasks
 - MYPP Platform Gantt Charts Provide a *Starting Point*



C. Estimate the Cost



- Estimate annual funding requirement to accomplish each lowest level subtask through 2017
 - Approach: Use consistent cost estimating methodology across all platforms for example:
 - All dollar estimates will be in constant 2007 year \$
 - Assume \$250K per person-year (average across labs, industry, academia, different job types, etc.)
 - Include capital equipment cost estimates
 - Etc.

Strategic Planning



- The estimate of cost will be internal to DOE
- DOE will seek stakeholder input on the activities, milestones, decision points, likely as an update to the MYPP.

Peer Review



Why a Peer Review

- Transparent, non-biased evaluation of technical, scientific, and business aspects of the Program, project results, and management
- Opportunity for outside recommendations
- Results are published and used to guide future Program activities



Objectives

- Evaluate the Program's approach
- Will our structure accomplish the goals and objectives of the Program, EERE and DOE?
- Is the Portfolio balanced?
 - Right mix of R&D, demonstration, and deployment
 - Balance across the supply chain
- Have we identified the right technical and market barriers, and are they being appropriately addressed by the portfolio?



Peer Review Scope



- FY 2007 R&D Portfolio worth approximately \$196.3 M
 - Required to review 85% of Program spending
- Each Program platform has performed interim project reviews (results summarized in each platform session)
- Competitively awarded, congressionally directed, and program- managed projects active in FY 2007 were reviewed
 - Projects selected in FY2007 for award were not included
- Individual reviewer comments published in Final Peer Review Report, along with response from the Biomass Program



Peer Review Committee



- Ralph Cavalieri, Ph.D. Academia (Washington State University)
- Terry Jaffoni – Ethanol (Clean Transportation Fuels)
- Irvin Barash – Finance/Investment (Vencon Management, Inc.)
- Daniel Sonke, Ph.D. Environment (Protected Harvest)
- Todd Werpy, Ph.D. Products (ADM)



Peer Review Committee



Portfolio Element Lead Reviewers

Lyle Stevens – Feedstocks

Donald Johnson - Biochemical Conversion

Mark Jones – Thermochemical Conversion

Bill Cruickshank – Integrated Biorefineries

Mike Tumbleson – Integrated Biorefineries

David Terry – Distribution and End Use Infrastructure

Shaine Tyson – Biodiesel and Other Projects



Initial Feedback from the Review Panel



- Feedback Areas
 - Program Overview
 - Technology Platform-Level Input
 - Other Comments

Biomass Program



- Applaud the program's portfolio expansion to include alternative biofuels in addition to ethanol
 - Program should better define "transportation fuels", and use the standard definitions to set R&D priorities (Need to articulate why the fuel of choice is the priority.)
- Appreciate use of systems approach to decision making. Review panel encourages further use of analysis results to effect program changes and decisions. (tracking vs. managing)
- Resource allocation does not seem to mirror the needs of industry
 - Thermochemical is significantly underfunded
 - Feedstocks funding increase is applauded, but should continue to be increased.
- Reviewers recognize increased diversity of feedstocks in Program focus, and encourage linking between all platforms' feedstock work to maximize effort.

Biomass Program



- Environmental impacts and sustainability needs to have a higher priority (across the supply chain)
- Recommend increased communication of Program goals to earmark recipients
 - A coordinated workshop of the earmark recipients may help to reduce redundancy

Platform-Level



- Feedstock Logistics and Integration are instrumental pieces to the Program. Resources should be allocated accordingly.
- Biochemical Platform is well organized and focused correctly
- Conduct a critical review of the thermochemical conversion program – if the potential for fuel production exists – additional funding should be applied
 - How will the results of program success be used in terms of setting future direction (i.e., UOP – pyrolysis, syngas conversion)
- Applaud the creation of an infrastructure and end-use platform
- Middle distillate replacement potential needs to be quantified and evaluated to help define priorities of “diesel replacement”
 - Potentially include biodiesel in the end-use platform

General Comments



- The reviewers encourage the Program to review and implement the Reviewer Comments noted at the Platform Reviews.
- Would like to see more coordination in intra- & inter-agency relationships (i.e., USDA and DOE feedstock activities)
- The reviewers thought some of the presenters could have done a better job of relating their efforts to the program goals and conversion technologies discussion

DOE Has Announced \$1 Billion in FY2007 Supporting Biomass R&D



- Selections Announced
 - \$385 million establishing six biorefineries over the next four years - expected to produce more than 130 million gallons per year of cellulosic ethanol; first TIA in DOE history among 4 DOE agreements
 - \$23 million in federal funding for five projects focused on developing highly efficient fermentative organisms to convert biomass material to ethanol
- Solicitations Closed and Under Review
 - \$200 million to support the development of small-scale cellulosic biorefineries at ten percent of commercial scale that produce liquid transportation fuels such as ethanol, as well as bio-based chemicals and bioproducts
 - \$38 million in federal funding to develop the “next generation” of enzymes.
 - \$9 million in federal funding for thermochemical biofuels development, specifically integrated syngas cleanup and fuels synthesis.
 - \$14 million in USDA funding and \$4 million in DOE funding toward USDA/DOE Joint addressing research and development of biomass based products, bioenergy, biofuels and related processes.
- Supported Office of Science Solicitation and Selections
 - \$375 million awarded to three new Bioenergy Research Centers to accelerate basic research in the development of cellulosic ethanol and other biofuels

Strategic and Performance Goals



Biomass Program

Develop cost-competitive, high-performing biomass technologies to enable production of biofuels and reduce dependence on oil through the creation of a new domestic bioindustry supporting the President's goal to reduce gasoline use 20 percent by 2017.

Feedstocks

Develop technologies to sustainably provide a secure, reliable, and affordable cellulosic biomass supply for the U.S. bioindustry

Conversion R&D

Develop technologies to convert feedstocks into cost-competitive commodity liquid transportation fuels (such as ethanol) as well as products and power.

Integrated Biorefineries

Through public-private partnerships, demonstrate and validate integrated technologies to achieve commercially acceptable performance and cost targets.

Biofuels Infrastructure

Evaluate technologies to enable the market penetration of biofuels through robust distribution networks and vehicle applications.

Cross-cutting Market Transformation: Accelerate deployment and commercialization of cellulosic biofuels through a coordinated set of program and policy initiatives.

Integrated Biorefinery Performance Goals (2007\$):

- Validate the economic and systems performance assumptions supporting the n^{th} plant design modeled production cost of \$1.33 per gallon

Budget



Budget Area	FY06	FY07	FY08 Request
Utilization of Platform Outputs			
Integration of Biorefinery Technologies	\$14,975,000	\$103,301,000 ¹	\$92,103,000 ²
Products Development	\$7,940,000	\$32,195,000	\$10,000,000
SBIR/STTR			\$2,760,000
TOTAL	\$22,915,000	\$135,496,000	\$104,863,000

¹Includes first year funding for 932(d), and 10% demonstration projects

²Includes second year funding for 932(d), and 10% demonstration projects

NOTE: Total of up to \$385 million available for 932(d) and up to \$200 million for the 10% demonstrations over the next 4-5 years



Key Accomplishments



- **A Forward Focused Deployment Plan**
 - Utilized industry and financial inputs
 - Determined the steps needed for commercialization
 - Validation at demonstration scale
 - Developed a sustainable deployment plan
 - Aimed first at low hanging fruit
 - Allow early successes to spur future development
 - Developed a progressive solicitation path forward
 - 10 percent of scale solicitations
 - EPAAct 2005
 - The path forward was trumped and accelerated by EPAAct
 - 932(d) mandated a “commercial scale” demonstration solicitation

Key Accomplishments



- **932(d)**
 - Completed the largest and most comprehensive solicitation OBP has issued to date
 - Established new guidelines and criteria
 - A more robust merit review process was instituted
 - Utilized an investment banker philosophy
 - Utilized a Risk Analysis firm
 - Employed an Independent Engineer
 - Six projects were selected
 - Developed a 2 phase approach
 - Lowering risk to selectees and government
 - Phase 1: Allowed design refinements, permitting, NEPA compliance, and risk mitigation
 - Phase 2: Allows for construction, commissioning and operation
 - Initiated a Technology Investment Agreement, TIA, for the second phase (first time used at DOE)

Key Accomplishments



- **932(d) - continued**

- 4 of 6 selectees have been awarded
 - Range Fuels was awarded a TIA for phase 2 and recently broke ground
 - » wood residues and wood based energy crops
 - Abengoa Bioenergy was awarded a phase 1 cooperative agreement
 - » corn stover, wheat straw, milo stubble, switchgrass, and other feedstocks
 - Poet was awarded a phase 1 cooperative agreement
 - » corn fiber, cobs, and stalks
 - BlueFire was awarded a phase 1 cooperative agreement
 - » green waste and wood waste from landfills
 - Negotiations are continuing logen and Alico
 - » Alico - yard, wood, and vegetative wastes
 - » logen - agricultural residues including wheat straw, barley straw, corn stover, switchgrass, and rice straw

- **10 % Demonstration Solicitation**

- Solicitation was completed and is in the review process
- The same guidelines and criteria established for the 932 solicitation will be used
 - The process has and will continue to improve as we travel along the learning curve
 - Selections are anticipated early in 2008