

U.S. Department of Energy, Biomass Program

Presentation to Biomass R&D
Technical Advisory Committee

December 2-3, 2008
Valri Lightner, Biomass Program

Biomass Program Mission



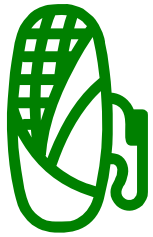
Develop and transform our renewable and abundant biomass resources into cost-competitive, high-performance biofuels, bioproducts, and biopower.

Focus on targeted research, development, and demonstration

- Support through public and private partnerships
- Deploy in integrated biorefineries



Successive Generations of Biofuels



Corn Ethanol

- Commercially available (no DOE research ongoing)
- Reduced GHG emissions
- Capacity constrained



Cellulosic Ethanol

- Focus of current DOE research
- Potential to lower GHG emissions 86%
- Uses biomass from waste and non-agricultural land



Advanced Cellulosic Biofuels

- DOE scoping studies in progress
- Could minimize environmental footprint
- Energy content and fuel economy similar to petroleum-based fuels

Biomass Program Goals



Short Term: Foster breakthrough technologies needed to make cellulosic ethanol cost-competitive by 2012 (cost target: \$1.33/gal).

Mid Term: Help create an environment conducive to maximizing the sustainable production of biofuels by 2017, including cost-effective technology, sufficient infrastructure, appropriate policies, and supportive consumers (cost target: \$1.20/gal).

Long Term: Increase the supply of renewable fuels to 36 billion gallons by 2022 -- especially contributing to the 21 billion gallons of cellulosic and advanced biofuels (per Renewable Fuels Standard in the Energy Independence and Security Act of 2007)



Solicitations Selections Announced Since September 2008

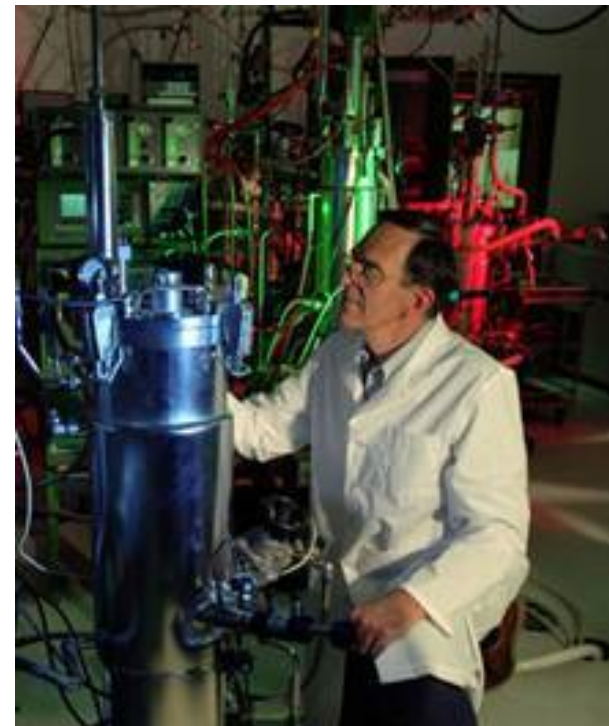


University R&D for up to \$4.4M (\$5.7M w/ cost share)

- **University of Toledo** - simultaneous conversion of cellulose to sugar and fermentation of 5 and 6 carbon sugars to ethanol with native yeasts
- **Steven's Institute of Technology** - evaluate and demonstrate a novel microchannel reactor to reform pyrolysis oil to synthesis gas
- **Montana State University** - evaluate algae cultures and identify populations that naturally have higher rates of oil production
- **University of Georgia** - develop process methods for harvesting algae and processing to biofuels and bioproducts
- **University of Maine** - model conversion and fermentation pathways of pre-pulping extracts and seaweed sludge
- **Georgia Tech Research Corporation** - evaluate and model the reaction kinetics in two experimental gasifiers using forest residues

Pyrolysis oil R&D for up to \$7M (\$8.75M w/ cost share)

- **UOP LLC** - develop and demonstrate at pilot scale an efficient, economical system for pyrolysis oil stabilization
- **Virginia Polytechnic Institute & State University** - catalytic hydrodeoxygenation (HDO) and upgrading together with pyrolysis in a single fluidized bed reactor
- **Iowa State University** - improve biomass pretreatment, bio-oil filtering fractionating recovery, and catalytic post-treatment
- **RTI International** - develop highly active and stable catalysts for the stabilization of bio-oil
- **University of Massachusetts** - produce a stable bio-oil that has low char content and a neutral pH using a combination of membrane and catalytic technologies



Upcoming & Pending Solicitations



In Progress

- Notice of Intent Issued October 2008 for *either* an Integrated Pilot-Scale or Demonstration-Scale Biorefinery
 - Up to \$200M DOE share over 5 years
 - Anticipate the final Funding Opportunity Announcement will be issued soon



FUTURE SOLICITATIONS

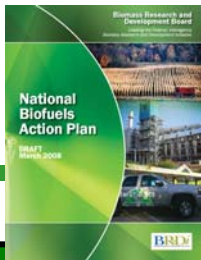
- R&D Lab Call
- Advanced Biofuels R&D (Winter), based on scoping study
- Annual USDA/DOE Joint Solicitation

USDA/DOE Joint Solicitation Planning

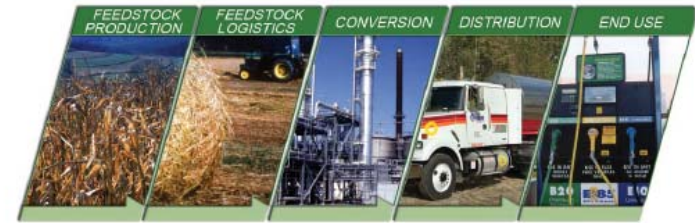


- The Food, Conservation, and Energy Act of 2008 (Farm Bill) Section 9008:
 - New technical areas for grants (with at least 15% of funding going to each area) include:
 - o Feedstocks Development
 - o Biofuels and Biobased Products Development
 - o Biofuels Development Analysis
- USDA has \$20M FY09 mandatory funds; DOE has plans for \$5M
- June 21 conference call with TAC: Gathered input on distribution of funds and evaluation criteria
- August 15 meeting: Results reported to Board
- Draft Funding Opportunity Announcement currently under review; release anticipated end of 2008





National Biofuels Action Plan Released Oct. 7, 2008



NBAP Action Area	Board Action Taken by Interagency Working Groups
Sustainability	<ul style="list-style-type: none"> • Inventory federal efforts & facilitate stakeholder collaboration
Feedstock Production	<ul style="list-style-type: none"> • Conduct feedstock availability and cost study • Formulate long-term interagency research plan
Feedstock Logistics	<ul style="list-style-type: none"> • Facilitate cellulosic feedstock logistics systems demonstrations
Conversion Science and Technology	<ul style="list-style-type: none"> • Inventory and coordinate interagency R&D activities • Develop 10 year interagency research plan
Distribution Infrastructure	<ul style="list-style-type: none"> • Integrate GIS mapping capabilities across federal agencies • Facilitate interagency collaboration on standards development
Blending	<ul style="list-style-type: none"> • Monitor interagency testing program • Formulate blends policy statement
Environment, Health and Safety	<ul style="list-style-type: none"> • Inventory Federal activities • Identify research needs & mitigation options

Preliminary Report on Impacts of Intermediate Ethanol Blends Issued Oct. 7, 2008



- DOE studying intermediate ethanol blends (allocated \$2.1 million in FY07 and \$12.5 million in FY08).
- The DOE test program is evaluating --
 - Vehicle exhaust and evaporative emissions
 - Catalyst durability and aging
 - Cold-start operation and drivability
 - Fuel-system and catalyst materials compatibility
- DOE is also evaluating impacts of higher ethanol blends on small engines
 - Testing leaf blowers, line trimmers, pressure washers, and small generators
 - Expanded test plan for marine engines, all-terrain vehicles, and motorcycles in summer 2008 with input from industry.
- Additional durability testing is required



Loan Guarantees



FY2007

- 143 pre-applications received
- Funds authorized February 2007
- 16 full applications requested
 - 6 for biomass
 - 2 submitted full applications
 - Others in fossil, industrial, solar, hydrogen, alternative fuel vehicles, electricity delivery, and reliability



FY2008

- Announced solicitation for \$30.5B on June 30, 2008
 - \$10B for renewable energy and electricity transmission
 - Applications due February 26, 2009

Economic Stimulus Package



- Biofuels Provisions

- extends a 30% tax credit for alternative fuel refueling facilities through 2010;
- extends a 50% first-year depreciation for cellulosic biomass ethanol plants to include any plant producing biofuels from cellulosic (non-food) biomass sources;
- extends through 2009 a production tax credit of \$1 per gallon for biodiesel and other biomass-based diesel fuels and a credit of 10 cents per gallon for small biodiesel producers;
- cuts the production tax credit for renewable diesel blended with petroleum to 50 cents per gallon;
- closes “splash and dash” loophole that allowed foreign producers to earn a U.S. tax credit.

Biorefinery Demonstrations Expedite Commercialization



Commercial-Scale Biorefineries (up to \$272 M)

- Four cost-shared, integrated biorefinery demonstrations to produce 98 million gallons of cellulosic ethanol in 5 years with variety of conversion technologies and cellulosic feedstocks



10%-Scale Biorefinery Validation (up to \$240 M)

- Cost-shared, integrated biorefinery demonstrations using cellulosic feedstocks to produce renewable fuels at one-tenth of commercial scale
- Nine projects now in progress

Commercial-Scale Biorefinery Demonstrations



DOE investments in cellulosic biofuels will accelerate commercialization and help create a biofuels market based on non-food feedstocks.

Performers	Feedstock Type	Conversion Technology	Status of Project
Abengoa	Agricultural Residue	Biochemical	Phase 1-Cooperative Agreement signed Sept. 2007
Bluefire	MSW	Biochemical	Phase 1-Cooperative Agreement signed Sept. 2007.
Poet	Corn cobs Corn Fiber	Biochemical	Phase 2-Technology Investment Agreement – Signed Oct. 2008
Range Fuels	Woody Waste	Gasification + Mixed Alcohol synthesis	Phase 2-Technology Investment Agreement – Signed Nov. 2007 Ground Breaking Nov. 2007

Small-Scale (10% of Commercial Scale) Biorefinery Demonstrations



Performers	Feedstock Type	Conversion Technology
ICM Incorporated	Agricultural Residue	Integrated biochemical and thermochemical
Lignol Innovations	Wood Residue	Biochem-organosolv
Pacific Ethanol	Agricultural & Forest Residue	Biochemical
NewPage Corporation	Wood Waste	Thermochemical
Ecofin, LLC	Corn cobs	Biochemical (solid-state fermentation)
Mascoma	Switchgrass & hardwoods	Biochemical
RSE Pulp & Chemical	Wood chips (mixed hardwood)	Biochemical
Flambeau River	Wood Residue	Thermochemical
Verenium Biofuels	Bagasse, Agricultural & Wood Residue	Biochemical



Major DOE Biofuels Project Locations

Geographic, Feedstock, and Technology Diversity



- Nine Small-Scale Biorefinery Projects**
- Four Commercial-Scale Biorefinery Projects**
- Four Improved Enzyme Projects**
- Five Projects for Fermentation Organisms**
- Five Thermochemical Syngas Projects**
- DOE Joint Solicitation Biomass Projects**
- Five Thermochemical Bio-Oil Projects**
- Six University Conversion Projects**

Office of Science Bioenergy Centers
 DOE Great Lakes, Madison, WI
 DOE Joint Bioenergy Institute, Berkeley, CA
 DOE Bioenergy Science Center, Oak Ridge, TN

Regional Partnerships
 South Dakota State Univ., Brookings, SD
 Cornell University, Ithaca, NY
 Univ. of Tennessee, Knoxville, TN
 Oklahoma State Univ., Stillwater, OK
 Oregon State Univ., Corvallis, OR