#### Biomass Research and Development Board Technical Advisory Meeting

Arlington, VA 15 November 2018 USDA Activities Update



Soil health provisions

#### **Section 2309 – Soil Health Demonstration Pilot Project**

Provides \$15 million / year for a soil health demonstration pilot project as part of the Environmental Quality Incentives Program to improve soil health, increase carbon levels in soil, and measure carbon levels. This program is similar to one proposed in S.2989, the Conservation for Very Erodible Row Cropland Act of 2018 (COVER Act), sponsored by Sen. Bennet.



• Research Provisions (ARPA-Terra/AgARDA)

#### Section 7128 – Agriculture Advanced Research and Development Authority Pilot

Provides authority and funding for advanced research at USDA. Specific provisions include support to transformative innovation in environmental sustainability and resilience to extreme weather, and total funding of at least \$50 million per year.



#### Clean energy provisions

**Title IX Clean Energy Funding**: provides over \$80 million / year in mandatory funding for Farm Bill energy programs at levels consistent with the 2014 Farm Bill, through bipartisan amendment from Sen. Klobuchar.

#### Section 6210 – Cybersecurity and Grid Security Improvements

Ensures cybersecurity and grid improvement projects are eligible for USDA Rural Utility Service loans. Based on S. 2991, the Promoting Cybersecurity for Rural Electric Utilities Act, cosponsored by Senators Gardner (R-CO) and Purdue (R-GA).

#### Section 9101 – Renewable Energy Systems Definition (Energy Storage)

Includes energy storage systems in the definition of renewable energy systems. This will allow storage technologies to access funds from the Rural Energy for America Program. Based on S. 2993, cosponsored by Senator Merkley.



#### Carbon utilization provisions

#### **Section 7409 – Biomass Research and Development**

Promotes research into carbon sequestration and utilization at the USDA as part of the Biomass Research and Development Initiative.

#### Section 9111 – Biogas Research and Adoption of Biogas Systems

Creates an Interagency Biogas Opportunities Task Force to coordinate policies, programs, and research to accelerate biogas research and investment.

#### Section 9113 – Carbon Utilization Education Program

Directs the USDA to make competitive grants to nonprofits or colleges and universities for carbon utilization education, including \$1 million per year of mandatory funding.

#### Section 6202 – Technical Assistance for Rural Electrification Loans

Provides for Department of Energy technical assistance to participants in the USDA rural electrification loan programs when establishing energy efficiency or renewable energy systems.





## USDA Bioeconomy Research Focus Areas

#### Feedstocks



#### Conversion



#### **Products and Markets**





## Feedstocks: Napiergrass development



Break even price:

- Napier \$85/ton
- Corn \$304/ton

#### Ethanol (gal/ac)

- Napier 1,175
- Corn 534



### Feedstocks: Switchgrass



5.1 ton/acre yield in year one



### 'Liberty': low-lignin, high cellulose switchgrass

#### Liberty vs. corn

- Liberty: marginal land
- Corn: best cropping land, producing 200 bu/ac

#### Ethanol production:

- Liberty: 530 gal/ac
- Corn: 567 gal/ac



## **Conversion Technologies**

- Hydrolysis
- Enzymatic (catalytic and non catalytic)
- Metal catalysis
- Pyrolysis and torrefication
- Microbial (bacterial, fungi and yeast)
- Anaerobic digestion





### Conversion: Thermochemical Platform





Slow – bio-char production Fast – Bio-oil produciton



## Conversion: Microbial Platforms

#### New yeast strains:

- with 90% ethanol conversion efficiency reduced costs by \$0.35/gallon
- 2. that converts coffee waste into ethanol
- 3. that converts xylose into ethanol
- 4. Yarrowia strain with 3X more lipid production





## Conversion: Microbial Platforms

#### New enzyme technologies:

- Antibacterial lytic enzymes reduce lactic acid bacteria 1000X increase ethanol yield 10X
- 'Enzyme-ladder' linking multiple enzymes improves biofuel production by 70X



## New products and advances

Partnering with the USDA to create bioproducts that meet market needs.





## Engineering better products









### **Engineered Forest Products**

HOME > MEDIA > BLOG > BLAST TESTING SHOWS CLT CAN TAKE THE HEAT

#### Blast Testing Shows CLT Can Take the Heat

Posted by Rebecca Wallace, Forest Products Laboratory, USDA Forest Service in <u>Forestry</u> Mar 30, 2018



All three structures remained standing after the testing – even tests designed to take the structures well beyond their design intent. (Photo courtesy of Air Force Civil Engineering Center AFCEC, Tyndall Air Force Base)

- USDA supported research is allowing engineered forest products to be developed that can displace steal and concrete.
- USDA investments are enabling new biobased markets.





#### **Goals and Objectives:**

- Assess the state of current energy markets, tracking and monitoring trends
- Develop a quantitative basis for evaluating technologies, markets, and new market opportunities
- Evaluate regional technical and economic potential for wood energy
- Assess new technologies and practices to improve biofuel conversion performance and the implications for environmental goods
- Monitor domestic and international actions that account for the environmental performance of biomass feedstocks – ensure that the latest science is taken into account





#### **Ethanol Analysis: 43% Lower GHG Balance**



### Corn-based ethanol GHG comparisons

Study	Sub-Analysis	Emissions Impact (gCO <sub>2</sub> e/MJ of corn ethanol)	Boundaries
EPA RIA	N/A	75	All 11 source categories
Wang et al. 2012	Without DGS Credit	76	Excludes domestic and international rice methane, domestic and international livestock, international farm inputs and fertilizer N <sub>2</sub> O Excludes domestic and international rice methane, domestic and international livestock, international farm inputs and fertilizer N <sub>2</sub> O
	With DGS Credit	62	
Dunn et al. 2013	Maximum U.S. LUC	68	
	Minimum U.S. LUC	62	
Wang et al. 2015	Displacement	61	Excludes domestic and international rice methane, domestic and international livestock, international farm inputs and fertilizer N <sub>2</sub> O
	Marginal	62	
	Hybrid Allocation	59	
	Process-Level Energy Allocation	46	
USDA/ICF 2016	ICF: 2014 Conditions	58	All 11 source categories
	ICF: 2022 BAU Scenario	53	
	ICF: 2022 High Efficiency – High Conservation Scenario	26	

### Land and ag based carbon management

#### Climate mitigation potential in 2030 (PgCO<sub>2</sub>e yr<sup>1</sup>)



## USDA BRDI Funding

Proposed USDA Biomass Research and Development Initiative (BRDI) funded projects (\$5,079,286 total USDA funding through NIFA)

- Valorization of biochar
- Lifecycle assessment of biochar in agricultural and forest ecosystems
- Next generation approach to quantifying land use change
- Agriculture linkages for simultaneous biofuel and rubber production





## The significance of carbon management

# Transition in thinking with respect to the major 'products' of the bioeconomy







- Biofuel electricity
- Carbon management
- Ecosystem services



### The bioeconomy and carbon management



#### Carbon storage in products and materials





Advanced land, forest, and soil management



#### **Research & Development**

- Seeking expert input on technical investments needed for both large scale BECCS and engineered wood construction

#### Analysis

- Resource assessment prime regions for purpose-grown biomass for BECCS and engineered wood buildings
- Carbon and ecosystem service pricing/incentive scenarios
- Quantifying tradeoffs between land use implications, carbon efficiency, and biomass efficiency (land use decision making)



## The RFS in a New Carbon Economy

- Address critical advanced pathways
  - e-RIN pathway
  - Biointermediate and co-processing guidance
  - Carbon utilization pathways
- Streamline approval processes
  - Outline approaches for rapid advanced pathway approvals
- Guidance for carbon negative pathways
  - Credit for ultra low carbon corn ethanol
  - Priortiy feedstock approval for biopower production (w/BECCS) – couple to e-RIN pathway



### Contact me

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- "Valorization of Biochar: Applications in Anaerobic Digestion, Livestock Odor Control and Plant Growth"
- Iowa State
- \$1.84 Million
- Topic Area B: Biofuels and Biobased Products Development
- The goal of this project is to advance the economic prospects for pyrolysis-based biofuels by developing value-added applications for co-product biochar.



- "A defensible, next generation approach to quantifying and characterizing land use change"
- Northwestern
- \$1.25 Million
- Topic Area C: Biofuels Development Analysis
- This project will develop a new, efficient method that fuses 1.) farmer survey data, 2.) remote sensing data, and 3.) aerial imagery to characterize land-use change, improving current techniques that are inconsistent and suffer from low accuracy for natural lands. In particular, it will apply active learning techniques and a convolution neural network architecture to making processing of very high resolution aerial imagery efficient and accurate. From fusing the three data sources, it will generate a high resolution classification map for use in LUC assessments.



- "BARRAL Biofuel And Rubber Research and their Agricultural Linkages"
- Ohio State
- \$2.49 Million
- Topic Area A: Feedstocks Development
- The project will develop the natural rubber (NR) and industrial sugar crop, rubber dandelion (*Taraxacum kok-saghyz*, TK, rubber root), in the northern US. Inulin and biomass from TK have mutiple conversion opportunities to biofuel. TK NR coproduct has qualities almost identical to the rubber extracted from rubber trees, and can be similarly used for a variety of applications, including technically-sophisticated, high performance automotive tires. The BARRAL Consortium, led by The Ohio State University (OSU) along with several industriees, proposes to overcome remaining key commericialization barriers faced by TK. The proposal builds upon previous successes in germplasm improvement, agronomy and processing, funded by public and private sources, and an established collaborative group (the PENRA Consortium) and expands the effort to multiple states.



- "Life-Cycle Assessment of Biochar in Agricultural and Forest Ecosystems: Effects on Production, Soil Fertility, and Economic Impact"
- Virginia Tech
- \$965,000
- Topic Area C: Biofuels Development Analysis
- This project proposes to test the effectiveness of biochar in enhancing soil fertility, primary productivity, and soil carbon sequestration in diverse agricultural operations including vegetable gardens, orchards, forest plantations, and pasture systems. Project sites will be across the nation.
- Proposal is recommended for funding because it is a high priority project that is closest to the remaining funds available, work can be done at this lower level of funding, and will have national implications from results.

