NEWBio: The Northeast Woody/Warm-season Biomass Consortium

Tom Richard, Penn State University
NARA Annual Meeting
May 3, 2016
NEWBio’s vision is to build robust, scalable, and sustainable value chains for biomass energy in the Northeast.
University and Federal Partners

Penn State University
Cornell University
SUNY ESF
West Virginia University
Delaware State University
Ohio State University
Rutgers University
Drexel University
USDA ARS ERRC
DOE Oak Ridge National Laboratory
DOE Idaho National Laboratory
NEWBio: Northeast Woody/Warm-season Biomass Consortium

**Extension**
- Willow
  - Double A Willow
- Switchgrass
  - Ernst
- Miscanthus
  - Aloterra
- Feedstock Improvement
- Harvest, Preprocessing & Logistics
  - Harvest
  - Store
  - Densify
  - Transport
    - Case New Holland, Aloterra, Ernst, TerraGreen

**Education**
- Biochemical
  - Enchi, Renmatix
- Thermochemical
  - Praxair, Primus Green Energy
- Bio-electricity
  - ReEnergy
- Human Systems
- Safety and Health
- Leadership and Evaluation

**Leadership and Evaluation**
- Case New Holland, Ernst, TerraGreen

**Biofuel Markets**
- Delta, American Refining Group

**Sustainability Systems**
- Harvest
- Preprocessing & Logistics
NEWBio Outcomes

Knowledge: *shared discovery*

Actions: *solving challenges*

Conditions: *a growing bioeconomy*
Knowledge

- Capacity for participatory decision-making
- Stakeholder engagement processes
- Stakeholders’ economic & social barriers
- Necessary incentives to overcome barriers
- Data for models, Decision Support Systems, policy, extension programs
- Genetic basis of willow and switchgrass yield
- Professionals & producers trained in biomass production & management
- Improved understanding of economics and environmental impacts of perennial biomass
- Quantified feedstock to fuel systems
- Regional prioritization of feedstock systems
- Changes/tradeoffs in ecosystem services in different feedstock systems
- Increased worker awareness and knowledge about biomass industry hazards
- Management safety awareness
- Increased knowledge about biomass resource as community or regional asset
- Pipeline of practitioners (1,000) trained
- Increased knowledge of sustainable bioenergy systems, measured by pre- and post exams, surveys and interviews
- > 30 faculty and 40 graduate students with demonstrated transdisciplinary collaborations, and perspectives
Perennial Grass Supply Chains

Miscanthus/ Switchgrass

Windrow Preparation

Harvest

Densification

Square Bale

Round Bale (Unwrapped)

Chop in Field

Round Bale (Wrapped)

Storage

Field Storage

Transport to Dry Storage

Transport to Wet Storage

Transport to Processing

Storage

Dry Storage

Ensiled Storage

Grind

Conversion

Pellets

Thermochemical

Biochemical

Fieldside

Off-Site

Grind

Processing

Transport to

Wet Storage

Dry Storage

Ensiled

Storage

Storage

USDA

United States Department of Agriculture

USDA

NEWBio

Northeast Woody/Warm-season Biomass Consortium

National Institute of Food and Agriculture
Short Rotation Woody Crops (Willow and Poplar), 2017, $55 Farmgate Price, Base Case Scenario
Actions

- Collaborative approaches to research, extension, education
- Landowner, community and public participation
- Expanded range of new, commercialized crop varieties
- Increased diversity & availability of perennial feedstocks
- Improved harvest, transport and logistics systems.
- Comprehensive public dataset used in integrated tools and models for sustainability analysis
- Use of hazard assessment tools, management plans and employee safety training programs
- Increased efficiency and capacity in biomass supply chain
- A sustainable flow of biomass to support emerging biofuels industry
- Commercial biorefineries operating and procuring biomass
- Increased employment in biomass production and use sectors
- Partner commitments to maintain regional coordination and increase permanent biomass workforce.
Willow Harvest Program

- 100 acres – Celtic Energy commercial biomass. West Branch, NY
- 30 acres – ESF bioremediation site. Solvay, NY
- 2 acres – ESF yield trial. Constableville, NY
- 2 acres - ESF various trials and nursery beds. Tully, NY
- 20 acres – Cornell various trials and nursery beds. Geneva, NY
- 2 acres – Cornell yield/amendment trial. Fredonia, NY
- 1 acre – Cornell yield trial. Potsdam, NY
- 30 acres – Penn State research trial. Rockview, PA
- 4 acres – Penn State yield and polyculture trial. Rocksprings, PA
- 15 acres – East Lycoming school biomass. Hughesville, PA
- 50 acres – IBSS poplar trials. Tennessee and Mississippi
- 25 acres – ESF Lafayette Road Trials. Syracuse, NY
- 4 acres – Vernon-Verona-Sherrill High School
- 6 acres – Cornell. Various trials
Conditions

- Stakeholders engaged in all portions of the biomass supply system
- Rural development and resilience for entrepreneurs, employment, income
- Increase willow and grass yield 25% & reduce production & harvesting costs 20%
- Viable crop systems on marginal lands; toolkit for mycorrhizal fungi establishment
- Improved GHG balance & energy yields
- Reliable, consistent, affordable perennial biomass supply across the region
- Improved, sustainable land management

- New supply chain businesses models
- Advanced biofuels, biochemical and biomaterials facilities and biomass production systems competitive in NE
- A balanced, sustainable flow of ecosystem services from feedstock systems
- Reduced exposure to hazards and risks. Reduced lost-time work injury & costs
- Strengthened educational pipeline to support the biomass industry
- Greater public understanding of and support for biomass energy systems
- Increased capacity in 3 EPSCoR states and regional 1890s universities
- Strong and lasting partnerships between biomass stakeholders in the region
Feedstock Partner: Switchgrass

Over 5000 acres of switchgrass in production. Currently processing over 20,000 tons/year
Feedstock Partner:
Miscanthus x giganteus

Over 4000 acres of miscanthus in production. Current markets primarily biocomposites and biomaterials.
Conversion Partner: Biopower

Operating nine biomass fueled power plants in the Northeast
Corporate headquarters in Latham, NY
Currently contracting for willow biomass from Celtic Energy
Conversion Partner: Supercritical Sugars

Operating Pilot Plant in Kennesaw, GA since 2008
Corporate headquarters in Valley Forge, PA since 2011
Partners include BASF, Total, Amyris, Virent
Transdisciplinary Targets for Year 4

- Demonstration regions – ReEnergy, Ernst, Aloterra, Green Team, TerraGreen, Renmatix
- Landowner and community perspectives
  - Feedstock production
  - Technical and business supply chains
  - Sustainability assessment
  - Economic impact
- Policy opportunities – Chesapeake Watershed, Clean Power Plan
- Business development – niche energy applications, biochemicals and bioproducts
Demonstration Regions

![Map showing demonstration regions and NewBio Sites.](image-url)
Biofuels and the Chesapeake – A Local Driver

Maximum Nitrogen Load Changes for Biofuels
Millions of pounds per year of nitrogen delivered from the Chesapeake Bay watershed to the Bay under five modeling scenarios.

- **Corn**: 5.0
- **Soybeans**: 2.6
- **300K Switchgrass**: -8.3
- **Corn with Cover Crops**: -17.1
- **1M Switchgrass**: -25.4

Assumptions for Alternative Scenarios:
- **Corn**: 300,000 additional acres of corn with typical levels of management practices
- **Soybeans**: 300,000 additional acres of soybeans with typical levels of management practices
- **300K Switchgrass**: 300,000 acres of switchgrass, converted primarily from hay and pastureland, with no fertilization
- **Corn with Cover Crops**: Cover crops on all existing and new (additional 300,000) corn acres and one quarter of all other row crops, watershed-wide.
- **1M Switchgrass**: 1 million acres of switchgrass, converted primarily from hay and pastureland, with no fertilization

Source: U.S. EPA Chesapeake Bay Program Office
# Markets for Biomass Crops

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<tr>
<th>Market goods</th>
<th>Supply</th>
<th>Demand</th>
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<tr>
<td></td>
<td>5-12 million tons of biomass per year (Chesapeake Bay Commission 2010)</td>
<td>$7.19/GJ - $8.12/GJ</td>
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<td>$100/ton breakeven price (Woodbury et al.)</td>
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<td>$135/ton reservation price (Mooney et al. 2014)</td>
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<td>$7.19/GJ - $8.12/GJ</td>
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<tr>
<td>Non-market goods</td>
<td>Maize to switchgrass = 23 kg N ha(^{-1}) y(^{-1})</td>
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<td>reduction in N loading to the Chesapeake Bay (Woodbury et al., in review)</td>
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<td>Biomass sorghum for P phytoremediation</td>
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<td></td>
<td>~1 Mg soil carbon /ha/yr</td>
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<td>Increased resilience to drought</td>
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<td>Pollinators, pest control</td>
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<td>Reduced N2O emissions?</td>
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<td></td>
<td>$10.7 kg N(^{-1})</td>
<td>$1.4 GJ(^{-1})</td>
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<td>(Woodbury et al.)</td>
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10 to 20% of the landscape in perennials results in 85 to 95% reductions in N, P and sediment!

Zhao et al. 2014
Incorporating Traditional Forest Product Markets in Biomass Evaluations

Greg Latta, University of Idaho

(see below for full description)
Growing a Sustainable Bioenergy Industry for the Northeast