The Mid-Atlantic Sustainable Biomass Consortium

Bioproducts for the Bioeconomy

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Led by West Virginia University, MASBio is a regional network of universities, businesses, and governmental organizations dedicated to building robust, scalable, and sustainable value chains for biomass bioproducts in the Mid-Atlantic region.

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One of several regional 5-year projects across the US for development of industries to develop biofuels and bioproducts

**OBJECTIVES:**

1. Develop a sustainable and economically feasible biomass for value-added bioproducts system
2. Encourage sustainable agriculture and forest management
3. Stimulate business development in rural areas

Focus on biomass and the production strategies, policies, and markets relevant to the Mid-Atlantic region
MASBio Map

Legend
- Industry Partners
- Institutional Partners
- Biomass Trials
- Surface Mined Areas

FPL (Madison, WI)
RMRS (Missoula, MT)
INL (Idaho Falls, ID)

Forest Residue
Dry Tons/Year
- 0 - 3110
- 3111 - 8298
- 8299 - 16058
- 16059 - 29515
- 29516 - 58713

0 25 50 100 Miles
What Is Biomass?

- Biomass is renewable organic material that comes from plants and animals.
  - Wood, wood processing wastes, and forest residues
  - Agricultural crops and waste materials
  - Biogenic materials in municipal solid wastes
  - Animal and human waste
Different Types of Biomass

- **Forest Residues**: Residues from timber harvesting, forest thinning, land clearing e.g. tree tops, branches
- **Agricultural Residues**: Stover, stalk, straw, leaves, chaff, husks left in the field after crop harvesting
- **Purposed Grown Crop**: Woody crops e.g. eucalyptus, willow, poplar, Grass crops e.g. miscanthus, switchgrass, giant reed
- **Industrial Waste**: Wood processing mills waste e.g. bark, chips, sawdust, Crop processing waste e.g. peanut shells, cotton gin trash
- **Municipal Solid Waste**: Woody waste e.g. yard debris, landscaping debris, construction & demolition debris, Biogas from landfills

Images courtesy of (left to right): Biomass Magazine; Di Donato et al. (2015); Biomass Decision Support System (BDSS) & Cornell CALS; Celignis & Biomass Pellet Mill; ClarksvilleNow & Fuel Cell & Hydrogen Energy Association
ENERGY CROPS
Non-food crops purposely grown for producing biofuels and bioproducts:
• Switchgrass and shrub willow in MASBio

Crops grown on marginal land:
• Reclaimed mine land
• Non-prime farmland, e.g. poor drainage, not level

FOREST RESIDUE AND OTHER WOOD WASTE

SUPPORTS SUSTAINABLE AGRICULTURE PRACTICES AND GOOD FOREST MANAGEMENT
Ethanol as Fuel

- **Late 1970s**: Oil Crises
- **1977**: Department of Energy Established
Other Laws Affecting Renewable Energy

- Farm Legislation
- Budget Reconciliation Legislation
- Air quality legislation of the 1990s

Amendments and Rule Making
Cellulosic Biofuels: NEWBio Project

USDA NIFA Sponsored (NEWBio.psu.edu)

- Second generation—not made from food
- Renewable
- Derived from a variety of biomass feedstocks
- Advantage of carbon sequestration
Outcomes of NEWBio Project

Cellulosic biofuel still not economically feasible

Strong reinforcement of the feasibility of other bioproducts
Market Opportunities for Lignocellulosic Biomass: Multi-Tier Market Reference Framework

A wide range of biomass products reflect multiple tiers of biomass business players, each offering different biomass-based product types and facing different competitors. This multi-tier market reference framework provides a common language for various entities in biomass supply chains by forming a systematic view of biomass market opportunities.

Tier 1 Companies
Biomass suppliers e.g. energy crop growers, loggers

Tier 2 Companies
Raw biomass users e.g. biorefineries

Tier 3 Companies
Industrial users of refined biomass e.g. manufacturers of plastic polymers and resins

Tier 4 Companies
Industrial endmarket users of biomass-derived products e.g. chemical company producing custom compounding plastic resins

Industrial Endmarket
Industrial users of biomass-based products for final assembly of finished products
MASBio Target Bioproducts

**Bio-Adhesives**
- Example (above): Kiilto Biomelt glue – a plant lactic-acid-based, hot-melt adhesive – launched in Finland in January 2019

**Biochemicals**
- Examples (above): Wood-based bio-monoethylene glycol (bioMEG) and bio-monopropylene glycol (bioMPG) by UPM Biochemicals, Finland

**Resins for 3D Printing**
- Example (above): eResin-PLA – a plant-extracted PLA photosensitive resin – for LCD/DLP/SLA 3D-printing technology by eSUN, China

**Carbon Products**
- Examples (above): Biochar produced from hardwood and switchgrass biomass feedstock

**Carbon-based Bio-Nanomaterials**
- Example (above): Carbon-based nanomaterials in lithium energy storage applications

Images courtesy of (left to right): Kiilto; Bio Market Insights; International Biochar initiative; Geng et al (2020)
Framework: Integrated Sustainable Biomass for Value-Added Products System

Land Reclamation & Feedstock Production (Task 1)
- Soil improvement: Mined land, Marginal agricultural land
- Feedstock production: Hybrid willow, Switchgrass

Harvest, Logistics & Supply Chain Management (Task 2)
- Cost-effective logistics approaches
- Storage and blending for continuous industrial supply with forest residues
- Configure and de-risk multi-feedstock supply chains
- Monitor feedstock quality

Value-Added Bioproducts (Task 3)
- Raw materials: Forest residues, Hybrid willow, Switchgrass
- Processes: Depolymerization, Stepwise-fractionation, CO₂ treatment
- Bioproducts: Bioadhesives, Biochemicals, Resins for 3D printing, Carbon products, Bicarbonate nanomaterials

Sustainability & Human Dimensions (Task 4)
- Coupled carbon and nitrogen cycles
- Water and soil quality
- Best management practices
- Human dimensions
- Policy and regulations

System Scale-Up Analysis (AI tools) (Task 5)
- Estimate high-resolution and land-scape level environmental impacts
- Scale-up models & engineering scalability analysis
- Techno-economic optimization
- Enhancing value-added product environmental performance
- Data mining and warehousing techniques for GIS analytics

Education (Task 6)
- Scholar program for undergraduates
- Online courses on biorenewables
- Certificate programs in land reclamation and green products
- Training program for primary educators

Extension and Business Development (Task 7)
- Demonstration and commercialization cases with industry partners
- Expand eXtension articles, offer workshops, webinars, and develop online resources
- Market potentials and marketing strategies for entrepreneurship and rural business development
- Socio-economic analysis for regional bioeconomic development
- Workforce development
- Tools for feedstock production, engineer processes and analyses
Contacting the Speakers

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