

THE NORTHEAST WOODY/WARM SEASON BIOMASS CONSORTIUM IN WEST VIRGINIA

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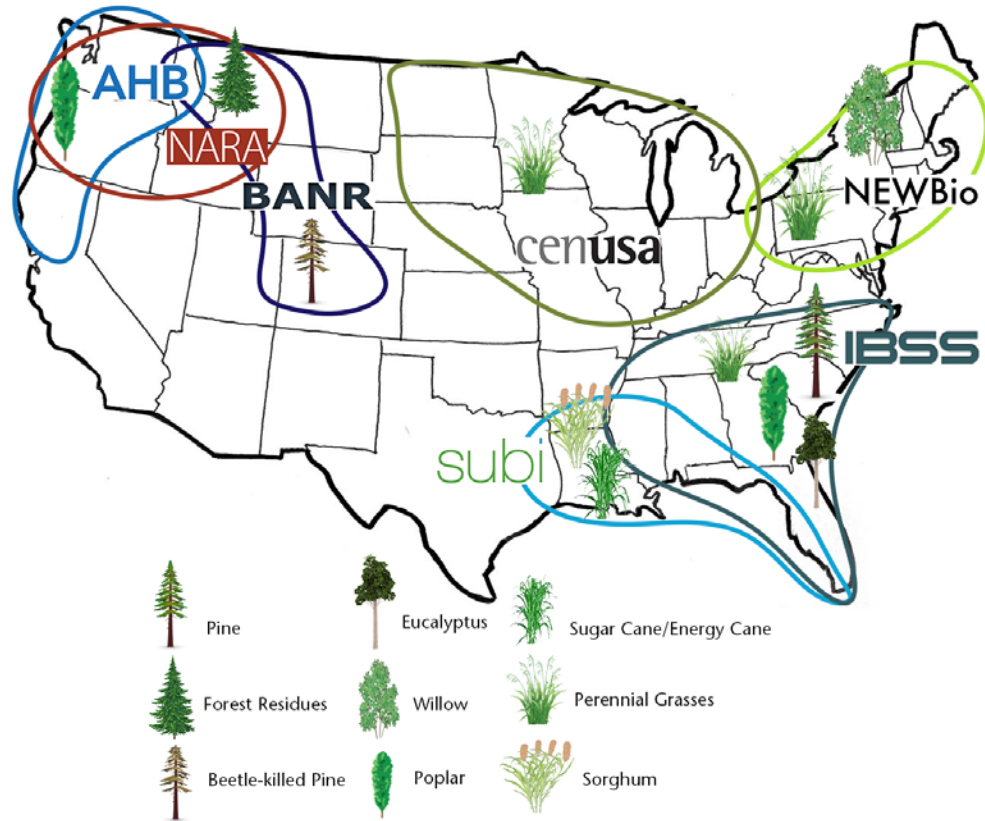
USDA NIFA CAPS



- We have potential to produce vast supplies of biomass that can be tapped to produce sustainable transportation fuels
- CAPs are developing regional systems for the sustainable production of biofuels
- Involve 26 land-grant universities; 6 other public universities; 1 regional consortia of community colleges; 2 non-profit organizations; 10 federal agencies; and 28 private industry partners



AFRI BIOFUEL FEEDSTOCKS AND PROJECT LOCATIONS



- USDA NIFA invested \$156 million in 7 projects across the US to assist in the development of advanced biofuels industries
- Focusing on Forest Residuals, Short rotation wood crops, and energy grasses
- Integrate Research, Education, and Outreach



USDA NIFA CAP DESCRIPTIONS

Acronym	Name	Leading Institution	Biomass
SUBI	Sustainable bioproducts initiative	LSU	Energycane & sweet sorghum
AHB	Advanced Hardwood Biofuels Northwest	University of Washington	PNW Hardwoods
CENUSA	Sustainable Production and Distribution of Bioenergy for the Central USA	Iowa State	Perennial grasses
IBSS	Southeastern partnership for integrated biomass supply systems	University of Tennessee	Pine, eucalyptus, and switchgrass
BANR	Bioenergy Alliance Network of the rockies	Colorado State University	Insect-killed pines
NARA	Northwest advanced renewables alliance	Washington State University	Forest residues and municipal solid wastes



NEWBIO - NORTHEAST WOODYWOODY/WARM-SEASON BIOMASS CONSORTIUM



- NEWBio is led by Penn State University and is investigating a variety of feedstocks including short rotation woody crops, switchgrass, and miscanthus for advanced biofuels.
- ~ \$10 million effort over 5 years



NEWBIO – PARTNERS



source:willow.cals.cornell.edu

- 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

PENNSTATE



Cornell University



Delaware State University



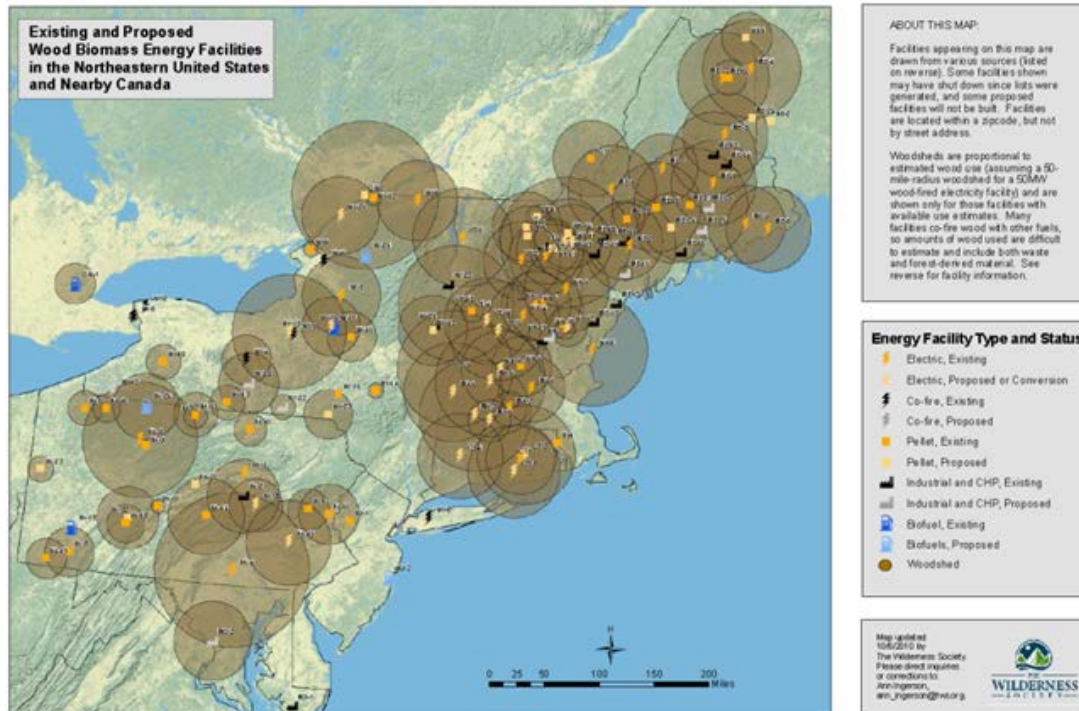
Idaho National Laboratory



WEST VIRGINIA UNIVERSITY
ENERGY LAND MANAGEMENT

WHY NEWBIO?

Facts about Northeast Bioenergy

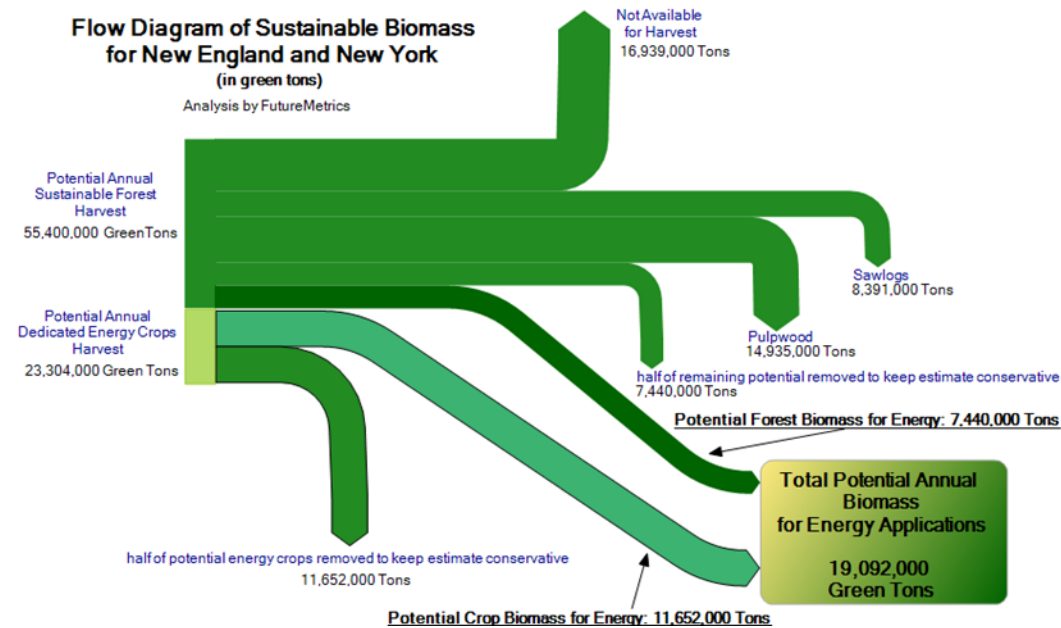


- 21% of the US population
- 6% of the nation's land area
- 17% of the US total petroleum consumption
- Consumes 86% of all the distillate oil used for heating
- Currently between 5 and 10% of energy consumed in NE is from renewables
- About 400 facilities using pulp or energy wood



WHY NEWBIO?

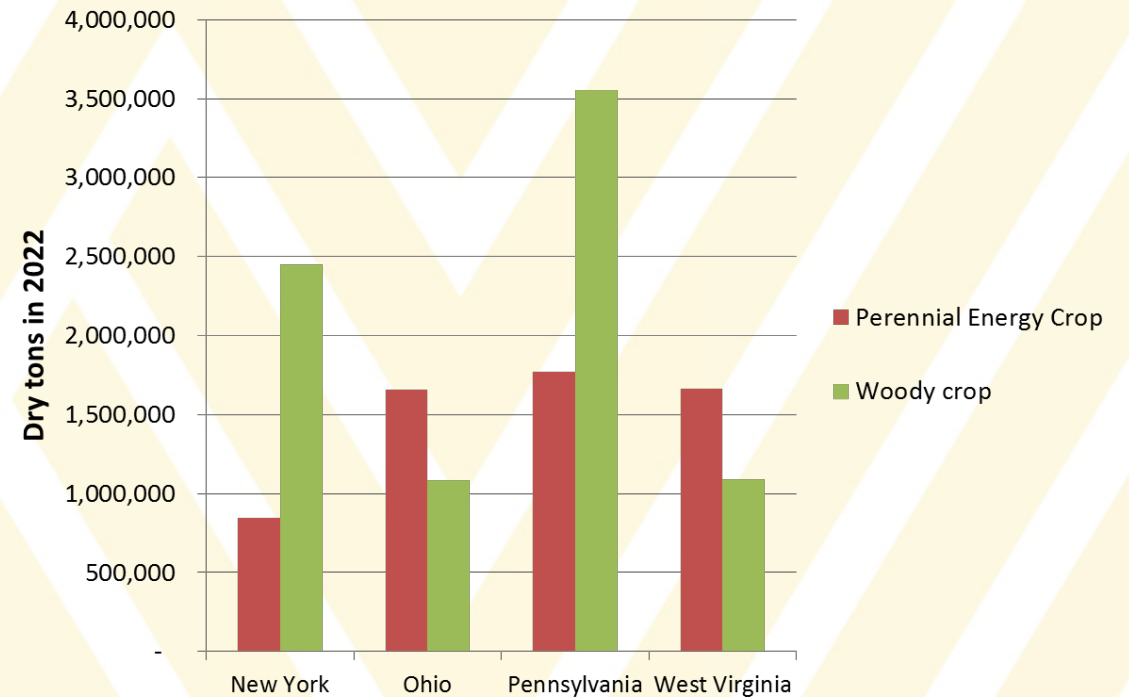
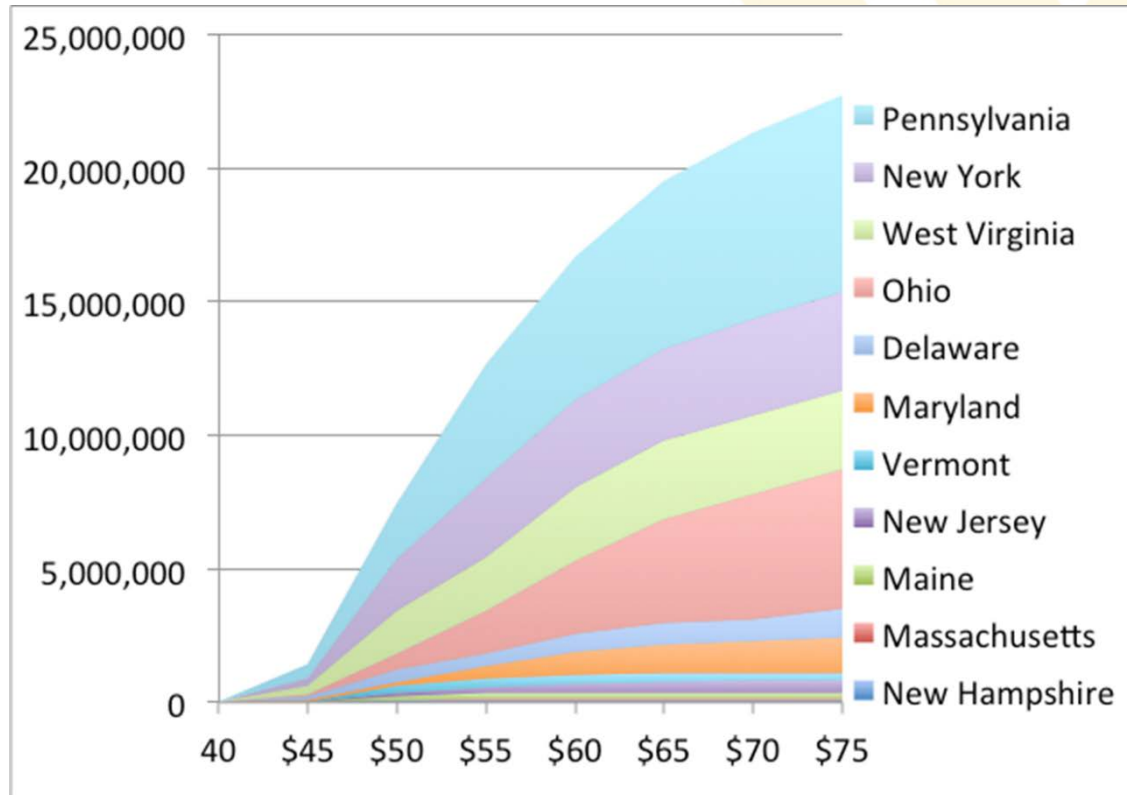
Facts about Northeast Bioenergy continued...



- **Unique wood basket**
 - Similar species composition
 - Lots of low use wood for due to harvesting practices and markets
 - Issues with economic availability
- **Use of marginal lands for energy crops**
- **WV produces ~8 Mil. Grn Tons/Yr**



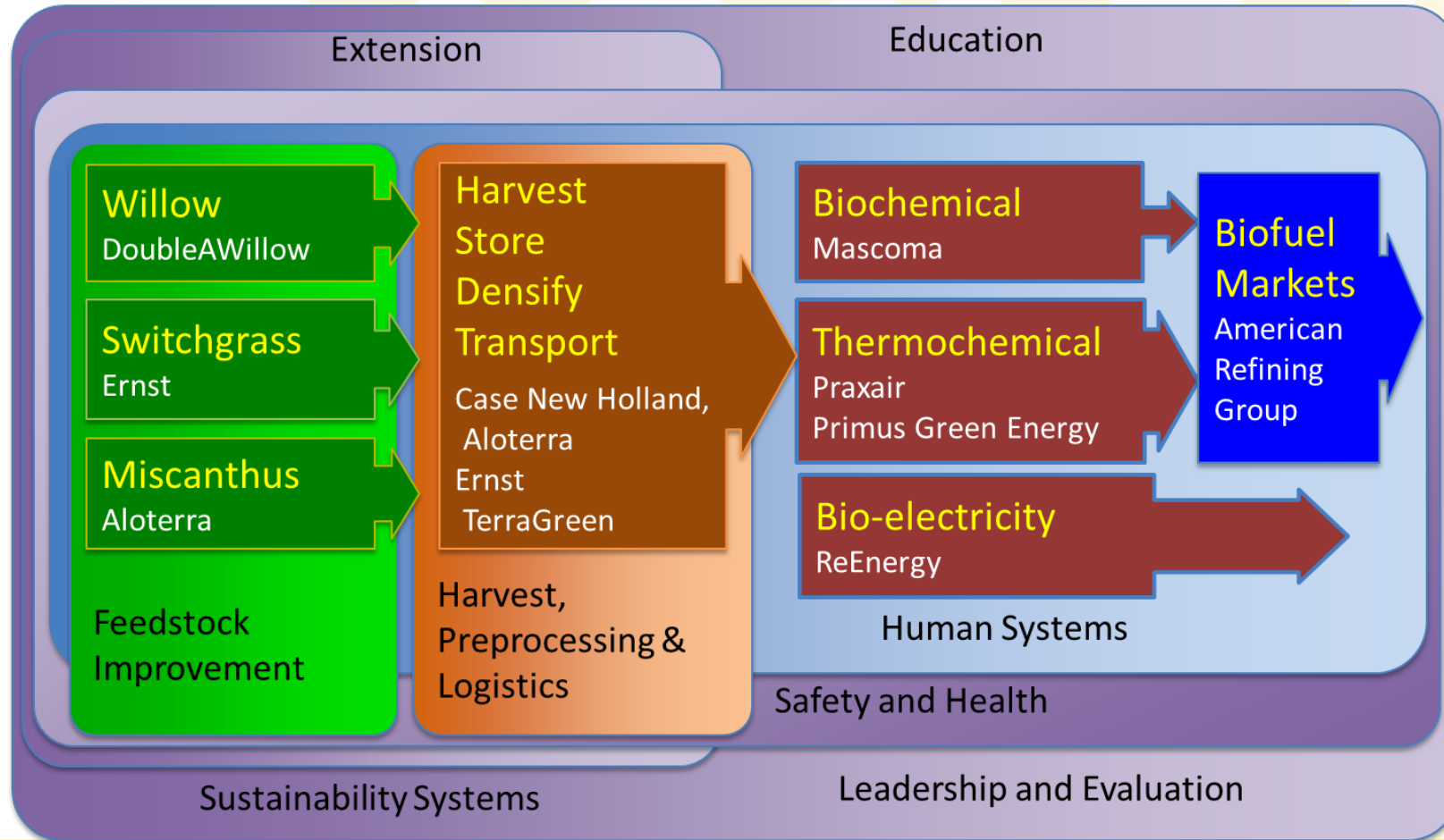
FEEDSTOCK SUPPLY - \$60/DRY TON BASE CASE



Source: Billion Ton Update 2011



NEWBIO STRUCTURE



WHY ENERGY CROPS?



- Large acreage in ‘marginal’ lands
 - No competition with food crops
- Aid in restoration
- Compared to forest biomass
 - Consistent quality
 - Consistent supply
 - Fast growing
 - High yields/acre



SHRUB WILLOW (SALIX)



source:willow.cals.cornell.edu

- Naturally found in cold to temperate climates and along streams
- Yields (4-6 dry tons/acres), fast growing and requires few inputs
- Can reach a height of 5-7 meters (15-25 feet) and can be harvested for 15-21 years



WILLOW BIOMASS PRODUCTION CYCLE

Site preparation



Planting



First-year coppice

Regrowth



One year post coppice



Three year post coppice



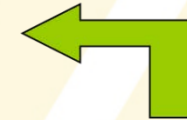
HARVESTING



source:willow.cals.cornell.edu



Three years old
after coppice



One year old
after coppice



Regrowth after coppice



At least 7
harvests



GIANT MISCANTHUS (*Miscanthus x giganteus*)



- Grass native to Asia and used ornamentally since 1800s
- Now sterile hybrid Giant Miscanthus (*Miscanthus x giganteus*)
- Growth potential (12 feet high) and tolerance to cold conditions and poor soils
- Can yield 8-12 dry tons (or more) per acre annually
- 15-20 years life
- Requires little maintenance



MISCANTHUS



Source:biomassmagazine.com

- Planted using rhizomes - establishment more expensive
- Takes 2 to 3 growing years to establish
- Weed control is essential for establishment years
- Likes low nutrient environment
- Responds to precipitation but tolerates drought
- Conventional hay or silage equipment used for harvesting - late winter/ early spring
- Used in Fuel pellets, animal bedding, absorbents, and fiberboard and paper based packaging



SWITCHGRASS (*PANICUM VIRGATUM*)



www.extension.org

- Warm season perennial grass native to the tall prairie region
- Commonly grown as a conservation crop or for wildlife forage
- Yields (4-6 dry tons/acre)
- Can grow as high as 2 meters (6 feet) in a year and can produce annual crop for up to 20 years



SWITCHGRASS



- Grown from seed or broadcast planted ~10lbs/acre
- 3 years for full establishment
- Weed control/ mowing is initially important
- Tolerates low fertility soils, but likes nitrogen
- Used in fuel pellets, briquettes, biomass logs , animal bedding and low grade feed



INDUSTRIAL COLLABORATORS

- Double A Willow – Willow production (Fredonia NY)
- Ernst Seed – Swithgrass production (Meadville, PA)
- Aloterra Energy – Miscanthus production (The Woodlands, TX)



NEWBIO IN WV



- Research
- Education
- Extension



RESEARCH – DETERMINING BEST WILLOW GENOTYPES



- Led by Steve DiFazio WVU Biology
- Field trials – testing commercial varieties on mine sites
- Developing and analyzing reference genome sequence
- Investigating genetic component of sex selection



YIELD TRIALS



- assess survival and productivity of improved varieties on a marginal site
- Originally planted in 2012 - 20% survival
- Problems in approximate order of importance: drought; deer; inadequate site prep/maintenance
- Replanted in 2014:
 - Improved site prep: Ditch Devil
 - Improved weed control
 - Electric fence
- Same design but focusing on 10 best performers from the 2012 trial



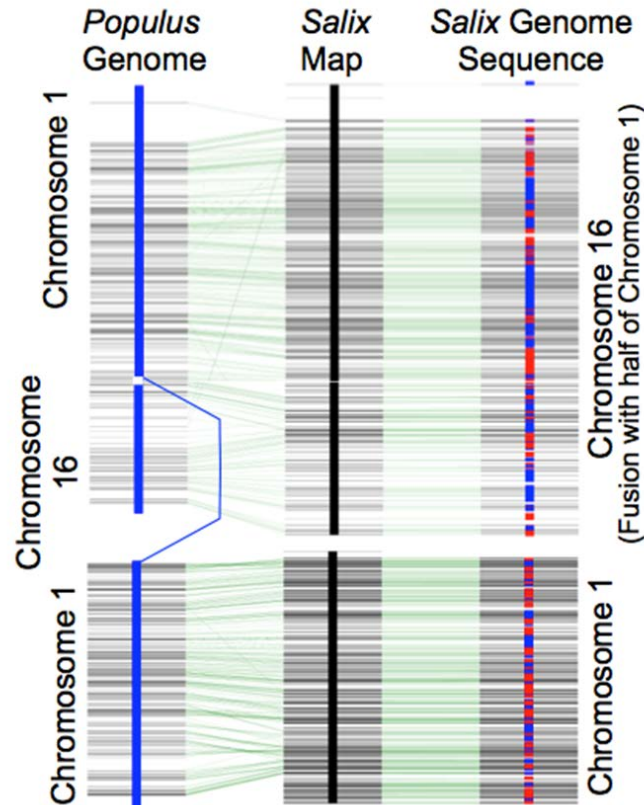
ASSOCIATION TRIAL



- Purpose is to identify genes controlling growth
- 90% survival
- developing molecular markers using a Genotyping by Sequencing Approach
- used to perform whole genome association studies which will enhance and accelerate willow breeding efforts



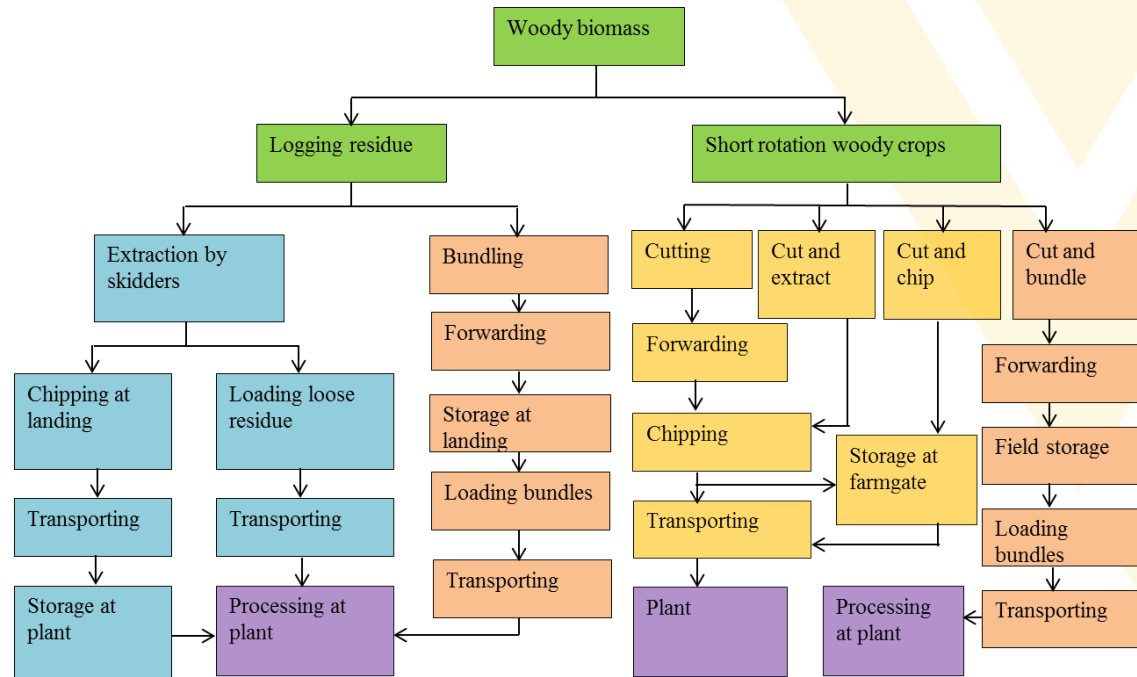
SALIX GENOME



- Working with US and International researchers to sequence and assemble a reference sequence for *Salix purpurea*
- Have assembled 300 million bases of the genome into 19 chromosomes and annotated 29,583 genes
- comparative genomics analyses to explore the genomic bases of similarities and differences between *Populus* and *Salix*



RESEARCH – HARVEST AND LOGISTICS MODELING



- Led by Jingxin Wang
- Using multi-objective decision models to:
 - Examine site suitability indices of all potential sites considering economic, environmental, infrastructural, and societal factors
 - Evaluate and entail the ranking of all potential locations



COST OPTIMIZATION



- Further objective is to minimize the total annual delivered cost of woody biomass from supply locations to plant locations
- Constraints include:
 - Biomass availability
 - Biomass handling system
 - General storage system balance
 - Storage constraints for bundling system
 - Woody biomass demand
 - Number of plants requiring woody biomass



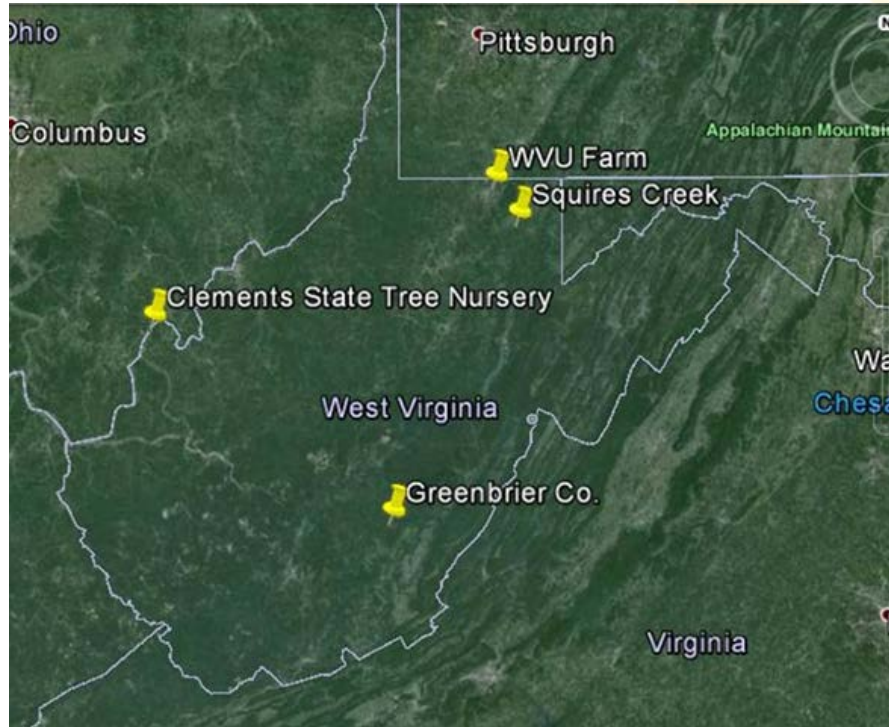
APPLIED RESEARCH/OUTREACH



- Led by Grushecky and Skousen
- Establishment research on Willow, Miscanthus, and Switchgrass
- Replicated willow sites
- Switchgrass, Willow, and Miscanthus Demonstration areas



REPLICATED WILLOW TRIAL



- 4 sites – 2 reclaimed surface mines, 1 marginal agriculture site, 1 row crop agriculture site
- Six varieties of willow established on each site



BIOCHAR TREATMENT



- Used biochar treatment to determine impacts on establishment
- High porosity
- Increase nutrient cycling
- Increase microbial activity
- Decrease soil acidity
- Carbon sink when applied to soils



REPLICATED WILLOW RESULTS



- ~50% survival in first year
- Lowest survival on row-crop site
- Better growth on treated cuttings



WV DEMO SITE



- Originally in cooperation with MWV
- 4 acre willow (6 varieties)
- 10 acre Switchgrass
- 2 acre Miscanthus



EDUCATION



- Led by Dave Devallance
- Developed from the Bioenergy & Bioproducts Education Programs (BBEP) at Cornell
- Provide professional development and hands-on teaching tools for STEM educators in the state
- Workbook activities (lesson plans) and laboratory exercises reinforced by field trips.
- Conducted 1 course in 2013, 1-week workshop to be held July 21-25, 2014



NEWBIO – MORE INFORMATION

SEARCH: THIS SITE | PENN STATE

Members' Portal United States Department of Agriculture National Institute of Food and Agriculture

NEWBio Northeast Woody/Warm-season Biomass Consortium

HOME ABOUT PEOPLE PARTNERS EDUCATION EXTENSION OPPORTUNITIES

Coppice regrowth of willow biomass crops in the spring after being harvested the previous winter.

E-News Signup
YouTube

Upcoming Events

June 10, 2014
[NEWBio Webinar: Pyrolysis of Biomass for Fuels and Chemicals](#)
Speaker: Akwesi A. Boateng, Lead Scientist, USDA-ARS, Eastern Regional Research Center, Wyndmoor, PA
1 p.m. Eastern Time
[More.](#)

September 10-11, 2014
[Next Generation Biomass Conversion Bioenergy Shortcourse Series](#)
San Francisco, CA
[Registration information](#)

Announcements

- [Switchgrass Budget for Bioenergy Production Published](#)
NEWBio adds an enterprise switchgrass budget and costing estimator spreadsheet to its growing library of tools to assist and inform landowners and farmers considering growing biomass crops. The fact sheet provides a detailed example

In the Spotlight

[Next Generation Biomass Conversion 2014 Bioenergy Short Course Offering](#)
Next up in the Bioenergy Shortcourse Series will be a two-day course on Next Generation Biomass Conversion, on September 10-11, in San Francisco. Speakers for the course will include nationally-recognized experts in biofuels conversion from the Lawrence Berkeley and Sandia National Labs, DuPont, Murrant

<http://www.newbio.psu.edu/>

