NEERA1005: Sustainable Wood Energy

November 8, 2012.

331 Forest Resources Building

Agenda

1. Welcome and introductions
2. Station reports
3. Selection of officers
4. Discussion of group activities and format
5. Close

NEERA 1005 Sustainable Wood Energy Regional Project
Progress Report for FY2011 - Prepared Nov. 3, 2011
Penn State

Research Activities

Forest Management - we are concluding a study that examines the impact and effectiveness of different biomass harvesting methods (PI: Marc McDill).

Species Development - we are conducting breeding studies of short rotation willow in an effort to develop improved varieties of the crop (PI: John Carlson).

Densification - we are conducting studies of the mechanics of biomass densification, with an eye towards better understanding and ultimately optimizing the pelletization process (PI: Hojae Yi).

Education Activities

We teach one undergraduate course in bioenergy, and are developing a total of four bioenergy courses for delivery as part of the upcoming Masters of Professional Studies in Renewable Energy and Sustainablility Systems (iMPS-RESS). Material from these courses should be available for adaptation to other education and extension purposes (Program Chair: Ali Demirici).

Extension Activities

Short Courses - We organized several short courses in the past year that were devoted to wood energy topics (Biomass CHP Systems, Cellulosic Supply Chains, Northeast Wood Energy), as part of the Penn State Bioenergy Short Course series (Contact: Dan Ciolkosz).

Website - We established and continue to develop our wood energy extension website (Site Maintenance: Dan Ciolkosz).

Webinars - We organized a series of monthly webinars on wood energy as part of a Northeast Sun Grant project (Host: Mike Jacobson).

Fact Sheets - We began development of a series of wood energy fact sheets that are designed to be easily adapted to and used in other states (Coordinator: Mike Jacobson).

Integrated Activities

We successfully submitted a proposal to establish the NEERA1005 Sustainable Wood Energy regional project.

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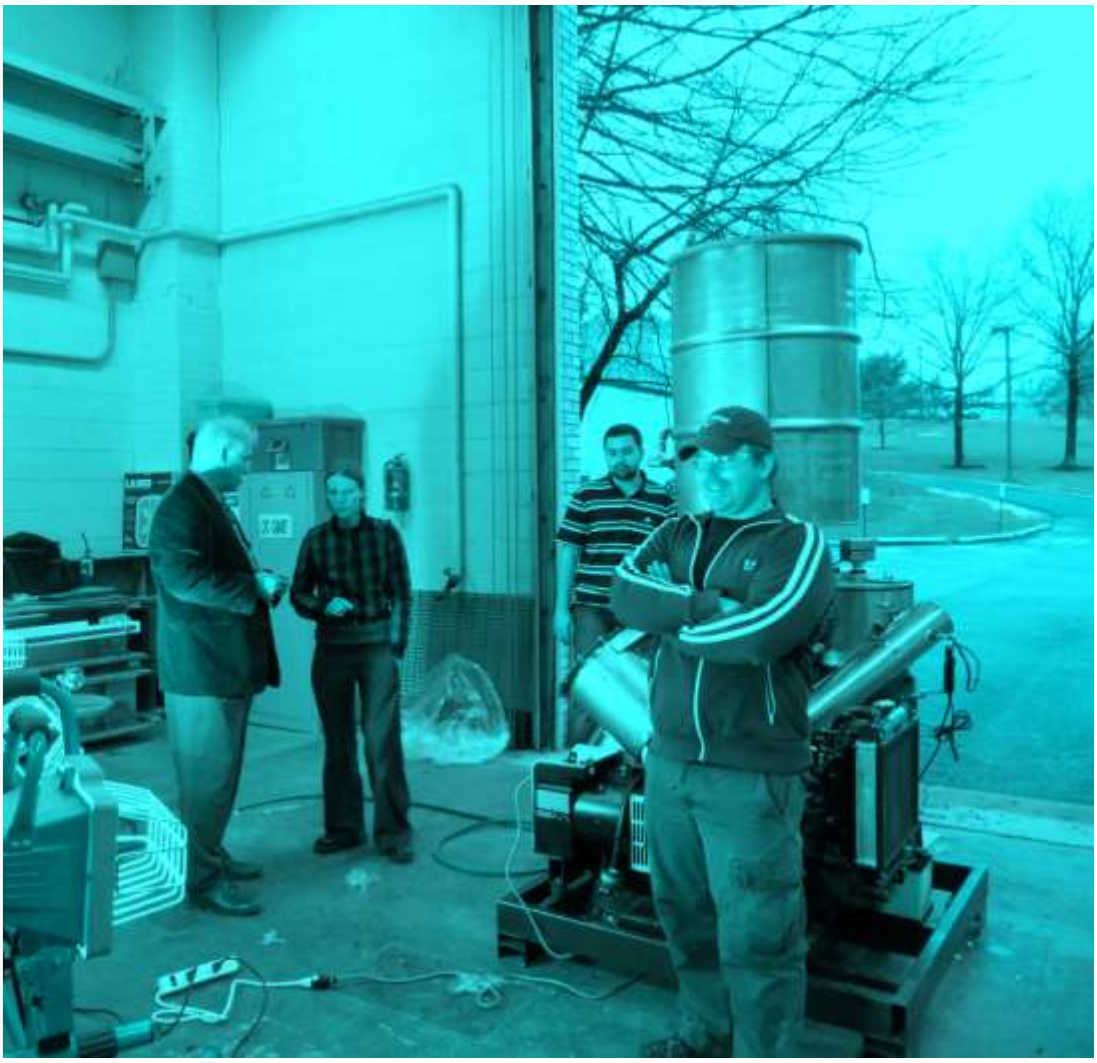
The activities at the New York State Agricultural Experiment Station in Sustainable Wood Energy are focused on the breeding, genetics, and commercialization of shrub willow bioenergy crops.

- In 2011, we produced ~800 new progeny in six families through controlled pollinations. Those progeny were produced both the aim of generating new, improved commercial cultivars, but also will be used as mapping populations to determine the genetic basis for traits important for yield, pest and disease resistance, and bioenergy production. We are beginning marker development for one of those mapping populations using genotyping-by-sequencing in collaboration with Ed Buckler's lab (Cornell, USDA-ARS) and Steve DiFazio (West Virginia).
- We planted ~12 acres of willow fields using three cultivars, 'Millbrook', 'Fabius', and 'Fish Creek' in a split field design across four parcels. In each parcel, half was fall plowed and fully disked and fitted in the spring, while for the other half, the vegetation was killed with glyphosate in the fall, but it was not plowed. The entire parcel was subjected to zone tillage in the spring using GPS guidance. On June 7, 2011 three of the parcels were planted by Double A Willow, using a GPS-guided four-row Egedal Energy Planter. The forth parcel was planted using a GPS-guided two-row NB Step Planter provided by Ag Development Services. Weed control was maintained using a combination of pre-emergence and post-emergence herbicides, including Dual Magnum and Prowl H_2O just after planting, then timely applications of Stinger and Assure II to control thistle, ragweed, and quackgrass. One field was in alfalfa previously, which was not killed effectively by three glyphosate applications prior to planting. We used a hooded application of Gramoxone to slow its growth in mid-summer, then a late season application of Stinger to further debilitate those plants. Overall establishment appears to be adequate, despite a very dry period in July.
- In collaboration with Greg Loeb (Cornell), we surveyed pest incidence in subplots of a ~13 acre trial planted in 2010 that includes seven cultivars each in two pure stand blocks and two blocks planted with a complete random mixture of those seven cultivars. The aim is to test whether a random mix of genotypes has an effect on pest and disease incidence or yield over time.
- Biomass harvested from the cultivar mixture trial and the zone tillage trial described above will be used as fuel in a wood chip boiler that will be installed to heat two farm unit buildings. An old pole barn was renovated to hold willow chips and upgrades to the heating systems of those buildings are being completed to accommodate the new boiler.
- Herbicide trials to test the phytotoxicity of Goal 2XL, Dual Magnum, Prowl H_2O, Stinger, and Assure II were conducted using seven cultivars on two sites in 2011, Geneva and Portland, NY. These data are being analyzed together with data from similar larger trials conducted in 2010 in Geneva, Fredonia, NY, and Escanaba, MI (with Ray Miller, Michigan State).
- Seven new willow varieties from the Rothamsted Research breeding program were imported under quarantine for testing in North America.

Submitted by Larry Smart, Associate Professor, Dept. of Horticulture, Cornell University, New York State Agricultural Experiment Station.

AEI- Bioenergy Initiative

West Virginia University



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Bioenergy and Bioproducts Research, Education, and Outreach Initiative at West Virginia University

1. Summary

Our *ultimate goal* is to advance an interdisciplinary and highly competitive bioenergy research team at West Virginia University to promote bioenergy research and development in the region. This bioenergy research team will facilitate the advancement of research needed to successfully bid on multi-million-dollar research awards under the USDA, DOE, and DOD. Our *long-term goal* is to establish a Bioenergy Research and Development Center at West Virginia University to provide technological innovations along with student and industry professional education, while promoting biomass utilization and economic growth of a regional industry. Advancement of the interdisciplinary bioenergy research team will not only strengthen existing collaborations in bioenergy research, education, and extension within WVU, but also put WVU in a leading position for regional collaborative projects with other universities, government agencies, and industry partners. The bioenergy team will be committed to collecting preliminary data and fostering relationships that are necessary for targeting larger grant proposals.

The team will focus on developing biofuel and bioenergy programs using West Virginia's abundant resources of biomass, coal and natural gas in four major categories: (1) Feedstock development, (2) Biofuel and bioenergy development, specifically "drop-in" biofuel and bioproduct development, (3) Biofuel development analysis, and (4) Education and outreach.

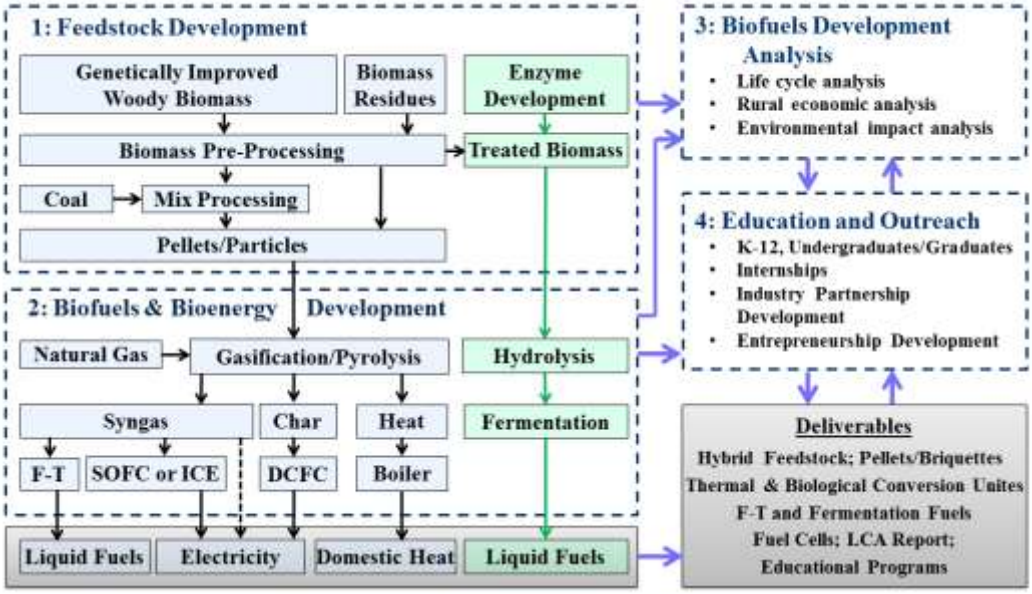

Figure 1. Concept flowchart of the proposed bioenergy programs.

2. Background and initiative

Concerns over energy security, environmental and human health, rural economic development, and the need to diversify products and markets for forestry and agriculture have resulted in a critical need to develop sustainably produced biomass feedstock, biofuels, bioproducts, and bioenergy. This interdisciplinary, innovative research team, and its ongoing research activities, aims to assist the United States in reducing its dependence on imported fuels. The projects conducted by this team fit WVU's Advanced Energy institute (AEI) for "Sustainable Energy" development, as well as the state and national energy strategic plans. We believe this effort will benefit the state of West Virginia by improving the utilization of West Virginia's abundant unique resources of biomass, coal and natural gas, by

strengthening the economy and rural community/workforce and by helping position West Virginia University on the forefront of bioenergy research and development.

3: Relevance and Merit

The Appalachian region is one of the most economically deprived areas in the U.S., but it is the most important hardwood producing region in the U.S. Approximately 65 million acres of timberland are located in the region. Forest growth continues to outpace removals at nearly a 2 to 1 ratio in the region, which indicates that the forestlands are currently managed sustainably. The Appalachian region produces high quantities of woody biomass and residues on an annual basis, which can be used together with the abundant coal resources to produce syngas, liquid fuels, biochar, and electricity. We propose creation of a deployable carbon-neutral hybrid biomass processing/conversion fuel system that will use mixtures of woody biomass and waste coal to yield syngas, liquid fuels, biochar via the torrefaction and gasification process, and electricity via the direct carbon fuel cell. The initiative will include the development of biomass feedstock appropriate for the region, biofuel and bioenergy technology, and business analyses. Our deliverables will be used for demonstrations to promote regional economic development.

4: Energy Efficiency/ Displacement, Rural Economic Development, and Environmental Benefits

The United States consumes 84% of its total energy from fossil fuel (39% from petroleum, 22% from coal, and 23% from natural gas) and only 3.5% of the total energy from biomass. In contrast, globally 13.3% of total energy is derived from biomass. The total available biomass in United States is quantified as 423 million tons/yr. There appears an essential need to efficiently and sustainably utilize woody biomass for bio-energy to substitute fossil fuels or coal to some extent in the U.S.

The Appalachian region is one of the most rural and economically deprived areas in the U.S. Per capita personal income was 20% lower in Appalachia than in the nation as a whole in 2007, $29,274 as compared to $36,601. Unemployment trends in Appalachia closely tracked the nation as a whole during the expansion phase of the business cycle and in 2008, the first year of the recession. In the fourth quarter the unemployment rate in Central Appalachia was 1.5% higher than the national average and somewhat lower in northern and north-central Appalachia. Nearly two-thirds of Appalachia's 420 counties have a higher unemployment rate than the nation as a whole. Not only will the team's research help reduce the use of nonrenewable fossil fuels, it is expected to lead to less dependency on foreign fuels and this initiative promote the economic development through job creation and income stabilization in disadvantaged rural areas of the region.

Promoting coal and biomass blends will not only increase U.S. share of biomass energy but also reduce greenhouse gases (GHGs) significantly. Biofuels from waste biomass or from biomass grown on degraded and abandoned agricultural or mining lands incur little or no carbon debt and offer immediate and sustained GHG advantages. Biomass is a carbon-bearing renewable energy resource, which makes it especially valuable for making carbon-bearing liquid transportation fuels. The carbon contained in biomass is not counted as a carbon input penalty since the biomass has removed this carbon from the atmosphere by photosynthesis. Our proposed fuel system will result in a lower life-cycle GHG emission rate and represents an opportunity to not only mitigate the impact of carbon fuels at stationary sources, such as the production facility, but also the impact of mobile sources such as automobiles that burn the product fuel. Because our research will use non-food biomass as a feedstock, such as forest residues and short rotation woody crops that would be grown on dedicated energy plantations, pressure on the supply of food-based biomass production will be alleviated.

5. WVU's Strengths in the Research Area

An interdisciplinary bioenergy research team is in place at West Virginia University. The team includes more than 10 key personnel from WVU's three colleges: the Davis College of Agriculture, Natural Resources and Design; Eberly College of Arts and Sciences; and College of Engineering and

Mineral Resources. Our strengths in bioenergy research include biomass feedstock development (Drs. DiFazio and Hawkins); biomass processing, harvesting, logistics, economic and environmental analysis (Dr. Wang); thermal chemical conversions of biomass/coal and bioproduct development (Drs. Zondlo, Singh); feedstock preprocessing (Dr. DeVallance); industry partnership and entrepreneurship development (Mr. Grushecky); direct carbon fuel cell and chemicals (Drs. Zondlo and Sabolsky); energy efficiency and analysis (Dr. Gopalakrishnan). *The team members obtained more than $19 million of funding with more than 95 projects, published more than 120 journal papers in the past five years for biofuel, bioenergy and bioproducts research.* The three Colleges have good bioenergy related facilities, equipment and software tools available to the group.

Over the past five years, the research team members have been working on several bioenergy research projects to produce biofuels and bioproducts. The research team members have established excellent relationships with other universities, national labs, and industries. The research team, along with collaborating institutions, has prepared numerous proposals in the past five years. Specifically, the team has submitted *four multi-university/institution proposals* in 2010.