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The University of Iowa Biomass Partnership Project

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The University of Iowa Biomass Partnership Project

Abstract
Biomass may be obtained from existing sources, such as industrial co-products (e.g., oat hulls and paper sludge), from the forest using managed timber stand improvement, and from growing perennial dedicated energy crops on marginal lands. Each of these sources may be developed in a manner that improves the sustainability of the University of Iowa energy supplies.

Keywords
Natural Resource Ecology and Management, Bioeconomy and energy

Disciplines
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How does The University of Iowa source biomass fuels to meet its 2020 goal of 40 percent renewable energy?

There are a number of biomass sources within 50 miles of Iowa City. Biomass may be obtained from existing sources, such as industrial co-products (e.g., oat hulls and paper sludge), from the forest using managed timber stand improvement, and from growing perennial dedicated energy crops on marginal lands. Each of these sources may be developed in a manner that improves the sustainability of the UI energy supplies.

Background

This project sought to help the University of Iowa identify and establish sources of renewable energy in its quest to achieve 40 percent renewable energy by 2020, one of the university’s designated sustainability targets. The Biomass Partnership Project (BPP) was established to plan for and develop new and additional supplies of renewable solid fuel (over 100,000 tons per year). Biomass will be co-fired with coal at the University of Iowa (UI) Main Power Plant, while simultaneously improving environmental performance of Iowa lands and resources (soil, water, air, plants and animals) and stimulating the local rural economy.

The objectives of the Biomass Partnership Project are to:
- Develop a plan that will increase energy sustainability at the UI while improving environmental performance of Iowa lands
- Develop a financial and procurement work plan for biorenewable fuel
- Produce, disseminate, and share processes and plans useful to urban communities, businesses, policy makers and industries in the region considering biorenewables as a fuel source

Approach and methods

In December 2010, the UI Office of Sustainability established a biomass partnership project (BPP). The purpose was to bring together and consult with a diverse group of experts in agronomy and agriculture, forestry and forest products, equipment manufacturers, fuel suppliers, environmental regulation and policy areas associated with co-firing biomass and coal. Participants in the BPP include the Iowa Department of Natural Resources director’s office as well as forestry and geographic information systems departments, U.S. Fish and Wildlife Service, U.S. Department of Agriculture, Natural Resources Conservation Service, Amana Forestry, John Deere, River Trading Company (UI’s coal supplier), Iowa State University faculty, Leopold Center for Sustainable Agriculture and University of Northern Iowa faculty.
The BPP focused on seven areas related to developing sustainable (environmental, social and economic attributes) sources of biomass fuel from the local area (50-mile radius from Iowa City).

**Dedicated Energy Crops.** A number of perennial plant species possess attributes beneficial for co-firing with coal, while simultaneously providing environmental and ecological benefits. The team determined it would be appropriate to begin developing a pilot production-scale planting of a specific clone of miscanthus grass. Acreage where relatively high amounts of chemical use and tillage are required for profitable row-crop production may be better suited for energy crop production due to reduced input requirements. Revenue generated from dedicated energy crops would be indexed to energy costs instead of agricultural commodity prices.

**Timber Stand Improvement (TSI).** TSI involves removing selected biomass material from the forest. Motivation for a TSI project is dependent on the landowner’s desires, including increasing commercial timber development, benefiting wildlife habitat, developing recreation, etc. Sustainable removal of forest material must be done under a management plan developed by a qualified forester. The local area’s timber industry is relatively small when compared with other areas in the country. It is likely TSI will be able to supply only a limited amount of biomass on a project-specific basis.

**Intrusive/Undesirable Species Removal.** Selected species of plants (e.g., reed canary grass) proliferate in areas where floodwaters kill native plant species. In publicly managed lands, this inhibits restoration of prairie and other more desirable ecological land uses. The project investigated harvesting and using these plants as a source of biomass fuel. The process requires harvesting in the fall, collecting and transporting, drying, densifying and storing the material prior to use. The combination of relatively low yield delivered by this process, the amount of processing required, and the limited amount of managed land available to harvest led the team to conclude that other higher yielding sources should be explored before developing this potential biomass source. (The researchers were later contacted by a vendor that does land management of public lands. He believes they can harvest reed canary grass and turn it into fuel.)

**Geographic Information Systems (GIS).** Land use data is available through various local, state and federal databases. GIS was used to determine the amount of “marginal” local land currently in corn or soybean production. There is sufficient “marginal” land in the area to allow 3,000-6,000 acres to be developed for dedicated energy crop production and satisfy 30 to 60 percent of the new renewable energy demand.

**Procurement and Logistics.** This area focused on identifying industrial organic byproducts suitable for use as biomass fuel in the local area and biomass handling, storage processing and storage issues. Using organic byproducts as biomass fuel is preferable to landfilling. However, the byproducts vary widely in availability and chemical and physical properties. Investigators will continue to find, evaluate and develop several viable sources of this material. The UI Main Power Plant does not have space available to expand for biomass processing (e.g., densification) and storage (silos).
Biomass fuel is less energy dense and requires up to twice the number of trucks to transport the same amount of energy compared to coal. As the amount of biomass used in co-firing increases, being able to densify (pelletize or cube) some or all of the biomass will be advantageous. Investigations into alternative fuel delivery processes, such as an off-site fuel yard and rail transportation, also are being conducted.

**Regulatory and Policy.** Environmental regulation of combustion sources is a complex topic and requires specialty consultants to prepare permit applications for submission to the Iowa Department of Natural Resources. Stack gas testing usually is required prior to issuing a final permit for a new fuel. These processes and procedures have been integrated into the plan for increasing biomass fuel consumption. Revised permits for both UI solid fuel boilers are now in place.

**Ecological Services.** Understanding the impact of using biomass as a boiler fuel from an ecological perspective will assist UI in maximizing the sustainable attributes of the fuel choices. Potential ecological services offered by biomass fuel include improved soil conservation characteristics of perennial plants, reduced agricultural chemical use and increased soil carbon inventory.

**Results and discussion**

Sources of biomass energy considered for this project were studied and evaluated to gain an understanding of a particular fuel’s traits in the three sectors of sustainability — economic, environmental and social. This analysis will help decision-makers to see beyond simple ‘lowest first cost’ analysis and provides for increased consideration of fuel traits and characteristics that may be difficult to monetize. For example, if considering harvesting wood from the forest as a source of biomass fuel, the harvest may be accomplished using a forest management plan developed by a qualified forester, or clear cutting the forest land may be entirely appropriate and necessary, such as in ecological restoration of prairies. The management plan is designed to ensure a sustainable harvest – one that improves forest health and productivity. Another example is changing land use from row-crop production to energy crop production. This change needs to be analyzed to ensure it is an appropriate use of that particular plot of land and not better suited to some other use. Finally, industrial byproducts considered for use as boiler fuel should not have other uses that would be more beneficial compared to using the material as boiler fuel. If a byproduct could be recycled, that is a higher use than using the material as boiler fuel. If the only other use of the material is landfilling, using the material as a boiler fuel is preferred, provided it is not a hazardous waste and has suitable physical and chemical properties for combustion.

**Conclusions**

This project developed a plan to sustainably increase use of renewable energy at UI to 40 percent by 2020. The plan calls for sourcing biomass from growing dedicated perennial energy crops, organic industrial byproducts, wood from forests and op
portunity wood fuels (trees damaged from storms, disease and land clearing). Procuring solid fuel renewable energy from these sources offers local farmers and businesses an opportunity to tap a new revenue source. It will redirect funds paid for fossil fuel that go out-of-state to an area within 50 miles of Iowa City. For farmers and growers, dedicated energy crops grown on marginal lands will produce significant ecological benefits in addition to offering them a market for a new perennial energy crop. The project is now in transition from planning to production development. The current primary focus is expanding the growth of dedicated energy crops and developing long-term supply agreements for wood chips and energy crops.

**Impact of results**

This project has the potential to stimulate development of a new agricultural commodity and accompanying market in southeast Iowa. It can be done in a manner that produces ecological and environmental benefits, including mitigating nutrient runoff, reducing soil compaction, increasing soil organic content, sequestering carbon and reducing air pollution from burning coal. The project also has social benefits, including financial and employment stimulus to the local agricultural economy as well as economic benefits such as procuring fuel locally instead of out-of-state. The project objectives were achieved, but significant work remains before the University of Iowa is able to achieve its goal of using 40 percent renewable energy.

**Education and outreach**

A website was established to share results and information about the biomass project: [http://sustainability.uiowa.edu/biomass/](http://sustainability.uiowa.edu/biomass/) A four-page Biomass Fuel Project brochure and two banner stands were produced for use at meetings.

Presentations about the biomass fuel project:

- Johnson County Historical Society,
- Iowa Association of Electric Cooperatives,
- Muscatine Rotary,
- University of Iowa Finance and Operations senior staff,
- Old Capital Kiwanis, Iowa City,
- University of Iowa Water Sustainability Advisory Board,
- Iowa State Senators Joe Bolkcom and Robert Hogg,
- 2012 Iowa State Fair,
- Iowa Recycling and Solid Waste Management Conference and Trade Show Iowa City,
- Nathan Young of the Iowa Flood Center and Ferman Milster of the UI Office of Sustainability each presented to the 2012 BioCycle conference in St. Louis, Missouri,
- Iowa City Sunrise Optimists, and
- Iowa City Public Library.

The project was featured as part of a series of three workshops sponsored by ISU Extension and the Leopold Center. Workshops were held April 18, 19, and 20, 2112 in three southeast Iowa cities. Information on the biomass fuel project was presented and stimulated discussions about how the project could use urban wood.
Two UI undergraduate class projects were related to the research:

- Sustainability Systems Class, spring 2012 semester, student project produced a video on Timber Stand Improvement.
- College of Engineering Program for Enhanced Design Experience, winter 2012/spring 2013, team of undergraduate engineering students generated a conceptual design for an off-site biomass fuel yard project.

**Leveraged funds**

No additional funds were leveraged.

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**Miscanthus planting 2013.**

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