University of Idaho

Prosperity *and* Sustainability: UI Wood-Based Bioenergy Development Project

Issue 3 Spring 2015 rev.

Project Update

Our team of students, staff, and faculty from the University of Idaho (UI) is in the final year of a 3-year project exploring the social and economic opportunities and challenges associated with wood-based bioenergy development in the Northern Rocky Mountain region of the northwest.

A $350,000 grant from the U.S. Department of Agriculture's Agriculture and Food Research Initiative supports the interdisciplinary effort to understand the tradeoffs and feasibility of bioenergy development options from multiple perspectives.

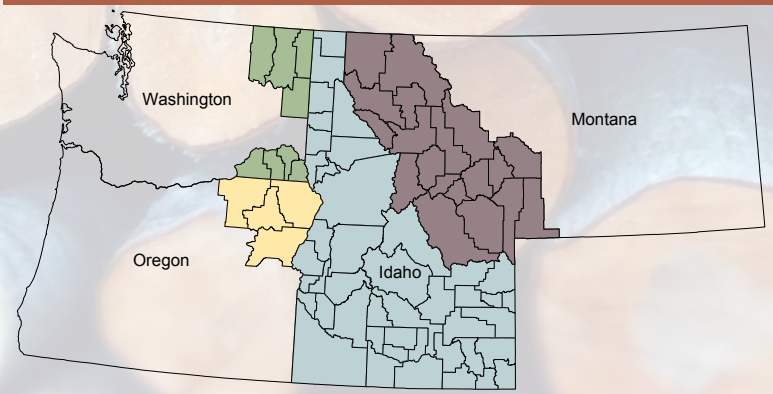
In July 2014, we convened our first Advisory Committee meeting. The Advisory Committee includes representatives from communities, industry, economic development, tribes, universities, government, and non-profit organizations. The Advisory Board provided valuable suggestions that strengthened our economic and supply chain models, simulations, and assessments. The board also helped interpret and validate the findings from stakeholder interviews we conducted in 2013.

We have worked with stakeholders to understand their knowledge of and interest in the use of woody biomass from local forests as a renewable energy source. Through interviews, meetings, and other interactions, we learned that many stakeholders would like to learn more about the technological feasibility as well as environmental, social, and economic tradeoffs associated with current and proposed bioenergy development projects. Generally stakeholders said the top objectives for any wood-based bioenergy development in the region should be promoting forest health and rural economic development.

This spring, researchers focused on finalizing and strengthening the modeling and simulation tool they developed in Year 2, and will finish the optimization modeling analysis by the end of summer 2015.

Study results will provide useful information for public and private decision-makers at the community, state, and regional levels. Our goal is to provide meaningful research that will help communities and agencies make informed decisions.

Study Region:



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A project of the Agriculture and Food Research Initiative: Socioeconomic Impacts of Wood-Based Biofuels Development Strategies on Northern Rocky Mountain Communities in the Northwest. Grant #2012-00948

USDA

RESEARCH TEAM UPDATES

COMMUNITY OUTREACH TEAM

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Objective: Engage stakeholders to guide the project and interpret project results.

After an initial stakeholder and scenario development meeting in 2013, the outreach team (Darin Saul, Soren Newman, and Debbie Gray) recruited an Advisory Board to provide grounded feedback on research and activities. The Advisory Board will also assist interpret and disseminate our project results to their own stakeholder groups. The board includes members representing economic development organizations, forest and energy industry, conservation groups, natural resource management (state and tribe), and university researchers from several related projects.

We held the first Advisory Board meeting in July 2014. Each project team provided updates, presented preliminary results, and highlighted next steps. The Advisory Board discussed the project, gave suggestions to strengthen the modeling/simulation and economic impacts assessment, and helped interpret and validate results of the stakeholder interviews conducted in 2013.

The next Advisory Board meeting will be in Moscow, Idaho, in June 2015. We will present research results and demonstrate the modeling tool to the Advisory Board to gather input and reactions to the project results. The board will also assist in developing our plan to distribute research findings.

The outreach team will convene several stakeholder meetings during late summer and early fall 2015 to disseminate project results to relevant community stakeholders. We will also collect feedback from attendees at each event.

The project team will develop and disseminate a final outreach publication for non-academic stakeholders during the fall of 2015. Finally, the team is developing a synthesis article to summarize the overall project and research findings that will be submitted to a peer-reviewed journal in 2015.

ECONOMIC IMPACTS TEAM

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Objective: Evaluate the economic impacts and contributions of each scenario, including backward economic linkages and the appropriateness of each strategy.

Professor Steve Peterson will begin economic impact analysis in summer 2015 after each team has finalized their data results. He will also analyze the economic impact of each scenario.

Peterson will present a paper at a professional conference on the results of the analysis in fall 2015 and will contribute findings to the project synthesis article and outreach materials.

REGIONAL OPTIMIZATION MODELING TEAM

Objective: develop a nonlinear optimization model to evaluate scenarios using different production technologies, varying fuel product pricing, and varying levels of production subsidies.

Professor Stephen Devadoss and M.S. student Eli Kosse gathered and analyzed relevant data (e.g. input and output prices, biofuel demand, and costs associated with production and distribution) to share with the other teams for final analysis. Kosse will complete his M.S. in Agricultural Economics in summer 2015.

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SIMULATION AND MODELING TEAM

Objective: Model overall viability and profitability of bioenergy strategies for woody biomass from community, state, and regional perspectives.

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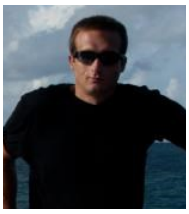

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Ryan Jacobson (M.S. student) and Professors Rob Keefe and Scott Metlen continue to refine and improve on their model of the overall profitability of bioenergy strategies in the Inland Northwest.

Keefe and Metlen have co-mentored Jacobson in experimental design, field research, and simulation modeling. Jacobson will complete his M.S. in Natural Resources, with a joint Certificate in Bioregional Planning, in summer 2015.

Jacobson, Keefe, Newman, and Saul will develop Jacobson's second thesis chapter into a peer-reviewed journal article in spring 2015. Findings will also be summarized and presented in the project synthesis article.

Keefe and Jacobson attended and presented the team's research at the Bioenergy Alliance Network of the Rockies (BANR) Annual Meeting in Moscow, Idaho, (October 2014), the Society of American Foresters Annual Meeting, and the International Union of Forestry Research Organizations (IUFRO) world congress in Salt Lake City, Utah, (October 2014).

This project is supported by the Agriculture and Food Research Initiative of the National Institute of Food and Agriculture, Grant # 2012-00948
To enrich education through diversity the University of Idaho is an equal opportunity/affirmative action employer and educational institution.

Year One Results: Scenario Development

With input from industry and government stakeholders, researchers developed three scenarios (local, regional, and international) to help determine potential economic and operational impacts of woody biomass production, conversion, and transportation in the Northern Rocky Mountains.

LOCAL, DECENTRALIZED SCENARIO

MOBILE CONVERSION STATIONS

Woody biomass is used to produce **drop-in fuels** and **biochar**. In this scenario, gasoline and biochar will be produced at mobile conversion stations located, for example, near areas that have high production of chips and **hog fuel** from logging residues, small diameter trees, and lodgepole pine killed by mountain pine beetle outbreaks. Chips and hog fuel processed within stands or at log landings will be transported directly to conversion unit sites without further intermediate processing. The small-scale mobile conversion stations will be located regionally in areas where a combination of large volumes of logging slash and/or beetle kill **feedstocks** are most readily available (e.g., the Jaype log yard in Headquarters, ID, and the Clarkia, ID, log sorting facility). Gasoline and biochar products will be transported by truck or rail to the location of their end use.

REGIONAL SCENARIO

BIO-AVIATION FUEL

Woody biomass in the form of chips or hog fuel from commercial logging residues and small diameter trees removed in thinning operations will be transported to a single, very large (more than 700,000 **BDT** per year) **Gevo-**owned bio-aviation fuel facility regionally located, either in Colville, WA, or western WA. This scenario corresponds directly to the Northwest Advanced Renewables Alliance (NARA) biofuels project analysis for the Northern Rocky Mountain region. Our analysis will expand on the NARA scenario to include the possible use of intermediate pre-processing plants, or depots, where chips and hog fuel will be upgraded to wood pellets, in order to increase the cost-effective transportation distance of feedstock materials that can feed the regional biofuels facility. For example, chips and hog fuel might be turned into pellets at a small pellet facility located at the Jaype log yard in Headquarters, ID, or the Clarkia, ID, log yard before subsequent transportation to the large biofuels facility in Colville, WA.

INTERNATIONAL SCENARIO

WOOD PELLET MANUFACTURING FACILITIES

Woody biomass in the form of chips or hog fuel from commercial logging slash (e.g., tree limbs, tree tops, and brush) and small diameter trees removed in thinning operations will be transported directly to a large wood pellet manufacturing facility in the Northwest region. Colville, WA, Lewiston, ID, and St. Maries, ID, will be considered as the pellet facility locations. Wood pellets will be shipped via truck, rail, or barge to coastal ports and then to international markets where there is significant demand. This scenario will be modeled after similar, high production pellet facilities in the southeastern United States and Vancouver, B.C.

RELATED PROJECTS IN THE ROCKY MOUNTAIN REGION

The **Northwest Advanced Renewables Alliance (NARA)** aims to build a supply chain for aviation biofuel with the goal of increasing efficiency in everything from forestry operations to conversion processes. The project includes a broad alliance of private industry and educational institutions from throughout the Northwest. Specific areas of focus are: education and outreach, providing a biomass-derived replacement for aviation fuel and other petroleum-derived chemicals, feedstock production, and evaluation of the social, environmental, and economic viability of the overall wood-to-biofuels supply chain. **Website: http://www.nararenewables.org/**

The **Sustainable Bioenergy Alliance Network of the Rockies (BANR)** brings together scientists (including University of Idaho's **Rob Keefe**), educators, and extension specialists from universities and government agencies across the region to work with industry and develop a comprehensive program addressing the major challenges limiting feedstock development, production, logistics, and utilization of insect-killed trees for the production of biofuels and biochar. BANR approach focuses on five major task areas: feedstock supply; feedstock logistics and processing; system performance and sustainability; education; Extension, outreach, health, and safety. **Website: http://banr.colostate.edu/**

BIOFUELS 101

BDT (Bone Dry Ton)
The volume of wood chips that would weigh one ton if all moisture content was removed

Biochar
A charcoal byproduct that captures and stores carbon dioxide from the atmosphere and can be used as an agricultural soil amendment.

Biofuel
A renewable energy derived from plant materials, to be used for heat, electricity, or vehicle fuel.

Drop-in fuels
Biofuels that are very similar to diesel, gasoline, and jet fuel and are ready to "drop-in" to existing infrastructure.

Feedstock
Any renewable, biological material that can be used directly as a fuel, or converted to another form of energy.

Gevo, Inc.
A renewable chemicals and advanced biofuels company headquartered in Douglas County, CO.

Hog fuel
An unprocessed mix of coarse chips of bark and wood fiber.

Woody biomass
Wood and wood-based residues (e.g., tree limbs, tree tops, brush, small diameter trees and other material derived from forest vegetation). Often an unused byproduct of current logging practices.

Year Two Results: Outreach and Modeling

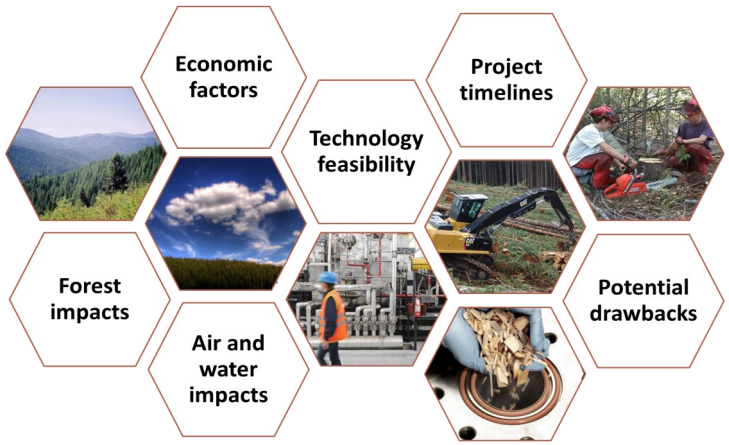
Community Outreach

Interviews with 49 stakeholders, including local and state elected officials, economic development professionals, industry, and others, investigated their perspectives on the benefits, obstacles, and tradeoffs of different bioenergy development scenarios.

Initial analysis of stakeholder interviews reveal:

- **'Most important' considerations:**
  Forest health and economic development in rural areas
- **Primary concerns:**
  Overharvest, air quality, and that rural communities will not benefit
- **Primary obstacles:**
  Biomass availability and access
- **Scenario preference:**
  Small-scale bioenergy development scenarios

Stakeholders want to know more about:



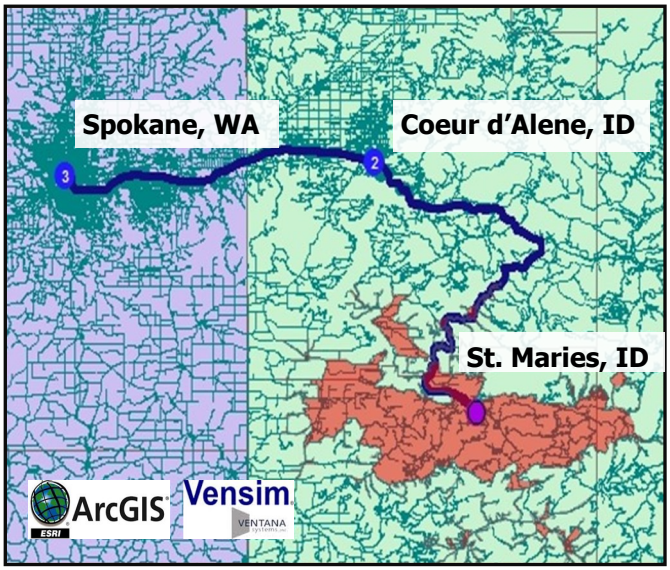
Simulation and Modeling:

First year activities:

- Developed a new geospatial simulation model to compare local, regional, and international bioenergy development scenarios using **ArcGIS and VenSim.** *See map at right.*
- Compared production rates and component costs for bioenergy development to provide the basis for analyzing economic impacts on local communities.
- Incorporated feedback from stakeholder interviews.

Initial results:

International pellet production (at $19.96 / million BTU) is the least expensive of the three scenarios. Processing costs for this relatively simple manufacturing process were lower than those associated with **local ($23.45 / million BTU)** or **regional ($23.73 / million BTU)** biofuel facilities. Pellet production costs were low enough to offset the additional mileage associated with transporting pellets to coastal ports (Seattle, WA) from the Inland Northwest.



Local Scenario Map:

The orange shaded areas show the 90 minute drive-time draw radius for logging residues adjacent to **Saint Maries, ID**. Residue estimates are from the Timber Products Output (TPO) database.

The blue line shows the shortest drive-time path from **St. Maries, ID,** to **Coeur D'Alene, ID,** where biomass is converted to a liquid biofuel. The fuel is then moved along the shortest path to **Spokane, WA,** to be used in cars or jets (liquid biofuel), or to generate electricity (pellets).