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Executive Summary

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Spatial Implications of a Wood Gasification System at UW-Stevens Point

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Executive Summary

This report explains a new model for calculating logging residue availability in Wisconsin. The Center for Land Use Education and the College of Natural Resources at UWSP designed and performed this study to use Geographic Information Systems (GIS) technology to investigate biomass as a feedstock to replace UW-Stevens Point's coal and natural gas consumption.

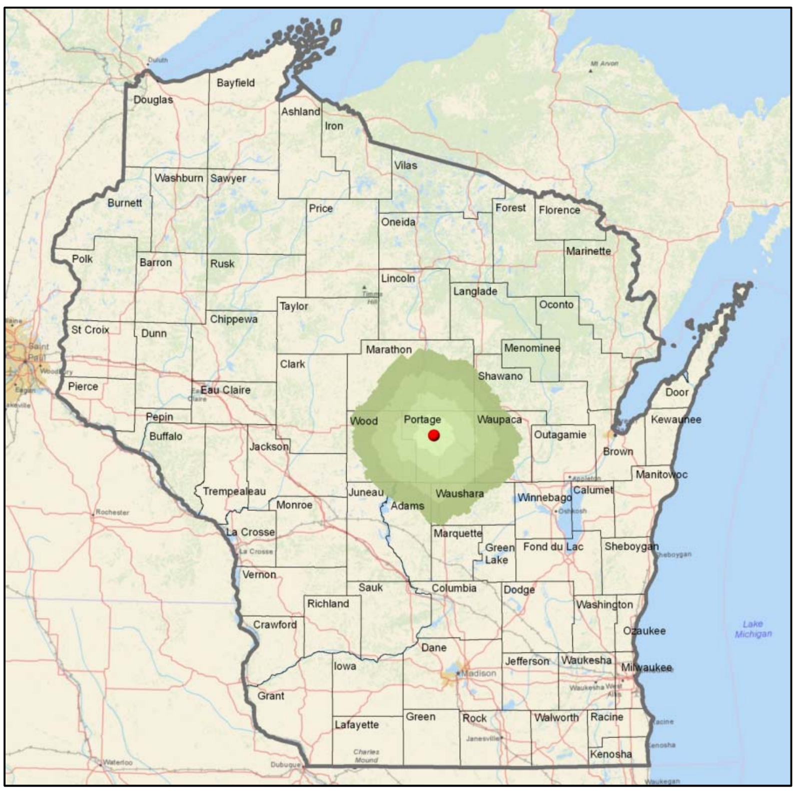
The University of Wisconsin - Stevens Point (UWSP) presently consumes over 200,000 MMBtu equivalent of purchased electricity and nearly 250,000 MMBtu equivalent of non co-generation fixed energy to meet its annual operating needs (Oehler 2009). The UWSP stationary facility uses coal and natural gas to heat and cool the campus. Part of the rationale to examine this type of facility was prompted by the Governor's selection of UWSP as one of a handful of state-owned facilities that would plan for a more energy-independent future, and UWSP's previous chancellor signing the President's Climate Pact, which committed the campus to a carbon-neutral future. Therefore, to meet these goals, the campus is in the early stages of investigating a biomass facility that would reduce its demand for gas and coal.

Wisconsin has a large and diverse forest resource base that could potentially provide the campus with renewable energy. Feedstock for the campus's biomass energy production could come from the harvest of non-merchantable timber and/or harvest residues. Residues from logging operations include limbs, tops, small trees, and dead or dying trees. Following a timber harvest, forest residues typically are left on site because of their low economic value. Currently, there is only minimal published research that quantifies the amount of available harvest residue in the state. However, a large amount of proprietary research has been conducted in this area over larger regions of the northern portion of the state related to feedstock for planned facilities. To understand the ramifications of such a biomass facility on campus, we generated a spatially explicit dataset of potential timber harvest residue from various spatial and non-spatial databases. We used GIS software to translate biomass residue volume required by the campus into a plausible landscape scenario in central Wisconsin. We also identified and mapped different facilities that are currently using biomass resources for thermal heating, bioenergy production, and electricity as well as their supply distances. The amount and distance traveled for each facility were used as constraints in our model. The results of this study will help campus officials visualize the spatial distribution and abundance of timber harvest residue in Wisconsin and can be used to approximate a 'harvestshed' or the land area needed to meet projected feedstock demands. This project provides a model and template for other institutions and businesses considering the feasibility of bio-fuel projects. This model also can be used to understand competition among numerous facilities over the same biomass resources.

Our spatial approach to quantifying available harvest residue in Wisconsin is unique in that it generates a detailed map layer that depicts the potential oven dry tons of residue for the entire state while taking into account both environmental and physical constraints. Building the model in an ArcGIS framework allows the user to make changes, modify assumptions, and re-run it to produce multiple scenarios.

Key Findings

Factoring in harvest and resource demand constraints, our spatial model shows that Wisconsin generates 1.3 million oven dry tons of forest harvest residue annually. As a comparison, in 2008, the Wisconsin Department of Natural Resources (WI DNR) estimated that there was over 1.5 million dry tons of forest residue available at 70% recovery rate for the entire state. Using ArcGIS Network Analyst, we identified feedstock supply zones at 10-mile increments out to 100 miles from the campus's physical plant and summarized the potential availability of harvest residue in each zone. Presently, our campus is considering a 600 horsepower boiler system that could produce nearly all the steam needed, except on the coldest days. It is estimated that a boiler that size, running 50% green basis moisture content would consume about 34,000 green tons, or 17,000 oven dry tons of biomass per year. At that size, we estimate that our biomass "harvestshed" to be somewhere between 30-40 miles. The model we developed assumes that a biomass storage site would be located on the UWSP campus. However, due to space and delivery challenges, campus officials are considering an off-site aggregation yard where harvest material would be chipped and dried before transported to campus. The final location of such a site could dramatically change transportation costs and the harvestshed scenario presented here.



We set out in this research to explore the potential for regional availability of woody biomass resources and draw upon GIS technology to calculate the land area needed to meet the campus's renewable energy needs. We focused on a set of readily available data and expert professional advice from several disciplines to model the geographic distribution of biomass in Wisconsin. Our results look promising and are more spatially advanced than other methods. We show that there appears to be enough logging residue within 40 miles of campus to meet current energy demands. Interestingly, with UWSP's harvestshed completely within another user's source area, enough biomass material exists to meet energy needs.

The maps shown in this report provide a much more detailed picture of not only biomass resource exclusions, but also where possible extraction opportunities exist. The datasets generated from this research could be easily accessed and queried to measure and analyze a wide variety of woody biomass development scenarios.