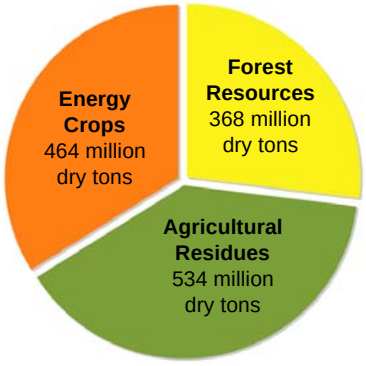
Biomass, Biofuels and Bioenergy:
Feedstock Opportunities in Michigan

Robert E. Froese, Ph.D., R.P.F. – froese@mtu.edu – **February 2007**

Forest Resources & Environmental Science
Michigan Tech



The US Department of Agriculture and Department of Energy estimate that enough biomass is available from urban waste, agricultural and forest sources in the United States to produce enough biofuels to displace 30% of current gasoline consumption. Of the 1.3 billion dry tons per year potentially available, dedicated energy crops and forest resources contribute 464 and 368 million dry tons per year, respectively.

Forecast Bioenergy Feedstock Supply in Michigan in dry tons per year.

Biomass Feedstock		Potential Supply	Currently Available and Unutilized	Available at $25/ton Farmgate Price
Forestry	Sawmill and pulp mill residues	1,764,796	Negl.	405,903
	Logging residues	869,468	869,468	113,031
	Thinning residues	1,875,978	1,875,978	243,877
Forestry Total		4,510,243	2,745,447	762,811
Urban Wood Waste		1,311,382	1,311,382	314,732
Dedicated Energy Crops		4,418,226	Negl.	44,182
Grand Total		10,239,851	4,056,829	1,121,725

Sources: USDA, DOE, Walsh (2006) and Michigan Technological University.

Supply of lignocellulosic (woody plant source) feedstocks depends on many assumptions. The potential assumes all land is available and energy crops are substituted for some food crops. Only forestry sources and urban wood waste are currently unutilized and available. The DOE has used a price of $25 per dry ton in feasibility analyses but at this price only a fraction of the potential is forecast to be actually available. Forecasts are currently very preliminary and reducing uncertainty in price and supply are critical to reduce risk and uncertainty that limit investment.

Among potential bioenergy feedstocks, forestry sources have some of the best attributes in terms of feasibility and environmental sustainability. Corn, for example, requires extensive cultivation, fertilization and pest control to ensure high productivity. In Michigan our forests, while not as productive per acre as corn, are extensive and largely unutilized as biomass sources. Extracting forest residues can be done sustainably with existing low-impact harvesting technologies creating essentially a new product from an existing resource.

Corn is energy and cultivation intensive - forest residues are not.

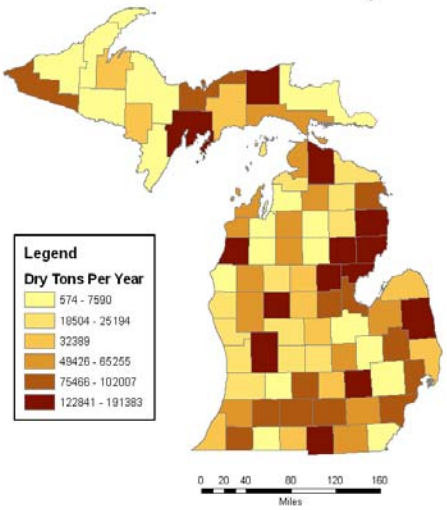
The Ideal Biomass Crop?	Forest Residues	Corn	Short-rotation Woody Crops	Perennial Grasses
Highly productive	no	yes	yes	yes
Widely available	yes and unutilized	limited	near none	near none
Site impact	low	very high	low	low
Low energy inputs	very low	very high	low-moderate	low
Noninvasive	yes	not relevant	genetically-modified	usually
Few pests or disease	usually	no	moderately	usually
Uses existing technology	yes	yes	somewhat	somewhat
Need storage facilities	harvest year-round	yes	harvest year-round	yes

With an extensive forest and agriculture landbase, Michigan has the potential to be one of the leading states in biomass feedstock production. In Michigan, forestry sources alone could supply over 4.5 million dry tons per year of feedstock, enough to support on a continuous basis six commercial-scale ligno-cellulosic ethanol refineries, each producing more than 50 million gallons of ethanol per year.

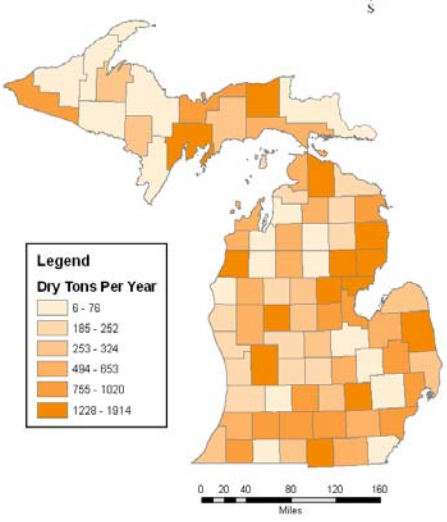
Estimating supply and inventory of biomass feedstocks is complex, and the quality of estimates varies by feedstock type. Some feedstocks, like forest residues, are readily estimated with high precision at the scale of a county or larger from existing forest inventory databases. Because energy crops are mostly grown only in test plots and compete for land currently in food production, supply depends on land substitution and modelled estimates of productivity.

Estimating feedstock price is more complicated that gross potential supply. This is because assumptions are needed about production and harvest cost components, practical rather than theoretical availability, environmental constraints and willingness of producers to substitute one agricultural crop for another depending on selling price. Price estimates for forest residues are some of the poorest because little current market data exist and little research has been done. Furthermore, inventory, technical and environ-mental constraints are spatially very variable and simply not available at scales finer than the county level.

Energy Crop Gross Potential



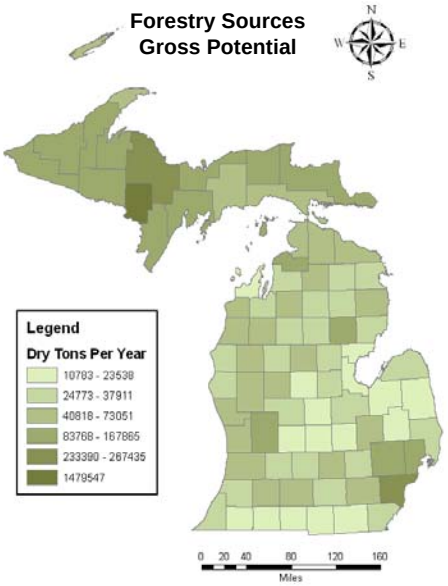
Energy Crop at $25/dry ton



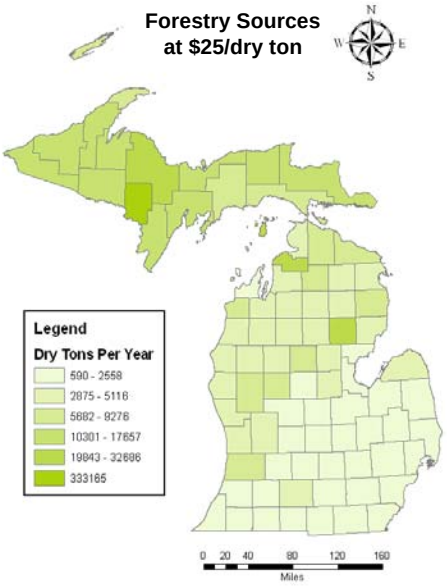
The maps above show forecast supply of biomass from dedicated energy crops (perennial grasses and hybrid or genetically-engineered poplar) in Michigan. Supply is concentrated in counties with existing agricultural lands or lands readily converted to tree plantations.

The maps below show supply of biomass from forestry sources, which includes logging and thinning residues and mill waste. Supply is concentrated in forested counties and those that have processing facilities at present.

Forestry Sources Gross Potential



Forestry Sources at $25/dry ton



"The lack of credible data on price, location, quality and quantity of biomass creates uncertainty for investors and developers of emerging biorefinery technologies."

— Office of the Biomass Program, U.S. Department of Energy (2005).