

Minnesota Power Trends in Biomass Energy



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Utilizing Biomass for Energy



- Biomass Overview
- Where are we today
- Where are we going
- Where will the biomass come from
- Supporting Actions / Recommendations

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- Biomass is a broad term used to describe material of recent biological origin that can be used either as a source of energy or for its chemical components.
 - The primary sources of biomass include trees, crops, algae and other plants, as well as agricultural and forest residues
- Biomass plants have been in place for decades, especially for cogeneration or combined power and process steam production (Combined Heat and Power – CHP)
- Biomass is one of the largest domestic sources of renewable energy. There are two basic approaches to sourcing biomass feedstock.
 - Growing plants specifically for energy use (closed-loop)
 - Using the residues from plants that are used for other things (open-loop)

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- Sources of biomass fuel and type of generation vary from region to region according to climate, soils, geography, and population density.
- Of the biomass resources used today, wood is the largest feedstock accounting for approximately 2/3 of US biomass consumption for energy.
- Although higher installation costs make biomass more expensive than fossil fuel powered generation, significant growth in dedicated biomass capacity is expected in regions with stringent renewable portfolio standards (RPS) requirements and limited supplies of lower cost resources, such as wind

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- Agricultural & wood bi-products:
 - Agricultural products include corn stalks and grass
 - Wood products include chips, bark, sawdust
 - Advancements in cellulosic research is expected to significantly enhance the use of plant and agricultural waste for bioenergy production
- Landfill Gas: gas that is created during the decomposition of organic substances in Municipal Solid Waste (MSW)
 - LFG consists largely of methane, carbon dioxide, and nitrogen
 - Landfill gas constitutes a high-value fuel for gas engines that can be effectively used for energy generation
 - 1 million tons of MSW has the capacity to produce ~432,000 cubic feet per day of LFG, about 0.8 MW of electricity

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- In 2007 MN Legislature established aggressive Renewable Energy Standards for electric utilities
- Requires increasing renewables as % of retail energy sales:
 - 12% by 2012
 - (MP is currently at about 12% with existing fleet)
 - 17% by 2016
 - 20% by 2020
 - 25% by 2025
- Renewables for Utilities: Wind, Water, & Wood

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- 26,000+ square-mile electric service territory located in northeastern Minnesota & NW Wisconsin
- Supplies electric service to over 155,000 retail customers + wholesale electric service to 16 municipalities.
- Developing more renewable energy
 - Currently we have:
 - Wind: ~125MW
 - Water: ~116MW
 - Wood: ~60MW

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- (2) biomass generation plants
 - Grand Rapids, MN (Blandin Paper)
 - Duluth, MN (New Page Paper)
- Each facility can consume ~1,100 tons of biomass per day
- Annual consumption is ~600,000 tons of biomass (~24,000 truck loads)
- Starting in 2010 we will be increasing our consumption of biomass at each facility

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Hibbard Energy Center – Duluth

- Located behind New Page Paper Mill
- ~35MW capacity
- Accepts shredded or chipped wood
- Typical Fuel mix: 70% wood/30% coal
- Consumes ~250,000 tons biomass annually
- Receives wood 24/7
- All trailers are emptied with a truck dump
- Safety orientation & PPE required for all haulers

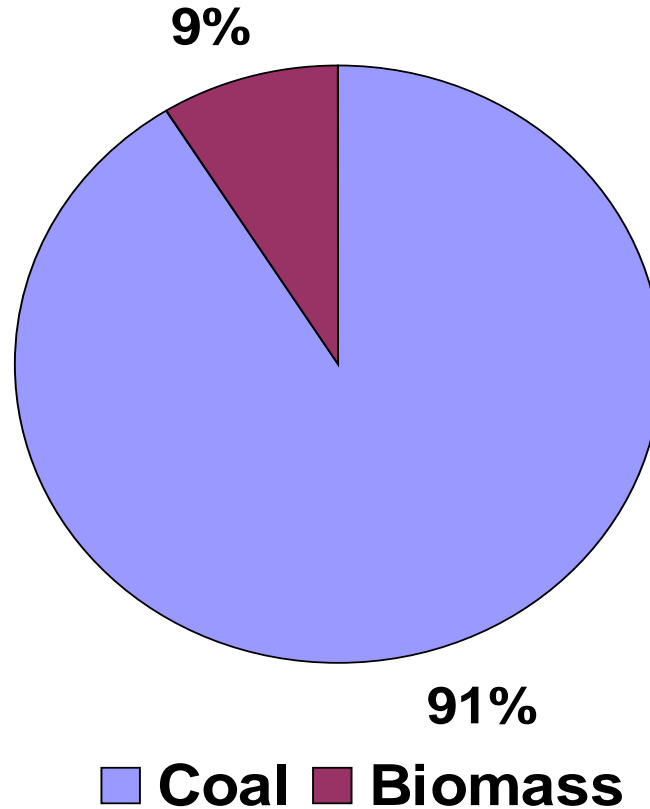
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Rapids Energy Center – Grand Rapids

- Located next to UPM/Blandin Paper Mill
- ~25MW capacity
- Accepts shredded or chipped wood
- Typical Fuel mix: 80% wood/20% coal
- Consumes ~350,000 tons biomass annually
- Receives wood 24/7
- Self-unloading trailers are preferred
- Truck dump available on-site
- Safety orientation & PPE required for all haulers

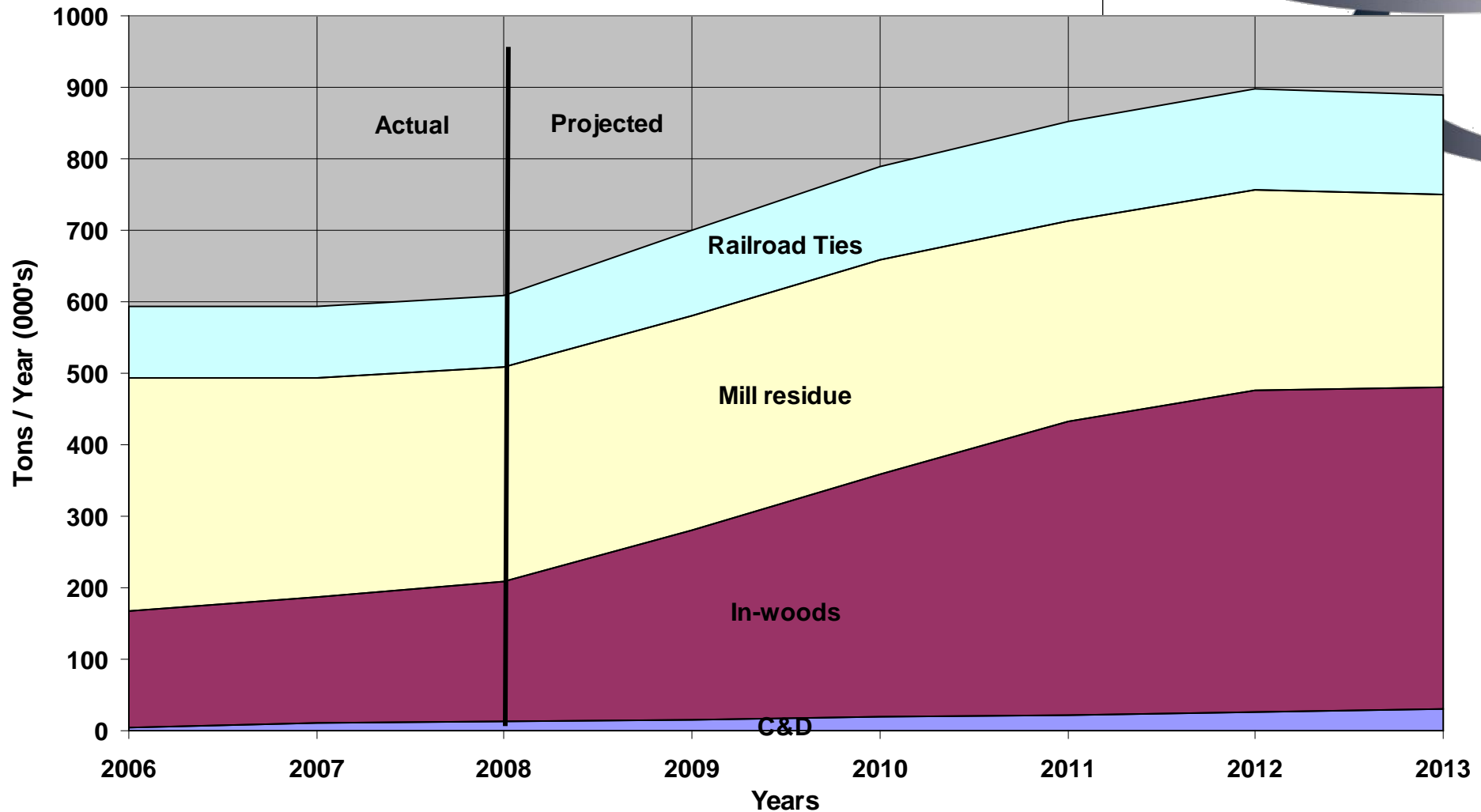
Solid Fuels



**Biomass = 600K Tons,
50+ suppliers**

**Coal = 5,600K Tons
6 suppliers**

Total Biomass Usage



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Wood Fuel.

The Wood Fuel shall be sourced as a residual of forest products manufacturing processes and will include processed woody material made up of sawdust, bark, chips and shavings. (See paragraph 5 below, for excluded materials) The heating value of the Fuel shall be a minimum of 4,000 British Thermal Units (BTU) per pound, as received for each delivery. The ash content shall not exceed two percent (2%) by dry weight of each delivery. The heat value and ash content will be determined by an independent third party testing service.

Maximum Moisture Content

Forty-five (45%), by weight. Moisture content with respect to any delivery shall be determined in accordance with ASTM specifications and procedures, or equivalent.

Maximum Size

Ninety percent (90%) or more of a delivery by volume shall be less than six (6) inches in every dimension. One-hundred percent (100%) shall be less than ten (10) inches in any dimension.

Fines and Sawdust

Fuel will be processed by a mechanical screen during manufacture. Fines and sawdust, defined as Fuel of a size 1/4 – inch or less, shall comprise no more than fifteen percent (15%) of gross tonnage for any individual truckload.

Excluded Materials

Fuel shall not contain any free ash, soil, cinder, and shall be free of foreign material, including but not limited to, sand, stone, metal, glass, rubber, plastics, pressure-treated or lead-based painted wood, chemicals and any hazardous or toxic substances as defined under law. Fuel shall be substantially free of grass and leaves. Fuel shall be free of pesticides (chemically treated wood). Pesticides are defined as “any substance or combination of substances intended for the purpose of defoliating plants or for preventing, destroying, repelling, or mitigating of insects, fungi, weeds, rodents, or predatory animals; including but not limited to defoliant, desiccants, fungicides, herbicides, & insecticides.”

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Raw Wood Waste:	Moisture ~40% BTU/lb. 5300 Ash % 3.16
Processed Wood Waste:	Moisture ~10% BTU/lb. 7447 Ash % 1.73
Wood Pellets:	Moisture ~3% BTU/lb. 8246 (16.9Mbtu/ton) Ash % 0.43

“Values should be used as average estimates of the values associated with their categories.”

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Types of “Processed Wood Waste”

- Wood trusses
- Plywood / OSB / fiber board
- Furniture (no lead paint)
- Dimension lumber
- Creosote treated wood

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Ash Utilization Program

- Residue from generation operations that is greater than 50% wood ash is used as an alternative liming material or potassium fertilizer for farm land.
- Two-boiler operation produces 2 – 3 ash loads per day, average 15 tons per load
- U of M Extension Service manages ash utilization program by testing soils and scheduling loads to farm locations
- 82% of ash is applied to farm land as a soil nutrient

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USDA – Biomass Crop Assistance Program

- provides financial assistance to producers or entities that collect, harvest, store and transport eligible biomass material to designated 'biomass conversion facilities' for use as heat, power, biobased products or biofuels.
- provides matching payment at a rate of \$1 for each \$1 per dry ton, not to exceed \$45 per dry ton.
- program will be available to eligible material owners for a period of two years.
- Contact your local 'biomass conversion facility', then county FSA rep.

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Emerging Technologies

- Thermochemical: using high temperatures to convert biomass with air (gasification) and without air (pyrolysis).
- Biochemical: enzymatic or acid hydrolysis / fermentation.
- **Torrefaction**: method for improving the properties of biomass as a fuel. Consists of a slow heating of biomass in an inert atmosphere to a max temperature of 300 °C. The biomass partly decomposes, giving off various types of volatiles. Treatment yields a solid uniform product with a lower moisture content and a higher energy content.

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Moisture	\$20	\$21	\$22	\$23	\$24	\$25	\$26	\$27	\$28	\$29	\$30	Moisture
10%	\$1.31	\$1.37	\$1.44	\$1.50	\$1.57	\$1.63	\$1.70	\$1.76	\$1.83	\$1.90	\$1.96	10% (7650btu/lb)
20%	\$1.47	\$1.54	\$1.62	\$1.69	\$1.76	\$1.84	\$1.91	\$1.99	\$2.06	\$2.13	\$2.21	20% (6800btu/lb)
25%	\$1.57	\$1.65	\$1.73	\$1.80	\$1.88	\$1.96	\$2.04	\$2.12	\$2.20	\$2.27	\$2.35	25% (6375btu/lb)
30%	\$1.68	\$1.76	\$1.85	\$1.93	\$2.02	\$2.10	\$2.18	\$2.27	\$2.35	\$2.44	\$2.52	30% (5950btu/lb)
35%	\$1.81	\$1.90	\$1.99	\$2.08	\$2.17	\$2.26	\$2.35	\$2.44	\$2.53	\$2.62	\$2.71	35% (5525btu/lb)
40%	\$1.96	\$2.06	\$2.16	\$2.25	\$2.35	\$2.45	\$2.55	\$2.65	\$2.75	\$2.84	\$2.94	40% (5100btu/lb)
45%	\$2.14	\$2.25	\$2.35	\$2.46	\$2.57	\$2.67	\$2.78	\$2.89	\$2.99	\$3.10	\$3.21	45% (4675btu/lb)

Questions?

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