Industrial Scale Cogeneration

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Minnesota Power at-a-Glance

- Large Industrial Customers
- High Load Factor
- 16 Municipal Wholesale Customers
- 144,000 Electric Customers
- 4th lowest rates in the country*

* Based on data from 2022.
Current Generation Fleet

- Taconite Harbor Energy Center
- Laskin Energy Center
- Boswell Energy Center & Generation Operations
- Square Butte
- Tenderfoot Energy Center
- Cloquet Energy Center
- Hibbard Energy Center
- Rapids Energy Center
- Wing River CBED Wind
- Bison 1 – 2010/2011
  - Bison 2 – 2012
  - Bison 3 – 2012
- NORTHERN MINNESOTA
- American Transmission Co. 345kv
- DC Line +/- 250kv
- BNI Coal
- WING DAKOTA
Energy Forward

• Less Coal
• More Renewables
• Natural Gas
Hibbard Renewable Energy Center

### History

- **Original facility**: dates back to 1931 as Minnesota Power’s first large coal fired facility.

  - **1931**

- **Units #3 and #4**: were added in 1947 and 1951.

  - **1947**

- **Facility shut down**: in 1982 due to economic downturn and rising production costs.

  - **1982**

- **Assets purchased by Minnesota Power**: in 2009 with goal to optimize renewable energy production.

  - **2009**

- **Re-missioned**: as cooperative effort known as Duluth Steam District #2 to serve Lake Superior Paper Industries.

  - **1987**

- **Facility**: shut down in 1982 due to economic downturn and rising production costs.

  - **1982**
Hibbard Renewable Energy Center

Benefits

• Provides a dispatchable source of renewable energy.
• Brings renewable diversity-Wind, Water, Wood.
• Use of existing steam assets more economical than new construction.
• Base load steam usage by the paper mill provides the platform for Minnesota Power’s electric generation to run more optimally in the power market; combined retail and steam customer benefits
Hibbard Renewable Energy Center

**WATER**
- is drawn from the St. Louis River and is purified then piped to the boilers. After processing, it is about as pure as distilled water.

**WOOD WASTE**
- from the paper mill, and other sources, is trucked to the power plant where it is ground to a uniform size. Roughly 900 tons can be stored in the wood waste storage facility.

**COAL**
- is shipped to the facility by truck. The coal bunkers can hold up to 600 tons and last approximately 2-3 days.

**BOILERS**
- No. 3 and No. 4 each convert water to steam at a rate of 305,000 pounds of steam per hour at 820 pounds per square inch of pressure and 725 degrees Fahrenheit.

**ELECTROSTATIC PRECIPITATORS**
- Clean stack gases by removing particulates.

**ASH COLLECTION**
- Residual ash is trucked to farms, for use in fields, and to ash ponds.

**TURBINE-GENERATORS**
- The primary fuel is biomass, this renewable energy is sent to the electrical grid for distribution.
Hibbard Steam System

800LB

- PB3
  - Coal
  - Biomass
  - Gas

- PB4
  - Coal
  - Biomass
  - Gas

- TG3
  - Condenser
  - MW

- TG4
  - Condenser
  - MW

- Renewable Electric Generation

- Process Steam

- Paper Machine
Benefit to MP Customers

Representative Hourly Wholesale Electric Prices

During on-peak hours prices exceed generating costs

During off-peak hours generating costs exceed prices

Run generator at low load or turn off
Run generator at full load
Rapids Energy Center

History

- Co-Located with UPM-Blandin Paper company in downtown Grand Rapids, MN.
- Original paper mill dates back to 1901 with Rapids Energy Center (REC) facilities constructed in 1979.
- In 2000, Minnesota Power purchased and began operating REC under a steam agreement.
- In 2012, Minnesota Power petitioned for optimization projects approval with Minnesota Public Utilities Commission.

Benefits

- Combined Heat and Power (CHP) arrangement is an extremely efficient conversion of energy.
- Generates biomass based electricity in support of renewable energy standards.
- Creates market for unusable wood such as bark, small limbs and harvest waste.
Rapids Energy Center

WATER
- Drawn from the Mississippi River and is purified at the rate of 2000 gallons per minute. When it is piped to the boilers, it is about as pure as distilled water.

WOOD WASTE
- From the paper mill and other sources, it's trucked to the power plant where it's ground to a uniform size. Roughly 1,500 tons can be stored in the wood waste storage facility.

COAL
- Shipped to the facility by truck. Using 100% coal at maximum steam capacity, the coal storage building holds a 1.5 day reserve. Approximately 80 tons of coal are used daily.

TURBINE-GENERATORS
- Reduce high pressure steam to the medium and low pressure steam required by the paper mills. In the process of reducing the high pressure steam to lower pressure steam, electrical power is generated. This power helps reduce the mill demands on the power grid.

HYDRO-ELECTRIC GENERATORS
- Installed at the Mississippi River Dam. They help supplement the paper mill power requirements.

BOILERS
- No. 5 and No. 6 each convert water to steam at a rate of 175,000 pounds of steam per hour at 1250 pounds per square inch of pressure and 900 degrees Fahrenheit. This high pressure steam is reduced to pressures usable by the paper machines in the turbine-generator. In the process, electrical energy is also produced.

ELECTROSTATIC PRECIPITATORS
- Clean stack gases by removing particulates.

ASH COLLECTION
- Residual ash is trucked to farms, for use in fields, and to ash ponds.

ASH STORAGE

BOILERS
- No. 7 & 8 Boilers are gas fired and also convert water to steam at the rate of 260,000 pounds per hour each. Steam is delivered to the header at 400 pounds per square inch and 640 degrees Fahrenheit. Both boilers supply #6 turbine-generator and the paper mill.
Key Points

- Biomass energy is an important piece of Minnesota Power’s renewable energy portfolio.
- Minnesota Power’s renewable energy strategy is to utilize the renewable resources that are the most affordable and reliable for our customers within our region and includes Wood, Wind and Water.
- Biomass fuel is abundant in our region and affordable to our customers because we utilize the least desirable parts of the tree for fuel.
- We are focused on optimizing existing assets to increase efficiency and output.
- Industrial scale cogeneration offer the best value for biomass generation.
- We will continue to assess all biomass opportunities in and adjacent to our region to provide value to our customers.
Challenges for Biomass

- Carbon neutrality questions.
- High cost position of biomass.
- Historically low natural gas pricing.
Questions?