

Biomass Hot Water District Heating for Small Communities without Natural Gas: The Grand Marais Story

**International District Energy Association
Annual Conference**

**Mark Spurr
FVB Energy Inc.**

June 29, 2015



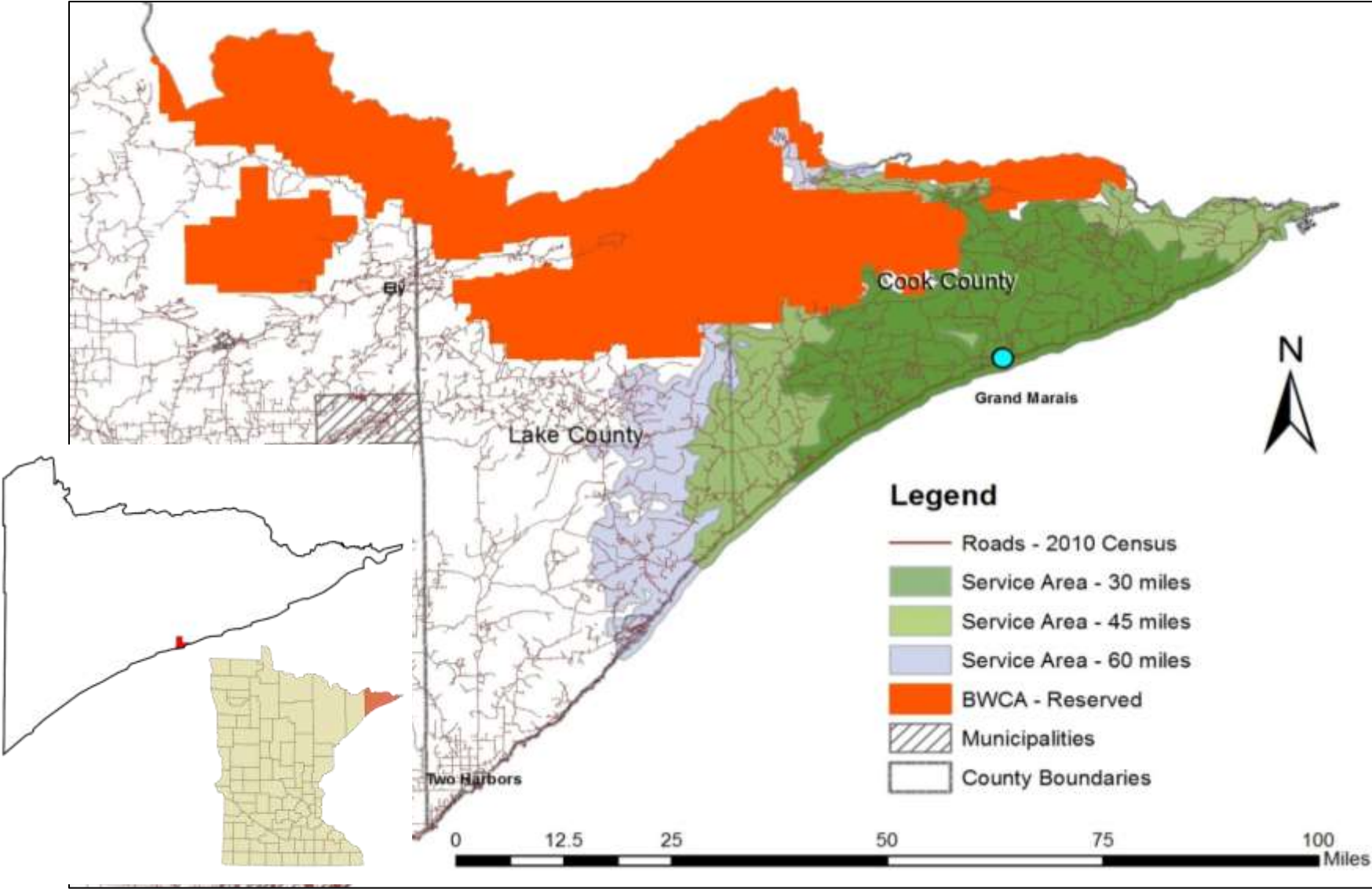
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Local Solutions*

40 Years of Experience in Sustainable District Energy Systems

Purpose of Presentation

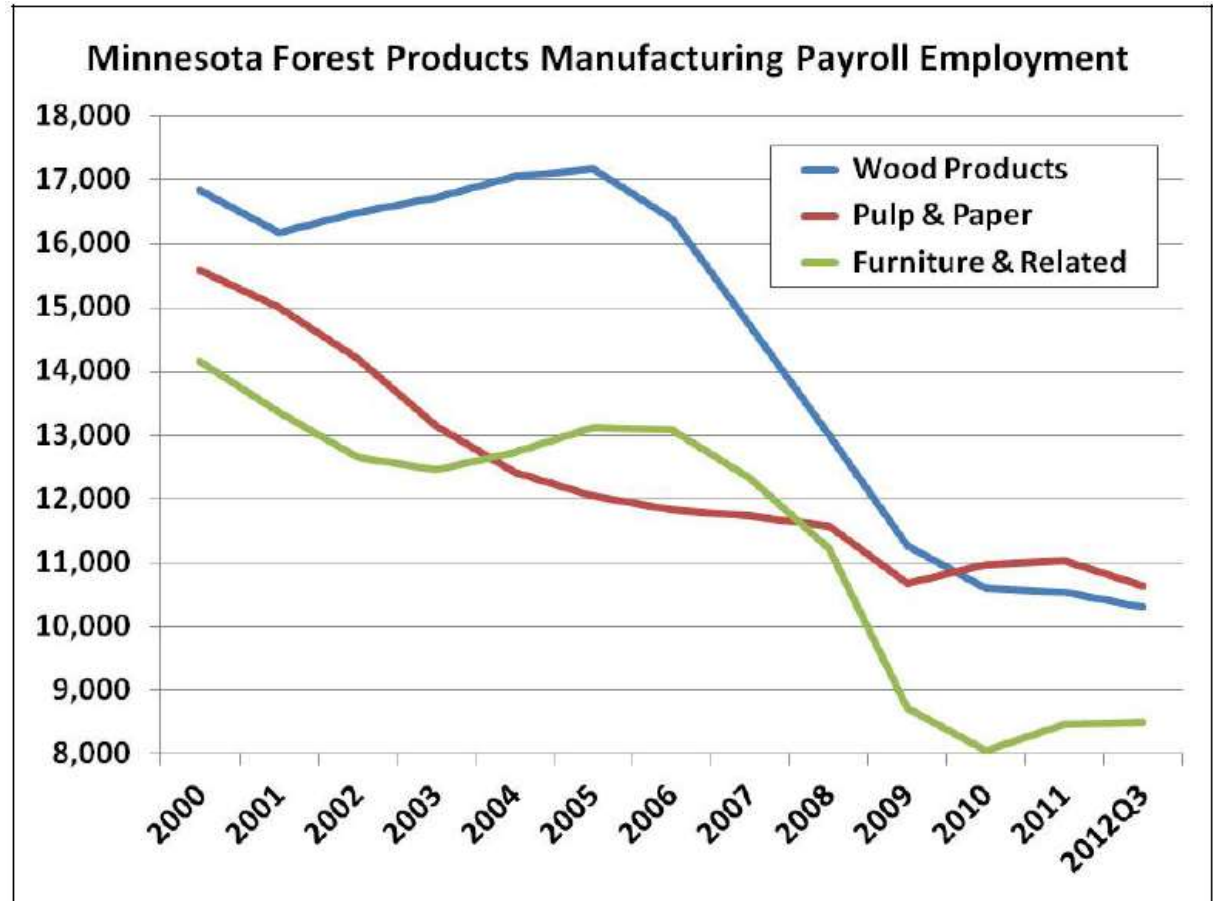
- **Case study of a rural community**
 - Without access to natural gas
 - With abundant woody biomass resources
- **Can biomass district heating be cost-effective?**
- **What are the benefits?**
- **What are the challenges?**
- **What are the lessons learned?**

Project Location



MN Forest Products Industry

- In the past decade, the state's paper industry has shed about 30% of its jobs
- 6 large mills have been permanently closed in the past 5 years
- Decline in forest harvest has resulted in overage, degrading forest resources
- "Firewise" programs have burned excess forest fuel in open pits
- Why not use the energy?

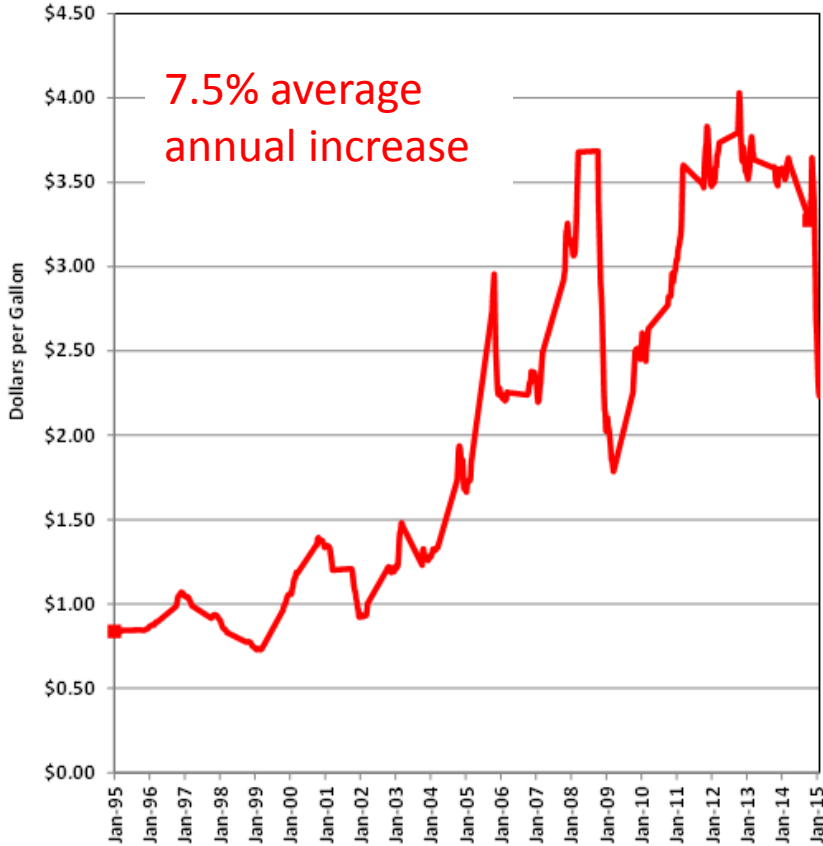


Compiled by the editor from Minnesota Dept. of Employment and Economic Development data. 2012Q3 data adjusted for both Verso and G-P closures.

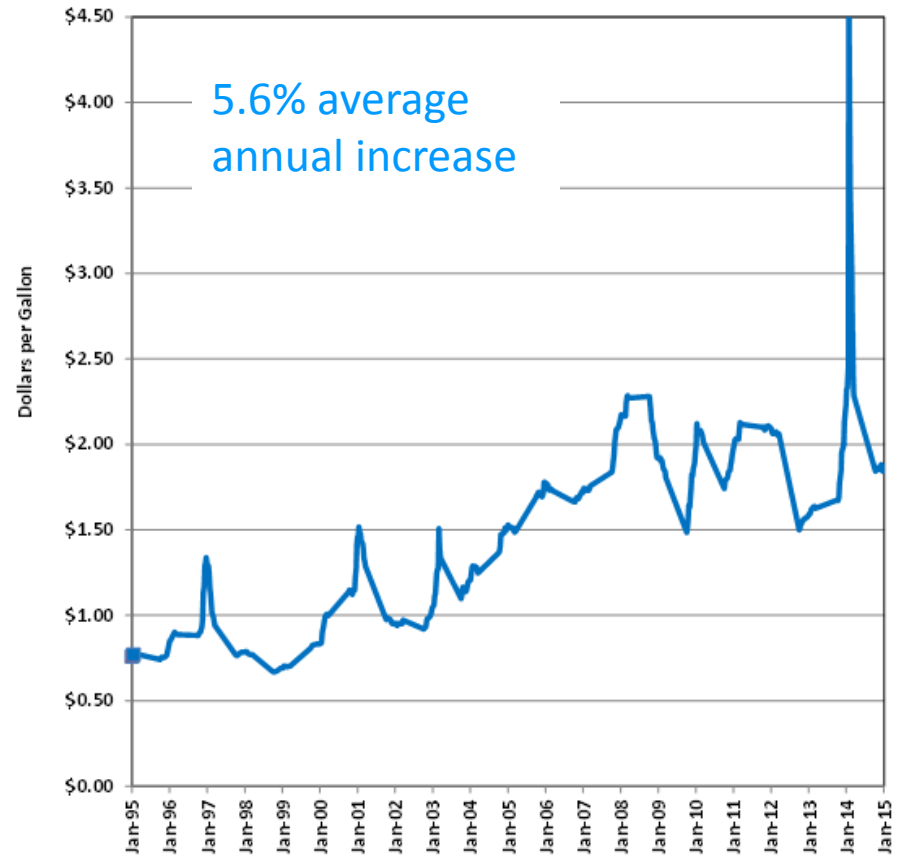
Historical Weekly Fuel Oil & Propane Prices

Residential Price Data for Minnesota

Minnesota Residential Fuel Oil Prices (Nominal Dollars)
Jan. 1995 to Jan. 2015



Minnesota Propane Prices (Nominal Dollars)
Jan. 1995 to Jan. 2015



Source: U.S. Energy Information Administration.

Why Biomass District Heating?

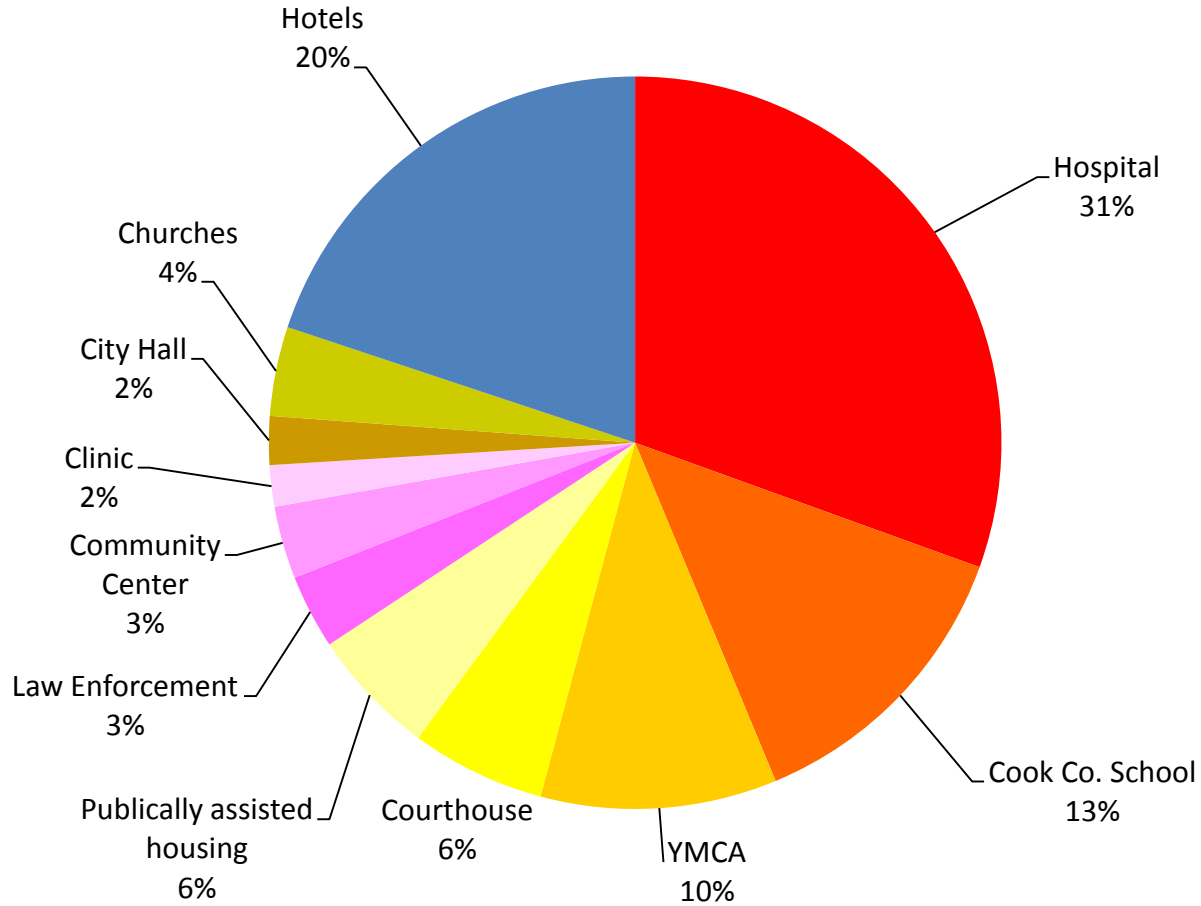
- Stabilize and reduce long-term energy costs
- Reduce dependence on imported fossil fuels
- Keep more energy dollars the local economy
- Create jobs
- Improve forest management including wildfire mitigation efforts
- Reduce carbon dioxide emissions

System Overview

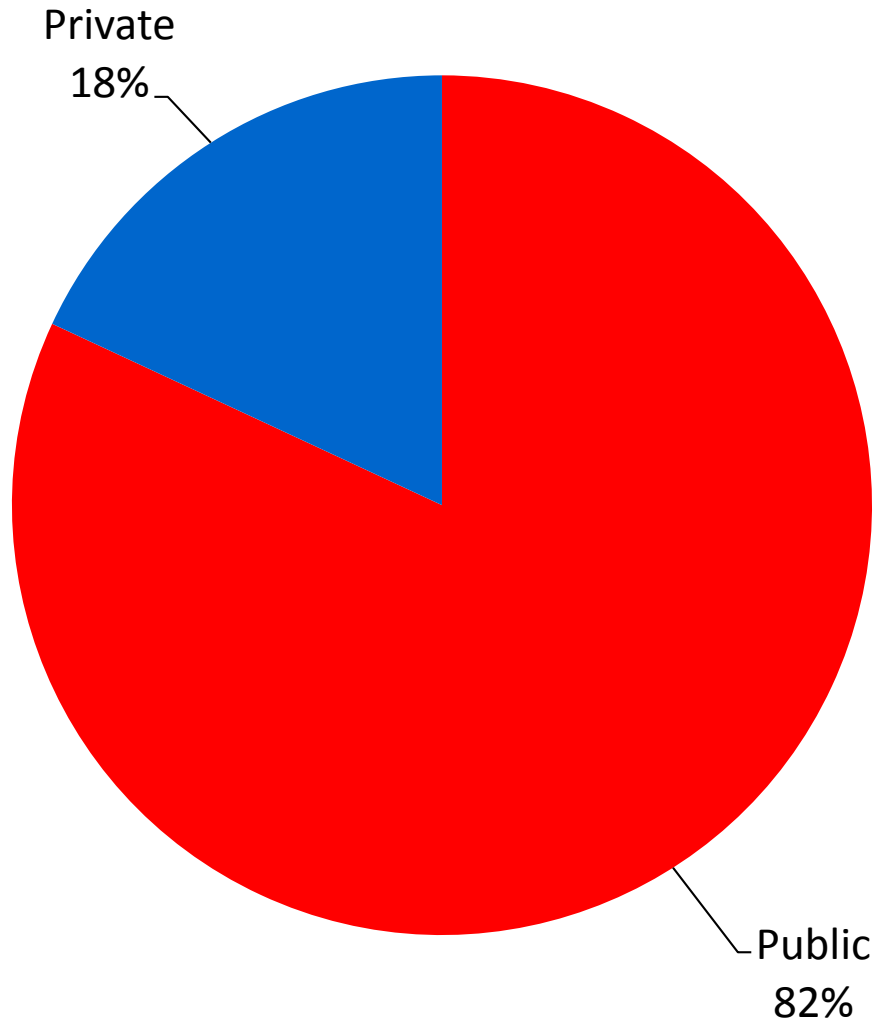


- Plant at Business Park
- Hot water distribution system
- Energy Transfer Stations in each building
- 18 initial customers
 - 28,000 million Btu of annual heat use
 - Peak system demand 13 million Btu per hour
- Ultimate capacity about double initial load

Customer Base



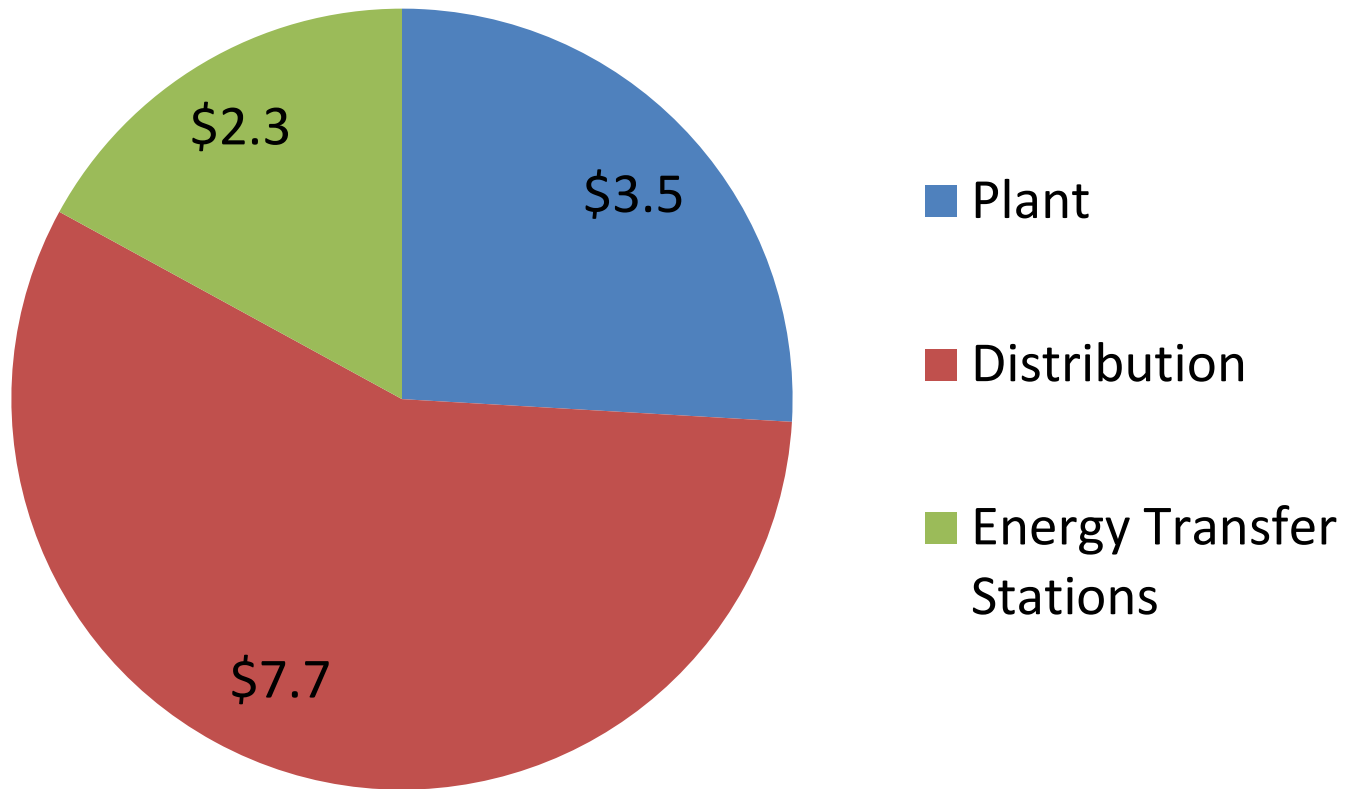
Heating Requirements by Sector



What are the Challenges?

- **High initial capital costs**
- **Reliable biomass fuel sourcing**
- **Perceptions regarding emissions**
- **Perceptions regarding future fossil fuel prices**

Capital Costs (million \$)



Biomass Fuel

- 5,000 green tons of fuel annually
- 45-55% moisture

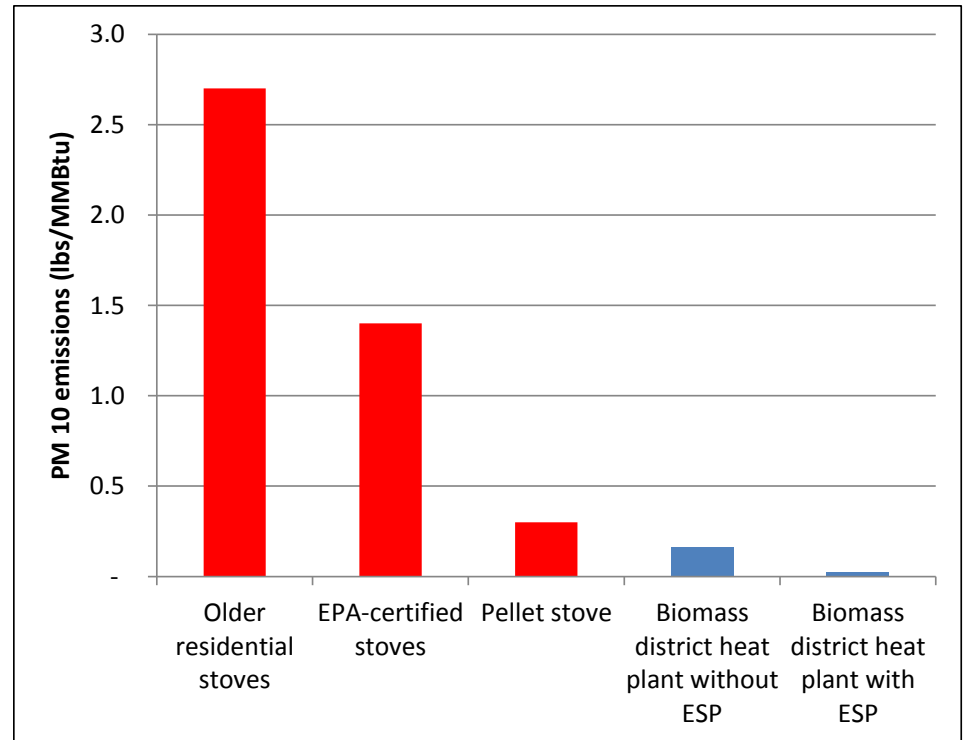
Sawmill residue currently trucked to Canada



Logging slash being burned or left to rot in the woods

Emissions

- Particulate matter (PM) is key issue
- Plant too small to have emission limits on PM or other emissions
- A multi-cyclone is the standard emission control technology
- Electrostatic precipitator (ESP) provides significant additional reductions



- Background levels of PM not monitored but likely high due to extensive use of wood in residential stoves

Business Plan

- Ownership by Grand Marais PUC (already provides electricity, water and sewer)
- Financing secured with 25 year customer contracts
- Goal: price first year cost of biomass district heating to be comparable with avoided costs of self-generation
- Financing
 - Attractive district heating rates cannot be achieved without substantial grant funding
 - State of Minnesota Bonding Bill
 - U.S. Department of Agriculture loan programs
 - Revenue bonds
 - General obligation bonds

Proposed District Heating Rates

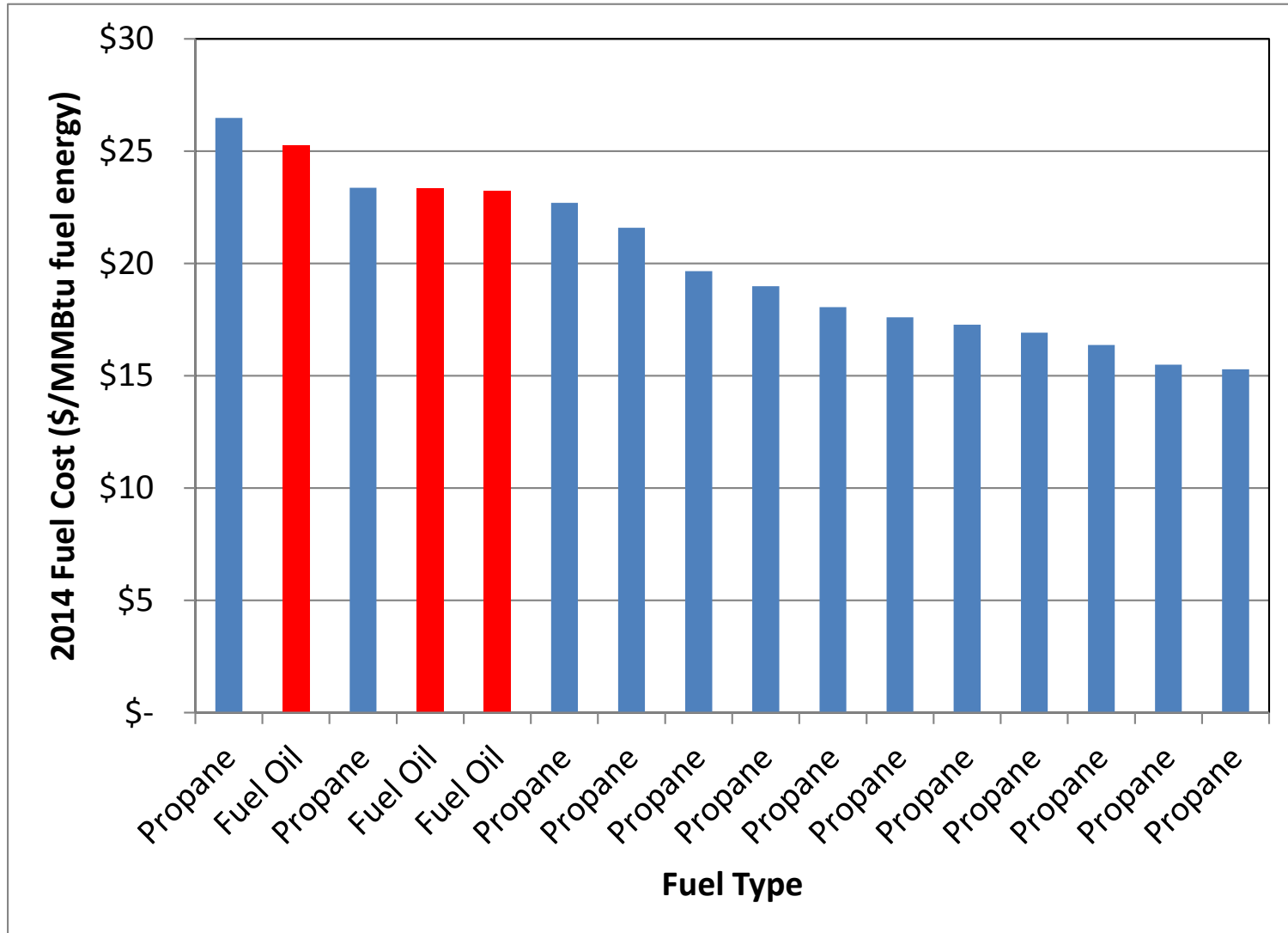
- **No Connection Charge for Initial Customers**
- **Capacity Charge**
 - Monthly capacity charge in the first 2 years of service \$4.30 per thousand Btu/hour (MBH) billed capacity.
 - This charge covers the fixed costs associated with financing and operating the system (debt service, maintenance, operations and administration).
 - Capacity charge would not change for the first 2 years of service.
 - Starting in 3rd year of service the capacity charge could be increased up to a contractually set limit of 4.25% per year.
 - To the extent that system growth allows the fixed costs to be spread over a wider base, the increases in the capacity charge can be constrained to less than the contractually allowed limit.

Proposed District Heating Rates

- **Energy Charge**

- Projected to be \$8.44 per million Btu of heat consumed as measured by the thermal energy meter.
- This charge covers the variable costs of running the system (primarily fuel and a minor amount of electricity), and would be a pass-through, i.e., these charges would reflect the actual variable costs incurred.

Large Variations in Fossil Fuel Prices Paid by Potential Customers in 2014



What Will Future Propane Prices Be?

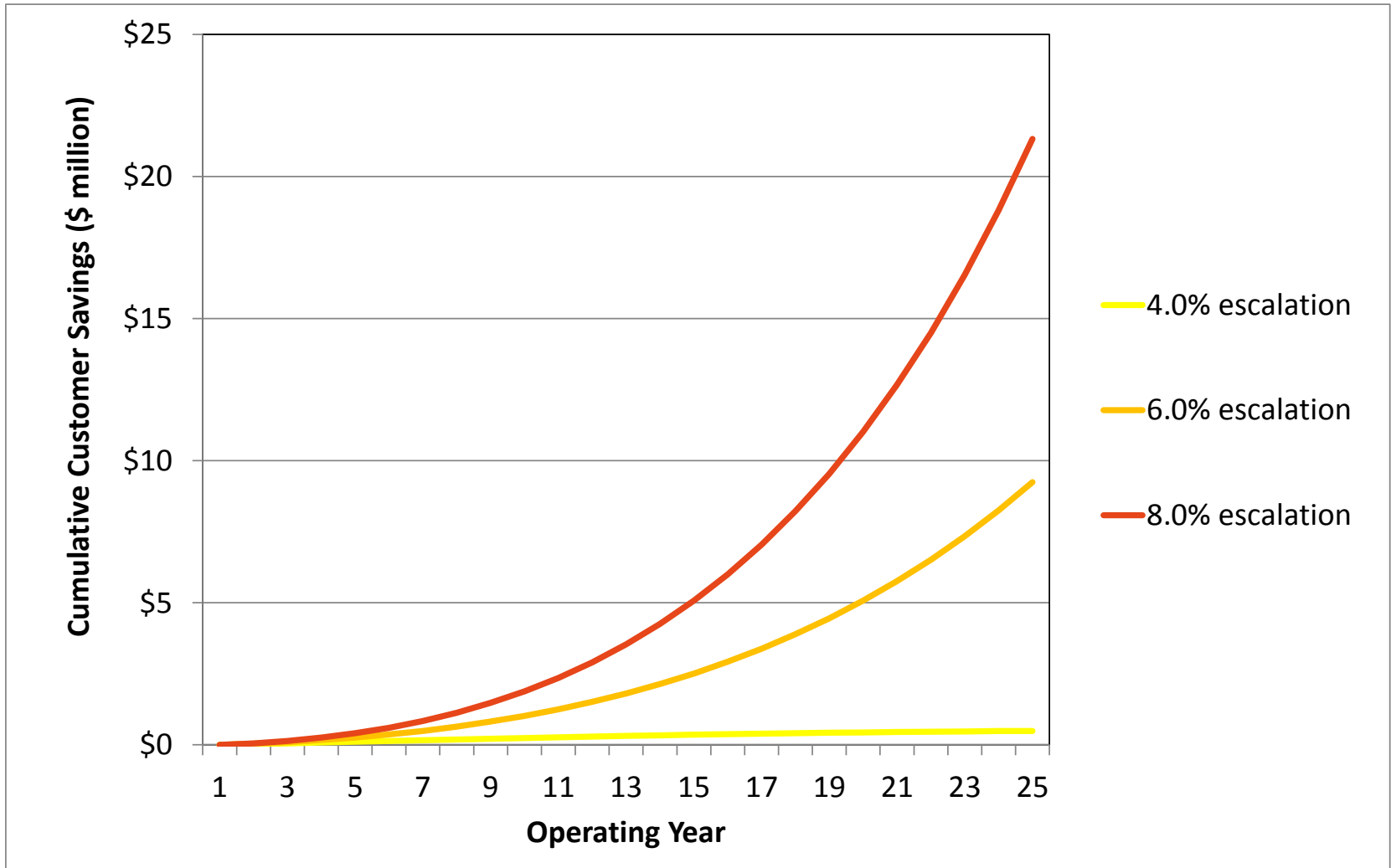
- It is difficult to make good long term energy decisions due to price volatility
- It is easy to be influenced by current conditions and recent trends
- Biomass district heating provides cost stability and predictability

Minnesota Propane Prices (Nominal Dollars)
Jan. 1995 to Jan. 2015



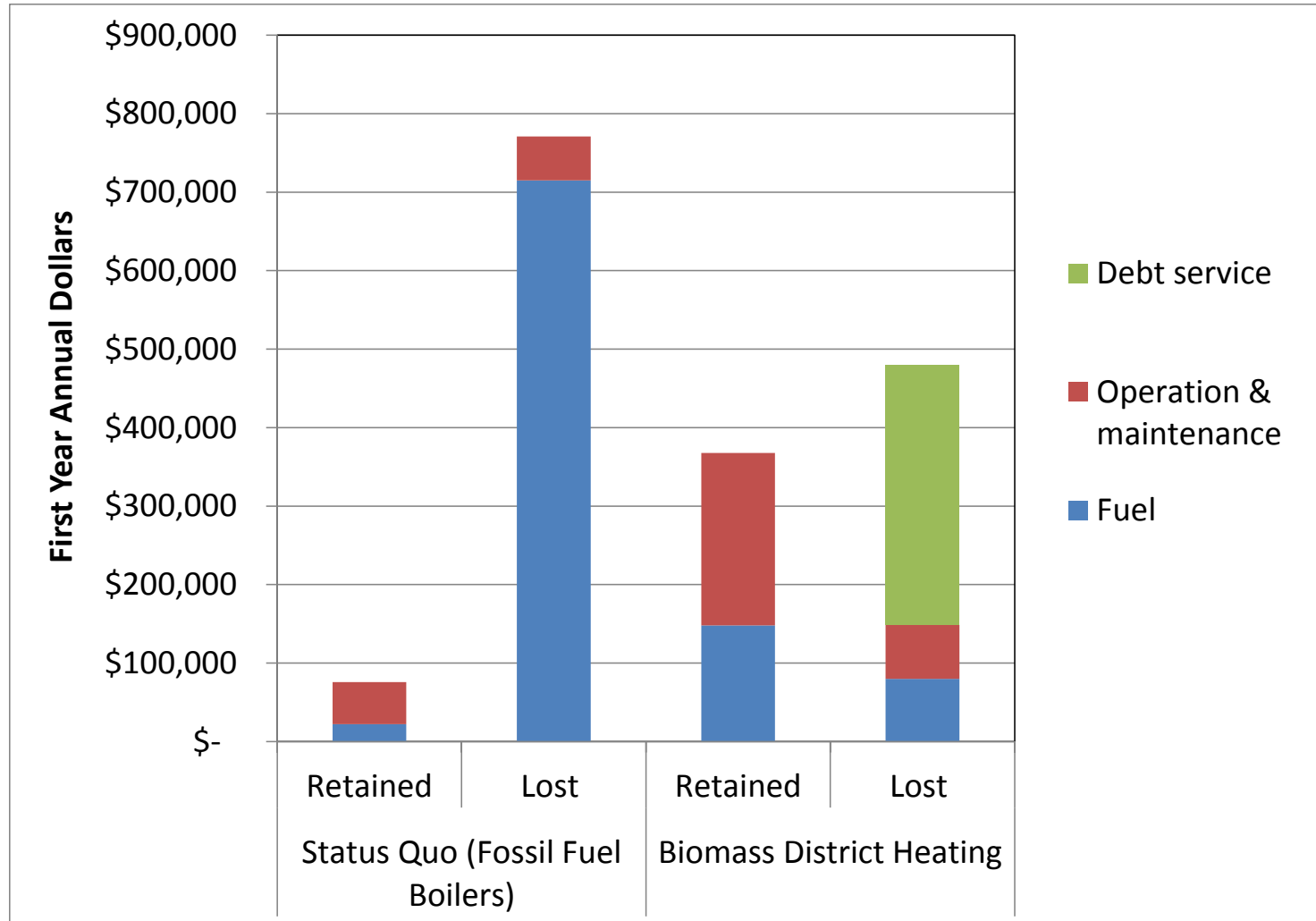
Community of Grand Marais

Cumulative Reductions in Direct Energy Costs



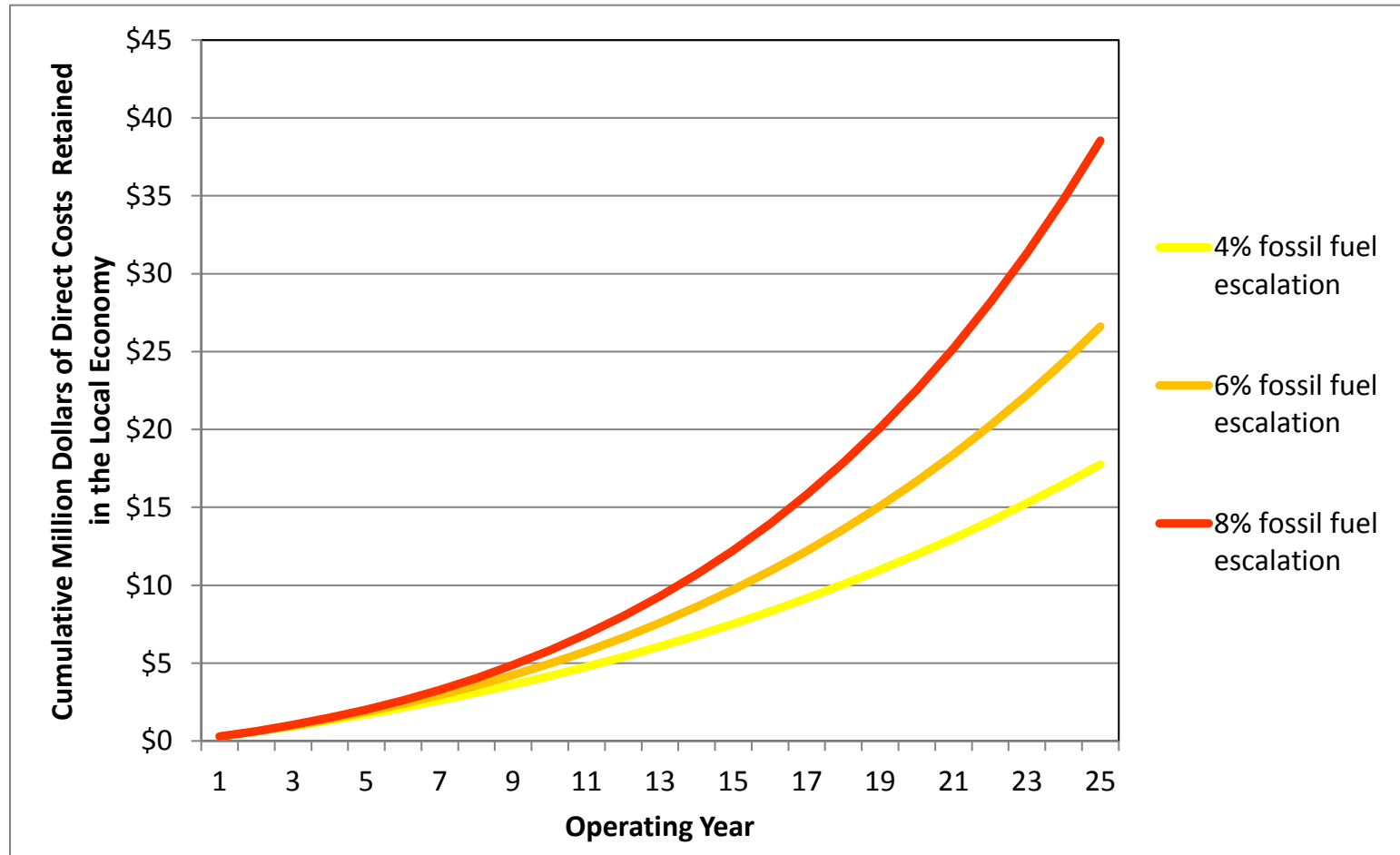
Community of Grand Marais

Direct Energy Dollars – Retention vs. Loss



Community of Grand Marais

Projected Cumulative Increase in Dollars Retained (Direct Energy Dollars Only)



Status

- **District Heating Service Proposals including full contract terms presented to key potential customers**
- **Most potential customers receptive to value proposition, and recognize long-term cost reduction and cost stability benefits**
- **Exception was the largest single potential customer (hospital)**
 - **Converting from fuel oil to propane**
 - **Getting proposals from fuel suppliers for 2-3 year contracts at less than \$1.00/gallon (\$10.90/MMBtu)**
- **Project cannot go forward without hospital**
- **Mothballing project for now**
- **City will monitor fossil fuel prices, with potential to revive project in the future**

Lessons Learned

- **Significant grant and/or extremely low interest loan funding is essential for small scale biomass district heating systems serving low density communities**
- **Communities lacking natural gas understand the benefits of biomass district heating relative to**
 - **Long-term cost stability and cost reduction**
 - **Retention of energy dollars in the local community**
- **Fossil fuel price volatility can work both ways**
- **It is important to emphasize long-term price trends rather than the current price trend**

Lessons Learned

- **It is useful to provide multiple opportunities for stakeholders to learn about the project and ask questions**
- **Concerns about biomass emissions (PM) must be addressed**
- **Carbon neutrality of biomass is a complex question that deserves reasoned answers**
- **There are lots of misconceptions about biomass derived from all the “information” on the internet**
- **Local political leadership is essential**

Thanks for your attention!

Mark Spurr

Phone: 612-607-4544

Email: [mspurr@fvbenergy.com](mailto:mspur@fvbenergy.com)



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