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Thunder Bay, Ontario District Energy Prefeasibility Study

Summary Report

March 2022

District Energy Systems

District energy systems provide a highly efficient way to heat and cool multiple buildings using a network of underground pipes. Thermal energy generated from a central plant (or plants) is transported by pipes and is used to heat or cool a water/glycol solution which is then transferred into each building's ventilation system via heat exchangers.

Climate change is a prevalent global issue. Transitioning from fossil fuels to renewable energy sources, like sustainably sourced biomass, will be vital as we work towards a low carbon economy. *How can we utilize highly efficient energy systems like district energy networks to reach low carbon goals?* Use forest-based biomass (residuals) to fuel the network! **Utilization of biomass for energy is proven to have significantly lower emissions than fossil fuels**, especially when using forest residuals (forestry and mill operations) that would otherwise decompose or be considered waste products. **Thunder Bay is in an excellent position to implement a biomass-powered district energy system;** leveraging the abundance of forest-based biomass resources and local forestry industries which produce surplus biomass as a by-product of their operations.

The Prefeasibility Study

Evaluating forest-based biomass as a low carbon fuel source in the Northwestern Ontario context.

The Centre for Research and Innovation in the Bioeconomy (CRIBE) is an independent, not for profit corporation, that drives the development of competitive and sustainable forest-based bioeconomy industries within Ontario. **In partnership with the City of Thunder Bay, and as part of CRIBE's Northwestern Ontario Regional Case Study initiative, CRIBE launched a prefeasibility study to determine if a biomass district energy system would be a viable option to replace fossil fuels (natural gas) for heating in the downtown north core of Thunder Bay, ON (Port Arthur).**

Port Arthur was chosen because it has several large buildings with considerable heat loads (360 kW to 1830 kW). A district energy system could reduce the electricity consumption and greenhouse gas emissions of these buildings, replacing more energy-intensive technologies (electric base-boards, water heaters, chillers, and air conditioners) and fossil-fuel reliant technologies (boilers and furnaces).

CRIBE retained Kozar Engineering Inc. (Kozar) and their team of worldwide leading experts in the fields of sustainable biomass heating and district energy system implementation, Biothermic Wood Energy Systems Inc. and Peter Anderberg's Nordic Heat, to provide a thorough study for the City of Thunder Bay and regional stakeholders.

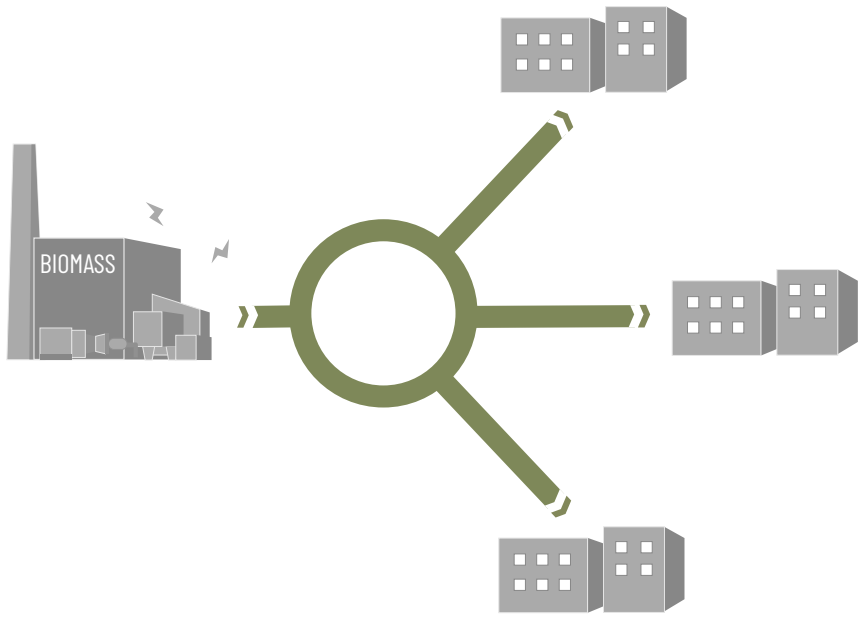
The Network's Supply - A Biomass Boiler Plant

The area of study was estimated to consume roughly 6 MW of heat energy. Instead of building one plant with a heating capacity of 6 MW, **a phased approach was suggested; installing three separate 2 MW heating units. All three units would be installed at the same location and would be connected to the district energy system in parallel.** This would allow for the plant to be constructed in stages, with capacity increasing as the demand on the district energy system increases.

The study looked at three potential sites on the Port Arthur Waterfront for the proposed heating plant. **It was determined that the area located south of the next phase of Prince Arthur Landing development would be the most suitable for a plant of this size.**

Modern biomass heating plants are highly automated and require little daily maintenance. Once installed, **two full-time plant technicians would be required to oversee the operation of the plant and coordinate the flow of fuel and ash.**

Figure 1. Proposed flow of energy from plant to district.



Connecting the Network

A supply and return piping network would connect the downtown Port Arthur district, and associated buildings, to the proposed biomass plant. The main supply and return pipes would run beneath the roads throughout the downtown area, with piping branching out to connect to the participating buildings. At a minimum, sections of Red River Road, Algoma Street, Court Street,

and St. Paul Street would need to be excavated to install the required piping. With the proposed plant being located at the waterfront, the piping would also have to cross the train tracks. Since the piping can not be buried below the railway, there were two proposed options; create a free-standing structure to support the pipe as it crosses over the tracks or suspend the pipe beneath an existing bridge.

Availability of Biomass

There are several softwood sawmills, pulp mills, and bioenergy cogeneration (heat and electricity) plants within the Thunder Bay region. **The 15,000 – 20,000 GMT of biomass per year required for the proposed Thunder Bay district energy plant would be readily and sustainably available through a long-term commercial supply agreement**.

Economic Analysis

What's required for the proposed district energy system?

- three 2 MW heating units
- building and infrastructure
- electrical and pipe connections
- assembly and commissioning
- pipe installation
- roadwork
- land purchase
- emissions compliance

If the biomass plant was located adjacent to south of the next phase of Prince Arthur Landing development, **the estimated capital cost would be $ 11,413,500.00** (does not include any private or government funding support).

Given the high capital costs and required piping construction **it is suggested that a phased approach is taken, beginning with a micro heating network to support the next phase of the Prince Arthur Landing development**.

Key Takeaways & Next Steps

As the price of natural gas is projected to exceed the projected charge-out rate for biomass energy by the year 2030, biomass energy supplied through a district energy system will continue to be a viable economic alternative for many end users. Although the project requires significant investment, a district energy system has the potential to offset more carbon intensive energy systems (particularly the ones found in older building within downtown Port Arthur). Furthermore, **this project could be an opportunity for Thunder Bay to lead in low carbon innovation, create jobs, and serve as example for other Ontario communities looking to decarbonize their heating and cooling systems**.

To help lay the groundwork for a district energy system in the future, there are several steps that should be completed now.

1. **Conserve energy** (both electricity and heat) in each building by reducing heat demand and recovering waste heat.

2. **Improve energy efficiency** by installing data gathering technologies such as sensors and smart meters to track energy use (as well as other conditions affecting energy use like climate).

3. **Investigate the feasibility of installing a small biomass plant** with the capability for expansion to support the energy needs of the next phase of Prince Arthur Landing. This could be used as a demonstration of the effectiveness of biomass energy and to determine how to reduce costs of potential future district energy systems. If this proves successful, further investigations into the feasibility of a district energy system as well as a heat study can be completed at that time with more infrastructure and experience available to support the concept.

4. Align expansion of a district energy system with planned roadwork. Decisions regarding the development of a district energy system should be finalized before the scheduled road improvements on Red River Road between Court Street and Cumberland Street. Each section of pipe which is installed in unison with a city planned roadwork project will reduce the capital costs of a potential future district energy system. For example, **there would be over 60% cost reduction to install pipe during the proposed Red River Road construction versus installing at a later date**. Any future roadwork which overlaps the proposed area of the district energy system should consider the installation of the distribution piping.

For more information about this study visit nextfor.ca.

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