BIOMASS DISTRICT ENERGY SYSTEMS

Biomass District Energy Systems

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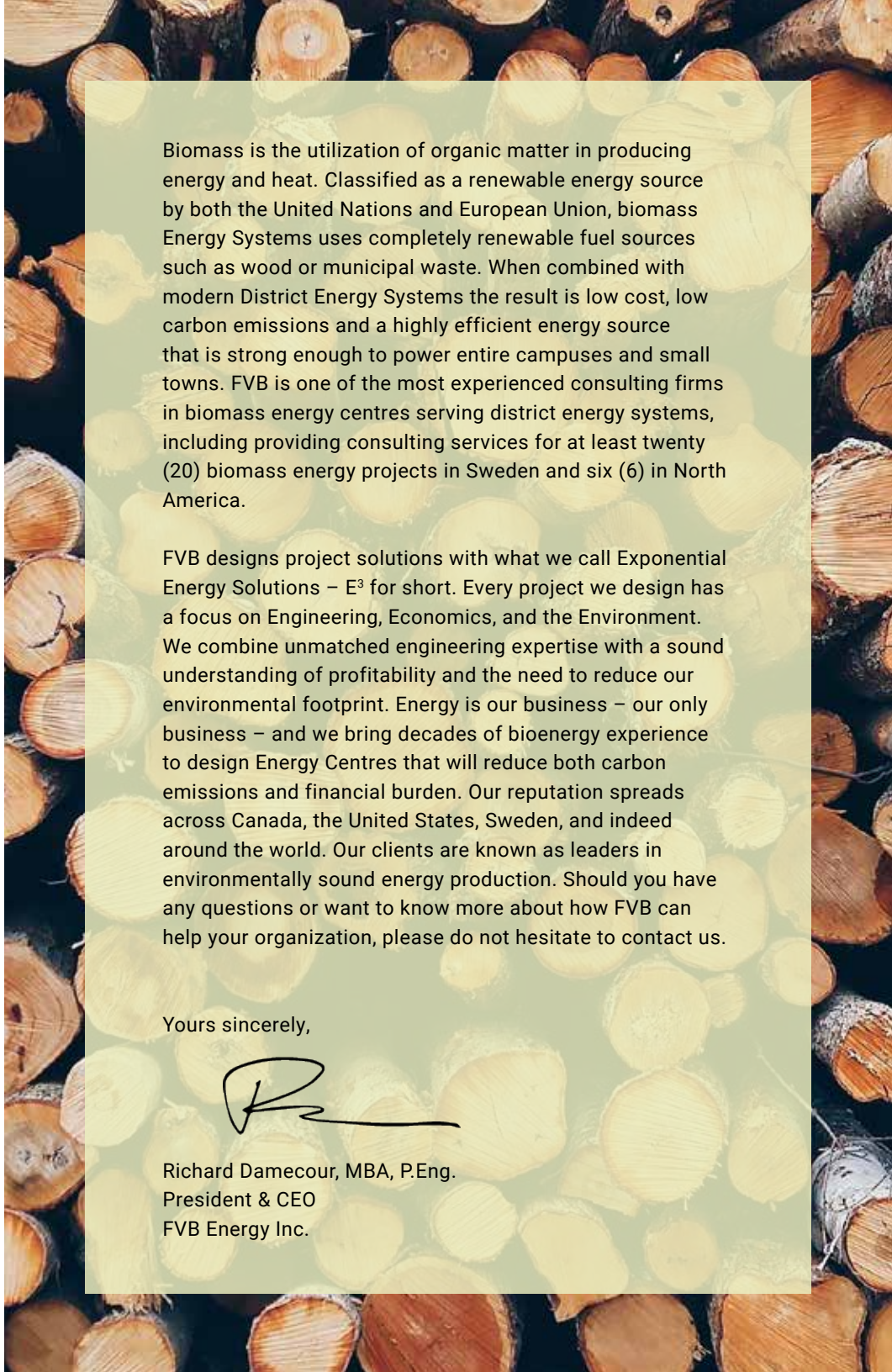


Biomass is the utilization of organic matter in producing energy and heat. Classified as a renewable energy source by both the United Nations and European Union, biomass Energy Systems uses completely renewable fuel sources such as wood or municipal waste. When combined with modern District Energy Systems the result is low cost, low carbon emissions and a highly efficient energy source that is strong enough to power entire campuses and small towns. FVB is one of the most experienced consulting firms in biomass energy centres serving district energy systems, including providing consulting services for at least twenty (20) biomass energy projects in Sweden and six (6) in North America.

FVB designs project solutions with what we call Exponential Energy Solutions – E^3 for short. Every project we design has a focus on Engineering, Economics, and the Environment. We combine unmatched engineering expertise with a sound understanding of profitability and the need to reduce our environmental footprint. Energy is our business – our only business – and we bring decades of bioenergy experience to design Energy Centres that will reduce both carbon emissions and financial burden. Our reputation spreads across Canada, the United States, Sweden, and indeed around the world. Our clients are known as leaders in environmentally sound energy production. Should you have any questions or want to know more about how FVB can help your organization, please do not hesitate to contact us.

Yours sincerely,

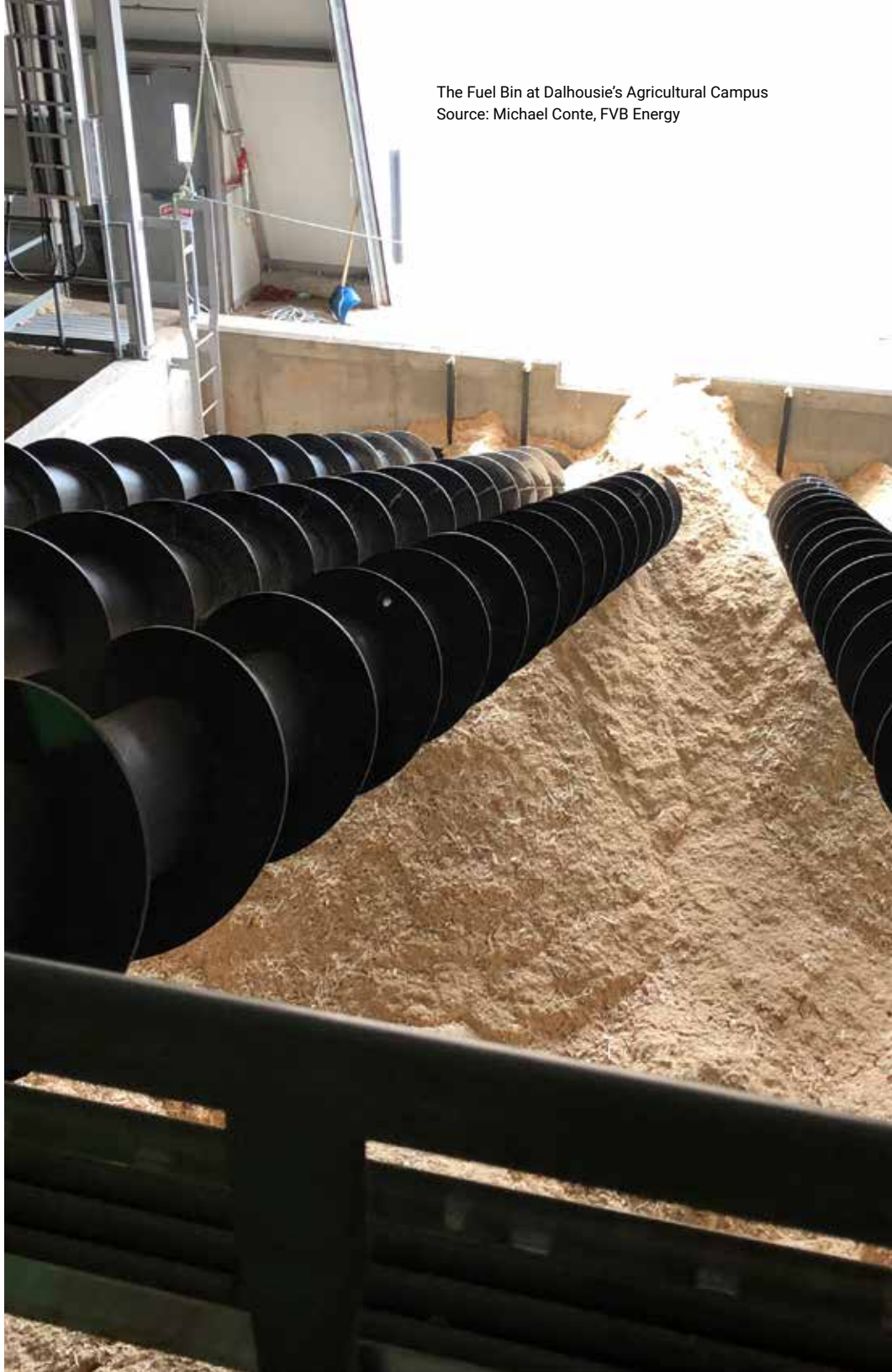
Richard Damecour, MBA, P.Eng.
President & CEO
FVB Energy Inc.

Dalhousie University Agricultural Campus

5.4MW$_t$ Biomass Combustion Boiler
Wood Waste Fuel
In Operation 2018

FVB was retained by Dalhousie University to advise on the most economical and sustainable option for executing on their community feed in tariff (COMFIT) contract while simultaneously designing the renewal of their existing biomass steam Energy Centre which had reached end of life. It was ultimately decided that the preferred option involved converting the facility and the campus from steam to hot water and installing a biomass combustion boiler. This included converting one of the existing oil fired steam boilers to hot water, retrofitting campus building mechanical and controls systems, and replacing the distribution piping system to utilize hot water. FVB chose a new 5.4MW$_t$ Biomass combustion boiler which generates hot oil that is circulated to an Organic Rankine Cycle Generator, producing 1.0 MW of electricity and 4.4 MW of heat. The 1.0 MW of power will be sold to the local electrical grid year round while the excess heat will be used to provide their campus with medium temperature hot water for space heating and domestic hot water.

FVB completed the screening study, design, procurement assistance, and remains heavily involved as the principal site field inspector and Engineer of Record. A steam to hot water conversion was completed on the campus in 2017; the campus is now served by a hot water District Energy System which this Energy Centre feeds.



The Fuel Bin at Dalhousie's Agricultural Campus
Source: Michael Conte, FVB Energy

Simon Fraser UniverCity

15 MW_t Biomass combustion boiler
Wood Waste Fuel
Expected Operation 2019

UniverCity TEC Source: Sean Casey / FVB Energy Inc

In 2008, FVB performed an initial concept study for the new residential development UniverCity, located at Simon Fraser University (SFU) in Burnaby, BC, which recommended biomass as a baseload renewable energy source for a new hot water district heating system to serve the development. Since 2011, FVB has provided design and construction support for 9 connected ETSs, 1150 additional trench metres (3800 tench feet) of piping, and two interim Energy Centres for the UniverCity System. All of this was completed while FVB supported Corix pursuing approvals for the future biomass energy centre, and a base load interconnect to the SFU Campus System. The Interconnect includes a 10MW_t heat exchanger, 830 trench metres (2700 trench feet) to the University and 560 trench metres (1800 trench feet) to SFU.

FVB has supported Corix in the development and design of a permanent Energy Centre: 15 MW_t biomass module, a 10 MW_t natural gas module, and associated equipment to provide Baseload renewable energy to both the SFU campus and UniverCity developments, and peaking/backup capacity for the UniverCity District Energy Utility. This includes provisions for fuel storage, a biomass combustion system, thermal energy exchange, and flue gas heat recovery. The biomass module also includes an emergency power generator capable of running the natural gas module and allowing for the safe shutdown of the biomass module. A 6 MW_t heat dump was designed to dissipate thermal energy in a safe and controlled manner when the biomass module needs to be shut down in emergency situations.

The use of thermal oil creates a safer working environment with reduced operating pressures over steam, and also allows for the future addition of power production equipment, turning the operation into a Combined Heat and Power facility.

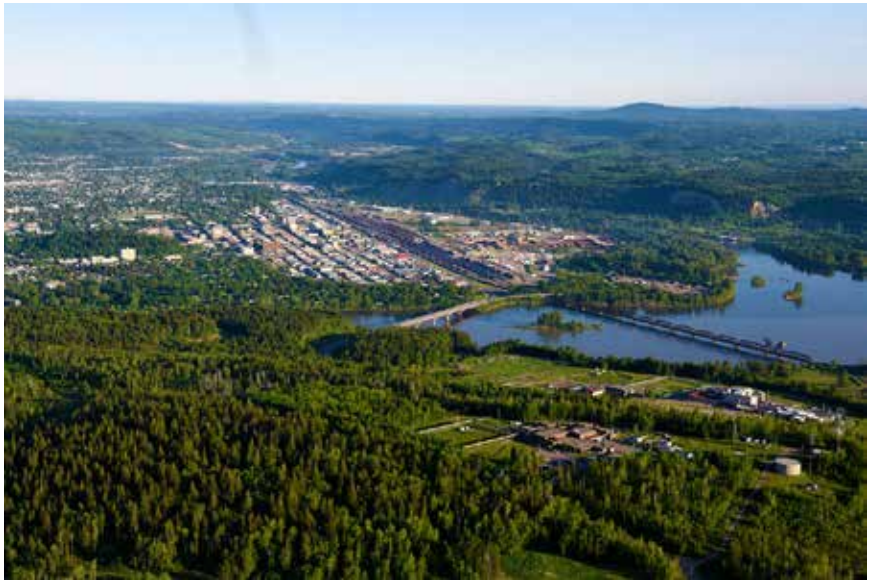
City of Prince George

Waste Heat Recovery 7.5MW_t
In Operation 2012

The biomass-based Prince George District Energy System (DES) provides heating for several landmark buildings in downtown Prince George, reducing greenhouse gas emissions by 1,900 tonnes per year. FVB was involved in the concept development of the modifications at Lakeland necessary to access this “excess and available” biomass energy. The state-of-the-art district energy system takes waste heat from the Lakeland sawmill and transfers it via insulated piping to heat the downtown core of the city, a move that makes sense financially, environmentally, and socially.

The mill produces heat by burning biomass waste for the purpose of drying sawn lumber. FVB’s system captures the waste heat from this process and uses it to heat water for the District Energy System. FVB provided feasibility studies, business case analysis, marketing, design, construction, and operations support for the district energy system, the 7.5 MW_t heat recovery energy centre, the 5MW_t capacity peaking/backup energy centre (expandable to 10 MW_t in future), 2,500 trench metres of piping (82,000 trench feet), and 9 building ETS connections.

FVB helped the city overcome the challenge of locating the Energy Centre by presenting the city with cost estimates based on piping requirements and the Energy Centre footprint. FVB also drafted energy service agreements and assisted the city in a marketing campaign to present DES as an attractive alternative to conventional forms of thermal energy.



Top: Components of the Prince George District Energy System, Source: FVB Energy Inc.
Bottom: The City of Prince George, Source: Wikimedia Commons

Sala, Sweden

For Sala-Heby Energi AB, FVB provided the initial concept design analysis and detail design for the central heating plant, distribution piping system, system hydraulic modeling, and building connections. Based on FVB's feasibility study, Sala-Heby Energi constructed a biomass-fueled combined heat and power (CHP) plant. The biomass CHP plant produces 10 MW_e and 22 MW_t. From 1998 to the present FVB continues to assist Sala-Heby Energi in expanding their system and connecting new customers. FVB has also prepared the detail design and tender documents for an additional Flue gas condensation Plant. FVB continues to provide support for combustion optimization, control systems and other miscellaneous system enhancements.

Katrineholm, Sweden

For Katrineholm Energi AB, FVB provided the initial concept design analysis and detail design for the biomass-fueled central heating plant, district heating distribution system, and customer connections. The fuel preparation process included cleaning dirt and rocks from tree residue, chipping the residue into smaller pieces, transporting and storing the fuel, and finally conveying the wood chips into the boiler. FVB also provided engineering services during the project construction and evaluated the feasibility of generating electricity sequentially with district heating production (combined heat and power). FVB was later hired to study the feasibility of adding a biomass-fueled CHP plant. At the time the optimum size was 14 MW of power and 31 MW of thermal energy. The district heating demand is 210 GWh/year and the peak demand is close to 80MW.

Härnösand, Sweden

FVB was hired by Härnösand Energi & Miljö to perform a feasibility study for a biomass fired CHP plant in Härnösand. After commissioning FVB conducted performance tests for the turbine and an economical evaluation of the project. The CHP plant is sized to supply 11.7 MW of power and 25.9 MW of thermal energy from the condenser, and 7.3 MW_t from the flue gas condenser unit. The biomass boilers use a mix of forest residue; saw mill waste, and peat. The boiler is rated at 50 ton/h at 92 bar, 510°C. The district heating demand is 166 GWh/year and the peak demand is close to 60MW. The CHP plant provides the city with 67 % of the district heating demand.

Hallstrahammer, Sweden

For Hallstrahammar Energi AB, FVB provided the initial concept design analysis and detail design for the biomass-fueled central heating plant, distribution piping system, system hydraulic modeling, and building connections. FVB also provided engineering services during the project construction and evaluated the feasibility of generating electricity sequentially with district heating production (combined heat and power). The district heating demand is approximately 100 GWh/year and the peak demand is close to 40MW.

Nyköping, Sweden

FVB was hired to study the feasibility for a biomass-fueled combined heat and power Plant installation to supply the existing district heating system with thermal energy. FVB optimized the plant size and configuration. The combustion system is a bubbling fluidised bed (BFB). The CHP plant is sized to supply 34,8 MW of power and 58,6 MW of thermal energy from the condenser and 11,5 MW thermal from the flue gas condenser unit. The BFB boiler can be operated on wood waste, peat, coal or oil. The 97,5 MW boiler is rated at 144 ton/h at 140 bar, 540°C. The district heating demand is 300 GWh/year and the peak demand is 115MW. The study included conceptual design and performance calculations for each option as well as capital cost estimates and financial analysis.

Nora, Nybysåg and Hasselfors, Sweden

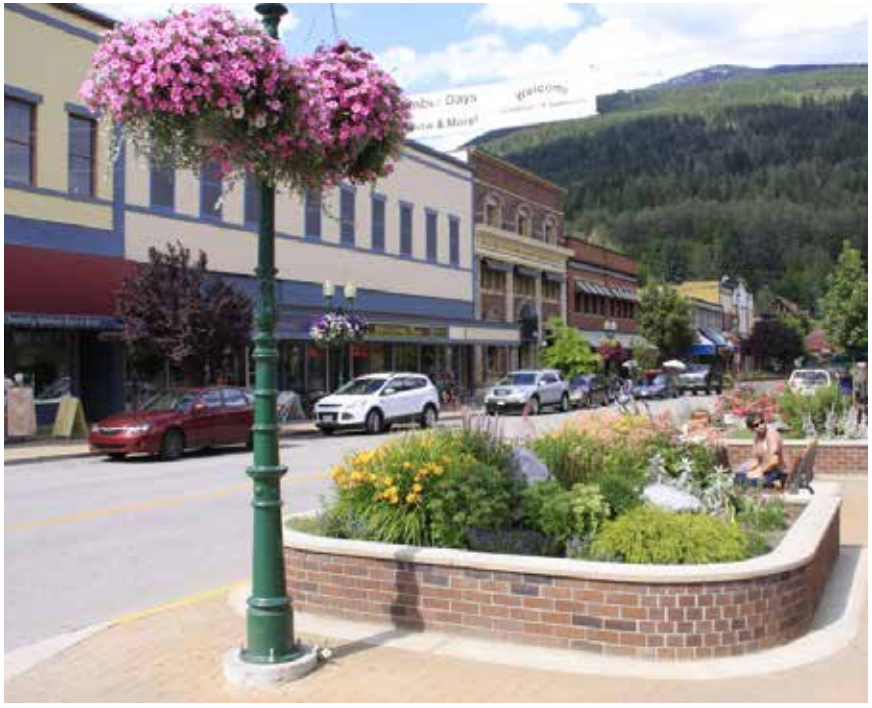
FVB has prepared conceptual drawings for biomass hot water boiler systems at three locations. The boilers are in operation and produce steam and hot water for sawmills and district heating to communities nearby. The boilers are 5-8 MW each. The combustion system consists of moving grate for wet biomass. The boilers went into operation in 2002.

Arvika fjärrvärme, Sweden

FVB has prepared the tender documents for the plant, tender evaluation, purchase, and project management and delivery inspection for the owner. The plant consists of a complete automatic biomass fuel handling and combustion system. The boiler is a bubbling fluidised bed (BFB) producing hot water for the district heating system in Arvika. The plant has a production capacity of 17 MW and an additional load of 4 MW from the flue gas condensation plant. The project was executed in 2000 through 2002.

The City of Revelstoke

1.5 MW_t biomass boiler
1.75 MW_t propane boiler
Wood Waste Fuel
In Operation 2005



Revelstoke Community Energy System uses a local, renewable waste fuel to generate heat for several important customers, such as the Revelstoke Secondary School and the new City Indoor Pool. FVB Energy provided business and engineering services from feasibility stages, through to design, construction, operation and expansion of the system.

The motivations behind The City of Revelstoke pursuing a Community Energy system were to develop infrastructure in the downtown core that provides highly competitive, efficient and environmentally responsible thermal energy, to utilize the valuable biomass resource otherwise wasted, to reduce local air emissions and cut the city`s carbon footprint, and keep energy dollars circulating within the community.

The Community Energy Plant is located adjacent to the Downie Timber dry kilns on Downie Street allowing the project to deliver low-pressure steam to the sawmill dry kilns. A biomass combustion module converts 7,000 tons of sawmill waste per year into useful steam and hot water and distributes the water utilizing European Standard (EN 253) thin wall steel pipe. The Central Energy plant uses the biomass boiler and a propane fired boiler to heat thermal oil to minimize the staffing requirements of the Provincial Boilers Branch. The 1.5 MW biomass boiler provides base load heating needs and the 1.75 MW propane boiler provides peaking and backup.

The system produces over 100% of the Customer's loads on an annual basis (85% by biomass) of displacing imported propane and cutting 3,200 tonnes of greenhouse emissions per year. The entire system is owned and operated by Revelstoke Community Energy Corporation, a for profit commercial enterprise that is owned by the City.

Left: The City of Revelstoke, BC
Source: Wikimedia Commons

The Village of Ouje-Bougoumou Source: Wikimedia Commons

Oujé-Bougoumou Québec

1 MW_t
Wood Waste Fuel
Plant in Operation 1993

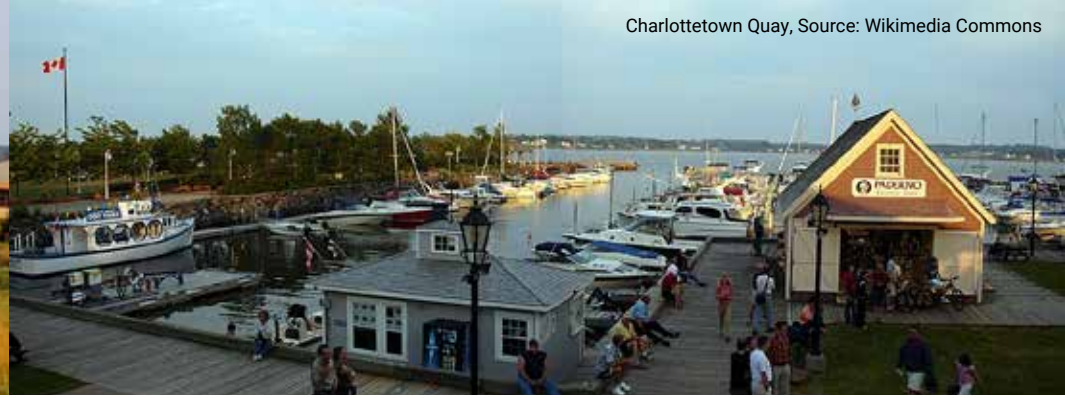
The Cree Nation of Ouje-Bougoumou selected FVB Energy Inc. to provide a variety of business development and engineering services for this district energy system, which provides heating services to an entire community in Northern Quebec. The system started operations in 1993.

The Energy Centre includes two biomass-fired boilers to produce 75% of the district heating system's annual thermal energy requirements. The boilers utilize wood waste from a nearby sawmill.

The Energy Centre has a capacity of 3.8 MW_t. The district heating system utilizes two fuel oil fired boilers and two biomass fired boilers to provide up to 90°C hot water. The distribution system utilizes a combination of European Standard (EN 253) thin wall steel pipe and plastic pipe (PEX).

Customers include 135 homes and 16 public buildings.

Charlottetown Quay, Source: Wikimedia Commons



Charlottetown Prince Edward Island

1.3 MW_e, 5 MW_t Biomass Boiler
Wood & Municipal Waste Fuel
Plant in Operation 1983

The Charlottetown district energy system is one of the oldest successfully operating modern district heating systems in North America served by biomass, and serves a combination of public and private sector buildings. This system uses biomass-fired boilers to burn 35,000 tonnes of sawmill waste and 30,000 tonnes of municipal solid waste (MSW) per year. The MSW is burned in a two-stage combustor (gasifier) and the sawmill waste is burned in sloping/moving grate combustors.

The Energy Centre has a peak load of 35 MW. The district heating system uses 121°F hot water and 1030 kPa steam. The distribution system utilizes a combination of European Standard (EN 253) thin wall steel pipe and direct bury steam piping.

FVB Energy provided the concept development and feasibility analysis for the biomass Energy Centre and district heating system, financial analysis and rate structure development, detailed design of Energy Centre, distribution piping and building connections, and operation management of the system and energy company.

Global Presence

Local Solutions

Toronto Edmonton Vancouver Ottawa Minneapolis Stockholm Västerås