# STEAM TO HOT WATER CONVERSION

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Advances in new technology have made energy efficient Hot Water District Energy Systems more accessible than ever before. In comparison to steam, hot water systems exhibit reduced heat loss, reduced emissions, and lower capital and maintenance costs, making them a perfect fit for sustainable communities.

FVB is one of the most prominent and established mechanical engineering firms in North America in district energy systems, with over 45 years international and 25 years North American experience. The experience of FVB's personnel is unmatched in the industry; the level of understanding we bring to each project is what sets us apart and reduces risk for our clients. This includes considerable experience in optimizing a range of factors necessary for a successful steam to hot water conversion - including building conversions, distribution technologies, and low carbon heat sources.

Included in these pages is just a snapshot of the steam to hot water conversion projects FVB has completed over the years. I am sure you will find that our knowledge of the requirements of this type of project is unparalleled throughout North America. 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.

# University of British Columbia

(2010 - Present)

FVB Energy has been involved with the University of British Columbia Steam to Hot Water Conversion Project since the initial feasibility study. FVB initially assessed technical feasibility and capital cost of replacing most of the existing steam distribution pipe system with a low temperature, hot water distribution piping system. A second study completed by FVB included complete design basis documents for energy transfer stations, a distribution piping system, an energy centre, and established a realistic concept, budget, and design guidelines.

This 5-year, 9-phase project carried a budget of $88 million and resulted in the reduction of UBC's thermal energy output by 24%, GHG emissions by 22%, and operational and energy costs by $5.5 million per year.

FVB was responsible for the design of a 200 BHP saturated steam (200 psig) boiler system and a 25,000 lb/hr (150 psig saturated steam) steam to hot water conversion station. The campus conversion also included 11 trench kilometers (6.8 trench miles) of buried piping, the conversion of 115 buildings, and the design and installation of over 100 energy transfer stations. The construction approach taken by FVB ensured that the campus did not lose service during the project and minimized disruption to the university.

FVB was also engaged by UBC to design a new large-scale hot water energy centre to serve the hot water district heating system, consisting of high efficiency natural gas boilers with a condensing economizer to maximize efficiency and provisions for alternative energy sources. FVB is now involved with providing operation support as UBC expands their biomass plant.

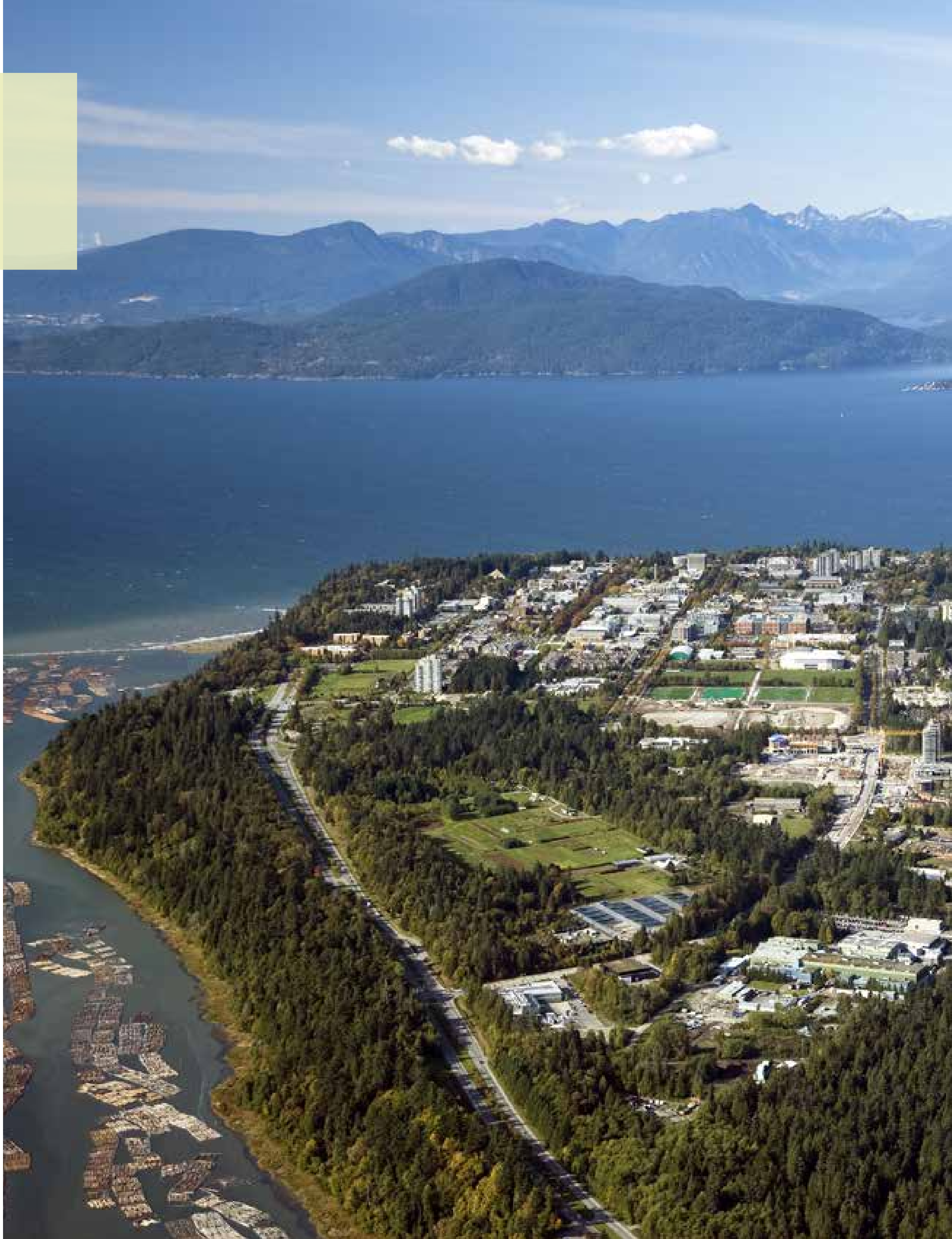

Photo: University of British Columbia

# University of Rochester

University of Rochester - Rush Rhees Library © Wangkun Jia / Adobe Stock

(2004 - Present)

FVB designed a new hot water district heating system for the University of Rochester to replace the existing steam system, providing full support to tendering, construction, commissioning, and operation of the new system.

Extra measures were taken to preserve heritage buildings being converted to the new hot water system. Furthermore, part of the work was completed in an operating research facility where excessive noise or vibrations would affect the ongoing projects. FVB used special tools to eliminate vibrations and worked around the facility's schedule to ensure the active research was not interrupted or affected by construction.

FVB performed engineering and construction support services for the successful conversion of more than 71 buildings from steam to low-temperature hot water, installation of 6,000 trench metres (20,000 trench feet) of EN253 piping, and connection of the buildings to the new hot water system. Thermal distribution efficiency was increased by more than 30 percent and the new hot water system was constructed and commissioned in 10 months (completed in 2006) without loss of service to users. The buildings were converted and connected to the completed hot water system in an ongoing process from 2005 to the present. FVB Energy is currently engaged to replace the Saunders Research Building distribution piping and are designing the River Campus hot water loop.

The customer connections used brazed plate and shell-and-coil heat exchangers for building heating and double wall plate and frame heat exchangers for domestic hot water heating. FVB also designed the expansion of the chilled water distribution loop serving the medical campus at the university.

# Energy Services Acquisition Program

Canadian Parliament Buildings


(2012 - Present)

Under the Energy Services Acquisition Program (ESAP), through Public Works and Government Services Canada (PWGSC), FVB is providing technical support to the Government of Canada for the steam-to-hot water conversion and operation of the district energy system that services the federal campus in Ottawa. The PWGSC systems in the National Capital Region provide heating and cooling to over 2,000,000 $m^2$ (21,000,000 $ft^2$) of floor area. The systems include multiple high pressure steam plants, including 500,000 lbs/hr and 350,000 lbs/hr facilities.

The upgrades consist of two phases. Phase 1 of the ESAP, currently underway, will convert the steam system to low temperature hot water and the steam-powered chillers to electric. It is expected that Phase 1 will lower emissions by 63% – equivalent to taking 14,000 cars off the road. Phase two will begin after the conversion and will focus on the transition from natural gas to carbon-neutral fuels like biomass and bio-oil, and is estimated to reduce GHG emissions by a further 28%. This retrofit project is expected to save the Canadian government more than CA$750 million (US$590 million) over a forty-year period.

With a reliable plan for the future of the District Energy Systems, FVB has functioned as Owner's Engineer and Technical support for the call for proposals, the Design Engineer for Building Conversions Designs, the Design Engineer for Tunney's Pasture, Cliff Street, and NPB CHCP Schematic Designs, and as Owner's Engineer for a Biomass Thermal Energy Study.

# Dalhousie University Agricultural Campus

(2015 - Present)

FVB was retained by Dalhousie University to convert the facility from steam to hot water and design the renewal of their existing biomass heating plant. This conversion included retrofitting campus building mechanical and control systems, conversion of steam boilers to hot water, and replacing the distribution piping system to one that can utilize hot water. 14 buildings were converted with 16 Energy Transfer Stations, 1,450 trench metres (4,750 trench feet) of pre-insulated steel heating piping were installed, and 290 trench meters (950 trench feet) of steam tunnels were re-purposed for hot water application.

The campus conversion was completed in October 2017; the campus is now using hot water with process steam for sterilizers and humidification generated locally at various buildings as required.

In designing the renewal efforts for the biomass heating plant, FVB chose a new 5.4$MW_t$ biomass combustion boiler which will generate hot oil circulated to an Organic Rankine Cycle Generator, producing 1.0 MW of electricity and 4.4 MW of thermal power. Dalhousie will generate electricity to sell to the local grid while using the excess heat 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.

The Fuel Bin at Dalhousie's Agricultural Campus
© Michael Conte / FVB Energy

# Dalhousie University Sexton Campus

The Henri Hicks Building at Dalhousie University © M.Ricon / Wikimedia Commons

(2014 - 2017)

Dalhousie University's climate action plan sets 2050 as the date by which it intends to reach carbon neutrality. Phasing out the steam heating system that services the three campuses in Halifax, Nova Scotia, is a key part of reaching this goal. FVB was engaged by Dalhousie to design the replacement of both the steam and condensate lines of Sexton Campus with 2.5 km (1.6 miles) of EN253/448 pre-insulated hot water lines with integrated leak detection. This includes 1600 trench metres (5,250 trench feet) winding intercity pipe required for the interconnection between campuses.

At full build-out of the Sexton Campus, heating demand will be approximately 10 MW (34 MMBtu/hr). FVB's design was efficient so as to require an economical 35°C (95°F) temperature delta T, allowing the piping size to be reduced from NPS 250 to NPS 200. The reduction in pipe size gives the design flexibility, makes the hot water distribution system easier to maintain, and allows for a more focused water treatment plan for the buried infrastructure.

The University will continue with a slow phase out of its steam system over the next few decades. To accommodate this phase-out plan FVB designed a steam to hot water conversion station that can be relocated from its current placement on Sexton Campus, where it is currently needed, to the steam-to-hot-water demarcation point by the Central Services plant.

# Stanford Energy System Innovations

(2011 - 2015)

The Standford University Energy System Innovations (SESI) project consisted of converting 155 buildings from steam to hot water and replacing over 30 KM (20 miles) of pipe in less than three years. The new hot water distribution system utilizes European Standard (EN 253) factory insulated thin walled steel pipe and HDPE outer jacket complete with a integral leak detection system.

To ensure that campus operation would be disturbed as little as possible during construction, the project was divide into multiple phases.

FVB completed a Peer Review of the design for the campus conversion, where we provided recommended building conversion and operational changes that allowed Stanford to achieve targeted hot water temperatures for the system. We also identified areas were it would be possible to achieve significant cost savings without impacting system performance targets, such as changes to building interconnection heat exchanger selection criteria and eliminating some of the proposed building conversion works that would have yielded little performance enhancement.

Success and cost effectiveness of conversions requires fundamental understanding of the drivers of year-round system performance, a broader view of energy consumption, introduction of more sophisticated technology to manage flow control, and a better strategy to prioritize capital expense within buildings to deliver the best long-term operation with the least risk. All of this FVB was able to provide thanks to our more than 25 years of experience in District Energy.

Stanford University 

# Global Presence

# Local Solutions

Toronto Edmonton Vancouver Ottawa Minneapolis Stockholm Västerås