Introduction-Juneau Delegation visit of Danish and Norwegian District Heating systems for situational awareness and understanding for potential district heating adoption in Juneau.

A Juneau contingent visited Copenhagen on June 6-8, 2016 and Drammen, Norway on Juneau 9-10, 2016.

Attending:
Brian Holst, JEDC Executive Director
Paul Voelckers, MRV Architects, Willoughby Improvement District
Jeff Duvernay, Harri Plumbing and Heating, Inc.
Keith Comstock, Juneau Hydropower, Inc.
Paul Grossi, Lobbyist for AK State Pipe Trades
Mary Becker, CBJ Assembly
Jim Rehfeldt, PE, Alaska Energy Engineering
Norway only-Duff Mitchell, Juneau Hydropower, Inc.

Copenhagen, Denmark

The Copenhagen visit was sponsored by the Danish Embassy and was led by Jacob Bjerregaard, Senior Advisor, District Heating.

Points of interest:

- District heat supplies 50% of the Denmark's heat demand, 63% of Denmark's residential demand, and 98% of Copenhagen's residential heat. Denmark is a leading nation in district heating with decades of experience.
- The country has a commitment to district heat as part of the country's goal to be independent of fossil fuel by 2050 for financial and environmental reasons.
- District heat must show that it offers a lower total heating cost to the building owner than alternative energy sources (mostly natural gas). District heating has been successful in establishing costs that are lower than fossil fuel alternatives.
- Energy sources include wind, biomass, rapeseed oil and natural gas. Biomass is considered a transitional fuel toward energy sources such as wind and solar with less global warming potential.
- Denmark produces excess wind energy when the wind blows hard and currently exports it to neighboring countries. They are looking at thermal storage options to store the energy and have successful thermal storage operations.
- District heat conversions range from 60% to 100% of potential customers.
- Taxes on electricity prohibit using wind-generated electricity to power seawater heat pump systems in Denmark. Because of this tax disincentive, almost no heat recovery sources are used for district heating in Denmark, with other countries, particularly Norway, taking the lead on seawater heat pump systems.
- Customers are given financial incentives to operate their systems in a manner that increases central plant efficiency (greater temperature drop) and reduces distribution losses (lower heating supply temperature).
- The district heat piping has a 40-50 year life. New piping is improved and better insulated.
- Domestic hot water is supplied by instantaneous heat exchangers; no storage losses. These are very efficient systems that optimize energy use and lower customer costs.

- Industry representatives were present to share their expertise and offer assistance in answering Juneau delegation questions. Industry representatives are eager to assist Juneau in developing and operating a cost effective and efficient district heating system for the community of Juneau.

Drammen, Norway

The Drammen District Heating plant tour in Drammen, Fjernvarme, AS was hosted by Jon Ivar Baak, CEO.

The Norway visit was sponsored by Vilter Manufacturing / Emerson Technologies, and Star Refrigeration. Emerson Technologies has developed the patents and design for the high temperature water system used in Drammen, the same high temperature seawater heat pump that is proposed for Juneau District Heating.

The Drammen Heating District has been served with heat produced by Emerson Technologies seawater heat pumps since 2011. Emerson, an America based, world leading industrial company, is committed to seeing the Juneau District Heating project develop and be successful.

Emerson executives involved in the Drammen visit included their Vice President, European Sales Manager, and American Sales Manager. Star Refrigeration (Europe's leading heating, ventilation and air conditioning firm) sent their VP of Business Development to meet with the Juneau Delegation.

Jim Rehfeldt and Duff Mitchell were also able to visit a wastewater heat pump system in Sandvika (suburb of Oslo) that extracts heat from raw wastewater that has had successful operations since 1987.

Items of Interest:

- Drammen District Heating energy is primarily supplied by seawater heat pumps, with back up natural gas boilers, and a biomass boiler.
- The seawater heat pump system has a 99.8% reliability. Pumps are sized for 28% of the peak load and supply 75% of the total heating load, since they run almost continuously. The goal is to add more seawater heat pump capacity (60% of peak load) so they can supply over 90% of the load. Drammen is building an additional seawater heat pump facility to heat their regional hospital complex and to connect additional areas in Drammen to seawater heat pump heating. Their expansion demonstrates the fiscal and reliability success of their seawater heat pump operations.
- Natural gas or biomass boilers supplement the heat pumps as needed. The lower cost option determines which energy source is used for supplemental heat. Drammen District Heating loses money when they operate on natural gas or biomass as these systems cannot economically compete with the sea water heat pump system.
- The district heating system is required by law to be less expensive than electric resistance heat. Only the heat pumps can achieve this; natural gas and biomass are both more expensive and are only used as a backup. The company loses money when they use back up natural gas or biomass sources. The last 2 winters has seen little need to use back up generation.

- The distribution piping is connected to an energy transfer station in each customer building. The transfer station includes a building heat exchanger and a domestic hot water heat exchanger. The transfer station is a fraction of the size or cost of the previous boiler or hot water system, and the building space needed. New buildings save costs and space by not constructing individual boilers or hot water systems. Each building is fully heated and receives their domestic hot water supply through the district heating with high customer satisfaction ratings.
- The seawater intake is 120’ deep and located 30’ off the bottom in the Drammen fjord. The piping distance of the intake is over 750 meters.
- The best opportunities for improving system efficiency is to lower the required building heating supply temperature and increase the heating water temperature drop in each building. Efficient transfer stations that offer communication software have also improved operational efficiencies.
- The distribution system offers substantial thermal storage for meeting the morning warm-up load without requiring the use of supplemental heat sources. This keeps operational and customer costs low.
- Fiber-optic cables are run to each building to transmit data such as energy use, flow and temperatures to the central plant. The communication between buildings and district heating plant leads to better efficiencies and reliability.
- The Drammen Plant was specifically built for district heating. Juneau received some good lessons on how to make improvements from their experience.
- The district plant in Sandvika is extracting heat from wastewater with a heat recovery heat pump, then supplying the heat to the district heating system. There are two sewage wastewater systems in Oslo. The Sandvika plant is the downstream plant of the inner Oslo district heating system.