IEA Bioenergy
Technology Collaboration Programme

Pellet production linked to combined heat and power plant

Falun, Sweden

Best Practices on flexible bioenergy

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The combined heat and power plant in Falun is linked to a wood pellet plant. This allows for longer running times and higher power production as the surplus heat can be used for the dryer in the pellet plant.

Project description

The city of Falun is located in central Sweden, some 200 km northwest of Stockholm. The municipality has a population of 60 000 inhabitants, of which 37 000 live in the central city. The city has an extensive district heating/cooling system managed by the public utility Falu Energi & Vatten (FEV). The utility is owned by the municipality, and also supplies electricity, water, fibre, and manages waste handling in the community. Most of the energy for the DH system is produced at the combined heat and power plant, Västermalmsverket, which predominantly uses woodchips as fuel. Falun has a close cooperation with the nearby city of Borlänge, and the two cities are connected with a 20 km long hot water pipeline, connecting the two heat grids and enabling a cost-efficient use of heat and fuels through the seasons. The base load production of heat for the two cities combined is a CHP in Borlänge using municipal waste as fuel.

The CHP in Falun has two boilers with a total capacity of 60 MW heat and 15 MW electricity. The total production per year is around 300 GWh heat and 80 GWh electricity. The heat grid has a length of 200 km. 90% of the residential heat demand in central Falun is supplied by the grid. Besides heat from the CHP, the system also receives waste heat from a computer center. A district cooling grid has an absorption cooler with 2.2 MW capacity, also taking energy from Västermalmsverket.

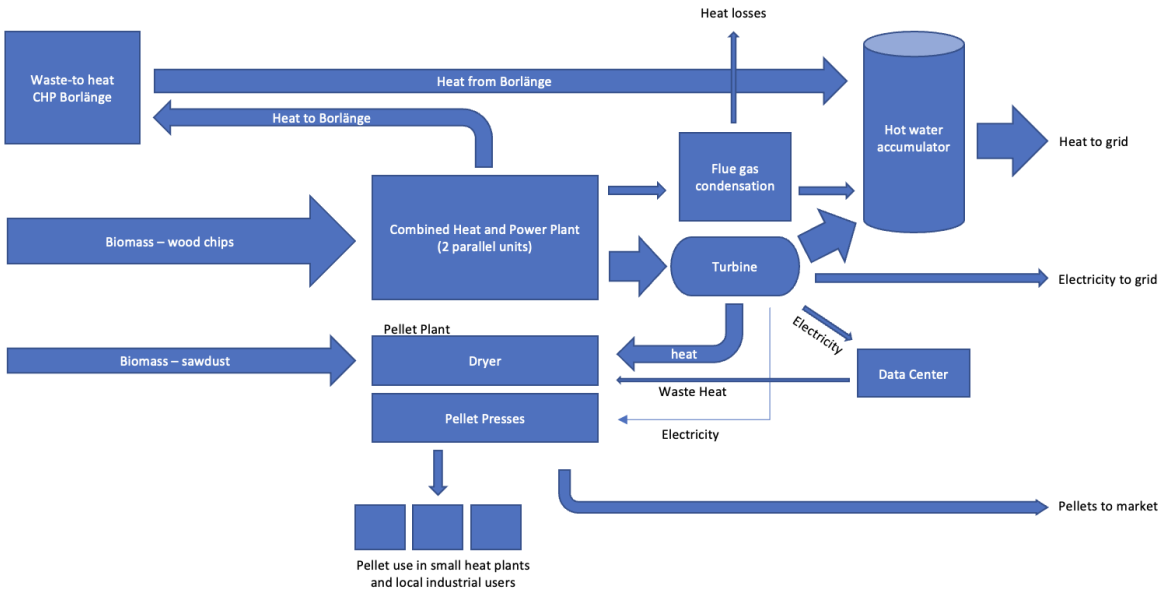

Figure 1: The chart shows the system design in Falun in overview.

In 2011, FEV opened a pellet plant linked to Västermalmsverket. The pellet plant uses sawdust from nearby sawmills as raw material and has a capacity to produce 50 000 tons of wood pellets per year. The dryers use excess heat from the CHP to dry the sawdust before pelletizing. The pellet plant is mainly running between spring and autumn when the heat load is lower than during the winter. This enables FEV to extend the running times for the turbines and produce electricity in a more flexible way. The plant also has a hot water accumulator with a capacity of 30 MW – 450 MWh (8400 m^3 water).

Base information	
Link for more information	https://fev.se/om-oss/om-foretaget.html
Contact person, **Email**	Mathias Bjurman, head of heating/cooling Mathias.Bjurman@fev.se
Location	Falun, Sweden
Technology supplier	Pellet factory: Salmatec (pellet presses), Zessor (crushers), Swiss Combi (dryer) CHP: Foster Wheeler 2006, Kvaerner 1993
Project Period	From 2011 and continuing
Demonstration plant start-up year	Full commercial production
Status	Commercial production of heat, power and wood pellets
Feedstock	Locally produced biomass (industrial by-products like bark and sawdust, residues from forestry), and waste wood.
Products	Heating/cooling, electricity, wood pellets
Capacity	CHP: 60 MW thermal, 15 MW electricity Pellet production: 50 000 tons/y Heat accumulator: 8400 m^3 water
Type of flexibility provided	Flexibility in electricity production, feedstock flexibility, energy storage
Total project cost	200 million SEK (20 million USD)

Technical and commercial details

The district heating system is a conventional solution for Scandinavian conditions, supplying most of the heat and hot water demand for the city of Falun. The unique solutions in this case are two: 1. The attached pellet plant. 2. The connecting hot water pipeline to the nearby city of Borlänge.

The cooperation with Borlänge enables the two cities to exchange heat and produce electricity in a more cost-efficient way. Baseload heat is produced at the CHP in Borlänge, which uses municipal waste as its major fuel. This must be incinerated all year around, and during summer this production is sufficient for much of the heat used in both cities, and hot water is supplied through the pipe from Borlänge to Falun. During other times, when the pellet plant in Falun is running, but the heat load in Falun is moderate, surplus heat from Falun runs through the pipe in the opposite direction. Delivery of heat from Borlänge also reduces the need for top-load heat production (see durability chart below).

The pellet plant allows more efficient use of the turbines at Västermalmsverket. The running times of the turbines (there are two parallel of 7+8 MW each) can be extended from 4 000 hours/year to 6 000 hours/year. This means improved economy, as the capital cost is relatively high for a biomass CHP.

Flue gas condensation provides opportunities to use biomass with high moisture content and still reach high energy efficiency rates, thus allowing high feedstock flexibility.

A hot water accumulator provides for short term flexible use of the heat. The accumulator can store 479 MWh of heat, which covers the heat demand for 10 hours in winter when the average temperature is minus 5°C.

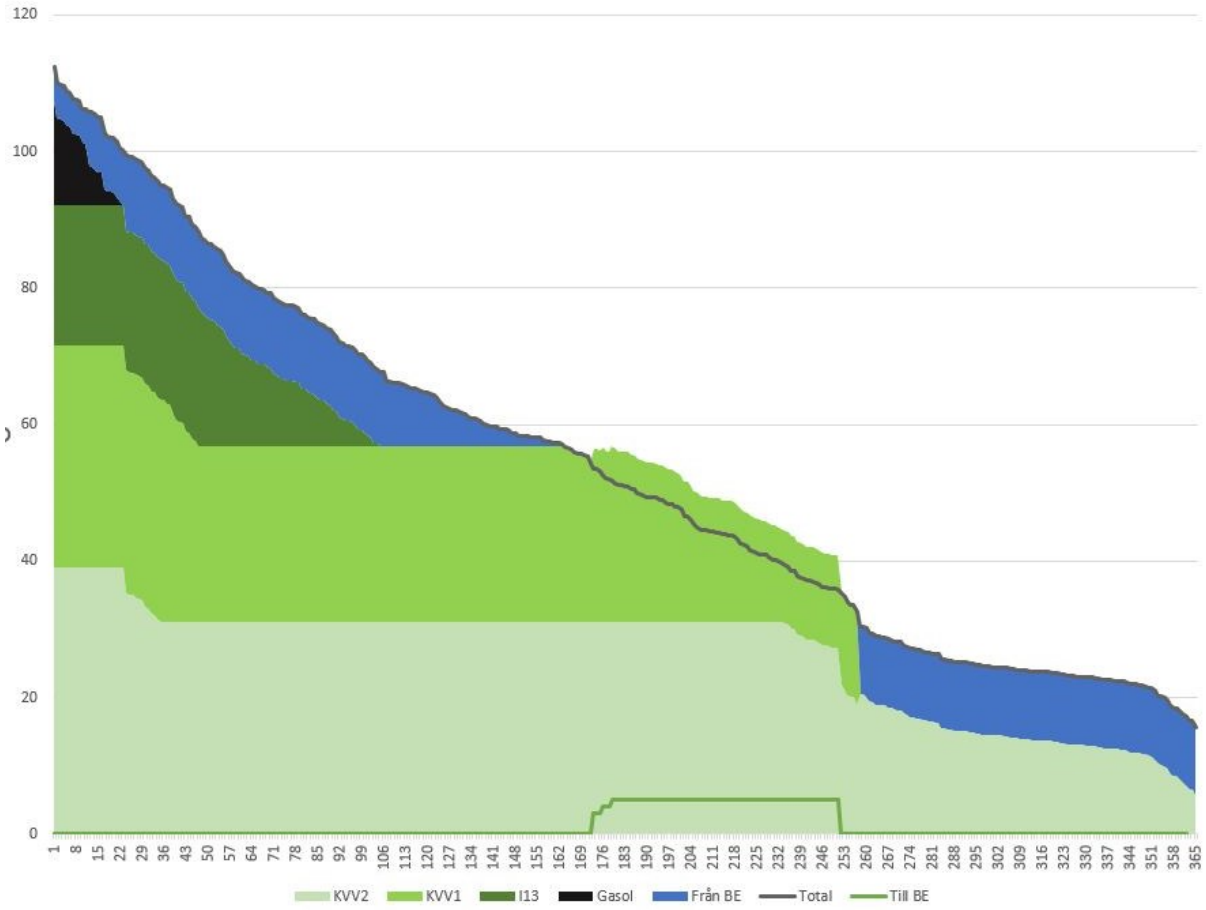

Figure 2: The figure shows the energy production through the year (durability chart). The total energy use in the DH system is 400 GWh/y. KVV1 and KVV2 (light green) are the two CHP units at Västermalmsverket. I13 (dark green) is another smaller heat boiler using woodchips. Top load demand is supplied by a gasoil boiler (could be converted to bio-oil). Blue shows the import of heat from Borlänge. During middle-load periods heat is exported to Borlänge. Durability chart, supplied by Falu Energi & Vatten.

Figure 3: View of the plant Västermalmsverket in Falun. The two chimneys show the location of two parallel CHP units. The pellet plant is located to the left of these units, and a cooling plant to the right. In the center is the accumulator. Behind the plant (in grey) is the data center. We can also see storage of sawdust for the pellet plant, and different types of biomass for the CHPs: bark, woodchips, sawdust, recycled wood and discarded wood/fuelwood.

Market opportunities and limitations

The solution is based on technology that is readily available on the market, and can be applied in most district heating systems.

Lessons learned

The system has been up and running for more than ten years and works well under market conditions, based on carbon pricing (ETS and carbon tax). A DH system like that in Falun can gradually be improved with new units increasing flexibility and offering new services to the city.