Heat recovery from local paper mill in Skjern, Denmark

This case study is part of a project catalogue produced by [ReUseHeat](#) to provide inspiration on how to utilize excess heat from urban sources for heating and cooling purposes. The catalogue contains 25 existing or planned projects out of which 12 cases are Danish and 13 cases are from other European countries[2].

Facts about this case

Installed heat capacity: 3 x 1.33 MW heat pumps + 2.0 MW direct heat exchange

Heat source: Low-temperature heat from the production process (43 °C)

Heat pump COP: 6.9

Production: 52 % of the district heating is based on waste heat from Skjern Papirfabrik

Investment cost: € 670,000 (Skjern Fjernvarme) and € 3.0 M (Skjern Papirfabrik)

Payback period: 5 years (Skjern Papirfabrik)

Period: Finished in 2012

District heating network: 3196 consumers

Link to web pages:
http://www.skjernfjernvarme.dk/
http://skjernpaper.com/

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Source: Skjern Papirfabrik, www.skjernpaper.com[1]

Description

The paper mill in Skjern, Skjern Papirfabrik, has invested in a large heat pump to make use of low-temperature waste heat from the paper drying process.

In the paper drying process at the paper mill, a huge potential for energy recovery was discovered in the hot exhaust air. The hot exhaust air was previously emitted to the surroundings, however by extracting heat from the energy intensive air, a vast potential of excess heat is

enabled. In 2012, three heat pumps of 1.33MW were installed at Skjern Papirfabrik, corresponding to a total heat pump capacity of 4.0MW. Heat extracted from the system is sold to the local district heating company, Skjern Fjernvarme. The paper mill owns the heat pump and the district heating company established a transmission line to connect the heat pump facility with the district heating network. The paper mill already delivered district heating before enabling the heat pump solution through 2.0MW direct heat exchange on natural gas boilers at the mill. The heat pump facility accordingly enlarges the well-working cooperation between the local industry and the district heating company. In 2016, the annual heat production in Skjern Fjernvarme was approximately 76,000MWh and the heat delivery from the mill was approximately 39,000MWh, corresponding to 52% of the total district heating production in Skjern. The remaining heat productions facilities at Skjern Fjernvarme are biomass boilers, which produced approximately 26,600MWh in 2016, and natural gas units which produced approximately 10,000MWh in 2016. The heat pump accordingly displaces both natural gas and biomass, corresponding to savings above 8000 tonnes of CO_2.

The district heating water is heated from 37 to 70 degrees Celsius with exhaust air temperatures between 50 and 58 degrees Celsius. The high air temperatures enable direct heat exchange, which reduce the temperatures to 43 degrees Celsius. This low-temperature heat is utilized in the three heat pumps, as direct heat exchange is not possible. The heat pumps are accordingly needed to utilize the remaining heat. The district heating network is coupled directly with the heat pump system at the paper mill, where a storage tank can stabilize the delivery from the mill. The annual COP is approximately 6.9, however COP-factors between 8 and 10 occurs in periods of part load operation.

The price of heat is calculated monthly, based on the actual production costs of the heat pump facility and the marginal costs at Skjern Fjernvarme. The transfer price is placed in between these two prices to ensure fairness for both parties. The production costs at the mill and the district heating company are dynamic and depends on fluctuating variables such as the natural gas price and the spot price on electricity. Purchase of heat from Skjern Papirfabrik is always the most beneficial option for the district heating company.[2]

References

1. [Skjern Papirfabrik](#)
2. Handbook - 25 cases of urban waste heat recovery