

Co-production with a gas engine driven heat pump in Tønder, 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: 4.3 MW gas and 3.3 MWelectric

Heat source: Process cooling (20 °C) and air

Heat pump COP: 2.16 using air and 2.9 using excess heat

Production: 40% of the total heat production in Tønder can be produced by the heat pump (based on air)

Temperatures: Excess heat is delivered to the heat pump at approximately 20 °C

CO₂-savings: Above 4000 ton CO₂ annually

Investment cost: € 4.92 M (does not include necessary investments for SAPA Extrusion)

Savings: Between € 725,000 and € 950,000 annually

Period: Finished in 2017

District heating network: 2700 consumers

Link to web page:

<http://www.tonder-fjernvarme.dk/>

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Source: Tønder Fjernvarmeselskab A.m.b.a.^[1]

Description

A gas engine driven heat pump unit in Tønder is expected to begin co-production of cooling and district heating in November 2017. Heat is supplied to the local district heating company, Tønder Fjernvarmeselskab, and cooling is supplied to the local company SAPA Extrusion. Previously, the heat production in Tønder was based solely on natural gas boilers.

The heat pump unit consist of two parallel mechanical heat pumps driven by either natural gas engines or an electrically powered engine, depending on the present economic conditions. Depending on the cooling needs at SAPA, the heat pumps can be driven by either ambient air or cooling water from SAPA. Using ambient air with a temperature of 7 degrees Celsius, the thermal capacity of the gas engine is 4.3MW and for the electric motor it is 3.3MW. By using more than one heat source, the heat pump investment is more robust, in the case of SAPA withdrawing their cooling needs. However, the two heat sources enable the heat pumps to operate with a larger heat pump capacity, compared to sole utilization of excess heat from SAPA.

Tønder Fjernvarmeselskab has approximately 2700 consumers connected to the district heating network and the annual heat production is currently 92,000MWh. The annual heat production from the heat pumps, using ambient air, is expected to be at least 36,100MWh, corresponding to nearly 40% of the total heat deliverance. If cooling water from SAPA is to be used, the potential is larger, as the efficiency of the heat pumps would increase. Water from SAPA can be delivered with a temperature of approximately 20 degrees Celsius, which is cooled to a temperature between 6 and 10 degrees Celsius. When using the gas engine, the heat pumps are basically natural gas boilers with average annual efficiencies above 200%.

In addition to the heat pumps, an accumulation tank has been established to store cold water, ensuring the supply for SAPA. The heat produced cannot be stored, meaning that the heat pumps must deliver supply temperatures around 70 degrees Celsius directly to the district heating network. Nonetheless, the heat pumps decrease the amount of natural gas used at the district heating company. Simulations predict annual savings between e 725,000 and e 950,000, depending on the natural gas price. If the gas price increase, the savings increase as well.

While SKAT, the Danish Customs and Tax Administration, which is Denmark's tax authority, have stated, that the heat is not excess heat, co-production is still used to exploit an industrial heat source and thus resembling reuse of heat from an urban source.^[2]

References

1. [Fjernvarmeselskab A.m.b.a.](#)
2. Handbook - 25 cases of urban waste heat recovery