

GAS ENGINE DRIVEN HEAT PUMPS IN TØNDER - DENMARK

Gasmotordrevne varmepumper i Tønder

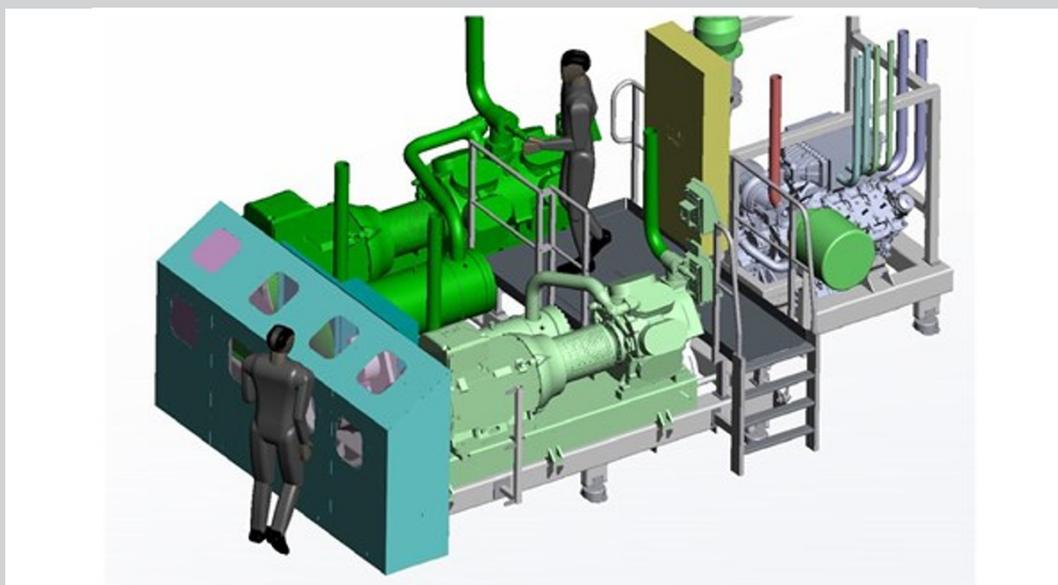


Fig 1: 3D-model of the gas engine driven heat pump unit in Tønder [www.tonder-fjernvarme.dk].

Summary of the project

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 °C, the thermal capacity of the gas engine is 4.3 MW and for the electric motor it is 3.3 MW. 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 also enable the heat pumps to operate with a larger heat

” HEAT PUMPS DRIVEN BY EITHER NATURAL GAS ENGINES OR AN ELECTRICALLY POWERED ENGINE, DEPENDING ON THE PRESENT ECONOMIC CONDITIONS ”

pump capacity, compared to only utilizing excess heat from SAPA.

Tønder Fjernvarmeselskab has approximately 2 700 consumers connected to the district heating network and the annual heat production is currently 92 000 MWh. The annual heat production from the heat pumps, using ambient air, is expected to be at least 36 100 MWh, 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



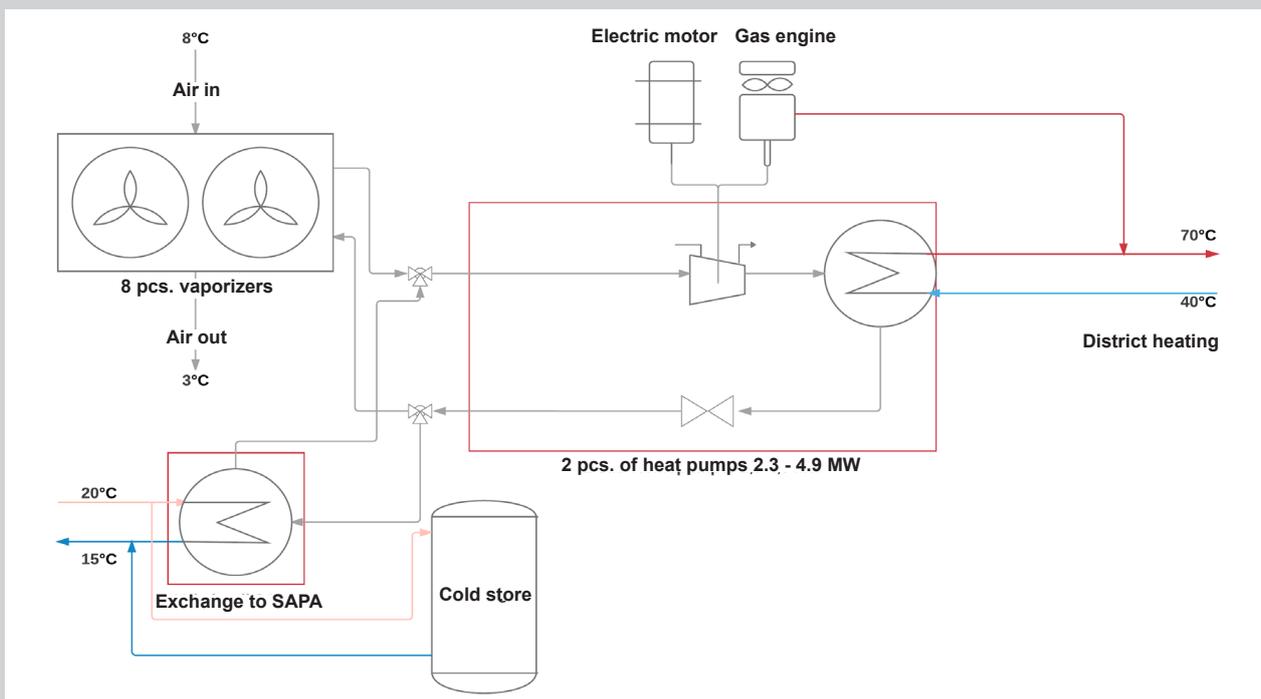


Fig 2: Principal sketch of the gas engine driven heat pump unit in Tønder.

temperature of approximately 20 °C, which is cooled to a temperature between 6 °C and 10 °C. 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 °C 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 5.4 and 7.1 million DKK, depending on the natural gas price. If the gas price increase, the savings increase as well.

Results

- The investment cost for Tønder Fjernvarmeselskab is 36.6 million DKK. This does not include the necessary investment for SAPA.
- The COP using ambient air is 2,16 and the COP using excess heat from SAPA is 2.9.
- The heat pumps are expected to reduce the overall annual CO₂-emission with approximately 4 000 tons.
- If current energy taxes are changed, it is possible to connect the electric engine to power the heat pumps.

FACTS ABOUT THIS PROJECT

Building type: -

Heated floor area [m²]: -

Installed heat capacity [kW]: 4 300 kW / 3 300 kW

District heating network: 2 772 consumers

Heat source: Ambient air and excess heat

Investment cost: 36.6 million DKK

Participating countries: Denmark

Time frame: Finished in November 2017

Link to web page or report:

<http://www.tonder-fjernvarme.dk/> (in Danish)

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IEA Technology Collaboration Programme on
Heat Pumping Technologies (HPT TCP)