

ENGINEERING
TOMORROW



Case Story | Sector Coupling

Flue gas heat recovery to enhance sustainable heating for **Frederikshavn** residents

At **Frederikshavn District Heating Utility (DHU)**, a 14 MW gas boiler is utilized during the cold months to ensure sufficient heat supply to the Frederikshavn community. A project was initiated by ME Production, involving Danfoss and heat pump OEM partner Energy Machines to enhance energy utilization by recovering boiler flue gas heat. This was accomplished by modifying the existing economizer to increase the recovered capacity and boost boiler capacity with the resulting condensing function. A heat pump is integrated in the system to boost the heat from exhaust recovery and back to the boiler. This initiative reduces operating costs and significantly contributes to CO₂ emission reduction.

As a result, Frederikshavn DHU can expand its existing heat production infrastructure while also reducing overall heat generation operating costs.

Introduction

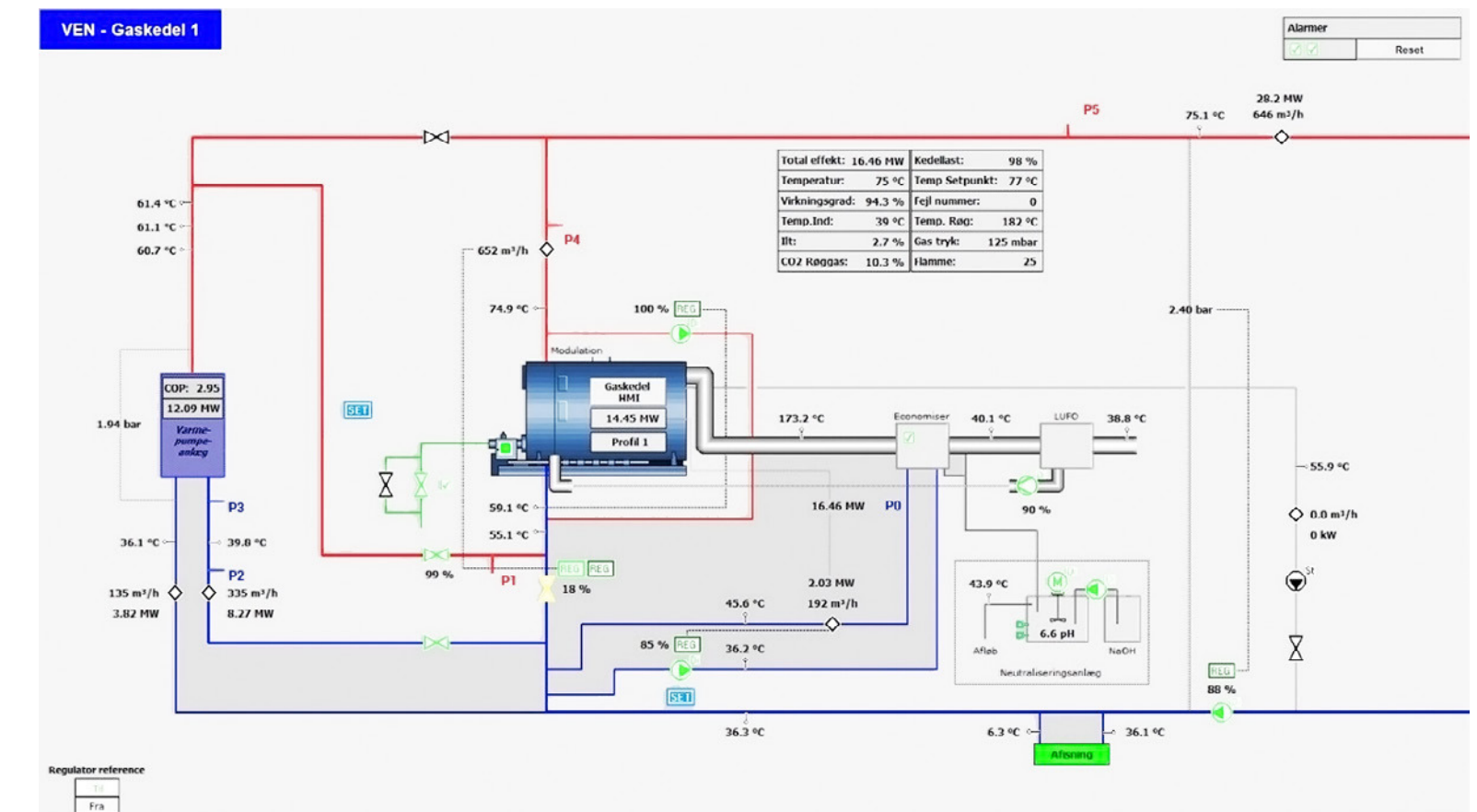
Frederikshavn DHU operates a 14-megawatt gas boiler to provide essential heating services during colder periods. To improve energy efficiency and reduce environmental impact, a project was initiated to recover more energy from the flue gas emitted by the existing biomass boiler system.

Frederikshavn District Heating Utility

Problem/Challenge

The main challenge was to maximize the energy recovery from the flue gas and enhance the overall efficiency of the heating system, driving down operating costs and end customer heat price. This required significant modifications to the existing economizer and integrating advanced heat pump technology.

Process diagram of current system



Solution

The solution involved rebuilding the economizer to recover heat from the exhaust in a closed chilled water heat pump evaporator loop. This recovered heat is then boosted through the heat pump to pre-heat the feedwater entering the boiler, thus reducing the boiler's workload. The flue gas condensing recovery leads to a high heat pump chilled water temperature, which in turn results in a lower temperature lift requirement for the heat pump and a high resulting heat pump coefficient of performance of 5.7.



Turbocor Heat Pump

Implementation

The project was implemented through a collaboration with Energy Machines and ME-Production. Energy Machines integrated a range of Danfoss solutions into the water-water heat pumps, including Turbocor® compressors and other essential components (See the fact box for more details).

Energy Machines is unique in utilizing a full portfolio of pre-configured Danfoss component solutions for their heat pumps. ME-Production managed the contract with Frederikshavn Forsyning and oversaw system design and control. The project also featured the first use of the new Alsmart™ controller, which was specifically programmed for this application.

Implementing our technology is projected to save

1,500 MWh

of energy annually, equivalent to the yearly heat consumption of 150 households.

Results/Outcomes

The project successfully enhanced energy recovery, leading to significant operational cost savings and a notable reduction in CO₂ emissions. The estimated energy savings is equal to the annual heat consumption of 150 households. The project also marked ME-Production's significant entry into the land-based market, demonstrating the effectiveness of their heat pump technology.



It's inspiring to see how collaboration helps develop new, innovative solutions, and ultimately send greener heat to the residents of Frederikshavn. We must deliver on the green transition, and therefore we need skilled companies, like ME Production, that have the courage to think outside the box and develop and design entirely new, green solutions,

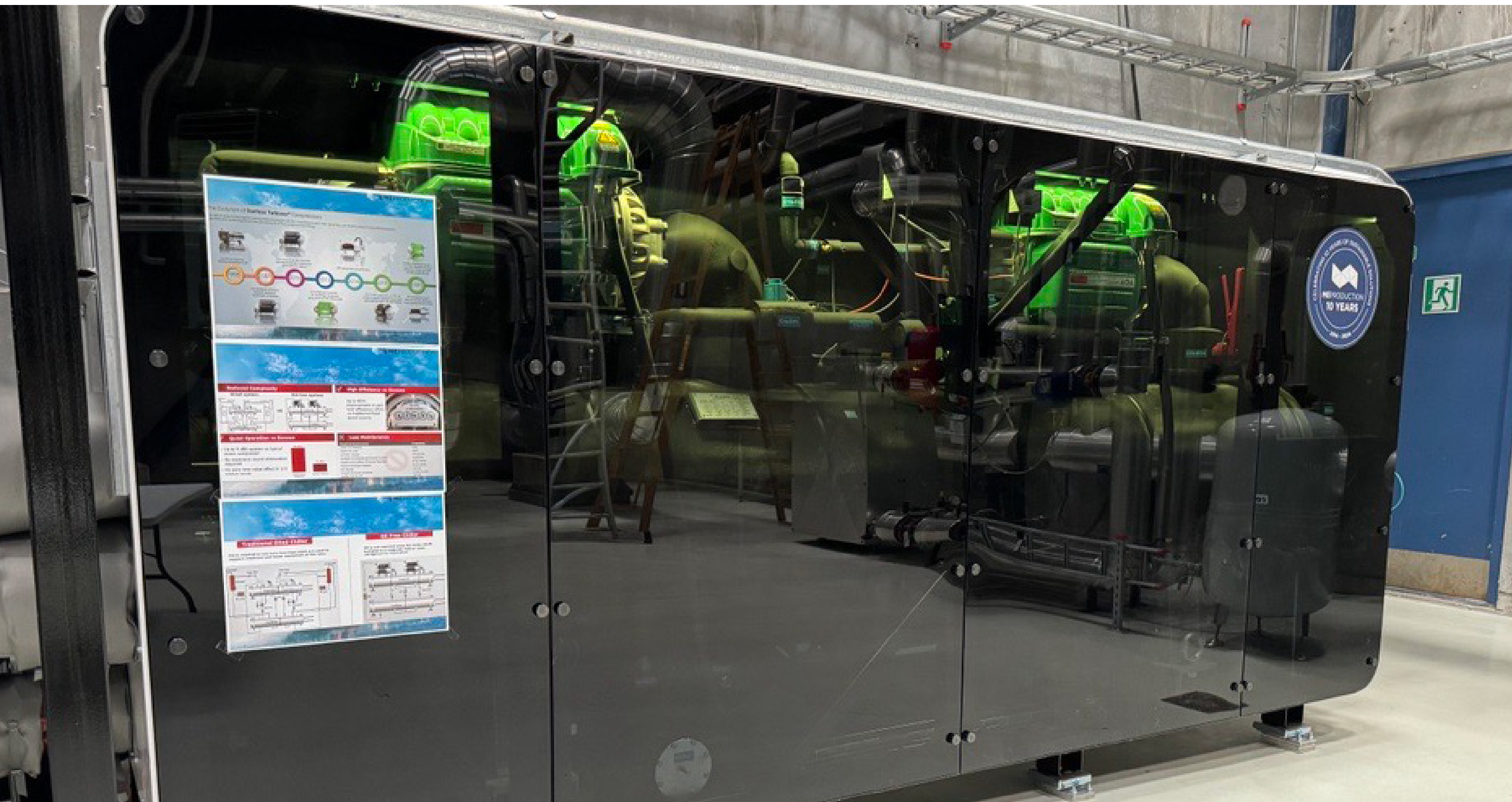


says **Mayor Birgit S. Hansen** of Frederikshavn Municipality.

Conclusion

The Frederikshavn DHU Flue Gas Condensing Heat Recovery Heat Pump project highlights the benefits of strategic collaboration and advanced technology in achieving energy efficiency and environmental

sustainability. This project's success sets a benchmark for future initiatives in both the district heating and maritime sectors.



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