STEAM GENERATING HEAT PUMP FOR PAPER MILL



Figure 1: Overview of the Steam Generating Heat Pump

Summary of demonstration case

The project involves the integration of a large-scale high-temperature heat pump (LHP) developed by Turboden in collaboration with a leading European company in the pulp & paper industry. The system is designed to generate 20 ton/h of superheated steam at 170°C using low-grade heat sources ranging from 10°C to 20°C.

The system delivers 12 MW of thermal power with a temperature lift of approximately 150K. A steam compressor is integrated in the system to meet the required pressure levels, enabling full compatibility with existing process infrastructure.

This project posed several engineering challenges, including:

- Fluid selection and thermodynamic cycle optimization to ensure efficiency and safety at high temperatures.
- Integration of turbomachinery and MVR technology, requiring precise control strategies and robust mechanical design.
- Material selection and corrosion management, due to the nature of the wastewater and high-temperature steam.
- Dynamic operation and load variation related to paper production, demanding advanced control algorithms and predictive maintenance strategies.

"This project gave us the opportunity to leverage our long-standing expertise in power plants and industrial thermodynamics to develop a truly innovative heat pump system for steam generation. Seeing it now in full operation is proof that industrial electrification is not only possible, but ready."

— David, Lead Project Engineer, Turboden

All information were provided by the supplier without third-party validation. The information was provided as an indicative basis and may be different in final installations depending on application specific parameters.

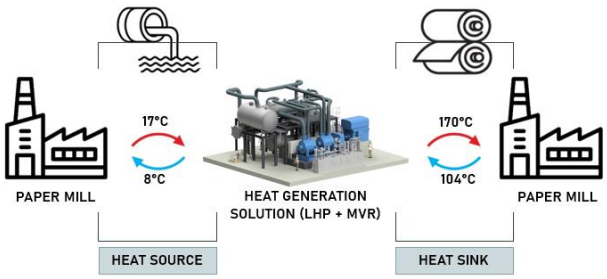

Figure 2: Representation scheme of the integrated heat pump for steam generation in the paper mill.

Operating experiences

The commissioning phase provided valuable insights into system behavior, control tuning, and operational flexibility. The system will operate continuously with the paper process delivering 20 ton/h of superheated steam at 170°C, starting from low-grade heat sources between 10°C and 20°C. Performance data indicates a COP in the range of 2, depending on load and temperature conditions. The integration has shown strong potential for energy savings and process optimization. Furthermore, the project stands as a state-of-the-art example of how high-temperature heat pumps can be effectively integrated into pulp & paper production processes. It showcases the potential of electrified steam generation as a replicable solution for industrial decarbonization, contributing significantly to the sector's transition toward climate neutrality.

Special learnings

This project highlights the importance of tailored engineering in industrial heat pump applications. The system was custom designed to meet the specific thermal and operational requirements of the paper production process, ensuring full compatibility with existing infrastructure. One of the key learnings was the need for a solution capable of adapting to process variability, with immediate response times and precise control. The successful implementation demonstrates that, through close collaboration with the end-user, it is possible to overcome technical barriers and deliver a high-performance system that enables electrified steam generation. This installation sets a benchmark for the pulp & paper sector and confirms the potential of large heat pumps to decarbonize other energy-intensive industries with similar thermal and steam demands.

FACTS ABOUT THE CASE

Installation year: 2025

Operating hours: 2000 h tests (from July to Oct 2025)

Working fluid used: Isobutane

Compressor technology: multi-stage centrifugal

System manufacturer: Turboden

Sector: Pulp&Paper

Performance in design point:

- **Heat source:** 17 °C → 8 °C, water
- **Heat sink:** 104°C → 170 °C, steam
- **Heat supply capacity:** 12MW
- **$COP_{Heating}$:** 2

Investment cost: N/A

Savings: N/A

Estimated annual CO_2 savings: approx.15000 t/a

Link to webpage or report:

What could not be done before is now possible: Turboden Large Heat Pump decarbonizes industrial steam demand. | Press releases | TURBODEN

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