

Heat Pump Awards 2026

Application submission

**Full-scale demonstration of a High-Temperature Heat
Pump for a paper mill in Weißenborn**

Fraunhofer IEG | Large Heat Pump Award

1. Application overview

Submitted	2026-08-19
Award category	Large Heat Pump Award
Title of the project	Full-scale demonstration of a High-Temperature Heat Pump for a paper mill in Weißenborn
Organisation name	Fraunhofer IEG
Exact address of the project	Fabrikstraße 1, 09600 Weißenborn/Erzgebirge, Germany
Funding	EU funds
Organisations involved in the project	Felix Schoeller GmbH & Co. KG (industrial site) SPH Sustainable Process Heat GmbH (technology provider)
Project ending date	2027-09-30
Project website	https://push2heat.eu/
Sector of application	Industrial

2. Applicant & EHPA contact details

Full name	Reuven Paitazoglou
EHPA member involved	Fraunhofer IEG
Role of EHPA member	Engineering, Technology assessment, monitoring, scientific coordination, dissemination

3. Project description & benefits

Project description (goal, problem addressed, and solution provided by the heat pump)

The implementation of a 1,2MW High-Temperature Heat Pump in a paper mill from Felix Schoeller upgrades unused waste heat from the drying process and supplies the drying process with low-pressure steam at a temperature level of 123°C (2,3bara). In order to overcome the temperature lift of over 80K a cascaded heat pump solution with two parallel compressors in each refrigerant circuit has been designed, manufactured and successfully implemented as a container solution on the premises of Felix Schoeller.

In comparison to other HTHP installations in the industry the double stage HP in Weißenborn is using a volatile heat source with temperature variations from 30°C to 70°C. Along the direct integration of the generated steam into the low-pressure drying section of the facility the volatility of the heat source highlights another challenge for a successful integration and operation of a thermal energy system with major decarbonisation potentials with respect to flexible operation in part- and full-load.

Moreover, the involved partners have shown that a structured approach beginning with a detailed assessment of the integration potential, the design of a cascaded double stage heat pump solution and an integration on site can be achieved in less than 24months.

Expected or achieved benefits

- Electrification of the steam production
- Utilization and upgrade of so far unused waste heat
- Increase of energy efficiency
- OPEX-cost reduction
- Diversification of the heat supply system (macro scale)

Obstacles/barriers encountered during development

- Optimal integration of the developed HP (heat pump) system on both the source side (waste heat) and the sink side (direct steam integration into the low-pressure section of paper drying)
- Cost-effective system design and setup with respect to LCOH
- Container solution for outdoor installation and in near proximity to the heat source/sink
- Control system integration for stable plant operation of the high-temperature heat pump
- Volatility of waste temperatures between 30°C and 70°C
- Staff training for plant operation and maintenance
- Partial load operation in case of reduced waste heat availability on the source side
- Necessary revision of the developed compressor design (reciprocating compressor by SPH) for high-temperature application

Why should this project win an award?

The industrial application of the cascaded HTHP clearly shows how high system efficiency (COP 2-3) for the provision of process steam can be achieved with temperature lifts above 80 K. This represents a promising and future-proof aspect for the decarbonization potential in energy-intensive industries and can be applied to other industrial processes with minimal adjustments.

The specific savings potential of the installed system on this site regarding operating costs is approximately €23 per MWh of steam, and regarding CO2 emissions, 50 kg CO2 per MWh of steam. As a result, in addition to an innovative heat pump application with direct process integration, high system efficiency, and strong decarbonization potential in the energy-intensive paper manufacturing industry, an economic criterion is fulfilled.

Due to the successful and first-time application of the heat pump technology, a solid foundation has been established for the end user (Felix Schoeller) and for the scaled-up deployment of further HTHP systems. The deployed technology actively contributes to the company's climate targets and represents a significant milestone for a decarbonized paper industry.

4. Technical specifications

Capacity of unit(s)	1180
Energy sources used	Electricity for operation of the compression stages (Waste heat as a heat source)

Coefficient of Performance (COP)	2.3 (nominal design condition)
Service provided	Supply of process steam at 123°C (2.2 bara saturated steam)
Refrigerant type	1st stage R515B; 2nd stage R1233zd (both synthetic refrigerants)

Heat pump details (compressor technology, heat exchanger, system configuration)

In a 2-stage system, two heat pump systems are cascaded and coupled by a common heat exchanger which works as a condenser for the first stage and as an evaporator for the second stage.

double staged and cascaded HP system

1st stage: 2 x screw compressor (Bitzer)

2nd stage: 2 x piston compressor (SPH)

flat plate heat exchangers for the heat source and internally

shell-and-plate heat exchanger for the heat sink

waste heat of the compressors is re-used as a heat source (increase of energy efficiency)

5. Renewable energy integration & grid response

Integration of renewable energy sources

Unused waste heat (zero carbon footprint and thus similar to renewable energy) is upgraded by means of electricity

Electricity from the power plant is generated in a CHP System using natural gas

Optionally the procurement of renewable electricity from the market can fully decarbonize the steam supply of the HTHP

Response to energy demand / smart grid integration

Currently any features in this regard are not established but fully applicable if the industrial partner identifies benefits for this operational strategy (in a capacity extended system with thermal energy storages)

6. Innovation and monitoring

Why the project is innovative

Full-scale application of a High Temperature Heat Pump

High decarbonisation potential

Direct integration of the heat source and sink circuit into the industrial processes

High Temperature Lift

Container solution allowing straight forward integration on the site

Safe operation according to existing standards and norms

Setup allows high level of transferability to other industrial complexes

Monitoring approach (performance, cost, and carbon targets)

An extensive monitoring system is designed, installed and verified for allowing the monitoring of operational data as well as a performance evaluation

Standardized communication protocols are used for the data handling

Data is stored centrally at Fraunhofer servers using

Dedicated works are performed at this stage to assess further the performance, cost and carbon targets depending on the operation performance throughout the monitoring phase of the project

Technology/technique developed solely for this project

Double stage high temperature heat pump for direct integration into the drying process of a paper mill

Differentiation from state-of-the-art solutions & market maturity

Fossil-free steam generation and sustainable upgrade of waste heat

Electrification of the heat supply and supply as well as price stability for generated steam

The implementation can be considered early commercial with an increase of the TRL for the used technology from 7 to 8-9

7. Replicability and regional impact

Why the project serves as a model for others

Standardized and modular solution for other energy-intensive industries

High level of applicability for upgrading low-enthalpy waste heat

Direct process integration

Higher temperature levels for process steam can be reached by extending the system with a MVR system

Potential for expansion to other locations/industries

Yes, this project can be adjusted with minor changes (if needed) to other industrial applications aiming to upgrade unused waste heat sources

Depending on the temperature level of the waste heat a single stage system can be targeted in order to reduced CAPEX and OPEX costs

Expansion of the overall thermal capacity with a modular setup of HTHP units

Barriers to replication elsewhere

A detailed and structured assessment of the integration potential of the HP technology (1stage or multiple cascades) along a techno-economic assessment are mandatory before the implementation phase

Financial barriers are given by the cost ratio of electricity to gas along expectations for ROI-values in the range of conventional heat supply systems. To overcome these, a techno-economic assessment for the most suitable heat supply scenarios must take into account. Moreover, a flexible operation by integrating thermal energy storage and the procurement of electricity at low costs can provide an economically sustainable solution

Use of standardized components allow a straight-forward production process with reduced CAPEX costs and straight forward certification process

Regional benefits (energy savings, emissions, jobs, infrastructure)

Decarbonization in energy intensive industries increase the tolerance/acceptance of the communities surrounding an industrial site

Moreover, specialized technical staff is needed (as service providers) or by the industrial companies to operate HTHP systems at a high efficiency

8. Commercial potential

Business opportunities for expansion, licensing, or commercial production

The opportunity given at the moment depends on the decarbonisation potential along midterm expected price increases (especially with the taxation of CO₂-Emissions) and an early identification of the application potential for an energy intensive industrial complex

Commercial potential (further elaboration)

Within the project, the application potential is highlighted on the basis of replication studies focusing on further relevant industrial sectors.