Heat Pump Awards 2026

Application submission

Open Loop High Temperature Heat Pump at BASF in Ludwigshafen

GKT GmbH | Large Heat Pump Award

1. Application overview

Submitted	2026-09-11
Award category	Large Heat Pump Award
Title of the project	Open Loop High Temperature Heat Pump at BASF in Ludwigshafen
Organisation Name	BASF SE
Exact address of the project	Carl-Bosch-Straße 38, 67056 Ludwigshafen am Rhein
Funding	Funded by the Federal Republic of Germany
Organisations involved in the project	GKT GmbH, BASF SE
Project ending date	Q2/2027
Sector of application	Industrial

2. Applicant & EHPA contact details

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EHPA member involved	GKT GmbH
Role of EHPA member	EPC Contractor

3. Project description and benefits

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

The project aims to decarbonize industrial steam generation by recovering waste heat that would otherwise remain unused. At BASF's Ludwigshafen site, waste heat from 1,900 t/h of steam cracker process water at 76°C is upgraded into valuable process steam using an 11-stage open-loop MVR heat pump system. The system delivers up to 60 t/h of steam at 5.8 bar(a) and approximately 47 MW of thermal output, with a COP of up to 3.4. Powered by renewable electricity, it is expected to reduce CO_2 emissions by up to 100,000 metric tons per year, providing a large-scale solution for more energy-efficient and low-carbon industrial steam supply.

Expected or achieved benefits

The key benefits of the project are the significant reduction in CO_2 emissions and fossil fuel consumption for industrial steam generation, combined with high system availability. By recovering and upgrading waste heat that would otherwise remain unused, the system provides a reliable and energy-efficient alternative to conventional fossil-based steam generation.

Obstacles/barriers encountered during development

One of the key challenges was meeting the high quality requirements for the produced process steam. The system therefore had to be carefully engineered to ensure that the steam generated from recovered waste heat meets the required specifications for reliable integration into the existing steam network.

Why should this project win an award?

This project is a first-of-its-kind implementation at this industrial scale. At BASF's Ludwigshafen site, GKT is delivering a turnkey large-scale heat pump system that converts waste heat from a steam cracker into carbon-free process steam.

With up to 47 MW thermal capacity, 60 metric tons of steam per hour and an 11-stage compressor system, it will rank among the world's most powerful industrial heat pumps of its kind.

Powered by renewable electricity, the system is expected to avoid up to 100,000 metric tons of CO_2 emissions per year and provide approximately 7% of the site's steam demand – demonstrating industrial decarbonization at a truly relevant scale.

4. Technical specifications

Capacity of unit(s)	47000 kW
Energy sources used	quench water as recycled waste heat and electricity for the compressors
Coefficient of Performance (COP)	COP 3,4
Service provided	Utilizaton of hot water from the steam cracker to produce LP steam at 5,8 bar(a)
Refrigerant type	water r-718

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

The waste heat utilization system works as an opern loop high temperature heat pump applying MVR technology. The energy from warm quench water is transferred via heat exchanger to a flash circle with demi water quality. This water is evaporated under vacuum conditions and recompressed by 11 radial fans in series to the discharge pressure of 5,8 bar(a)

5. Renewable energy integration and grid response

Integration of renewable energy sources

Renewable electricity from renewable sources can be used to operate the compressors of the heat pump. In this particular project BASF will operate the system with certified renewable electricity and therefor we will be able to reduce CO2 emissions accordingly.

Response to energy demand / smart grid integration

The system can operate efficiently across a wide capacity range of 60–100% of its nominal load without significant loss of efficiency. At loads below this range, a portion of the steam from the discharge side of the compressors is recycled back to the suction side to keep the compressors operating safely above the surge line. However, during bypass operation, the COP decreases with decreasing load and can drop to approximately 1. The system can even operate without an active heat source by using full steam recirculation, enabling hot standby operation. The system is designed for approximately 400 start-stop cycles per year.

6. Innovation, monitoring and replicability

General (all awards)

Why the project is innovative *(all awards)*

It is the first system of its kind to combine this number of compressors in series with such a high steam production capacity. Combined with a high COP, a wide operating range, fully automated operation, high availability, and ease of maintenance, this open-loop heat pump represents the state of the art in today's industrial heat pump technology.

Monitoring approach (performance, cost, and carbon targets) *(all awards)*

There a several continuous measurements in place like flow and temperatures of in- and outlet of the heat source, pressure and flow of the discharged steam as well as electrical consumption. The data is collected and processed in the PCS of the customer and used to prove the achievement of CO2 reduction objectives to authorities.

For Innovation Award

Technology/technique developed solely for this project *(Innovation Award only)*

No. The technology was not developed exclusively for this project. It is based on GKT's established MVR technology and was specifically engineered and scaled to meet the requirements of this large-scale industrial application.

Differentiation from state-of-the-art solutions & market maturity *(Innovation Award only)*

Compared to conventional closed-loop heat pumps, the open-loop system uses water as the working medium, eliminating hazards associated with conventional refrigerants, such as toxicity, flammability, or explosion risks, while also reducing related safety requirements. Its large-scale steam production, high COP, wide operating range, and multi-stage compressor configuration further distinguish it from conventional solutions. The project represents an early commercial deployment, demonstrating the technology at an unprecedented industrial scale and paving the way for broader market adoption.

Regional benefits (energy savings, emissions, jobs, infrastructure) *(Innovation Award only)*

The company benefits directly from significant energy savings and emission reductions. By recovering waste heat from the steam cracker and converting it into process steam, the system

reduces the demand for conventionally generated steam and therefore the consumption of fossil fuels. When powered by renewable electricity, the project is expected to reduce CO_2 emissions by up to 100,000 metric tons per year, making a substantial contribution to regional industrial decarbonization.

Commercial potential *(Innovation Award only)*

The technology is already commercially available and marketed by GKT under the name CompriVAP. Its modular and scalable design enables application across a wide range of industries wherever suitable waste heat is available and process steam is required. The BASF project demonstrates the technology at a particularly large industrial scale and provides a strong reference for further commercial deployment and market expansion.

For Large Heat Pump or Building Solutions Award

Why the project serves as a model for others *(Large Heat Pump or Building Solutions Award)*

This system is applicable across a wide range of industries, wherever process steam is required and suitable waste heat is available. Typical range of waste heat energy for such systems start with 1,5 MWth up to 60 MWth and more.

Potential for expansion to other locations/industries *(Large Heat Pump or Building Solutions Award)*

This system is independent from the type of heat source and can process any type like warm water, process condensates and other liquids as well as steam or gas and can produce steam up to 20 bar. Taking these features into account, the CompriVAP system can be adapted easily to the customer's specific requirements and brown field situations.

Barriers to replication elsewhere *(Large Heat Pump or Building Solutions Award)*

The main economic barrier is the ratio between fossil fuel and electricity prices, combined with customers' expectations regarding investment payback periods. Another challenge is the additional space required for large-scale heat pump installations.

Business opportunities for expansion, licensing, or commercial production *(Large Heat Pump or Building Solutions Award)*

The technology is already commercially available and marketed by GKT under the name CompriVAP. The BASF project demonstrates its applicability at an unprecedented industrial scale and provides a strong reference for further deployment. CompriVAP can be applied across a wide range of industries wherever suitable waste heat is available and process steam is required, creating significant opportunities for further commercial expansion.