



NET-ZERO INDUSTRIES

MISSION



Project Title	AHEAD (Advanced Heatpump Demonstrator)
Industry Partner	Takeda Manufacturing Austria AG
Industry Sector	Chemicals & Refining
Technology Pathway (Primary)	Electrification of Production and Processes
NIM Pillar	Technology Demonstration
Source	NIM Awards 2023
Description	<p>The AHEAD-project is a partnership of Takeda with the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK); the Climate and Energy Fund; and the AIT Austrian Institute of Technology. AHEAD is a New Energy for Industry (NEFI) project as part of the Austrian Science Technology Innovation (FTI) initiative "Flagship region Energy".</p> <p>In the AHEAD research project, a natural gas-free steam-generating heat pump will be integrated into industrial operation for the first time, aiming to achieve a carbon dioxide (CO₂) reduction of up to 90 percent at one of Takeda's major manufacturing sites in Vienna using only natural refrigerants. This project underpins Austria's leading role in high-temperature heat pump research and is intended to serve as a practical example for the entire pharmaceutical industry as well as other industries aiming to reduce their CO₂ emissions.</p> <p>The innovation of this project is the steam-generating heat pump, which is operated exclusively with 100 percent natural refrigerants and combined with steam compressors to achieve the highest heat recovery temperatures to date. The AHEAD system can reach temperatures of 200-260°C, exceeding temperature needs of Takeda's steam supply, at 184°C, required for manufacturing.</p> <p>The project team will also develop a concept for the replication of the AHEAD system for other Takeda locations in Austria and worldwide. In addition, the decarbonization potential of this technology is being investigated for other important industrial sectors with high energy consumption, such as the paper, chemical and food industries.</p> <p>The technical foundation of the project is a CO₂-neutral energy center already in operation at the Takeda location in Vienna using 100 percent natural refrigerants. These refrigerants are highly efficient and do not emit CO₂.</p>
Innovations Employed	<p>To date, a large part of the process heat demand in pharmaceutical production has been created by mainly using natural gas. The AHEAD project will replace natural gas with an innovative, steam-generating heat pump system from the company Sustainable Process Heat, which is combined with steam compressors to generate temperatures of 200-260°C, exceeding temperature needs of Takeda's steam supply, at 184°C, required for manufacturing. A CO₂ reduction of up to 90 percent and complete net-zero CO₂ emissions over a period of seven months per year will be achieved at Takeda's manufacturing site in Vienna. This corresponds to 1,900 t reduction of CO₂ per year.</p>



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Dimension of Novelty	Company & Country It was new to Company, Country and International
Innovation Collaboration	In-house Cooperation with scientific institutions Austrian Institute of Technology (AIT) External Partners Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK), Climate and Energy Fund (Beide Lieferanten!)
Intellectual Properties	No property rights or protection strategies (Mit "Copy with pride" als Begrueudung) Learning from each other and sharing insights is an important tool, especially in the field of sustainability. "We are very proud of our innovative high-temperature heat pump project, AHEAD. However, this doesn't mean that we intend to hide and keep this idea secret from competitors and other industry sectors. This technological flagship project is meant to serve as a practical example for the entire pharmaceutical industry and also for many other industrial companies and sectors that aim to make their processes carbon-free."
IP Links	principle of 'Copy with pride' (from your counterparts or even competitors): It's fine and acceptable to adapt what others have done. Build on their hard work and investment and outperform them based on their mistakes and learnings.
Timetable & Progress	System complete and qualified. First of a kind commercial system (TRL 8) Project started in 2022
Financing (Public/Private)	Funding Public - Yes Climate and Energy Fund (Development)
Finance Links	Climate and Energy Fund (Development)
Project Phase TRL	TRL 8
Problems to be Solved and Risks to be Managed	Since a steam-generating heat pump using natural refrigerants had never been built before, a new compressor had to be developed. The implementation on site is difficult because 300 kg of flammable refrigerants have to be implemented as well as the safety engineering for the resulting requirements have to be worked out. We will intensify R&D in the AHEAD project and expand the range of refrigerants to be used in their heat pumps to butane. The most important advantages of butane are its favourable thermodynamic properties for heat pump applications, the very low GWP value of 0.006 and that it is not subject to F-Gas regulation. This is a new and



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promising market segment. SPH will gain knowledge and experience in coupling the steam generation heat pump with steam compressors, which significantly increases the number of industrial applications that can benefit from a heat pump for process heat supply. The project results are the basis to create new products based on the AHEAD system. Successful demonstration in a research project increases trust in a new technology and pushes further roll-out.

Preliminary or Final Results Achieved

1,900 t reduction of CO₂ per year (Technologie, Kostenveränderung OPEX vielleicht)

CO₂ Emissions Reduction Potential - Implementation and Future Market

The target market include industrial sectors with significant shares of process heat < 200 C. Those are paper and print; food; and chemicals and petrochemicals (including pharmaceuticals). In the medium term, it is assumed, that 10-25% of the companies with more than 50 employees install an AHEAD system to supply 2.5 t/h steam for their processes. This is a potential market of 58-144 heat pump units related to investment of 200-600 million for heat pump manufactures and other trades involved in integration (e.g. building, process control system, electric installation, piping) and planning. Thus, the installation of renewable steam supply systems has a positive effect on local value creation. Long-term, fossil energy carriers should be replaced by renewable energy. It is assumed that they are replaced by steam generating heat pumps (full potential).

Market Positioning

Not applicable yet due to the fact, that we make at the moment the facility integration planning. The presentation of the Ahead project approach leads to a lot of request from other industries with high temperature need. See in the communication link below.

Project Location

Austria

Project & Technology Links

[Takeda](#)

[Click on Video Project AHEAD](#)

[Press Release Steam without Gas](#)

[Press Release Sustainability as a common task](#)

Technology Links

[Takeda](#)

Takeda Unveils First Industrial Application of Natural Gas-Free Steam Generation in Pharmaceutical Industry in Partnership with Austrian Government and Institute of Technology.

[Press Release](#)