Annex 58

High-Temperature Heat Pumps

High-temperature heat pumps have considerable potential for the decarbonization of industrial process heat for ever increasing temperature levels. They enable the utilization of excess heat to reduce primary energy consumption, lower CO2 emissions and achieve economic benefits. However, collaboration among technology providers, end-users, policymakers, and R&D organizations is crucial to overcome barriers and maximize the potential.

Key Findings

The IEA HPT Annex 58 project analysed the potential and barriers of implementing high-temperature heat pumps in industrial applications. The intention was to improve the knowledge about the technology's potential among various stakeholders, such as manufacturers, potential end-users, consultants, energy planners and policy makers to ultimately accelerate market deployment.

1. A technology review identified various HTHP technologies and active supplier developments. Reviews of 15 completed demonstrations show benefits of heat pumps in industries like food and beverage, pharmaceuticals, refineries, chemicals, and more. Information was standardized using templates, as shown in Figure 1.

2. Maturity of HTHPs depend on capacity and temperatures (see Figure 2). Transitioning to heat pump-based process heat is influenced by technological development, the ability of end-users to adapt their processes, and regulatory and economic constraints. Addressing all these factors is crucial for accelerating decarbonization of industrial process heating.

3. HTHPs can be integrated into various processes, with opti- mal practices varying by process requirements. Standardi- zed HTHP concepts can meet the prevalent requirements for steam generation, hot water production, and heating with large temperature glides.

4. Developing a decarbonization strategy is essential for effi- cient site decarbonization. Key components include setting goals and timelines, and data collection while considering near-future technological developments.

5. Large-scale HTHP projects must consider safety, economic, and performance requirements in the design without over- specifying the concrete heat pump design. Testing should be transparent, clearly defining how heat pump perfor- mance will be measured against promises.

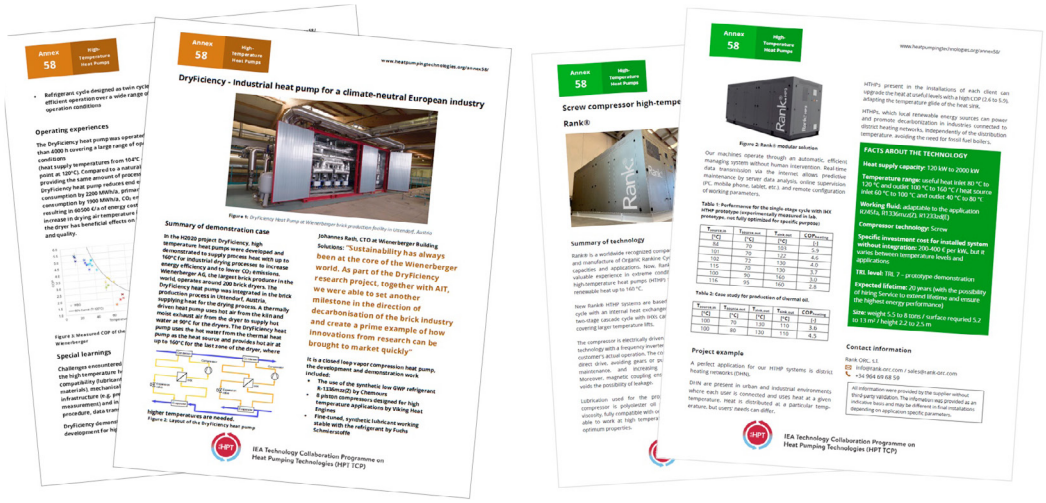

Figure 1. Examples of two-page brochures where the information about the technologies and demonstration cases was collected

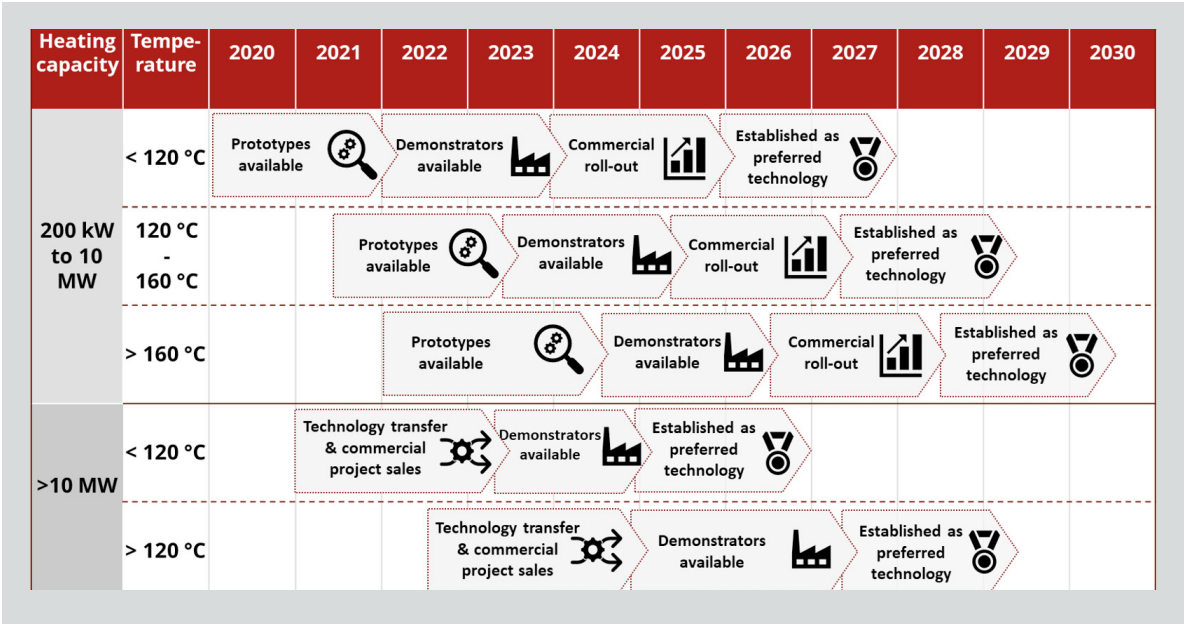

Fig. 2: Development perspectives for HTHPs towards 2030

Background

The decarbonization of industrial process heating is a top priority to achieve climate goals as process heating accounts for a considerable share of the final energy consumption and greenhouse gas emissions of industries. The European statistics show that 67 % of the demand between 100 °C and 200 °C was directly covered by fossil fuels. High-temperature heat pumps are a promising alternative to fossil fuels to provide process heating for this temperature range at the highest efficiency using potentially emissions-free electricity. However, the deployment of heat pumps for temperatures above 100 °C is still limited. Enabling a large variety of industries to convert their process heat supply to high-temperature heat pumps requires a common understanding of the technology, its potential, and its perspectives.

Objectives

The overall goal of Annex 58 was to improve the understanding among various stakeholders and to provide supporting material to facilitate and enhance the transition to a heat pump-based process heat supply. In particular, the different tasks aimed to:

- Provide an overview of the state of the art of HTHPs and future perspectives, including technologies available in the market and under development.
- Present best practices for the integration of HTHPs in the most promising application areas
- Create strategies for the transition to heat-pump-based process heat supply.
- Develop guidelines for handling industrial heat pump projects with a focus on defining heat pump specifications, and on testing and validating heat pump performance.
- Disseminate the findings to various stakeholders enhancing the knowledge base and creating awareness.

Further information

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Publications:	Final reports available on the Annex 58 homepage: https://heatpumpingtechnologies.org/annex58/
Internet:	https://heatpumpingtechnologies.org/annex58/