



Technology Brief

Revisions of chapters on process heating in the Technology Catalogue (January 2026)

The Danish Energy Agency has published an updated and revised Technology Catalogue on process heating in January 2025.

The focus of the revision has been to update and expand the description of high temperature heat pumps and steam generating heat pumps, simplify existing datasheets on traditional boilers and remove outdated chapters and datasheets. In addition a special focus was given to process heating technologies using electricity.

Electrification of process heating in industry is an instrument to meet net zero goals. High temperature heat pumps play a key role in this electrification and are currently being developed for higher temperatures and capacities, with several technical solutions projected to be ready within the next 5-7 years.

The new simplified datasheets have reduced the amount of datasheets from more than 30 to 15. This has been done by creating technology specific addons, like the possibility of adding a condenser to a boiler to increase the efficiency. All datasheets have also been adjusted to real 2025 prices.

A special focus on the latest update has been on the status of high temperature heat pumps and their projected market expectations.

Status of high temperature heat pumps

Multiple development and demonstration projects are underway. Based on current momentum, strong market demand, and political focus on electrification and decarbonization, the following outlook is projected for the next 5–7 years (i.e. 2030-2032).

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Heating capacity	Temperature	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
200 kW to 10 MW	< 120 °C	Prototypes available	Demonstrators available	Commercial roll-out	Established as preferred technology							
	120 °C - 160 °C		Prototypes available	Demonstrators available	Commercial roll-out	Established as preferred technology						
	> 160 °C			Prototypes available	Demonstrators available	Commercial roll-out	Established as preferred technology					
>10 MW	< 120 °C		Technology transfer & commercial project sales	Demonstrators available	Established as preferred technology							
	> 120 °C			Technology transfer & commercial project sales	Demonstrators available	Established as preferred technology						

Figure 1: Expected developments of the available delivery temperature of high-temperature heat pumps.

Steam-generating high-temperature heat pump systems applying steam compressors

This technology is a combination of a traditional vapor compression heat pump, an evaporator vessel (around atmospheric pressure) and a number of turbo steam compressors.

The system is depicted in figure 2. The traditional heat pump supplies heat at a temperature around 85-90 °C to the *sub atmospheric pressure vessel*. The heat is supplied to the water in the vessel, which evaporates, as the pressure is sub atmospheric. The evaporated water vapor is compressed in turbo *steam compressors*. The pressure increase per steam compressor causes a temperature increase of 8-10 K (increase in saturation temperature) [5]. After each steam compressor liquid injection is applied as intercooler before next compression step. This catalogue considers a saturation temperature of 150 °C after the last steam compressor. This setup requires 7-8 steam turbo compressors or 1 screw compressor in series, but the complexity is greatly reduced when the pressure ratio is lower.

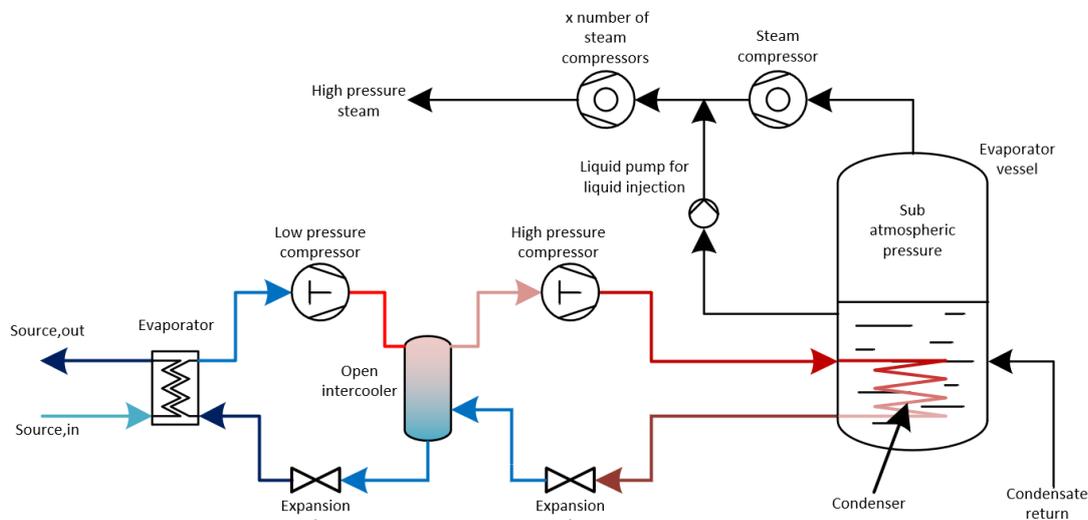


Figure 2: Sketch of two-stage compression heat pump in combination with booster turbo compressors. Components and process is described in detail above. [6]

The addition of steam compressors to a high temperature heat pump system (to generate steam instead of hot water at 125 C), decreases COP by 15% and increases equipment costs by 0.2 million EUR per MW in the datasheets.

Prediction of performance and costs

The performance and costs of the technologies for which datasheets have been revised are broadly similar to earlier estimates. This reflects that most technologies in the process heat sector are mature, and therefore technology prices and their projections are stable. As the old datasheets were based on 2020 EURO prices and the new is in 2025 EURO, a comparison between the two has to account for the change of financial year.

Calculation example using the data sheet

Below is a calculation example for a heat pump intended to supply steam. The source temperature is 60 °C and the supply temperature is 140 °C steam. The thermal capacity needed is 2 megawatts.

Temperature lift: From 60 °C to 140 °C (80 K)

Size: 2 MW

Sink: Steam

Estimating COP:

- 1) Access the data sheet for HTHPs with supply temperatures up to 150 °C.
- 2) Find the efficiency (COP) based on a temperature lift of 80 K. This is estimated to 2.4 (240%).
- 3) Due to steam generation, calculate the new efficiency based on the decrease rate (15 pct.-points in 2025).
- 4) The COP is estimated to 2.25 (225%).



Estimating CAPEX:

- 1) Access the data sheet for HTHPs with supply temperatures up to 150 °C.
- 2) Find the nominal investment (includes equipment and installation). This is estimated to 1.55 MEUR/MW capacity.
- 3) Add the extra cost of steam generation equipment at 0.2 MEUR/MW capacity.
- 4) Add the extra cost of equipment for a temperature lift above 75 K at 0.2 MEUR/MW capacity.
- 5) This will result in a total nominal investment of 1.95 MEUR/MW capacity resulting in a total investment of 3.90 MEUR for the given heat pump with a size 2 MW.

This example is only intended to give the user an insight into how the catalogue can be used in a specific calculation.