Steam producing heat pump (SPHP)

Aneo Industry AS

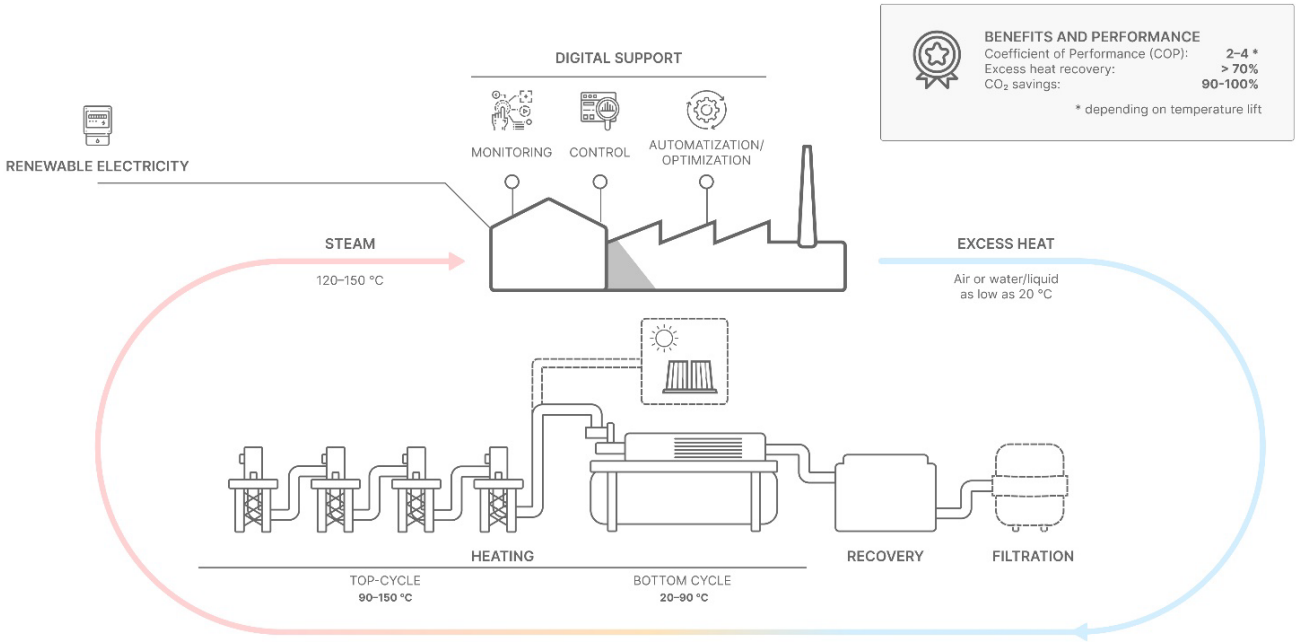

Figure 1: Steam producing heat pump (SPHP) with excess heat recovery and multi-stage compression.

Summary of technology

The core technology of Aneo is an integrated heat pump system which can supply process heat in the form of pressurized steam of up to 150°C or 5 bar(A). The steam producing heat pump (SPHP) is standardized for excess heat temperatures between 20°C and 90°C. The SPHP integration includes an energy recovery unit for moist air, however also other excess heat sources can be integrated.

The recovered heat is transferred to a bottom cycle which upgrades the energy into low pressure steam. The bottom cycle uses Ammonia (R717) as working media. The low-pressure steam is further compressed by multistage steam compressors and can reach up to 5 barA/150°C. The multistage cascading also enables the usage of steam (or hot water) at lower temperatures or pressure levels which improves the COP of the system.

The principal layout of the SPHP is given in Figure 1 and is a combination of a closed loop bottom cycle and an open loop top cycle (typically known as Mechanical Vapor Recompression). The top cycle can also be integrated as closed loop according to process requirements.

The most relevant application areas are in the food, pulp and paper as well as chemical industry for processes like drying, evaporation, sterilization, thermal treatments or similar processes. However, also other application, process and plant integrations are possible.

The SPHP uses natural refrigerants such as Ammonia and Water as working media and heat carrier. Compressor types are centrifugal fans for the top-cycles and piston compressors for the bottom cycle. The pilot system is a 1.5 MW steam producing heat pump which is currently under installation and will start-up end of 2022.

Aneo is establishing and operating the SPHP systems onsite for customers through an "Energy as a Service" platform. The technology, integration, investment, reliability and technical risk as well as the

service costs are part of the service platform. The customer pays for the energy supplied by the SPHP system.

Currently the system is only available in Norway, however from 2024 also other costumers in the EU can be equipped with the system.

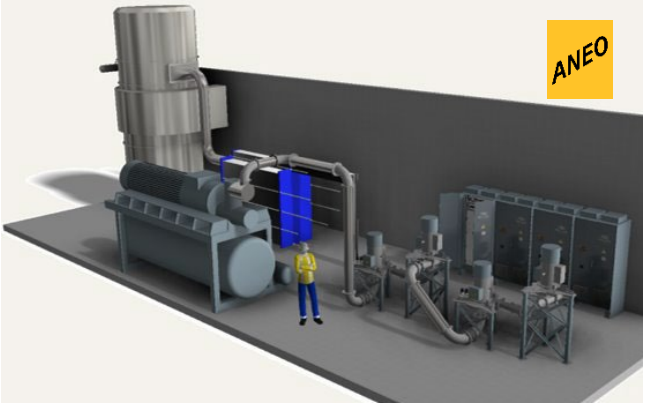

Figure 2: Illustration of SPHP system of Aneo Industry.

Table 1: Performance.

$T_{source,in}$ [°C]	$T_{source,out}$ [°C]	$T_{sink,latent}$ [°C]	p_{steam} Bar(A)	$COP_{heating}$* [-]
40	30	120	2.0	2.9
40	30	150	5.0	2.3
60	40	120	2.0	3.6
60	40	150	5.0	2.7
70	50	120	2.0	4.2
70	50	150	5.0	3.0

*The given COP values are indications of the possible onsite performance based on an assumed excess heat recovery temperature and will vary depending on the best suited integration concept.

Project example

Aneo is currently establishing a showcase for the integrated SPHP system which is supplying 2 tons/h process steam. The heat is hereby extracted from a moist air exhaust, which is cooled down to 30°C while sensible as well as latent heat is recovered. The heat pump is supplying hot water at 80°C and process steam with 2 bar(A) at 120°C. The total energy supply is 1.5 MW with a COP of 3. The energy contract includes a guaranteed annual operation for the customer.

FACTS ABOUT THE TECHNOLOGY

Heat supply capacity: 1.2, 2.5 and 5 MW (10 MW optional)

Temperature range: up to 150°C in the form of 5 bar(A) steam supply (latent) as open loop heat pump.

Option for pressurized hot water with temperautre glides in the form of closed loop heat pump.

Working fluid: Ammonia (R717) and Water (R718).

Compressor technology: Bottom cycle is based on pistion compressor and top cycle is based on centrifugal fans.

Specific investment cost for installed system without integration: the system is available through "Energy as a Service" contracts.

TRL level: TRL7-8 (Subsystem are on TRL8-9)

Expected lifetime: 20-25 years (depending on operational hours)

Size: depending on integration and temperature lift

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All information were provided by the supplier without third-party validation. The infomation was provided as an indicative basis and may be different in final installations depending on application specific parameters.