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ANEEO

Integration of a 1.6 MW steam  
supplying heat pump into the  
feed production process



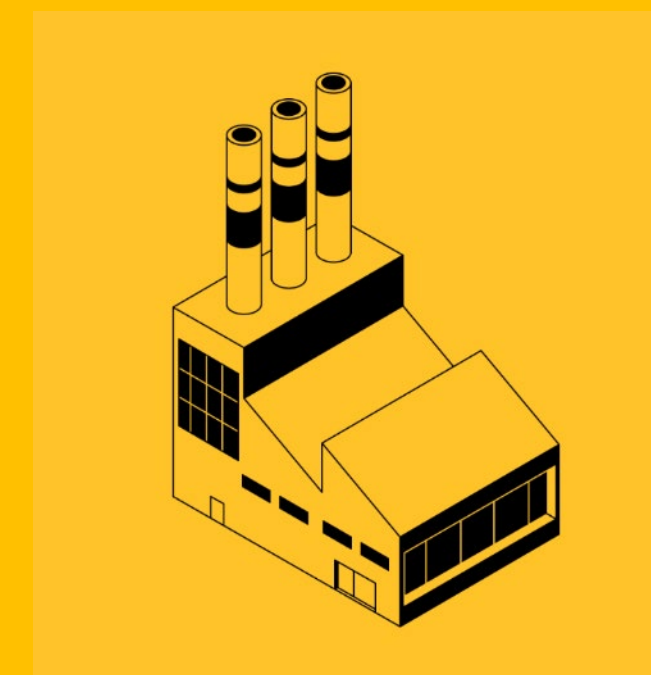




## Integration of a $1.6 \text{ MW}_{\text{th}}$ steam supplying heat pump into the feed production process

Christian Schlemminger, Aneo Industry  
Michael Bantle, Aneo Industry

18.03.2024 Steam generating heat pumps, OST Webinar

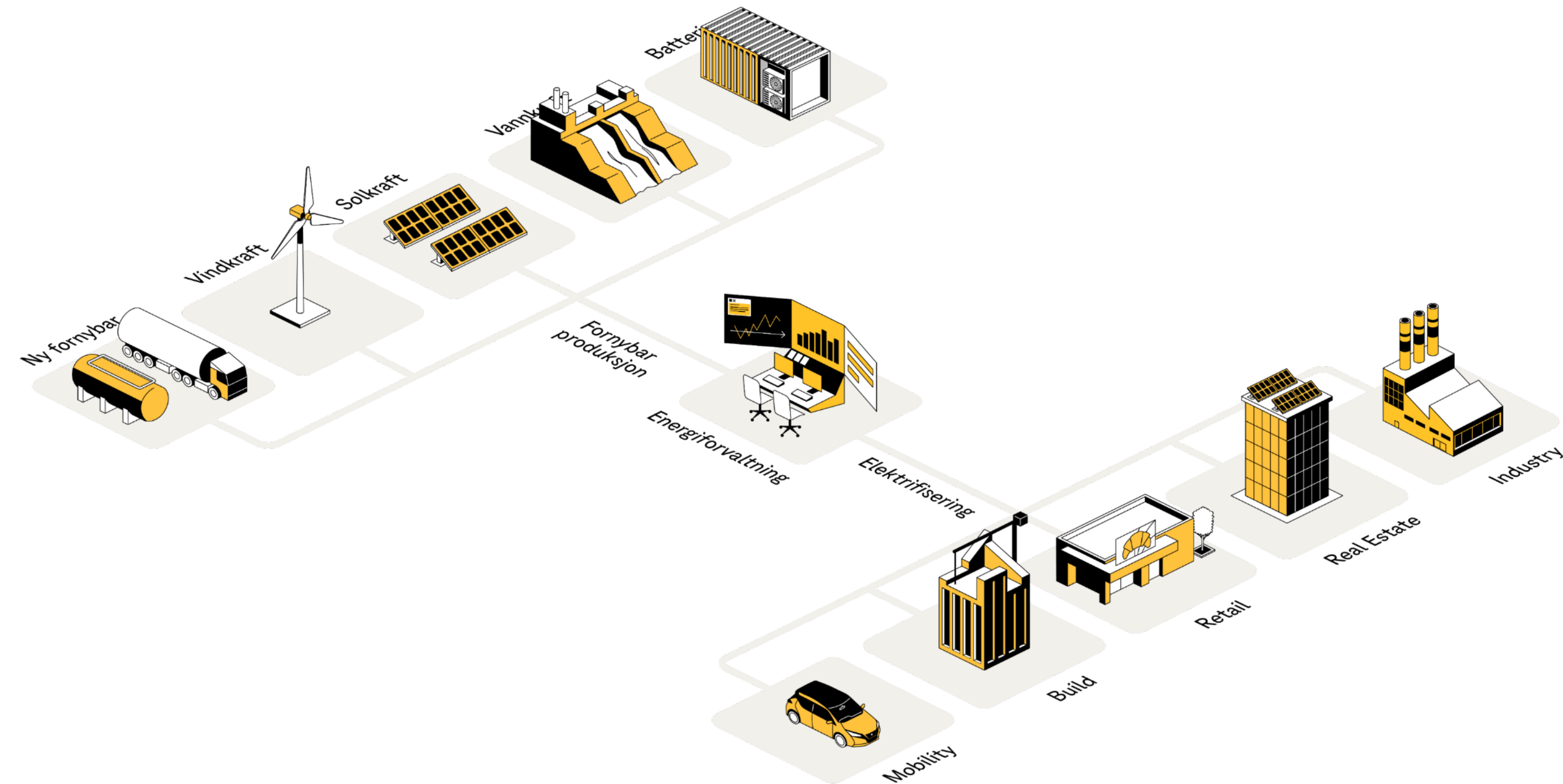




# About Aneo Industry AS

## Aneo Industry in brief

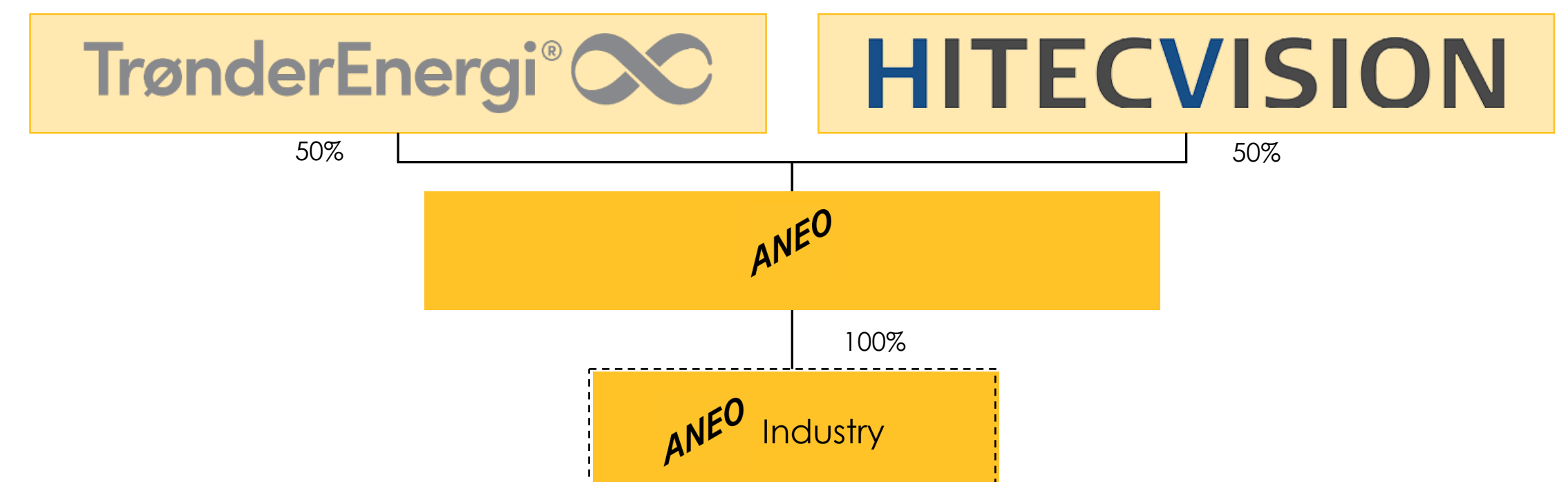
- Aneo Industry is an energy services company delivering complete solutions within waste heat recovery for industrial customers
- The company provides high temperature heat pump solutions resulting in increased energy efficiency and elimination of climate emissions for its customers
- Founded in May 2022 by Nordic renewable energy company Aneo




## Aneo in brief

- Aneo is a nordic renewable energy company with operations within renewable energy production, electrification and energy efficiency
- Established in 2022 and owned jointly by Norwegian utility TrønderEnergi and private equity investor HitecVision

## Corporate Structure



# Aneo Industry enables industrial customers to achieve ambitious ESG targets



Energy  
efficiency  
60% - 80%

Reduces  
climate  
emissions  
up to 100%

Releases grid  
capacity and  
reduces  
expensive  
power peaks

Natural  
refrigerants for  
future proof  
integration



# Motivation for integration of a steam producing heat pump



## Felleskjøpet

- Norwegian agricultural concern
- 4200 employees; 1.75 billion € revenue
- owned by around 39000 farmers
- around 100 stores
- 7 factories for feed production
  - Thermal conditioning reduced chemical use to minimum

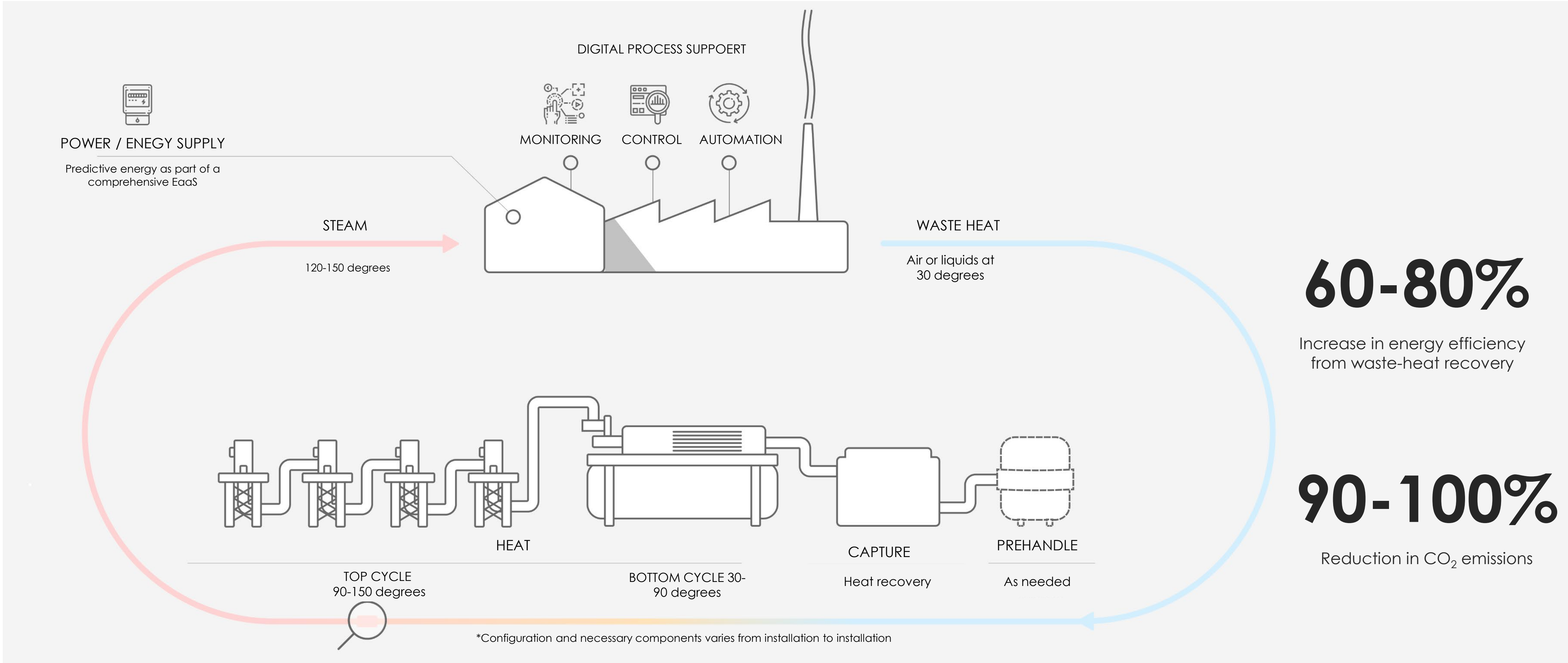
### HP installation at FKA Skansen aims to:

- Reduces grid capacity by up to  $1.2 \text{ MW}_{el}$
- Utilization of  $1.2 \text{ MW}_{th}$  excess heat
- Zero emission production in the agricultural sector
- Steam production of 7.5 GWh per year supplied to two production lines
- Identify best practice integration and transfer to other production sites
- Reduced odour nuisance from factory



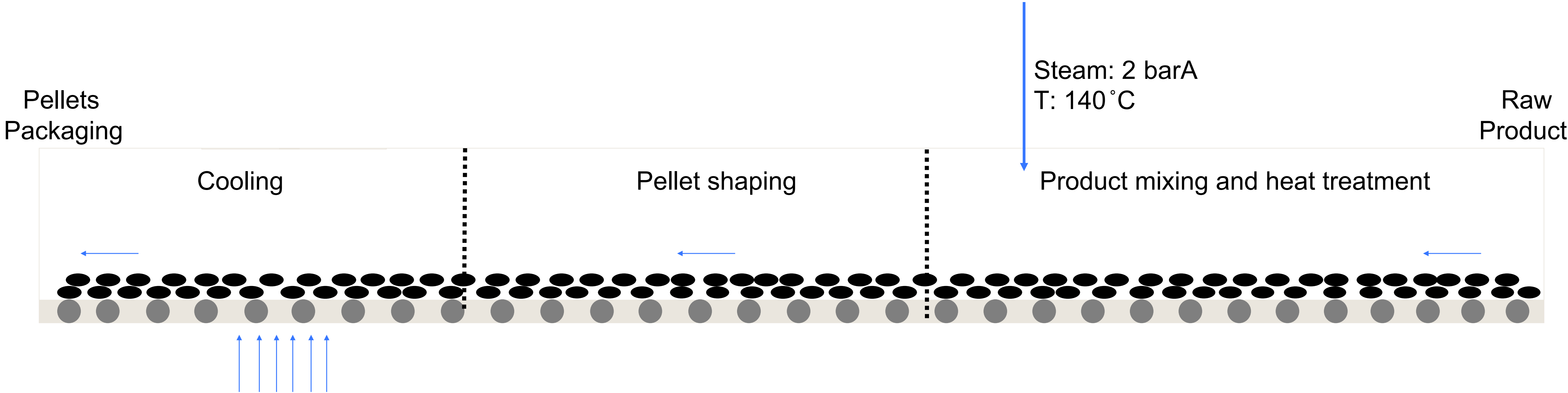
# Waste-heat recovery and electrification with compelling benefits

Utilising waste-heat to reduce opex, eliminate climate footprint and release grid capacity



Detailed process demand and waste heat quality are essential inputs for optimal SPHP design.

# Pet feed pellets process with heat recycling



The thermal integration as close as possible to the core process enables:

- Lower temperature lifts → high COP
- Multiple production lines → high utilization



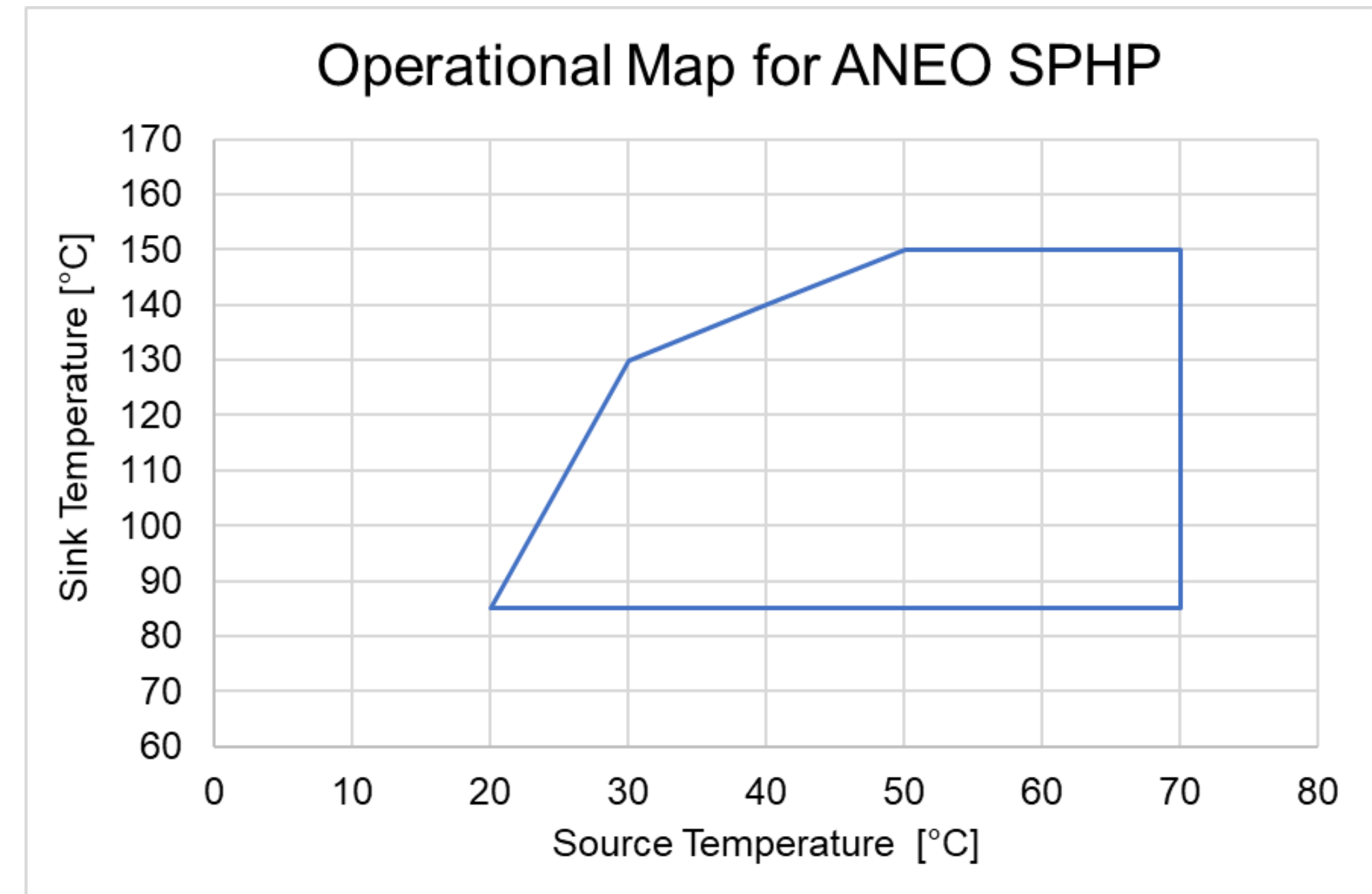
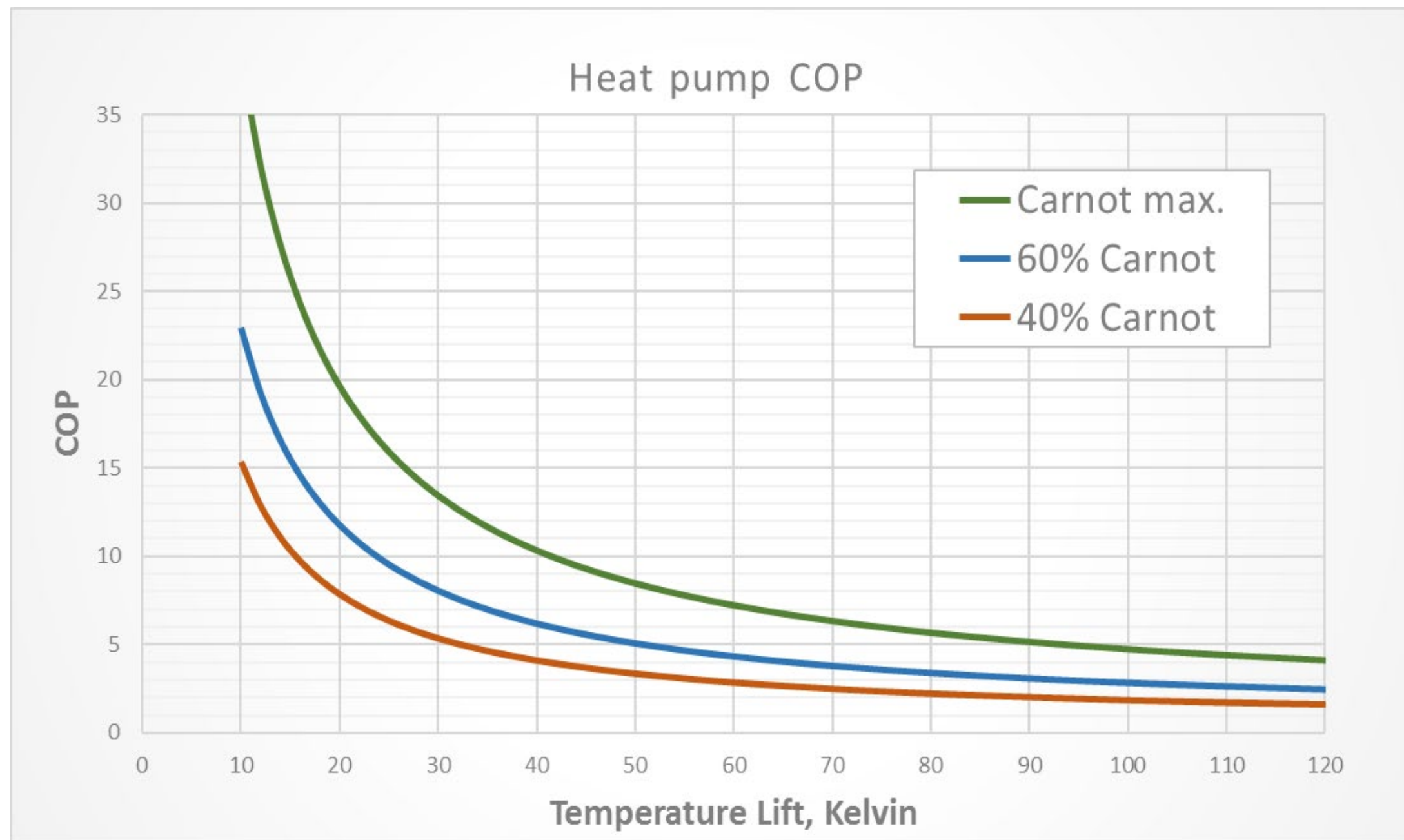


# The first steam-producing heat pump has been installed at Felleskjøpet Agri in Trondheim

- ✓ Produces 2 tons of steam per hour
- ✓ Recycles air-sourced waste heat
- ✓ Capacity of 1.4 – 1.8 MW<sub>th</sub>
- ✓ Efficiency gain of 67%



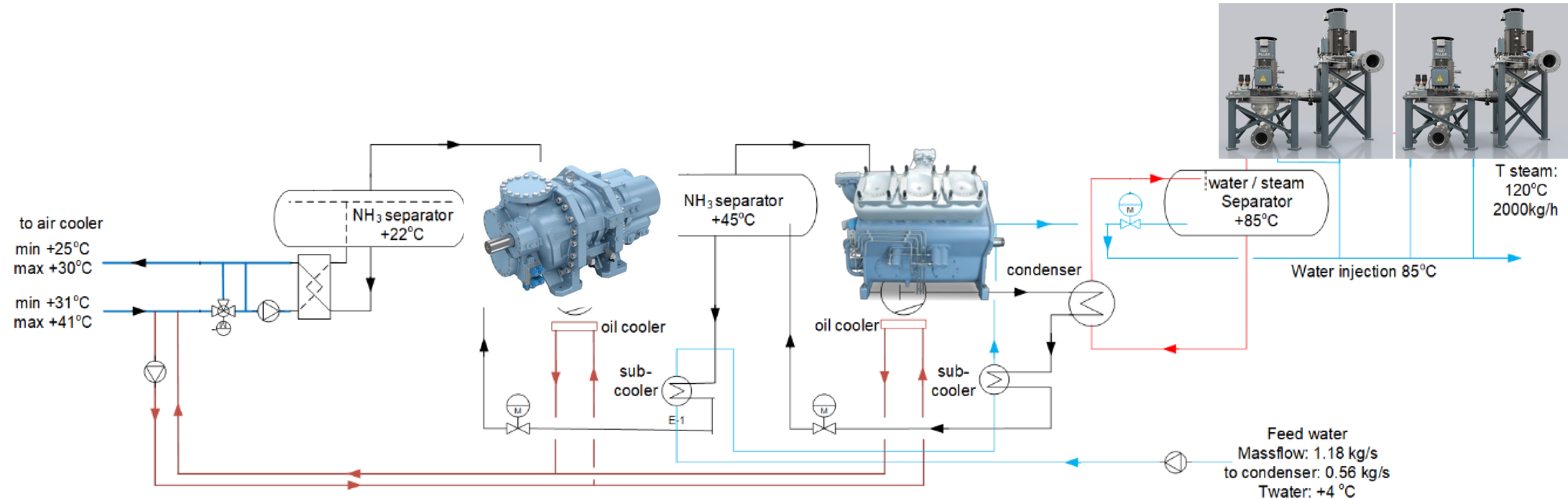
# FRIGG– Performance and operation range



- High temperature lifts (typical >60K) lead to demand for multistage and/or cascade heat pump
- Low temperature lifts results in high COP



# Frigg – simplified system design



The thermal integration is key:

- Utilization of oil cooling
- Two stage R717 system allows a wide range of heat source temperatures → high utilization



# FRIGG— does it work?



Heat pump off:

- Condensing moisture ( $1 \text{ t}_{\text{steam}}/\text{h}$ ) at process cooling air vent



Heat pump on:

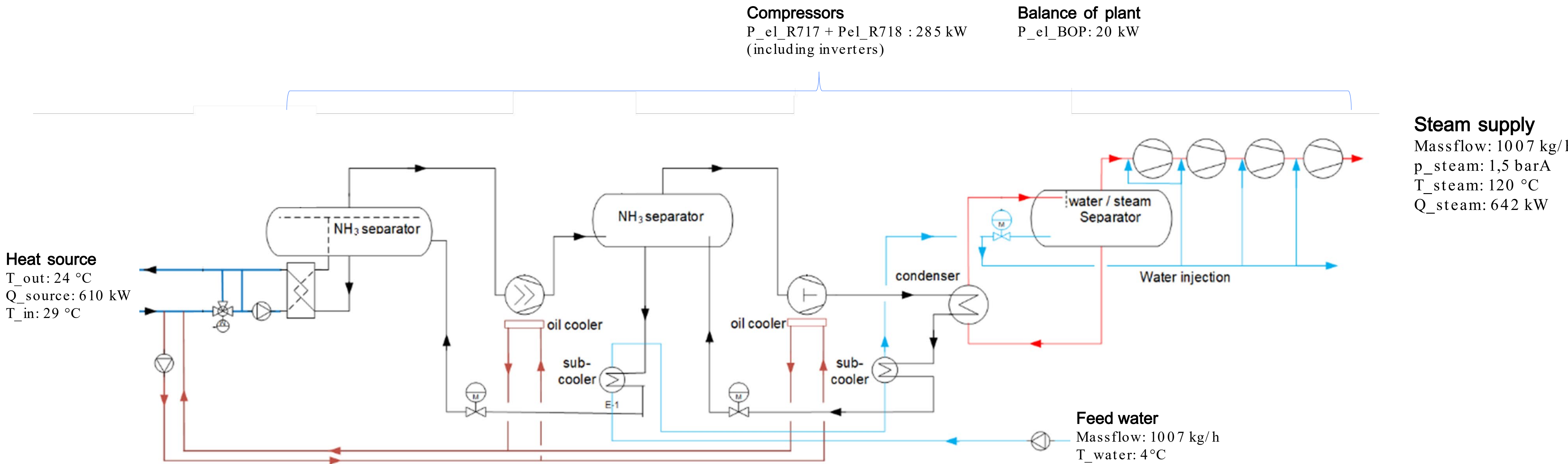
- $1 \text{ t}_{\text{steam}}/\text{h}$  produced by FRIGG





# FRIGG– simplified energy analysis

One production line in operation



## Performance

part load operation:

- $COP_{shaft\_steam \text{ only}} : 2,1$
- $COP_{shaft} : 2,6$
- $COP_{total} : 2,4$

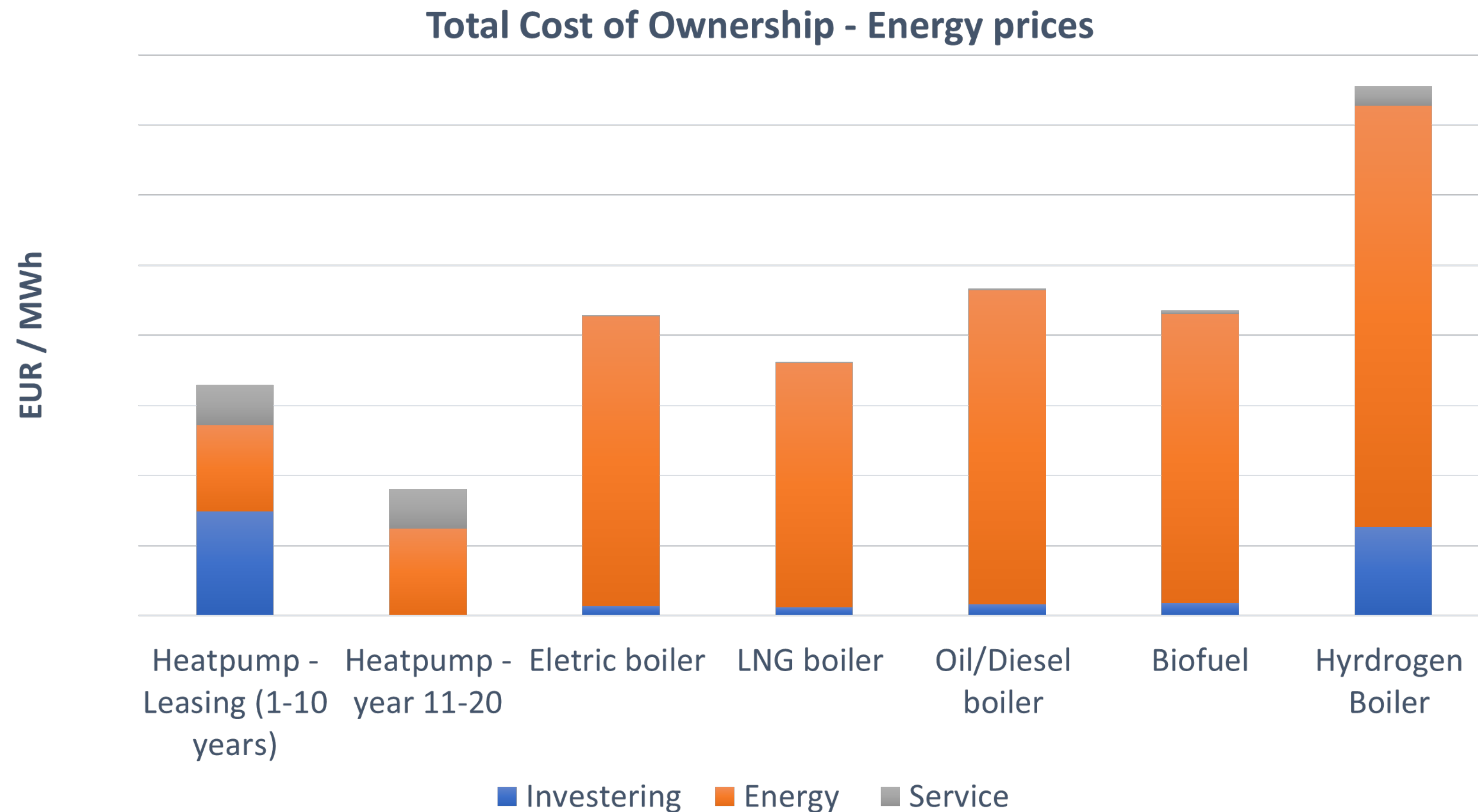
## Expected performance / design conditions

full load operation:

- $COP_{shaft\_steam \text{ only}} : 2,4$
- $COP_{shaft} : 3,4$
- $COP_{total} : 3,1$



# Cost analyse: General Trend for total Cost of Ownership (TOC)\*\*\*



\*\*\* depending on country, location, HP performance, operational hours, local energy prices



# Felleskjøpet Skansen – Lesson learned so far

- Excess heat recovery temperatures are in most cases lower than 45°C
  - *Moist air is often not utilized as excess heat in Food/Feed, Chemical and Pulp/Paper sector*
- Traditionally required steam pressures at the process line are often between 2 – 5 bar
  - *Product temperatures higher than 100°C are destroying the product. What is the minimum supply temperature?*
- Need for flexible steam supplying heat pumps with temperature lifts up to 100 Kelvin (and more)
  - *Multistage compression in order to achieve high COPs*
- Natural refrigerants are preferred by the customer
- Further developments of standard HP + MVC technology reduce technical risk
- Integration of the HP is the critical part
  - Integration concept as close to the process as possible
  - Low pressure steam supply network and control results in increased COPs → lower OPEX
  - Hot stand by operation is often required to increase utilisation
- Achieved performances are in line predictions



*Felleskjøpet with ANEO as supplier is winner of «The 2024 Norwegian Industrial Heat Pump Award»*

**ANEO**



# Thank you for your attention!



The project received financial support from ENOVA







## Business model

- 1 Complete solutions within industrial heat pumps and waste- heat recovery
- 2 Aneo reduces the customer's risk, owns the service model and ensures energy efficiency gains
- 3 Total supplier including project delivery and operations as well as the option of a financing model that eliminates capex
- 4 Enabling customer to focus on their core business instead of optimizing the CAPEX heavy machinery
- 5 Customer pay a predictable price and benefit from OPEX reduction through energy efficiency and climate emissions savings