Case studies

Visionary heating and cooling solutions

Natural Refrigerants ONLY

FENAGY
FUTURE ENERGY SOLUTIONS

At Fenagy, we are passionate about what we do and fully committed to our customers. Our customers are always our focus, and we strive to deliver top service in every project.

OUR VALUES

HONESTY
RELIABILITY
PASSION
AVAILABILITY
HUMILITY

Heat pumps and cooling systems – engineered for you and our planet

Fenagy A/S designs and manufactures large-scale heat pumps and industrial cooling systems for district heating and industrial applications. Using only natural refrigerants - CO_2 and hydrocarbons - our products align with the transition to renewable energy sources like solar and wind, while actively contributing to the shift toward sustainable energy systems.

We provide efficient, competitive and customised heating and cooling solutions that drive the electrification of heat production and eliminate the need for fossil fuels. Close collaboration with our customers is a priority throughout every stage of the project process, and our aftermarket service ensures long-term support after installation.

Founded in Denmark in 2020, Fenagy now employs nearly 100 people at our production and administrative facilities in Aarhus.

Visionary solutions

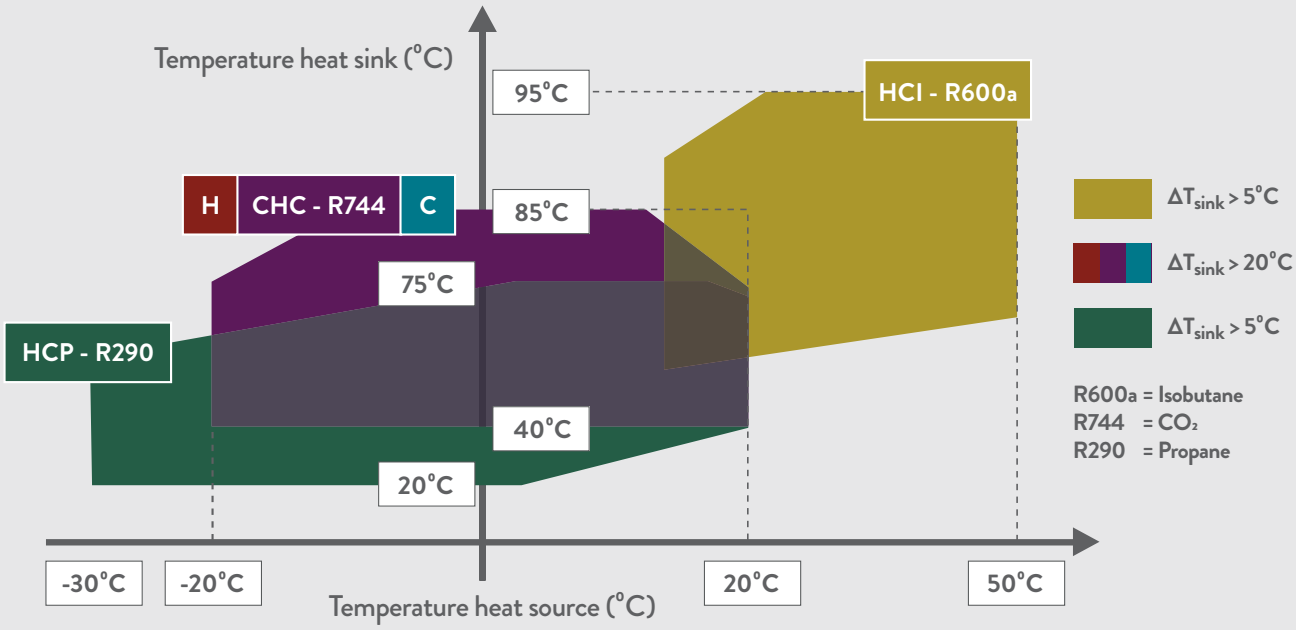
With a proven track record in sustainable heating, this brochure presents a selection of our diverse projects, each demonstrating a visionary, efficient and climate-friendly heating solution. The cases cover district heating installations, sector integration, waste heat recovery, energy storage, grid balancing, biogas production and more.

See for yourself and discover the possibilities within these case studies.

We only work with natural refrigerants

Fenagy develops and manufactures refrigeration and heat pump systems based on the natural refrigerants CO_2 and hydrocarbons. We always use natural refrigerants because they are efficient and have no harmful effects on the environment and climate - unlike all alternative synthetic refrigerants.

Natural Refrigerants ONLY



Certifications

Fenagy holds several certifications that demonstrate our commitment to quality, safety, sustainability and security. We are ATMO Approved for our use of natural refrigerants, CE marked for compliance with EU safety and environmental standards and ISO 9001 certified for quality management. Our welding meets ISO 3834-2 standards for durability and reliability. Additionally, we ensure robust cybersecurity by complying with the EU's NIS2 directive.

ATMO Approved

CE

ISO 9001 CERTIFIED

FORCE

NIS2

R744 - CO_2

CHARACTERISTICS

- Natural refrigerant with a wide temperature range
- Non-toxic and non-flammable
- Excellent choice for air-sourced heat pumps for direct use in the energy collectors and with high delta T on the heat sink side
- Optimal for medium-temperature water-sourced heat pumps, chillers and combined heating and cooling applications
- Medium-high temperature level on heat sink (up to 85°C supply temp) with high delta T on the heat sink (dT: 30-40K)

APPLICATIONS

District heating, heat networks, industrial processes, food industry, greenhouses, data centres, logistics centres, offices, hospitals and HVAC in general.

R600a - Isobutane

CHARACTERISTICS

- High-temperature natural refrigerant
- Suitable for water-sourced heat pumps and chillers
- Can be used in a wide temperature range on both the heat source and heat sink sides
- Robust operation under various operating conditions
- Use of efficient screw compressors and high COP of the cycle
- High temperature level on heat source (up to 40°C evap. temp)
- High temperature level on heat sink (up to 95°C supply temp) and ideal with low delta T on heat sink - serial coupling on water side at higher delta T

APPLICATIONS

Data centres, CCUS, biogas, geothermal, PtX, industrial processes, CO_2 heat pump sub-cooler and as booster in district heating systems.

R290 - Propane

CHARACTERISTICS

- Low-temperature natural refrigerant
- Suitable for lower temperature water-sourced heat pumps and chillers
- Low temperature level on heat source (down to -30°C evap. temp)
- Medium temperature level on heat sink (up to 75°C supply temp)
- Ideal with low delta T on sink and heat source
- High refrigeration capacity ensures compact solutions with small footprint
- Can be combined with isobutane in serial hydraulic couplings

APPLICATIONS

Heat networks, industrial processes, food industry, data centres, offices, hospitals and HVAC in general.

Denmark's largest CO_2 air-source heat pump to date

THE HEAT PUMP

The installation consists of five H-2600 air-source CO_2 heat pumps, with a total heating capacity of 12 MW. While wood chips will remain the primary heat source, the heat pumps are expected to meet the entire heat demand during summer periods.

40 evaporators - energy collectors – are installed outside the machine room to draw heat from the ambient air. Down the middle is a covered walkway with integrated electrical panels to ensure safe and easy access for service and maintenance of the evaporators.

In addition to the heat pumps, Fenagy has supplied a C-300 chiller (with heat recovery), also using CO_2 as refrigerant, delivering 140 kW of cooling to the machine room and transformer room. The excess heat from this process is recovered and fed directly into the district heating network.

The accumulation tank on site is 5,000 m^3 and can store up to 300 MWh of heat. With this storage, the heating plant can produce extra heat when electricity prices are low, store it in the accu-tank and supply it to the district heating network when prices are high. This setup increases operational flexibility and reduces the overall energy costs.

In total, the heat pumps can supply enough heat for more than 2,000 households

C-300 chiller unit (with heat recovery) for cooling of machine room and transformer room

HADERSLEV

THE CASE

In 2024, Haderslev district heating in Denmark expanded its facilities with a new energy plant, which includes Denmark's and probably the world's largest CO_2 air-source heat pump to date. The machine room is inside a 2,000 m^2 new building and holds five CO_2 heat pumps, a chiller (with heat recovery) and two defrost units. In connection with the new building, an electric boiler (15 MW) and a 5,000 m^3 accumulation tank have also been installed. Finally, a new transmission line has been established from the energy plant to the local consumers in Haderslev.

The expansion was driven by an expected increase in heat demand, as many residents have transitioned away from natural gas. With the new energy mix, the Haderslev plant increases the share of green heat in the network, improves both flexibility and supply security – and not least, reduces heating costs for consumers.

For Fenagy, this project represents our largest commissioned heat pump installation to date.

SPECIFICATIONS

Year: 2024
Heat pumps: 5 x H-2600 AW
Application: Air-to-water heat pumps
Heat capacity: 12 MW (34°C/76°C return and flow (4°C/85% ambient conditions)
Chiller (with heat recovery): C-300
15°C/7°C cold side, 34°C/76°C warm side
Cooling capacity: 140 kW
Accumulation tank: 5000 m^3

Exploiting the fluctuating electricity market with large-scale air-source heat pump

THE CASE

In Vildbjerg, Denmark, three H-1800 air-source CO_2 heat pumps complete the district heating company's heating system. Alongside these heat pumps, the setup includes a 12 MW electric boiler, two 3.5 MWe CHP units, solar heat collectors and substantial energy storage in two hot water energy accumulators. Together, they ensure optimal heat production regardless of electricity prices.

The energy storage holds approximately 7,000 m^3 of hot water, providing significant flexibility to switch units on and off in response to electricity price fluctuations while reliably meeting the heating needs of around 2,000 consumers.

VILDBJERG

THE HEAT PUMP

The heat pump installation consists of three standard H-1800 AW units, each with six evaporators, positioned side by side. Thorbjørn Madsen, Director at Vildbjerg Technical Works, expresses his excitement about the installation, saying: “The heat pump optimises our existing electric boiler and CHP units, enabling us to exploit the advantages of the fluctuating electricity market”.

Due to special wind and weather conditions, the units have even produced snow while generating heat. This is just one example of the way large-scale air-source heat pumps can interact with the forces of nature, and why our technical experience and intelligent control systems are essential to ensure reliable, stable operation without unforeseen issues.

The heat pump was commissioned in 2023 and fully handed over to the customer after commissioning.

SPECIFICATIONS

Year: 2023
Model: 3 x H-1800 AW
Application: Air-to-water heat pump
Capacity: 7 MW · 35°C/68°C hot water (5°C/85% humidity)
Heat source: Air
COP: 3.2
Defrost method: Glycol

CO_2 heat pumps
- the perfect heating solution for greenhouses

Horticultural greenhouses operate with low return and high supply temperatures - conditions where CO_2 heat pump technology outperforms all other refrigerants. These temperatures match Danish district heating, where large-scale CO_2 heat pumps already deliver proven megawatt-scale results.

THE HEAT PUMP

The heat pump is an H-1200 air-to-water, supplying 1.5 MW of heat and using CO_2 as a refrigerant. It is installed in a high-qualit technical enclosure, which is a fully approved machine room with lighting, ventilation, CO_2 alarm and sound dampening panels. The enclosure was delivered with a concrete foundation, so only a levelled sand pad needed to be prepared on site for the installation.

Next to the heat pump and the existing accumulation tank, built in 1997, stand four evaporators that collect heat from the air. A glycol circuit, developed by Fenagy, ensures reliable defrosting through a unique control algorithm.

The heat pump has been in operation since January 2024 and supplies about 50% of the greenhouse heating demand, operating alongside the existing natural gas boilers (6.5 MW) and CO_2 fertilisation systems.

The accumulation tank - where heat can be stored when electricity is cheap - is a central part of the heating system. It is cycled daily - typically ranging from 15–20% to 80–85% full, and even more actively during winter when the load increases. “Even though the COP of the heat pump falls to around 2.75 when it’s cold outside, we make money with it in the winter,” says Klaus Søgaard.

Markhaven’s installation shows that even a relatively small project can deliver measurable energy savings and emissions reductions - and the same CO_2 heat pump technology can be scaled for greenhouses that are ten or twenty times larger.

SPECIFICATIONS

Year: 2023
Model: H-1200 air-to-water heat pump
Capacity: 1.5 MW · 40°C/65°C return/flow (5°C/85% humidity)
Refrigerant: CO_2 (R744) - natural, non-toxic, non-flammable
Defrost: Glycol

MARKHAVEN

THE CASE

Markhaven is a 32,000 m² horticultural greenhouse located in Denmark. Like many in the sector, the business has relied on natural gas for heating, but to reduce reliance on fossil fuels, Markhaven, in 2023, invested in an air-to-water CO_2 heat pump. The existing heating system already had an open accumulation (buffer) tank and manifold, which made it easy to integrate the new heat pump. "Many greenhouses are built like this," explains owner Klaus Søgaard. "We just added another unit to the manifold."

CO_2 management is an essential factor in horticulture. During summer, when heat demand is lower, Markhaven prioritises CO_2 enrichment to stimulate plant growth - a standard practice in greenhouse horticulture. While this means the gas boilers are still used during certain periods, the heat pump reduces overall fossil fuel use and improves system flexibility. Over the year, the heat pump now covers around 50% of the heating demand, significantly lowering Markhaven's carbon footprint without compromising crop performance.

"With the heat pump, we've chosen a solution that is both sustainable and reliable. Our production is now secure – even if the gas supply were to be interrupted. That gives us peace of mind in uncertain times.

Fenagy has delivered a solid product and provide excellent service. They have a lot of experience from similar projects – and I would choose them again without hesitation. For me, it's also about taking responsibility and leading the way in the green transition."

Klaus Søgaard
Markhaven Greenhouse

The heat pump is installed in a fully equipped technical enclosure next to the greenhouse.

Maerskgaarden residential community

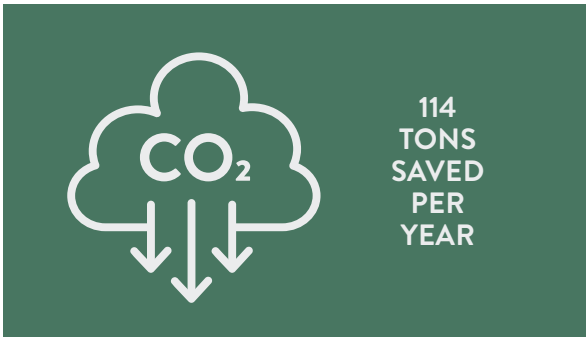
Plug-and-play heat pump for communal heating

The heat pump is enclosed by sound panels.

SPECIFICATIONS

Year: 2025
Model: H-300 close coupled, air-to-water
Capacity: 0.3 MW · 40°C/70°C return/flow (5°C/85% humidity)
Refrigerant: CO_2 (R744)
- natural, non-toxic, non-flammable
Defrost: Cold gas

Maerskgaarden residential community has replaced gas boilers with a heat pump.



THE CASE

Maerskgaarden is a residential community with 82 senior housing units on the island of Taasinge in Denmark. Like many smaller residential sites, it previously used gas boilers for heating. Now, the community has fully electrified its heating supply, with Fenagy delivering a robust, plug-and-play heat pump.

The system centres on an H-300 air-to-water heat pump using CO_2 as refrigerant. With a capacity of 300 kW, it supplies heating to the 82 homes in combination with a 350 kW electric boiler and a 4.5 m^3 accumulation tank, enabling 100% fossil-free heating. The heat pump can support system balancing and price-optimised operation, but as this was not part of the business case, a small buffer tank was installed to provide stable operation, rather than fully decoupling production from demand.

The heat pump is installed outdoors on a concrete foundation and enclosed by sound panels to minimise noise. Although the unit itself operates at a low noise level, additional sound insulation was required due to its location close to a residential area with very strict noise limits.

On-site installation is simple: an electrician connects the cables, a plumber connects the pipes, and the system is ready to run shortly after delivery.

Delivery on site. The close-coupled heat pump is here installed on a concrete foundation.

MAERSKGAARDEN

Close-coupled heat pump and V-shape evaporator (energy collectors) installed inside a sound enclosure.

The close-coupled heat pumps and chillers are plug-and-play solutions delivered on a single steel frame with the heat pump/chiller in an enclosure at one end and energy collectors or a gas cooler at the other. Available with capacities from 300-600 kW. The heat pump can deliver supply temperatures up to 85°C.

THE HEAT PUMP

The Maerskgaarden installation features Fenagy's H-300 close-coupled heat pump in a sleek new design. The system is delivered as a compact, plug-and-play unit on a single steel frame: at one end is the heat pump module housed in an enclosure with integrated control systems, lighting, ventilation and sound insulation, and the energy collectors are mounted directly next to it on the frame.

The H-300 uses CO_2 as a natural refrigerant and can deliver hot water up to 85°C. It has a robust cold gas defrost system, which has been refined and optimised for the V-shape solution over three winter seasons on four similar heat pumps. This experience has now been incorporated into an enhanced PLC programme and implemented in the upgraded H-300 CC unit, ensuring stable operation even under harsh winter conditions.

The close-coupled design is also available as a chiller or combined heating/cooling system, typically used in industrial settings or for communal and district heating. It's a practical, scalable solution that supports affordable and sustainable energy supply.

At Maerskgaarden, the system contributes to the green transition and ensures stable indoor temperatures year-round – all in a streamlined, space-saving and low-noise setup.

Turning data centre waste heat into district heating

Image for illustration purposes only · site under construction

THE CASE

In collaboration with Finnish contractor Caverion, Fenagy has supplied six isobutane/propane heat pumps to a utility company providing district heating to Kajaani in north-east Finland (Phase 1, 2025). The heat pumps recover excess heat from a nearby data centre and feed it into the district heating network. Following the success of this first phase, a second phase has been agreed (2026) for an additional nine units – bringing the total to 15 heat pumps.

The data centre is being expanded in stages, and Fenagy's modular heat pump concept matches this approach precisely: capacity is added as the facility grows, ensuring the system is always right-sized to the actual cooling demand and the waste heat it generates. By connecting heat pumps to the existing cooling water circuit, the system both provides server room cooling and recovers excess heat for district heating. The original chillers remain in place for backup only.

As data centres require cooling year-round, they are a stable and reliable heat source for heat pumps. In winter, waste heat is recovered for heating the city -in summer, excess heat is released via the existing dry coolers.

SPECIFICATIONS

Year: 2025/2026
Heat pumps: 6 x HCI-3000 (1st phase)
9 x HCI-3000 (2nd phase)
Application: Combined heating and cooling
Refrigerants: Isobutane & propane
Heat source: Excess heat from data centre
Cooling/heating capacity: 25.8/33.5 MW

KAJAANI

THE HEAT PUMPS

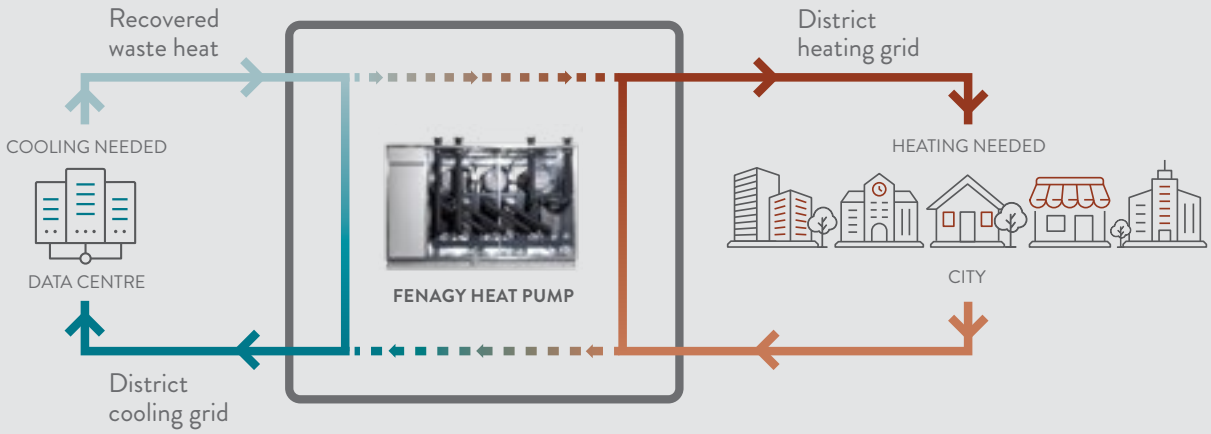
The heat pumps are customised HCI-3000 units designed to provide both heating and cooling. Each unit has three compressors - two using isobutane and one using propane.

Waste heat from the data centre enters at around 30°C and is raised to approximately 85°C to meet district heating requirements. On the cold side, the units supply 20°C water for server room cooling, independent of the district heating return temperature, which in this case is about 50°C.

Isobutane and propane are both highly efficient, PFAS-free, natural refrigerants with an extremely low global warming potential.

When fully implemented across both phases, the system will deliver 33.5 MW of heating and 25.8 MW of cooling.

Sector integration · No heat wasted · Optimal energy efficiency



HCI-3000

FENhouse: Heat pump and machine room in one

SPECIFICATIONS

Year: 2024
Model: 2 x H-2600 in FENhouses
Application: Air-to-water heat pumps
Capacity (heat):
5.2 MW (5°C ambient, 42/75°C hot water)
COP: 3.0
Defrost method: Glycol
Hot water storage: 10,000 m^3
aFRR operation: 5 minutes start/stop

Hanstholm District Heating Utility has shifted its energy mix from 70/30 in favour of biomass to 70% electricity-based heat production - with two CO_2 air-source heat pumps.

Each heat pump is installed in a FENhouse enclosure, delivered to site as a fully approved machine room.

Only 6 months from order -> heat production

THE CASE

Over three years, heat demand in Hanstholm increased by a third, driven mainly by new industrial customers in the fish processing and aquaculture sectors, where production processes and sanitation require supply temperatures of up to 80°C.

To meet rising demand and support its ambition to participate in the balancing market, the utility needed to expand production capacity while maintaining operational flexibility. A CO_2 heat pump solution was the natural choice, thanks to its ability to deliver temperatures of up to 85°C and its rapid start-stop capability for grid-support services.

Today, Hanstholm supplies heat to households and industry while also providing flexibility to the regional electricity grid.

HANSTHOLM

HEAT PUMPS IN ENCLOSURES

Hanstholm's solution features two H-2600 air-to-water heat pumps, each housed in a FENhouse enclosure. The FENhouse setup made the project fast and straightforward, with only 6 months from order to first heat delivery and no need for a new building. A new building would have taken much longer to approve and forced Hanstholm to rely on more expensive production units in the meantime. The fast-track process therefore meant significant cost savings.

A FENhouse is fully prepared for plug-and-play integration with energy collectors and the local district heating grid when delivered on site. Each enclosure is designed with easy service access, integrated lighting and ventilation - and complete with piping, defrost module and control systems.

Together, the two units deliver 5.2 MW of fossil-free heating capacity at temperatures of up to 85°C. This supplies heat to the town's 1,100 households and meets the needs of local industry, where high-temperature hot water is required for processing and cleaning.

The heat pump installation is part of a new production mix, which also includes a 10 MW electric boiler, two large accumulation tanks (10,000 m^3 total) and a 6.3 MW woodchip boiler. Gas engines remain available for emergency operation and market participation.

The FENdefrost system ensures reliable operation of the evaporators even in snow and frosty weather.

The walkway by the evaporators provides easy service access.

FENhouse

- Fully approved machine room
- Heat pump, piping, defrost module and controls
- Lighting, ventilation, CO_2 alarm and sound dampening
- Easy service access
- Cost-effective and time-saving
- Modular and scalable
- Multiple design options

OPTIMISED ENERGY COLLECTORS AND FENdefrost

Next to the FENhouses are 12 next-generation Güntner evaporators acting as energy collectors and capturing ambient energy year-round. Each energy collector is equipped with 14 fans and can deliver up to 300 kW.

Fenagy's advanced control system, FENcontrol, and glycol-based defrost circuit, FENdefrost - tested and refined over five winters - help maintain high output and operational reliability throughout the Danish winter.

District heating network combines air and wastewater for efficient heat supply

THE CASE

In Fårevejle, Denmark, a brand new district heating network is heated by a combination of air and wastewater. The wastewater heat pump handles the base load, while the air-source heat pump steps in if the demand exceeds the wastewater system's capacity.

FÅREVEJLE

H-1200

H-1800

THE HEAT PUMP

The heat pump installation consists of two standard H-1800 AW units and one H-1200 WW unit.
The wastewater system includes two accumulation tanks from which energy is extracted. Before the water enters a water-to-water heat exchanger, it is filtered through a self-cleaning filter. Additionally, the heat exchanger is equipped with a clean-in-place system, ensuring reliable and stable operation. The wastewater can be cooled down to around 2°C allowing maximum energy to be extracted.

The heat pump was commissioned in 2023 and fully handed over to the customer after commissioning.

SPECIFICATIONS

Year: 2023
Model:
2 x H-1800 AW · 1 x H-1200 WW
Application:
Air-to-water and water-to-water heat pump
Capacity:
AW: 3.5 MW · WW: 1.3 MW
40°C/70°C hot water (5°C/85% humidity)
Heat sources: Air and wastewater
COP: AW: 2.9 · WW: 3.05
Defrost method: Glycol

Transportable air-source heat pump

THE CASE

Fenagy's very first heat pump – a 600 kW air-to-water unit – was developed and designed during the autumn of 2020. The heat pump was installed at a biomass-fired district heating system in a small city outside Aarhus, where it operated in combination with a straw boiler and oil boilers for peak load and back-up. The heat pump served as both a test unit and a demonstration unit.

SPECIFICATIONS

Year: 2021/2023

Model: H-600 (AW)

Application: Air-to-water heat pump

Capacity (heat): 600 kW

(5°C ambient, 40/70°C hot water)

Heat source: Air

COP: 2.9

Defrost method: Glycol

HEAT PUMP TEST PROJECT

Fenagy received DKK 250,000 in support from the Green Investment Pool, and Kredsløb utility company in Aarhus purchased the heat from the heat pump for the district heating network. During the test period, Fenagy paid a fixed price for electricity, and Kredsløb paid a fixed price for the heat. When this agreement expired, the operation of the heat pump needed to be changed in order to still be cost-effective, and as the demonstration site had fulfilled its purpose, Fenagy decided to move the heat pump.


HARLEV


TRUSTRUP

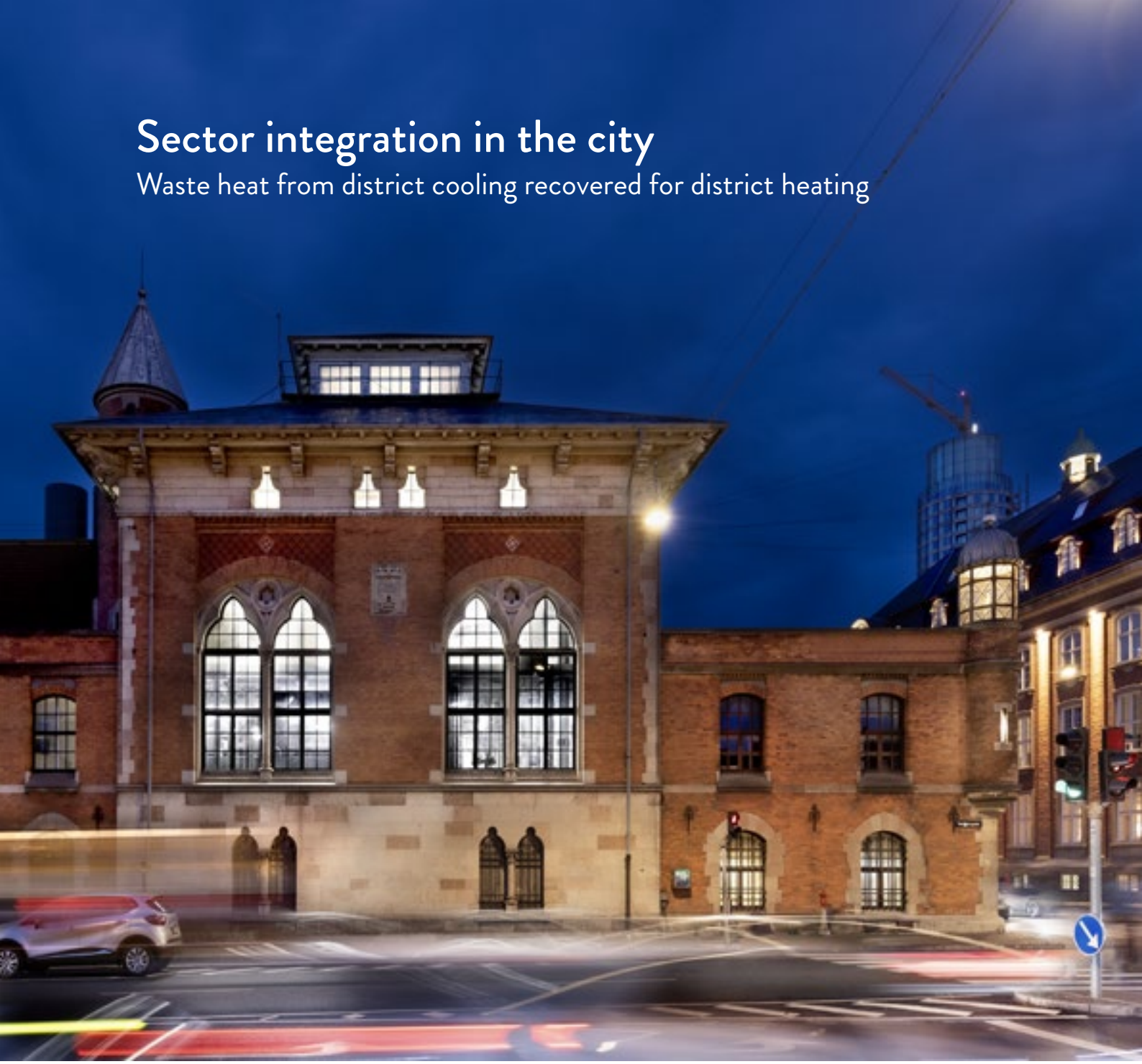
MOVING THE UNIT

In 2023, the heat pump was sold and moved to a different district heating plant in Djursland, Trustrup/Lyngby, where it supplies heat to the small town Balle – approx. 50 kilometres away from the original site.

The move was done in just 2-3 weeks showing that a factory-built unit from Fenagy provides a great opportunity to buy a mobile unit for consumers in areas where a transmission line for district heating has not yet been established. They can buy a heat pump first and then connect to the district heating once this is established.

Sector integration in the city

Waste heat from district cooling recovered for district heating



THE CASE

In the heart of Copenhagen, a historic building is home to a new Fenagy heat pump installation by HOFOR, a key district heating and cooling provider in the city. This heat pump is the first of 10 planned units, which together are expected to replace up to one-third of the biomass currently used for heating and will eventually provide heat to approximately 130,000 apartments.

The heat pump utilises waste heat from HOFOR's district cooling facility at the same location. In the summer, excess heat in the district heating network can be rejected into seawater taken from the city harbour. As the electricity used comes from wind and solar energy, the project is an excellent example of effective sector integration.

KIRKESALEN

THE HEAT PUMP

The heat pump installation consists of two H-1800 WW units and one H-1200 WW unit, customised to meet the specific requirements of this unique location, which has very limited space and strict noise regulations. The racks are slightly shorter than usual, with larger pumps integrated on both the cold and warm sides. Additionally, the compressor compartments are sound attenuated using specially designed panels, reducing noise levels from Lw = 105 dB(A) by 4-5 dB. The heat pumps are equipped with special vibration-reducing machine feet to prevent vibrations from being transferred to the machine room.

The three racks are positioned at two levels on a steel frame. The heat pump uses CO_2 as a refrigerant, which is an optimal choice for a mid-city location in terms of safety. It supplies heat to approximately 2,500 homes in Copenhagen.

The heat pump was commissioned in the autumn of 2024 and fully handed over to the customer after commissioning.

SPECIFICATIONS

Year: 2024
Model:
2 x H-1800 WW · 1 x H-1200-WW
Application: Combined district cooling and district heating
Capacity:
4.9 MW heating · 3.3 MW cooling
47°C/75°C hot water · 12.5/5.5 cold water
Heat source: Water
COP: 2.7

Sector integration with combined heating and cooling

THE CASE

IKEA Aalborg aimed to replace its four aging HFC refrigeration systems with a carbon-neutral solution. Aalborg District Heating then proposed a partnership to combine heating and cooling through sector integration.

They now have a Fenagy air-to-water heat pump with a chiller module for air conditioning, installed by Krebs A/S. IKEA enjoys efficient air conditioning in the summer, while capturing waste heat from this process and feeding it into the district heating grid. In colder months, the heat pump uses air as a heat source to provide heating for both IKEA and the district heating network.

AALBORG UTILITY - IKEA

THE HEAT PUMP

The H-1200 AW/WW heat pump, using CO2 as a natural refrigerant, is designed to provide flexible cooling and heating. It is housed in a Priess enclosure and equipped with Fenagy's advanced ejector technology, FenEject, with an automated PLC system that optimises capacity, chiller, evaporator and defrosting operations.

The installation includes four energy collectors (250 kW each) installed on 2-metre legs on a concrete foundation. Below the collectors is a drainage system to manage condensate during defrosting. With a summer cooling capacity of 750 kW, the system fully meets IKEA's cooling needs while also contributing waste heat to the district heating grid.

This installation is a prime example of sector integration, demonstrating how combining heating and cooling contributes to a more sustainable energy future.

SPECIFICATIONS

Year: 2022
Model: H-1200 AW/WW
Application: Air-to-water and water-to-water heat pump
Capacity (Heat): 1200 kW (5°C evaporation, 72/40°C hot water)
Capacity (Cooling): 8/13°C
Heat source: Air
COP: 3
Defrost method: Glycol

Combined heating and cooling for biogas production

THE CASE

The biogas plant in Tønder, Denmark, will be one of the largest plants in Europe when completed. Annually, it will process 900,000 tons of agricultural feedstock and industrial organic waste and produce 40 million Nm^3 of bio-methane, equivalent to 400 GWh per year – enough to cover the annual energy consumption of 20,000 households.

The biogas production process begins with feedstock from local farmers being delivered and loaded into storage tanks. Once inside, the feedstock is heated by an HCI heat pump to stimulate the production of biogas. The generated biogas then goes through a purification process, and once upgraded, it can be fed into the natural gas grid, replacing natural gas and contributing to a sustainable energy supply.

The remaining feedstock, after processing and gasification, is cooled by the HCI heat pump system. This cooling step captures the remaining energy and converts the degassed feedstock into an eco-friendly fertilizer. Essential nutrients are preserved, odour is reduced and the fertilizer is ready for use on fields.

THE HEAT PUMP

The installation includes three HCI-3000 heat pumps, using isobutane as a refrigerant. Each HCI-3000 unit is installed in a sound-dampening enclosure, ventilated by an EX-fan to ensure a negative pressure and maintain the right temperature in the cabinet. The entire system is controlled by a Siemens PLC with added Fenagy algorithms for the most essential functions.

HCI heat pumps can deliver supply temperatures up to 95°C. The heat pumps have been commissioned and in operation since the summer of 2024. Tønder Biogas plant will be completed in 2025.

HCI-3000

SPECIFICATIONS

Year: 2024
Model: 3 x HCI-3000
Application: Water-to-water heat pump
Capacity: 5-7 MW
Heat source: Water
Refrigerant: Isobutane

Flexible heating and cooling - integrated in one energy system

Project: VELUX LKR Innovation House
Photo: Adam Mørk

SPECIFICATIONS

Year: 2024
Energy system: CHC-1200 AW + WW
Application: Combined heating and cooling (CHC)
Heating capacity: 1.3 MW, 35 °C/55 °C hot water (5 °C/85 % humidity)
Cooling capacity: 500 kW, 10 °C/4 °C cold water
Heat source: Air + excess heat

THE CASE

In Østbirk, Denmark, VELUX is transforming a former warehouse into a state-of-the-art facility, which will be the company's central hub for research and development: the VELUX LKR Innovation House.

Fenagy has delivered a highly flexible energy system for the renovated building – a system designed to meet the heating and cooling comfort requirements year-round.

The energy system supplies both heating and cooling, either independently or simultaneously. This customised system combines air-to-water and water-to-water heat pump operation while also meeting the building's cooling demand.

In winter, the system delivers heat; in summer, it provides cooling. During spring and autumn, it runs in combined mode – enabling energy to be recovered and redistributed internally. For example, surplus heat from sun-exposed south-facing rooms can be used to warm cooler, north-facing areas.

PROJECT PARTNERS: *PRAKSIS ARCHITECTS · SØREN JENSEN ENGINEERS · KG HANSEN · DETBLÅ LANDSCAPE*

VELUX LKR INNOVATION HOUSE

THE ENERGY SYSTEM

The installation features a CHC-1200 air-to-water and water-to-water system that uses CO_2 as a refrigerant and integrates both heat pump and chiller functionalities. The setup includes specially developed air heat exchangers, which function as both energy collectors and heat rejectors. In summer, they operate in gas cooler/chiller mode to expel heat to the surrounding air. In spring and autumn, depending on whether cooling or heating demands the most energy, the air heat exchangers function as gas coolers or evaporators to boost and/or balance the system. In winter, they collect ambient energy to enable full air-to-water heat pump operation.

At the core of the solution is Fenagy's PLC system, which intelligently controls the operating modes in real time based on demand. This ensures smooth seasonal transitions and efficient internal energy balancing.

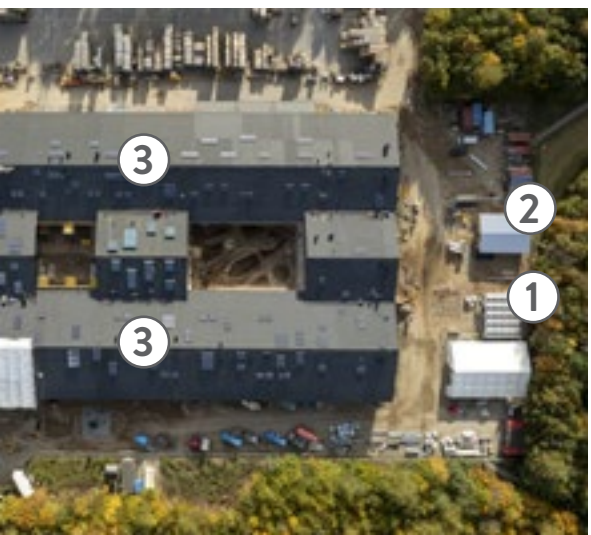
With this integrated solution, VELUX will be fully selfsufficient in heating and cooling - independent of external energy sources. The compact design requires minimal machine room space while delivering optimal energy performance and consistent indoor comfort in the entire building.

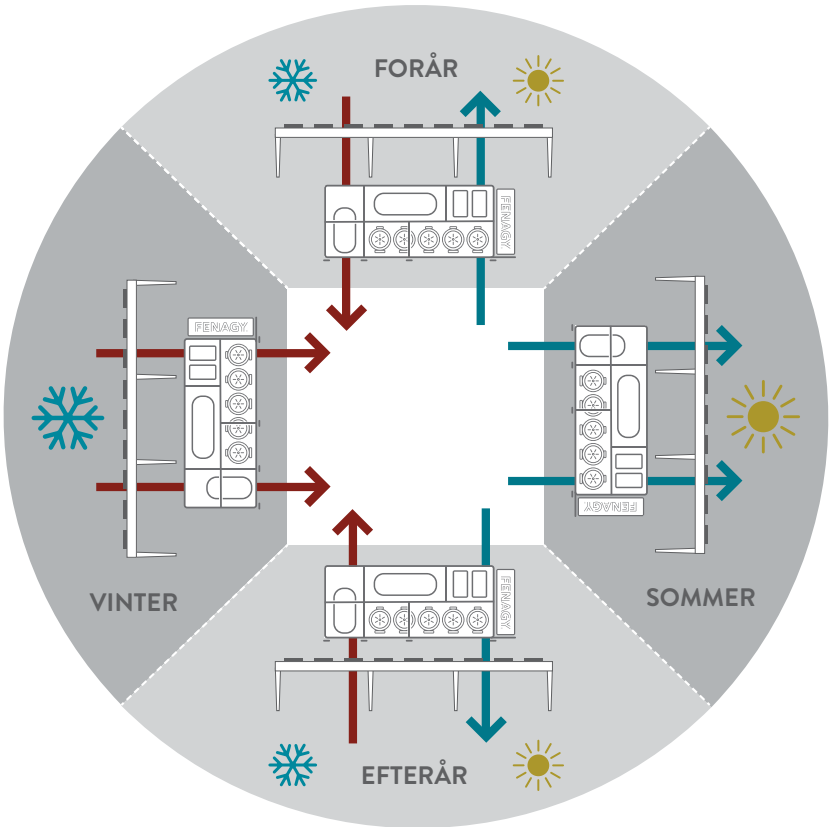
The energy solution supports the holistic renovation vision of the VELUX LKR Innovation House, uniting sustainable building design with year-round comfort and energy efficiency.

Project: VELUX LKR Innovation House
Photo: Adam Mørk

SEASONAL FLEXIBILITY

1. AIR HEAT EXCHANGERS
2. FENAGY ENERGY SYSTEM
3. LKR INNOVATION HOUSE





Project: VELUX LKR Innovation House
Photo: Adam Mørk

Air-source heat pump cuts heating costs and helps balance the electrical grid

THE CASE

The district heating company in Sdr. Felding, Denmark, has expanded its existing biomass-based production facilities with the integration of a large heat pump, a sizable accumulation tank and a 10 MW electrical boiler. This visionary installation exemplifies the future of district heating, which will be emission-free, and the installation serves as an important player in balancing the electrical grid. Notably, it has the capability of absorbing large quantities of green electricity during periods of abundance, and then utilising the stored energy from the tank during times when the electricity supply is lower than the demand.

SDR. FELDING

THE HEAT PUMP

Fenagy has provided two H-1800 air-sourced heat pumps, including 12 flatbed evaporators, and the installation is executed by Krebs A/S. The heat pumps are equipped with Fenagy's latest ejector technology, FenEject, optimised evaporators, and controlled by a Fenagy PLC, which has algorithms for capacity control, evaporator control and defrost. The control system can start and stop the machines so fast that they are well-suited and relevant for electrical grid balancing.

SPECIFICATIONS

Year: 2022
Model: 2 x H-1800 (AW)
Application: Air-to-water heat pump
Capacity (heat): 3.5 MW
(0°C ambient, 35/70°C hot water)
COP: 2.96
Defrost method: Glycol

Modular, fossil-free heating – a flexible solution for a growing community

THE HEAT PUMP

At the core of the new installation are four large H-2600 CO_2 air-to-water heat pumps, collectively delivering up to 9,4 MW at -1°C and as much as 12.3 MW when outdoor temperatures reach 15°C.

Each unit features six Bitzer 8-cylinder compressors and an integrated district heating pump.

The new heat pump facility is a state-of-the-art installation. Mounted on an 8-metre steel frame, 32 Güntner evaporators draw in ambient energy, even during the cold and humid Danish winters. A glycol circuit, developed and refined by Fenagy over three winters, ensures reliable defrosting through a unique control algorithm.

With a COP around 3, the heat pumps represent the most efficient and cost-effective heating option for most of the year. Combined with solar thermal energy and intelligent storage, they form a highly flexible system, capable of responding dynamically to changes in weather, electricity pricing and grid demand.

With population growth expected, the system is future-ready: Fenagy's modular heat pumps make it easy to scale up capacity whenever needed – and the site in Ry has already allocated space for expansion.

RY

THE CASE

Ry District Heating Utility provides heat to 95% of households in the Danish towns of Ry and Gl. Ry – a total of 3,450 consumers – with an annual production of 71,000 MWh and a peak load of 22 MW. The utility companies in the two towns merged in 2024 and are now connected by an 8.5 km transmission line.

Previously, Ry relied primarily on wood-chip boilers, while Gl. Ry was heated by a gas boiler. Today, the joint utility's diverse and flexible energy mix includes an electric boiler, two wood-chip boilers, solar thermal collectors, a ground-water heat pump - and now, four high-efficiency CO_2 heat pumps supplied by Fenagy. Two oil boilers and a gas boiler are kept, but for back-up only.

SPECIFICATIONS

Year: 2024
Heat pumps: 4 x H-2600 AW
Application: Air-to-water heat pumps
Heat capacity: 10 MW, 33 °C/70 °C hot water (5°C/85% humidity)
Heat source: Air
COP: 2.9
Accumulation tanks:
1500 + 3500 = 5000 m3

The system in Ry is designed for maximum flexibility. Heat produced by the heat pumps and the electric boiler can either be fed directly into the district heating network or stored in two large accumulation tanks (5,000 m^3 total) when electricity prices are low. In the summer, the solar thermal collectors and heat pumps provide most of the heat for the two towns. In winter, the wood-chip boilers supplement the system.

The shift to heat pumps and flexible electricity consumption has dramatically reduced fossil fuel dependency.

As a result, the use of natural gas has been nearly eliminated – cutting CO_2 emissions by an estimated 80–100 tonnes annually. Additionally, the system contributes to grid balancing: the heat pumps and electric boiler can ramp output up or down in real time, helping to stabilise the grid and optimise energy costs.

Original site expanded with accumulation tanks

New nearby site with energy collectors and heat pumps

Quiet efficiency
Air-source heat pump in residential area

THE CASE

The district heating company in Mejlby has expanded its production facilities with an electrically driven heat pump. They wanted a heat pump for base-load operation to reduce gas consumption. The existing gas boiler now serves as back-up and for peak-load operation. Together with their gas-driven CHP system, they can now produce cheap heat, both when the electricity price is high and low.

THE HEAT PUMP

The heat pump is installed in a Fenagy premium enclosure, delivered plug-and-play, and placed outside the existing buildings on the site. The enclosure is soundproof, ensuring that the 35 dB(A) noise requirements of the residential area, where Mejlby district heating is located, are met. Outside air evaporators are installed right next to the heat pump enclosure and run silently.

The heat pump is running almost constantly because the gas boiler alternative is more expensive to operate, but in periods with high electricity prices, the existing gas motor can be used to produce electricity, and the heat pump can be shut down. The heat pump is a standard CO_2 air-to-water heat pump, equipped with the latest Fenagy ejector technology, FenEject, and controlled by the Fenagy PLC with algorithms for capacity control, evaporator control and defrost.

SPECIFICATIONS

Year: 2022

Model: H-1200 (AW)

Application: Air-to-water heat pump

Capacity (heat):

1.3 MW (0°C ambient, 32/70°C hot water)

Heat source: Air

COP: 3.34

Defrost method: Glycol

District heating with flexible heat production and large energy storage

THE CASE

In Nykøbing Sjælland, Denmark, four H-1800 air-source CO_2 heat pumps enhance the district heating company's heating system. The heating setup also includes a 10 MW electric boiler, a CHP unit and substantial energy storage in two accumulation tanks, ensuring optimal heat production regardless of the electricity price.

The energy storage holds 9,500 m^3 of hot water, providing great flexibility to switch the units on and off in response to electricity price fluctuations, while consistently meeting the heating demands of approximately 2,000 consumers.

NYKØBING SJÆLLAND

THE HEAT PUMP

The heat pump installation consists of four standard H-1800 AW units and 24 evaporators, positioned in two groups of 12 opposite each other. The four H-1800 heat pumps are the first Fenagy units equipped with the highly efficient 70 m^3/h 8-cylinder compressors from Bitzer. The heat pumps can start and stop in about 5 minutes and produce hot water up to 85°C, providing optimal flexibility for planning and operation.

The heat pumps were commissioned in 2023 and fully handed over to the customer after commissioning.

SPECIFICATIONS

Year: 2023
Model: 4 x H-1800 AW
Application: Air-to-water heat pump
Capacity: 7.9 MW · 42°C/70°C hot water (5°C/85% humidity)
Heat source: Air
COP: 3.0
Defrost method: Glycol

Contact us

Feel free to contact us anytime to learn more about our solutions and how they can benefit your project.

Let's work together to create a greener, more efficient future.

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Natural Refrigerants ONLY

Visionary solutions

With a proven track record in sustainable heating, this brochure presents a selection of our diverse projects, each demonstrating a visionary, efficient and climate-friendly heating solution. The cases cover district heating installations, sector integration, waste heat recovery, energy storage, grid balancing, biogas production and more.

See for yourself and discover the possibilities within these case studies.

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