

Case study

Office Heating and Cooling with Ammonia, Vienna

Decarbonizing heating and cooling in the renovated European Patent office with ammonia heat pumps

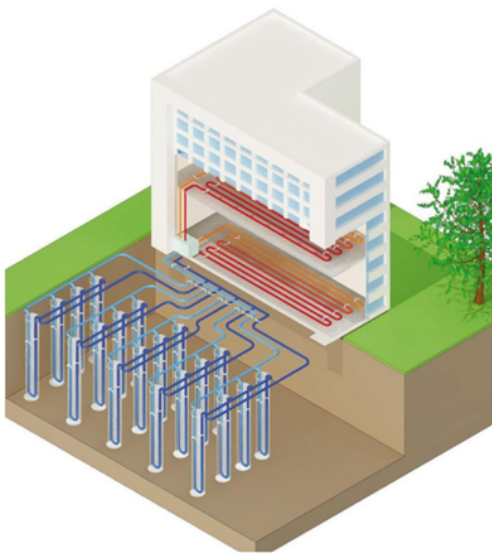


Photo credit: Alfa Laval

Key information

Client: European Patent Office, Vienna

Supplier: Equans (heat pump system); Alfa Laval (heat exchangers)

Type of facility: Office building

System start-up: 2024

The European Patent Office (EPO) in Vienna transformed its 1972 headquarters into one of Austria's most sustainable office buildings through a renovation completed in 2024. At the heart of the energy concept are two tailor-made ground-source heat pumps using ammonia (R717) as refrigerant, delivering highly efficient heating and cooling with zero global warming potential.

The installation - supplied by Equans with Alfa Laval compact plate heat exchangers - played a vital part when the building earned a BREEAM Outstanding certification, the highest rating in the German-speaking region of Europe, with 100% scores in Energy, Health, Waste, and Environmental assessment categories.

Requirements

The EPO's Vienna office building, dating from 1972, had reached the end of its operational life. Demolition and full reconstruction would have been the conventional route, but the EPO decided to renovate in line with European Green Deal ambitions. The project required a state-of-the-art heating and cooling solution that could meet the following objectives:

- Transform the building into a climate-neutral, highly sustainable “Green Hub” by 2024 and achieve full carbon neutrality by 2030
- Achieve BREEAM “Outstanding” certification — the highest level of the Building Research Establishment Environmental Assessment Method
- Use a natural refrigerant with zero global warming potential (GWP), zero ozone depletion potential (ODP), and zero trifluoroacetic acid (TFA) content
- Minimise energy consumption while ensuring reliable year-round heating, cooling, and domestic hot water supply
- Avoid demolition where possible: retaining the original concrete structure was estimated to save approximately 50% of the CO₂ emissions of a full rebuild

Solution

The integrated energy heating and cooling concept for the EPO Vienna headquarters centres on a geothermal ground-source system with 20 probes drilled 200 metres deep into the ground below the building's second basement level. An ethylene glycol brine circulates through these probes, acting as a heat source in winter and a heat sink in summer. Two tailor-made Equans smartPACK-L7 compact heat pump units drive the system.

Ammonia (R717) was selected as the refrigerant due to its outstanding thermodynamic properties and its environmental profile: GWP = 0, ODP = 0, and zero TFA content. While ammonia requires careful system design due to its toxicity, the smartPACK-L7 integrates Alfa Laval semi-welded plate heat exchangers (type T10-EW) as evaporators and condensers, minimising the refrigerant charge to an absolute minimum while maximising heat transfer efficiency.

In heating mode, the evaporator cools the glycol brine from 16°C to 7°C at an evaporation temperature of 4°C, extracting approximately 252 kW of geothermal energy. The condenser delivers 292 kW of space heating at a condensing temperature of 50°C. A dedicated Alfa Laval fusion-bonded plate heat exchanger uses compressed ammonia gas at 116°C to heat domestic hot water to 60°C, providing a further 38 kW. In summer, the system reverses into chiller mode, with the ground probes absorbing excess building heat.

The system achieves a coefficient of performance (COP) of approximately 5, meaning 80% of all heating and cooling energy originates from the ground and only 20% is consumed as electricity. A photovoltaic installation covering both the roof and the building facades generates more electricity than the building needs for heating, cooling, ventilation, lighting, and hot water combined - making the building effectively energy-positive. A wooden facade, rainwater retention tanks, and extensive green planting complete the sustainability package.

Key Benefits and Features:

- Ammonia as refrigerant: GWP = 0, ODP = 0, and zero TFA content
- High energy efficiency: COP of approx. 5 — 80% of building energy supplied by geothermal ground energy
- Carbon-neutral design: Combination of ground-source heat pump, on-site PV generation, and passive building measures delivers carbon neutrality by 2030
- Circular economy approach: Retaining the original concrete structure reduced embodied CO₂ by approximately 50% compared to full demolition and reconstruction
- Compact, safe system design: Alfa Laval T10-EW semi-welded plate heat exchangers minimise ammonia charge, reducing toxicity risk while maximising heat transfer performance

Technical data

Cooling capacity: ~252 kW

Heating capacity: 292 kW

Evaporating temperature: 4 °C

Condensing temperature: 50 °C

Main components:

- 2x Equans smartPACK-L7 heat pump units, including
 - 4x Alfa Laval T10-EW (semi-welded) plate heat exchangers
 - 1x Alfa Laval fusion-bonded PHE DHW heat exchanger

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