



GEO EXPLORATION TECHNOLOGIES



The climate protection technology for geothermal energy utilisation in buildings via the water supply network

AquaPowerNet® (APN) is an innovative fossil-free heating network technology which, based on the subsurface drinking water distribution network, can make a significant contribution to climate-neutral and energy-efficient heating and cooling in the building sector.

With the APN system, geothermal energy – which is continuously regenerated primarily through sewer wastewater heat (heat recovery) and thermal radiation (including from road surfaces) – is easily extracted in the vicinity of the mesh network supply pipes (Fig. 1). The geothermal energy is extracted via the evaporation of carbon dioxide (CO₂) within sealed pipe-jacket sections (Fig. 2) and utilised decentrally by means of heat pumps in the buildings adjacent to the pipes. APN thus enables water suppliers and heat consumers to operate a safe and compliant **heat supply** system without compromising the independent **water supply** operation. In contrast, interventions within pipelines, as well as through-pipes and bypass diversions using conventional heat exchangers, are not eligible for approval, partly due to the risks associated with refrigerants and biofilm, as well as hydraulic limitations (stagnation zones, extensive tube flow contact).

The processes and devices developed for the functional expansion and implementation are protected by patents and patent applications as the proprietary industrial property of Geo Exploration Technologies GmbH (GET), which acts as the system provider. To this end, the following GET-proprietary APN system components are being developed for series production by OEM suppliers or are already commercially available:

- **CO₂ collar evaporator:** Sectional cladding of the existing pipeline or cast replacement pipe sections using hermetically sealed, pressure-resistant, easy-to-install and remove high-tech housing half-shells for the direct evaporation of the natural refrigerant fluid CO₂ (non-toxic, non-flammable and non-explosive, GWP 1), thereby completely ruling out any risk to drinking water quality;
- **CO₂ heat pump:** installed within the building for heating (also suitable for retrofitting into old buildings) and cooling, as well as for domestic hot water production (up to 90°C, legionella-safe) using CO₂ refrigerant (R744), connected to hot and cold water tanks;
- **CO₂ building connection:** supply line (gas) and return line (liquid/wet steam) of the CO₂ fluid between the evaporator and the heat pump as part of the process circuit.



GEO EXPLORATION TECHNOLOGIES

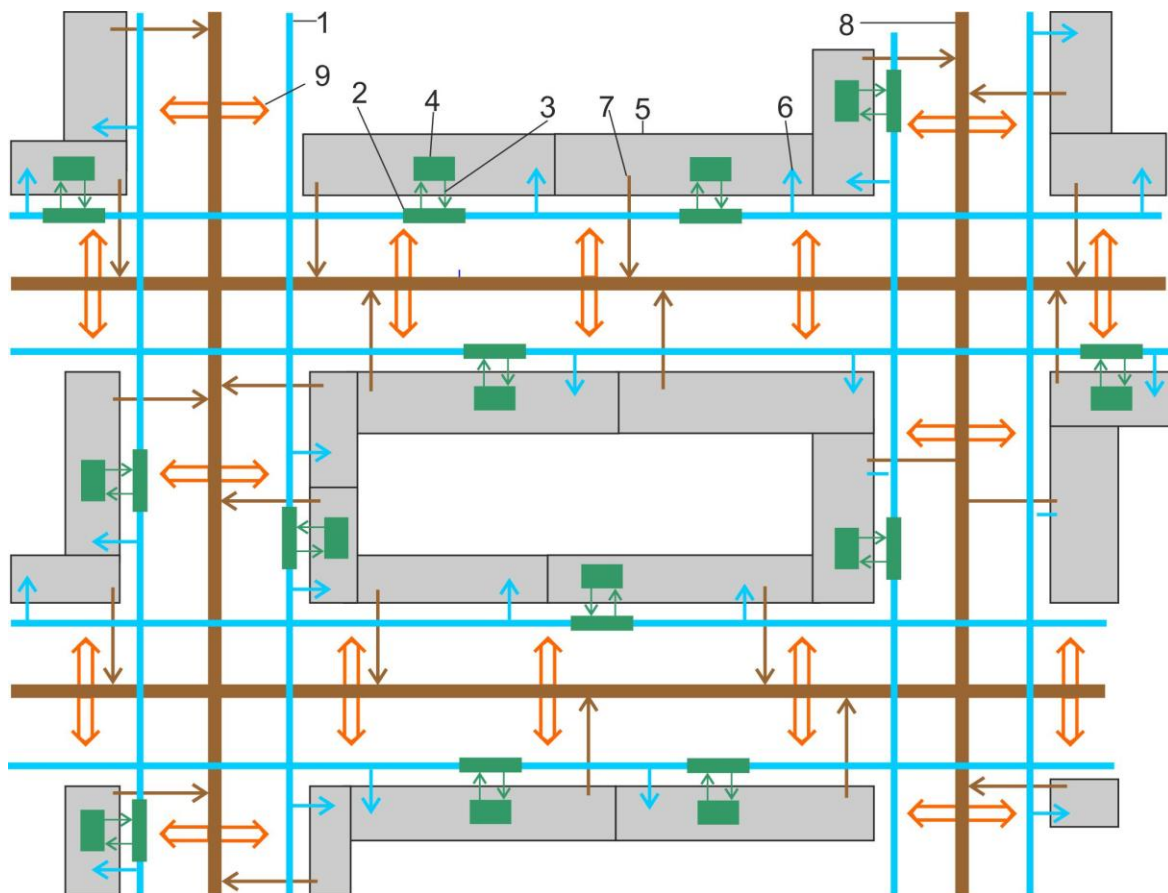


Fig. 1: Schematic structure of the **AquaPowerNet**[®] system in a mesh network: 1 water supply pipe, 2 CO₂ evaporator, 3 CO₂ building connection pipes, 4 CO₂ heat pump, 5 user building, 6 domestic water supply pipe, 7 domestic sewage pipe, 8 main sewage pipe, 9 heat flow from 8 (higher temperature) to 1 (lower temperature).

Specifically, the **APN direct heating network** offers the following advantages:

- High **energy efficiency** due to the high temperature of the ground/supply water (geothermal source), which is typically distributed as follows throughout the year: lowest in February (January to March) at approx. 10–12°C, rising from March/April to September (August to October) to approx. 20–22°C (in some cases > 25°C) and then falls from November, at approx. 17°C to approx. 14–15°C in December. There is therefore a phase shift of approximately 1.5 months between the average air temperature trough in winter and peak in summer, and the delayed, attenuated trough and peak in the supply water temperature, which exhibits an amplitude level that is 5 to 10 K higher or lower. This has positive effects during the autumn/winter and winter/spring transition periods.



GEO EXPLORATION TECHNOLOGIES

- 100% **climate neutrality** when operating heat pumps with greenhouse gas (GHG)-free electricity.
- 100% **free of pollutants**, in contrast to the combustion of fossil fuels (crude oil, natural gas) and biogas, which produces harmful chimney emissions of sulphur dioxide, nitrogen oxides, particulate matter, carbon monoxide and mercury.
- 100% **drinking water safety**, as the CO₂ collar evaporator does not come into contact with the drinking water and is therefore permitted for use in the operation of water supply systems in accordance with Section § 13 (5) of the Drinking Water Ordinance (TrinkwV).
- Due to the year-round extraction of thermal energy from the ground (without heat injection) for hot and cold water production, the APN system is also suitable for sustainably reducing the climate-induced rise in **drinking water temperature** in summer (in compliance with regulations < 25°C), thereby also counteracting urban heat island effects in the long term.
- **Cost-effectiveness** is assured for the water supplier/network operator on the basis of, for example, heat contracting and synergy effects. For heat consumers, it may be the only affordable alternative against the backdrop of rising energy transition costs. In particular, heating operation and hot water production are also suitable for buildings that have not undergone energy-efficiency refurbishment and which require high user side inlet-outlet water temperatures. In summer, dew-point-independent cooling is also possible for existing radiators whilst simultaneously providing hot water. Overall, this allows for significant savings on conversion and renovation costs, whilst still enabling climate-neutral and efficient heating and cooling using renewable energy.
- The geopolitical risk and thus the **dependence on imports** of natural gas and crude oil is permanently reduced, as domestic renewable geothermal resources can be utilised. Supply disruptions and price shocks (rises in world market prices) are therefore no longer relevant for APN users.
- Compared to **district heating networks**, APN has lower investment and operating costs, and significantly higher energy efficiency with annual performance factors APF of 4 - 5.5, as the pipeline network and operations (water supply) as well as the renewable energy source (geothermal energy) are already widely available. Furthermore, the APN system can be combined with district heating networks and is particularly suitable for use in areas where there is no municipal connection and usage obligation (ABZ).
- Compared to **air-source heat pumps** and air conditioning units, APN has a significantly higher energy efficiency (COP) due to the higher temperature of the heat source. Furthermore, there are no issues regarding space, damage or theft of the outdoor units, no disruptive continuous noise and no visual eyesores, as the APN evaporators are installed underground at a depth of approximately 1.5 metres. Another drawback of air-cooling is the hot air emitted by the compressors in the outdoor units, which causes further heating and heat build-up in city centres.



GEO EXPLORATION TECHNOLOGIES

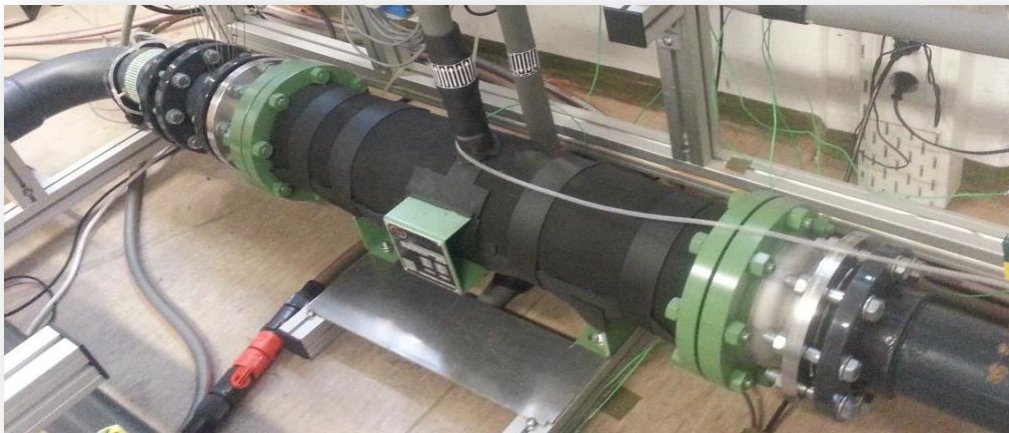


Fig. 2: CO2 evaporator demonstrator (previous model) on the laboratory test bench

Furthermore, with the long-term growth of **APN usage**, there are further advantageous options:

- **Security of heat supply** can be guaranteed for all users even during cold spells with very high overall heating energy consumption, by generating a circulating volume flow via ring main pipe and mesh network using a network pump, which temporarily generates additional heat output, particularly during night-time operation. This additional thermal energy can be stored in the heat storage tanks of the user buildings for daytime consumption.
- **Decarbonisation** of fossil-fuel-based district heating networks through the replacement with climate-neutral surface geothermal energy as a renewable heat source, which can be tapped using APN.
- Use of industrially captured and/or air-extracted CO2 for permanent **CO2 storage** in the evaporator heat pump circuits (negative emissions).

Publications:

- Blokker et al. (2013): Thermal energy from drinking water and cost-benefit
- Blokker & Pietterse-Quirijns (2013): Modelling temperature in the drinking water distribution system
- Geo Exploration Technologies GmbH (2025): Natural circulation evaporator for water supply pipes for decentralised geothermal energy extraction, WO 2025/219012 A1
- Kaus, A. & Boening, W. (2010): Method for extracting geothermal energy from a water supply network, European Patent EP 2 223 020 B1
- Kaus, A. (2018): AquaPowerNet (APN): Development of the APN geothermal heating system for extracting thermal energy from the water supply network, Final Report, TIB Publication, BMWi Funding 03ET1018A.