



GEOKOAX[®]
geothermal systems

Retrofit of an apartment block

in a groundwater protected area
with drilling depth restrictions
(31.8 RT / 112 kW)

December 2017

As part of the complete retrofitting of the apartment block dating from the 1960s, the existing oil heating system was replaced with a geothermal heating system that fully meets heating requirements of 112 kW (31.8 RT).

The energy system was initially designed to use a double U-bend borefield. However, early during the regulatory approval process it was identified that the project site was situated above a groundwater protection zone with a drilling depth restriction of 128 ft / 39 m. To guarantee a successful project and to meet the heating demands of the building within the land area available, the geothermal system was redesigned using the high-performance GEOKOAX probe system. The use of GEOKOAX probes resulted in a 47 % reduction in total drilling length and a 36 % reduction in capital costs.

The conversion to the geothermal energy system resulted in annual savings of 69 % in terms of CO₂- emissions and 73 % in terms of operating costs. The system generated a positive return on investment after 10 years!



The old building dates 1965 and was completely renovated and energy optimized.

Background: Energy Retrofit

The building was constructed in 1965 with 24 apartment units. In order to preserve the building's value and to keep it attractive for existing and future tenants, the housing company opted for an energy-efficient retrofit.

Redesign and Implementation

The initial borefield design specified the use of conventional double U-bend probes. The limited property size and the minimum borehole spacing allowed for a maximum of 24 conventional double U-bend probes to be installed. To meet the building energy requirements, the independent expert tewag GmbH, determined that 24 boreholes at 272 ft / 83 m each would be necessary (a total of 1,992 m or 6,534 feet). During the design phase, the Authority Having Jurisdiction determined

that project site was atop an area that required groundwater protection and imposed a drilling depth restriction of 128 ft / 39 m rendering the use of double U-bend probes unfeasible.

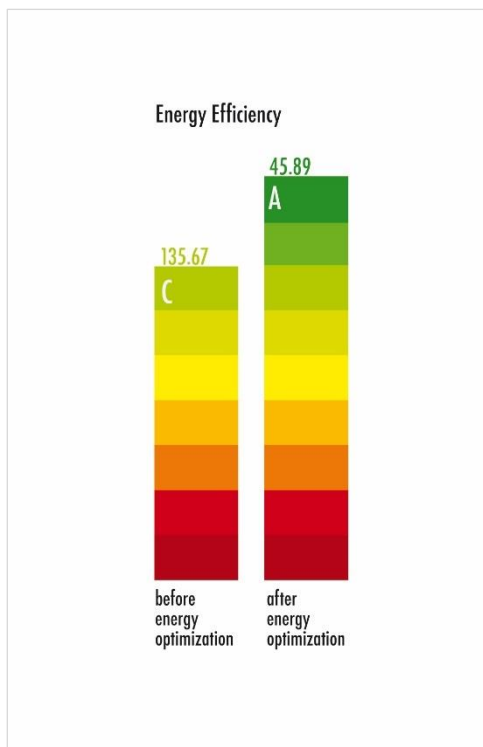
The project's geothermal system was redesigned based on the GEOKOAX high-volume probe system totaling 936 m (3,070 feet) resulting in a successful installation that reduced approximately 3,470 ft (1,057 m – over 1.0 km) of installed ground heat exchanger length and the corresponding drilling costs.

Completion

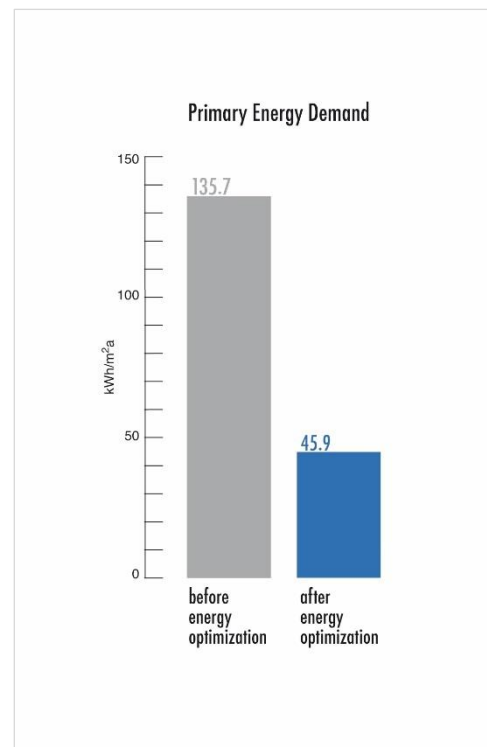
The GEOKOAX probe system was installed adjacent to the building. The energy from the subsurface is extracted by [four water-water heat pumps](#) (type: Therm-Select) with 8 RT (28kW) each. The demands for space heating are completely satisfied by geothermal energy. The domestic hot water requirements for 100 people is pre-heated to approximately 113 °F (45 °C) using geothermal energy. The final increase to 140 °F (60 °C) is effected by electrical energy to ensure thermal disinfection and prevent the creation of legionella. The geothermal system does not use any fossil fuels as an energy source, requires only electricity as a power source and can take advantage of favorable, cost-saving rates specifically for heat pumps provided by many utilities.

Energy efficiency and requirement

Due to the retrofit measures implemented, the energy efficiency of the building rose from class C to class A. The base energy requirement after the retrofit was substantially reduced by two-thirds (66 %).



Upgrade from energy efficiency class C to A

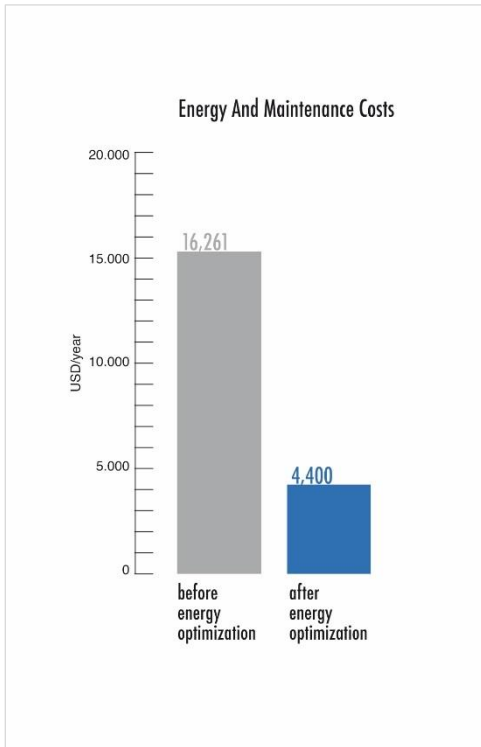


Reduction of primary energy demand

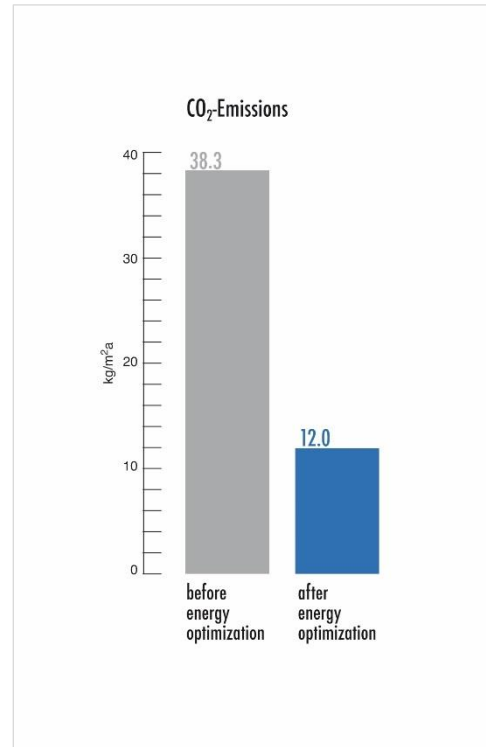
Energy and maintenance costs and CO₂-emissions

The existing heating system incurred significant operating costs. The retrofit solution, geothermal energy, that is reliably available all year round for free, has slashed energy and maintenance costs by 75 % in this building.

After switching to the geothermal solution, CO₂-emissions fell by more than two-thirds compared to the previous output emissions.



Energy and maintenance costs



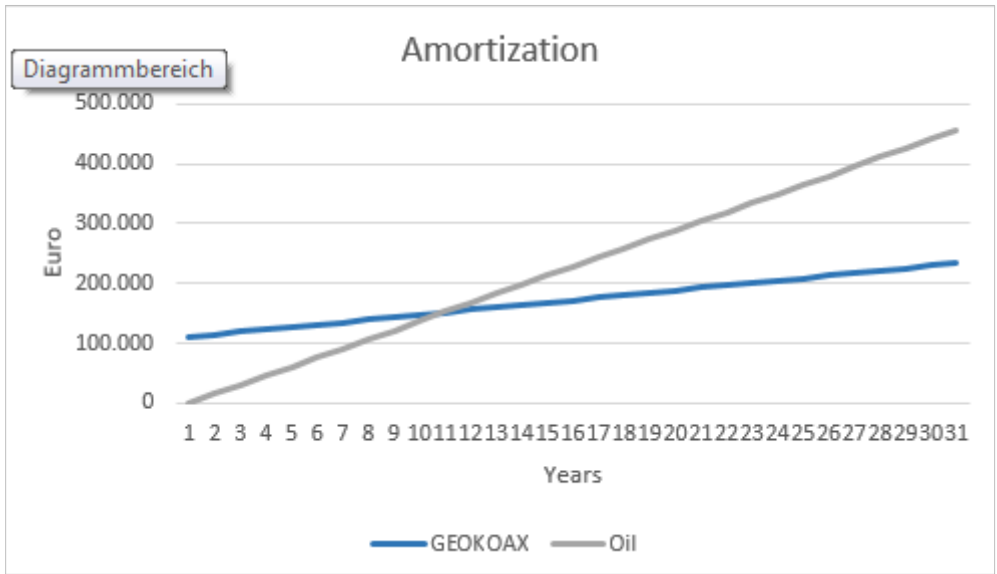
Drastic reduction of CO₂-emissions

Despite the initial investment cost for the geothermal system of about \$128,382 (120,000 €), the conversion has already paid for itself in the tenth year. After 30 years, the geothermal system will have saved between \$158,000 – 317,000 (150,000 – 300,000 €) in energy costs.

Operating cost savings: (Oil ./ Energy) after 30 years:

basis oil price 2012: approx.. \$317,000 (€ 300,000 or 73 % savings)

basis oil price 2016: approx.. \$158,000 (€ 150,000 or 50 % savings)

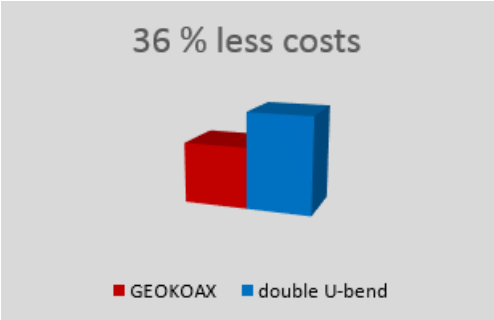
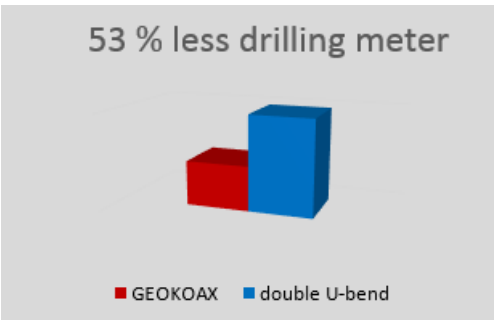


Comparison of heating costs for GEOKOAX and oil-heating

When comparing with the originally planned double U-bend configuration there is a significant amount of saving in drilling meters and investment costs.

Parameter	GEOKOAX	double U-bend
Length of all probes in feet	3,070	6,535
No. of boreholes x depth in US feet	24x128	51x128
Volume of brine fluid in US gallon	3,170	660
Costs in US dollar	68,446	107,108

Table and graphical view: comparison GEOKOAX versus double U-bend



In summary,

- 🔥 53 % less probe length
- 🔥 36 % lower investment costs
- 🔥 69 % less CO₂ emissions
- 🔥 73 % less operating costs

After 10 years, the system has paid for itself.

The GEOKOAX company

geoKOAX GmbH, which is headquartered in Munich, Germany, is an innovative international company with distribution partners in Europe and a subsidiary in North America, GEOKOAX, Inc. geoKOAX GmbH offers not only a repeatedly awarded heat exchanger technology but also customized complete solutions for the heating and cooling of buildings.

The GEOKOAX geothermal high-volume probe

The GEOKOAX technology has received multiple awards including winner of the prestigious German Innovation Award for Climate and Environment 2015 ("Innovationspreis für Klima und Umwelt (IKU)") recognized by Germany's Federal Minister for the Environment.

The GEOKOAX high-volume probe, the best performing geothermal probe system, enables reliable solutions for heating and cooling of residential and commercial properties. To date, geothermal systems have experienced limited market acceptance due to high "first-costs". The innovative and patented GEOKOAX technology substantially reduces the total ground heat exchanger length required to satisfy building loads which results in a significant *decrease* in installation costs. This innovative and disruptive ground heat exchanger opens the market to affordable geothermal technology for everyone, anywhere.

Due to the shallower drilling depth required, GEOKOAX technology can be used not only in sensitive terrains and sites subject to drilling depth restrictions but also in smaller properties with high energy requirements. The larger energy supply generated by a GEOKOAX system reduces the required drilling depth by up to 70 %. The lower initial investment costs are particularly beneficial large-scale projects.

Participating Project Companies:

Geothermal volume probes: geoKOAX GmbH

Design and systems engineering: En-Go (energy renovation of buildings)

Independent Expert: tewag GmbH

Sources of graphics: En-Go - Martin Inden, geoKOAX GmbH

Contact:

Joerg zu Dohna
geoKOAX GmbH
Am Kirchenhoelzl 13
82166 Graefelfing
Germany
Phone: +49 89 4520 9470
www.geokoax.com
info@geokoax.com