Basic knowledge

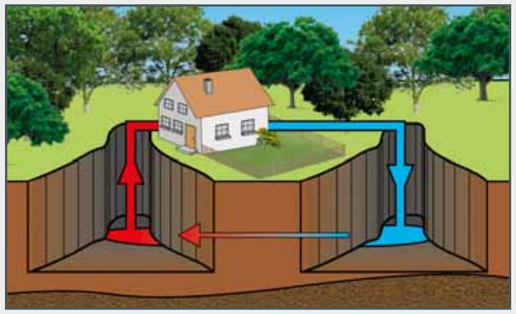
Shallow geothermal energy

The thermal utilisation of the soil to a maximum depth of 400 m is called near-surface or shallow geothermal energy. The ground is the heat source. Due to its large mass, the ground can store thermal energy particularly well and does not react to temperature fluctuations of the ambient air. This is the advantage of the ground over air as a heat source.

There is an underground pipe system in which a liquid heat transfer medium circulates. The medium heats up in the ground and is transported to the surface for further use, e.g. for a heat pump.

Technical implementations

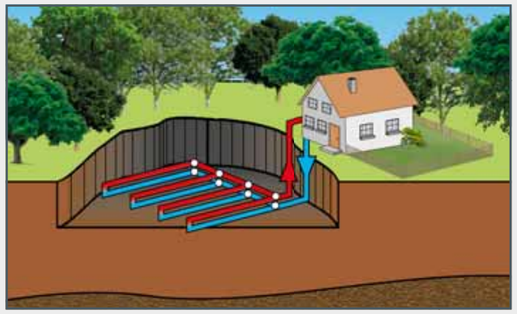
There are various options for using the thermal energy of the earth's surface. The technical implementation is dependent upon the local conditions, the desired power and the combination with other energy systems. In the field of shallow geothermal energy, firstly a distinction is made between open and closed systems and secondly between collectors and probes.



Dual well system

The dual well system is an open geothermal system without thermal retroaction on the heat source. It can be used for heating or cooling purposes, where groundwater serves as a geothermal heat source or heat sink. These systems require sufficient groundwater to be present at the site in layers near the surface.

This groundwater is pumped from a well to the surface of the earth. The well depths are between 6 m and 15 m for small installations in one- and two-family houses. In heating mode, a heat exchanger extracts heat from the groundwater. If groundwater quality is good and purity high, the heat exchanger can be designed as an evaporator of a heat pump and the groundwater can be used directly by the heat pump. In order to conserve the groundwater reservoir, the groundwater must be returned to the soil after thermal use via a discharge well. There must be sufficient distance between the well and discharge well so that there is no hydraulic short circuit. There must be no thermal retroaction in the system. One advantage of this system is the almost constant groundwater temperature throughout the year.



Geothermal collectors

Geothermal collector is the generic term for closed geothermal heat exchangers with thermal retroaction on the surrounding ground. The standard design is the horizontal geothermal collector.

These collectors are installed approx. 1 m to 1,5 m below unsealed ground surfaces. Due to the low installation depth, the heat transfer medium in the collector can reach temperatures below 0°C in heating mode and must therefore be frost-proof. The surrounding soil also usually freezes during the heating period. Regeneration of the temperature of the ground is mainly carried out by heat transport from nearby layers of the earth, ambient air, solar radiation and penetrating precipitation.

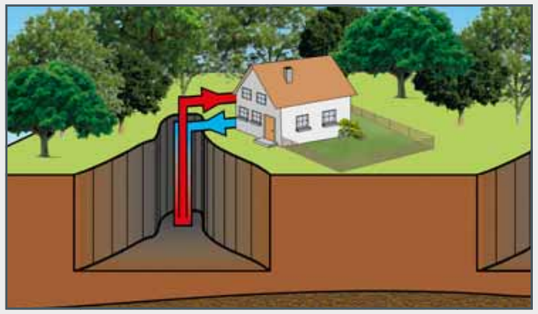
Depending on the ground conditions, about 15 m^2 to 30 m^2 collector surface area per kW of heating power is required. Due to the relatively high ground temperatures, geothermal collectors are rather unsuitable for cooling buildings compared to other systems.

Geothermal probes

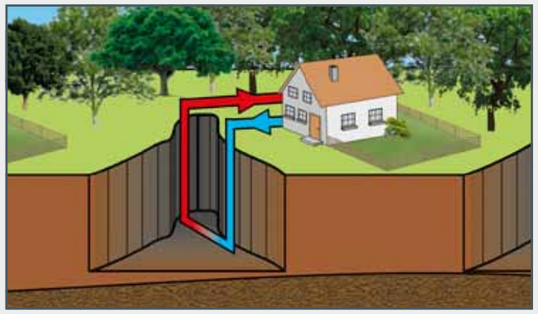
Geothermal probes are heat exchangers that are inserted vertically or at an angle into the ground. In most cases, these consist of plastic pipes inserted into boreholes. The probes can be designed in different ways. Geothermal probes are a closed geothermal system with thermal retroaction on the ground.

For small heating systems up to 30 kW, geothermal probes usually tap depths between 50 m and 150 m, with one or two geothermal probes usually being sufficient for a single-family house. If required, more geothermal probes can also be combined to form a geothermal probe field.

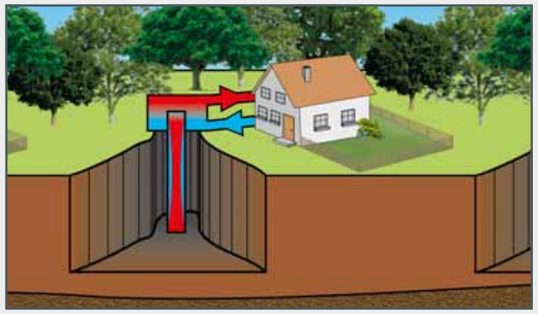
Geothermal probes are further subdivided according to the type of heat transfer and heat transport. Probes in which a water/antifreeze mixture is pumped by means of a circulation pump in the circuit between the geothermal probe and the consumer are referred to as geothermal probes with forced circulation. The absorbed geothermal heat is released at the earth's surface in a heat exchanger, which is located, for example, in a heat pump. Geothermal probes with forced circulation can also be used according to the reverse principle for cooling purposes by transferring heat from a building to the cooler ground via the geothermal probe. In other words the ground can also be used as a thermal store.



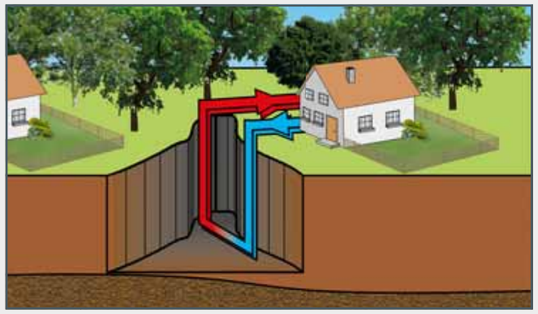
Coaxial probe



U-shaped probe



Probe with heatpipe principle



Dual U-shaped probe