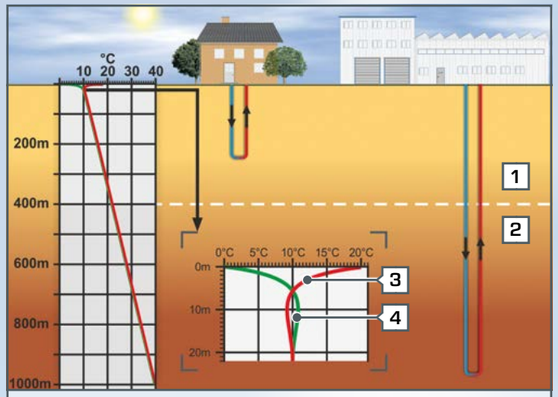
Basic Knowledge
Geothermal Energy

Thermal energy from the ground

Geothermal energy refers to the use of thermal energy stored beneath the earth's surface. This thermal energy is usually available anywhere and at any time, which is a significant advantage compared to other renewable energies such as solar energy and wind power. Therefore, it makes sense to take advantage of this geothermal energy.

In the upper area of the earth's crust (about 0…20 m) the temperature is determined by the climatic conditions at the earth's surface. Below this region, the temperature is constant over time and only depends on depth. On average, the temperature increases by 3°C for every 100 m. For the most part, the thermal energy is the result of the decay of radioactive isotopes of uranium, thorium and potassium.



1 shallow
2 deep
3 summer
4 winter

Differentiating geothermal fields

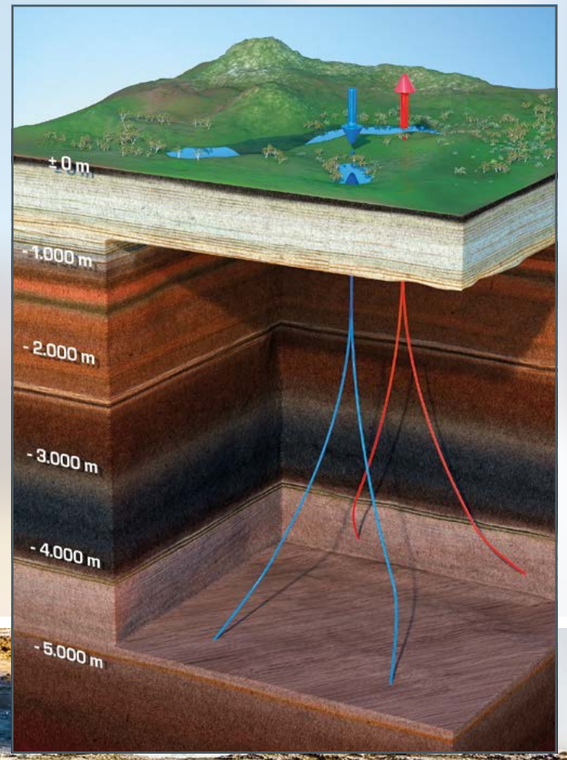
Usually when talking about geothermal energy a distinction is made between shallow geothermal energy and deep geothermal energy.

Shallow geothermal energy

Shallow geothermal energy refers to the use of thermal energy stored in the upper area of the earth's crust (about 0…400 m). Shallow geothermal energy is particularly useful for heating private households.

Deep geothermal energy

Deep geothermal energy is when the thermal energy is stored in regions about 400…5000 m below the surface. Since this requires deep drilling, this form of usage is significantly more cost-intensive than shallow geothermal energy. Therefore, deep geothermal energy is mainly suited to industrial applications.



Using geothermal energy

Using geothermal energy requires interdisciplinary expertise in a variety of fields, such as mining, geology, mechanical engineering, plant engineering and civil engineering.

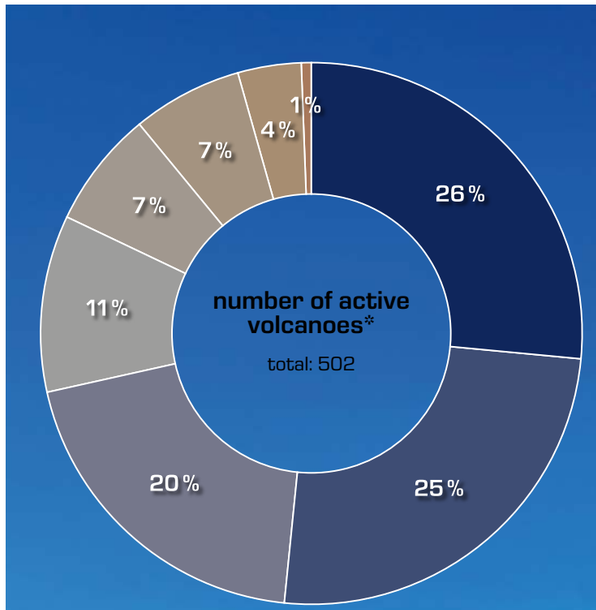
The use of geothermal energy also depends on the temperature of the geothermal field. If the temperature is low, the energy is used for heating and cooling. If a higher temperature is present, the energy is used to produce electricity.

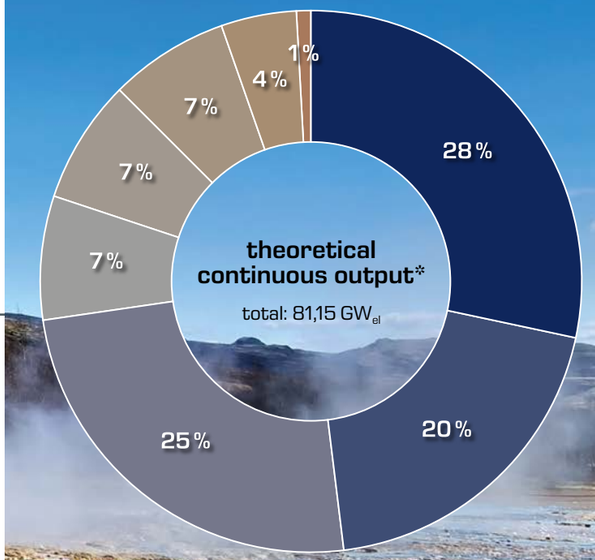
In building services engineering, only low feed flow temperatures are required for underfloor heating, for example. Heat pumps are used in order to keep the drilling depth low. Therefore environments which are putatively too cold or too warm can also be used for cooling and heating purposes. Operating costs can therefore be reduced to operation of the heat pumps.

Potential and outlook

The potential for use of geothermal energy is divided according to the geothermal fields. For thermal anomalies with volcanic activity, a theoretical continuous electrical output of around 81 GW_{el} has been determined in just 8 countries. As a comparison by size, the gross electricity consumption in Germany was around 600 TWh in 2013. This is equivalent to a continuous output of 68 GW_{el}.

The global comparison shows that exploiting the theoretical continuous output of active volcanic regions alone could cover 4 % of the global electricity demand. If other geothermal energy fields, both shallow and deep, are exploited as well, coverage of the global demand for heat and electricity is possible.





- USA
- Indonesia
- Japan
- Philippines
- Mexico
- Iceland
- New Zealand
- Tuscany (Italy)

*selected countries

Source: V. Steffansson: World geothermal assessment

Subject Areas

Geothermal Energy

The effective use of geothermal energy requires a geothermal field with elevated temperature, effective heat transfer to the subsequent cycles and the efficient use of the energy. Depending on the temperature level of the source, geothermal energy can be used for heating only or for conversion to electricity with utilisation of the residual heat.

Both types of usage require heat exchangers to transfer the extracted heat to the subsequent cycles. The disadvantage of multiple cycles is the energy loss during heat transfer. The main advantage is a much longer service life of the system, since corrosive components are prevented. In geothermal systems, water circuits and refrigerant circuits with heat pumps are used for heating purposes. The water circuit is the more efficient option, since it does not require electrical energy for a heat pump. However, the temperature of the geothermal field must be higher.

The conversion into electricity, for example in steam turbines, requires higher temperatures again, which can be found in deep geothermal energy. The energy gained is used to operate a steam circuit with turbine and generator, which produces electricity.

Subject Areas	2E0 Products
Heat exchangers	**WL 110** Heat Exchanger Supply Unit **WL 110.01** Tubular Heat Exchanger **WL 110.02** Plate Heat Exchanger **WL 110.03** Shell & Tube Heat Exchanger **WL 110.04** Jacketed Vessel with Stirrer & Coil **WL 315C** Trainer for Various Heat Exchangers
Shallow geothermal energy	**ET 101** Simple Compression Refrigeration Circuit **ET 262** Geothermal Probe with Heatpipe Principle **ET 264** Geothermal Energy with 2-Well System **HL 320** Solar Thermal Energy and Heat Pump Modular System (Combination 3)
Deep geothermal energy	**ET 850** Steam Generator **ET 851** Axial Steam Turbine