

Thermodynamics Process to generate Power

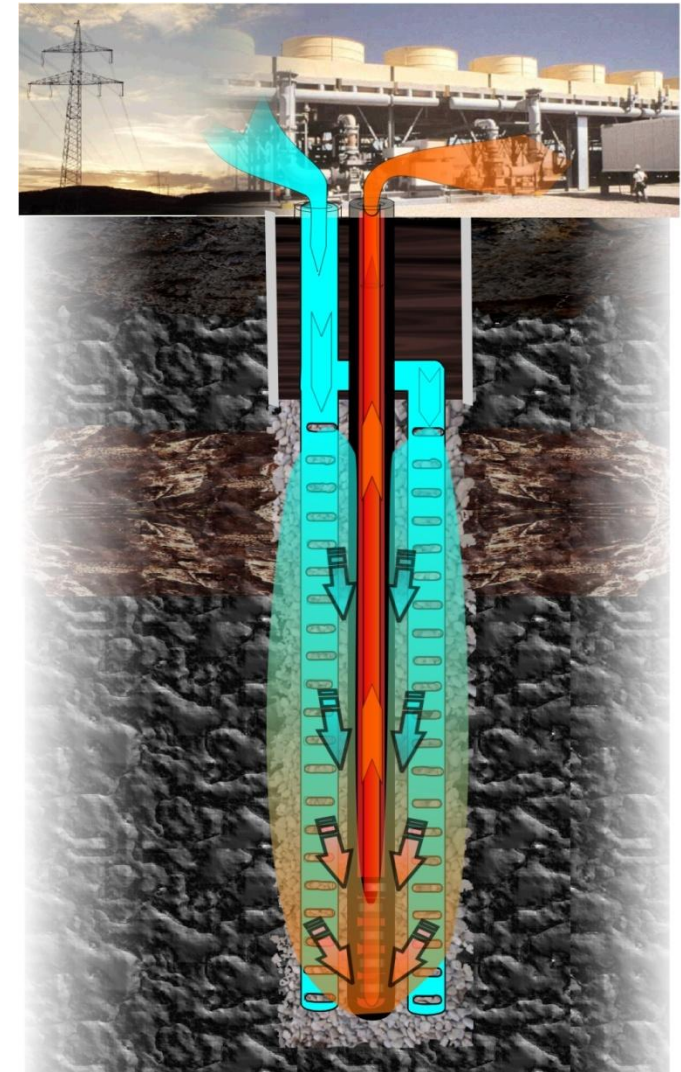


Swiss Green Geothermal Technology

Power Plant Sins (Switzerland)

Project Sins

Depth	8'600 m
Base temperature	265 °C
Circulation temperature	155 °C
Circulation volume	130 m ³ /h
Return flow temperature	75 °C
Delta spread	80 K



Project Sins Power Plant



The project Sins is a GEO Power project with force-steam coupling. The power is delivered to a greenhouse company which produces in the essential vegetables under glass.

The power is delivered according to the power feed llaw of Switzerland.

The technical data of the project will be shown in the upcoming slide.

Average up time/year	8'600 h/year
Energy volume/year	110'498 MWh
Power production/year	18'783 MWh
Heating energy/year	10'000 MWh
Cooling energy/year	18'224 MWh



Technical Data Power Project

Drilling 8.600 m

Drilling time and construction 12 months

Power production planned for 2012

Circulation of water (steam) by 155°C

Thermic power 12,8 MW

Average up time/year 8'600 h/year

Energy volume/year 110'498 MWh

Power production/year 18'783 MWh

Heating energy/year 10'000 MWh

Cooling energy/year 18'224 MWh

CO₂ savings/year 38'298 tons

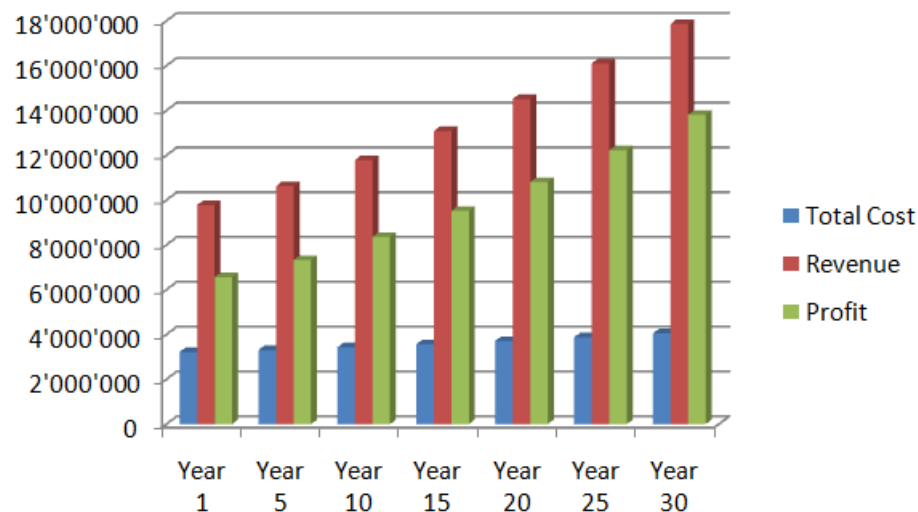
On account of the one hole method circulation amounts of the circulating water are determinable by calculation of conformist piping in advance.

Also the pumping achievement of the circulation pump is computable in advance. On account of the long-standing measurements and experiences we can also calculate the thermal achievement after knowledge of the exact geology.

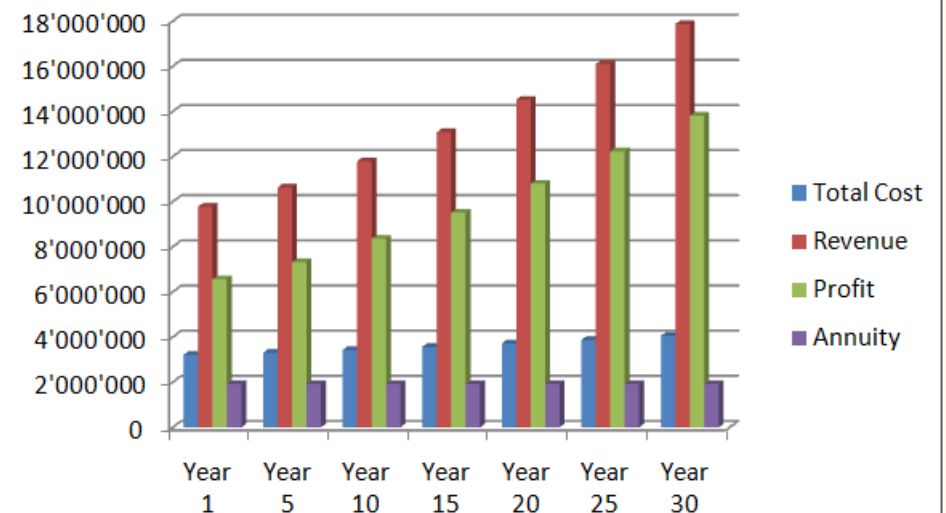
The electric achievement is computable depending on thermal achievement and the efficiency of operating system ORC. It will be calculated based on the input temperature, the return temperature and the chill temperature.

Commercial Project Calculation

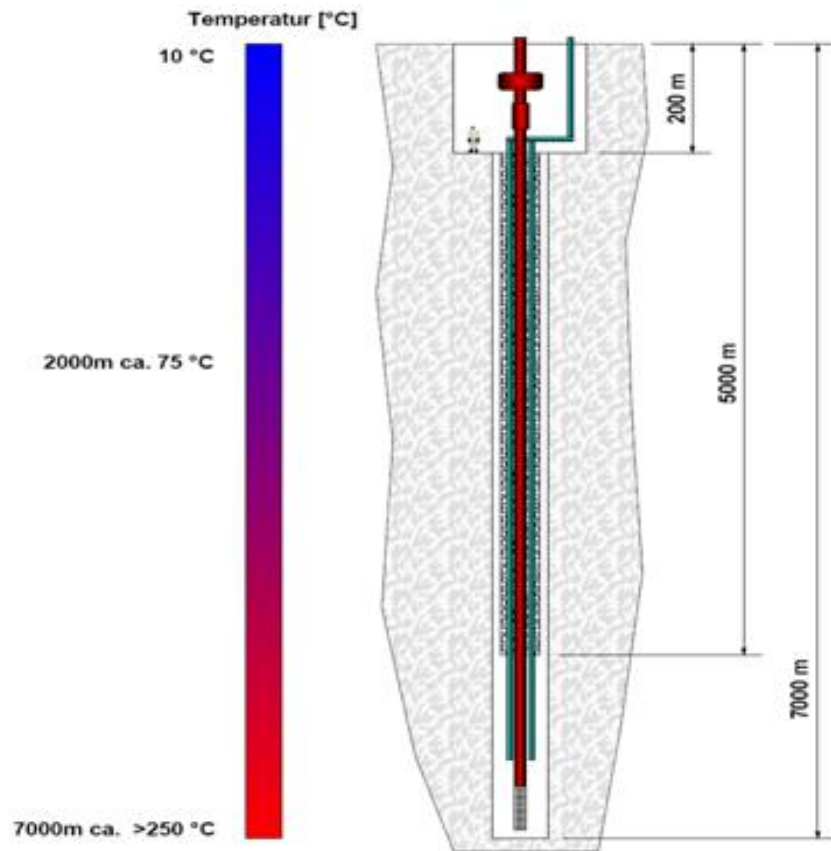
Price level power	CHF 340.- /per MWh
Price level heating	CHF 50.- /per MWh
Price level cooling	CHF 194.- /per MWh
Price/volume guarantee	20 years



Investment	CHF 75,2 Mio.
Revenue first year	CHF 9,78 Mio.
Grossprofit	CHF 8,44 Mio.
PBT	CHF 6,51 Mio.
Price increase	3% (only 70% passed)

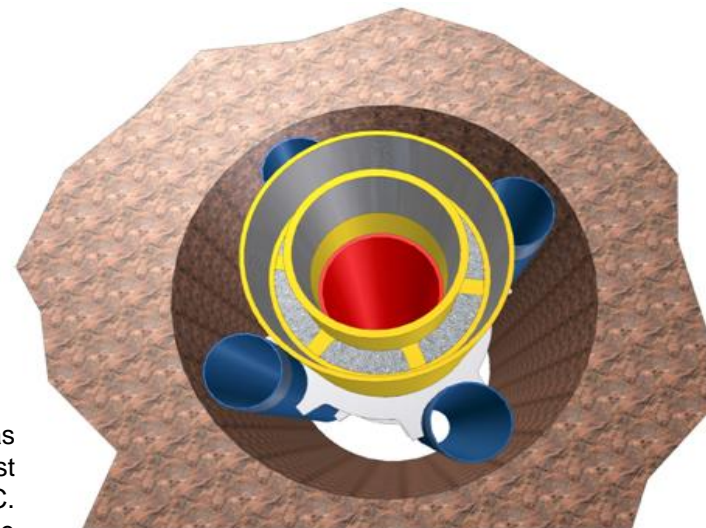


Technical Borehole Installations



Technical installation data:

- Piping until 8600 m depth
- Longer lifecycle in comparison to usual installation material
- At 8000 m there is a pressure of 800 bar
- The isolation is according to the pressure
- Vaccum bottle principle



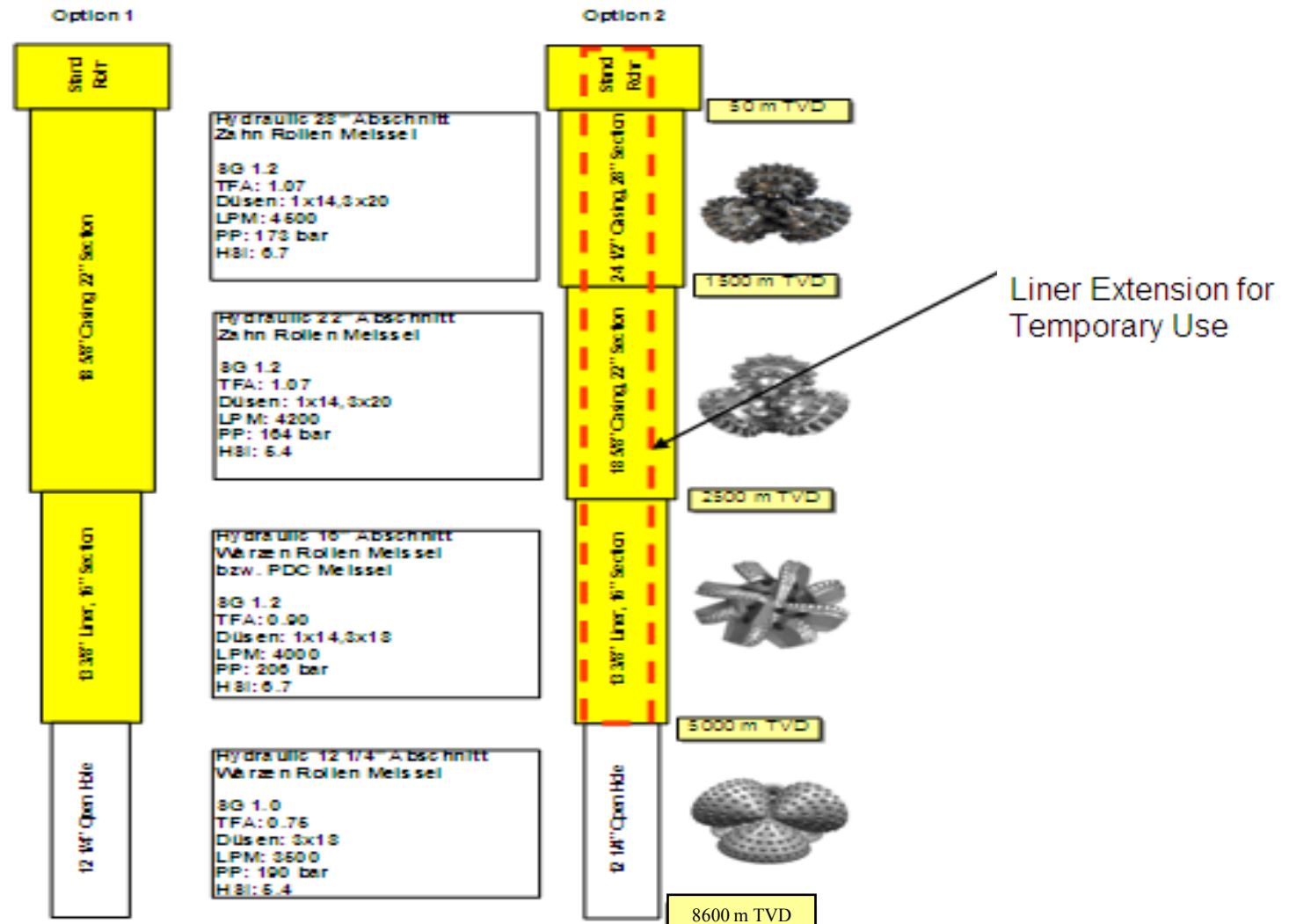
In the open drilling the system GEOPower is inserted after reaching of the end depth as planned. This system is based on an especially developed steel alloy. This alloy must stand in the isolation area high pressure up to 800 bar and temperatures up to 260 ° C. The weight of the installation system (pipes) must be dimensioned in such a way that the system with not more than a 500 t drilling rig can be lowered into the borehole.

Drilling Technology Layout

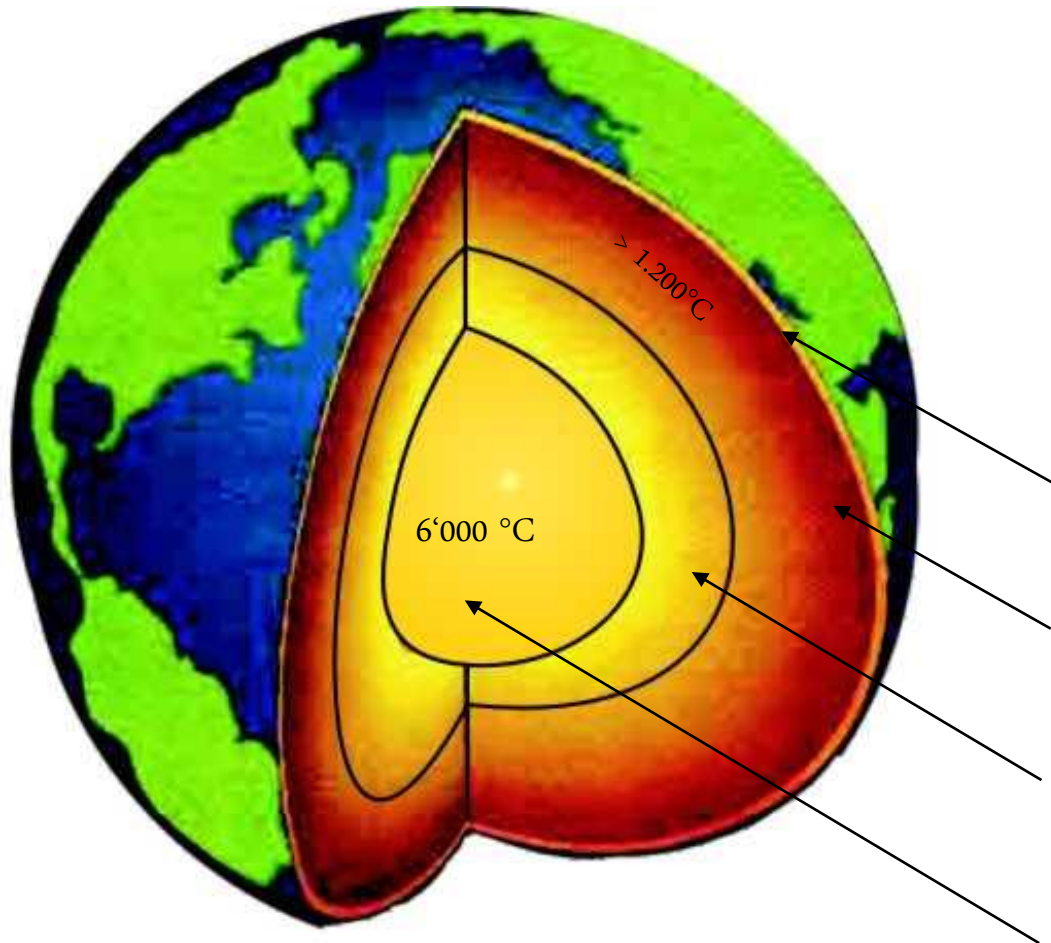
Option 1 with a driple telescoping until the gneiss at about 4.500 m.

Option 2 with a fourfold telescoping until the gneiss at about 4.500 m.

From 4.500 m until 8.600 m there is in gneiss a solid formation stability expected. The drilling remain open there.



Earth Structure



The cause for these physical laws are the geothermal energy flow from the coat zone in the earth's crust. They supply the earth's crust to more than 90% with geothermal energy. Less than 10% of the geothermal energy is produced in the earth's crust even by radioactive reaction processes.

This is recognizable in the geothermal gradient of the granite. In spite of the radioactive reaction processes highest by far his geothermal gradient is determined by the radiation energy. The radioactive reaction processes cannot raise the gradient recognizably.

Earth crust 7- 43 km

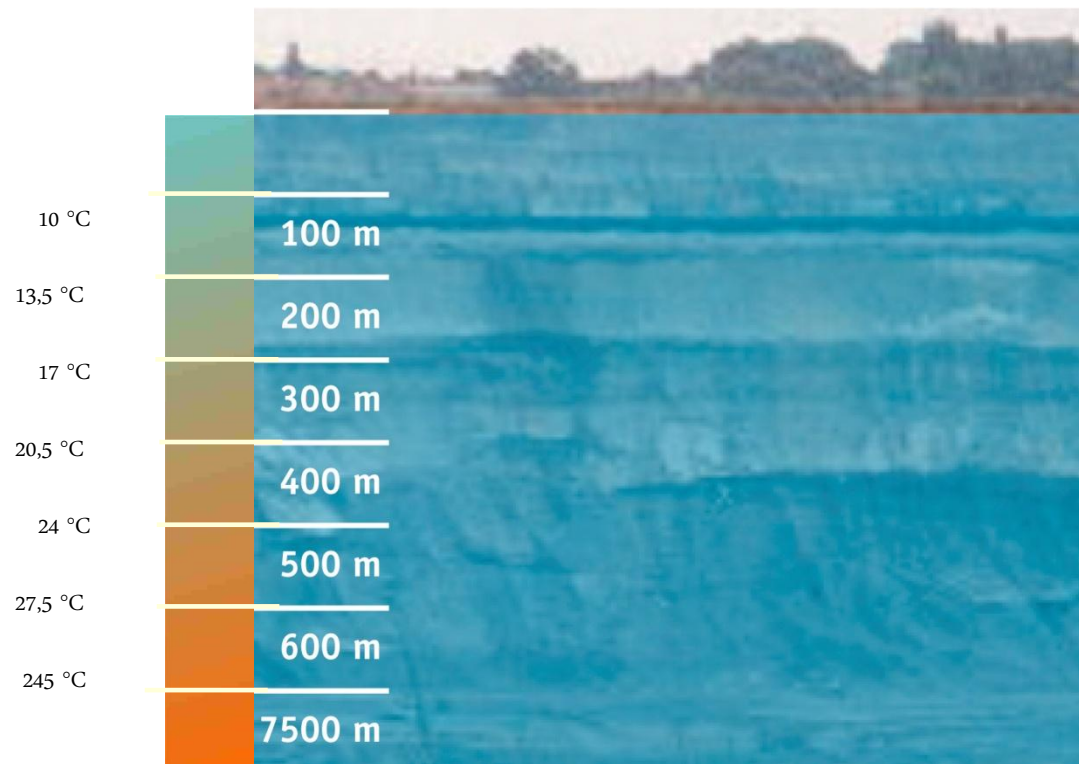
Coat 2.850 km

Outer earth nukleus radius 2.258,5 km

Inner earth nukleus radius 1.221,5 km

Earth Crust Water Saturation

The formation is water saturated beginning at ground water level.



A circulation process = convection is released by the complete water saturation of the formation.

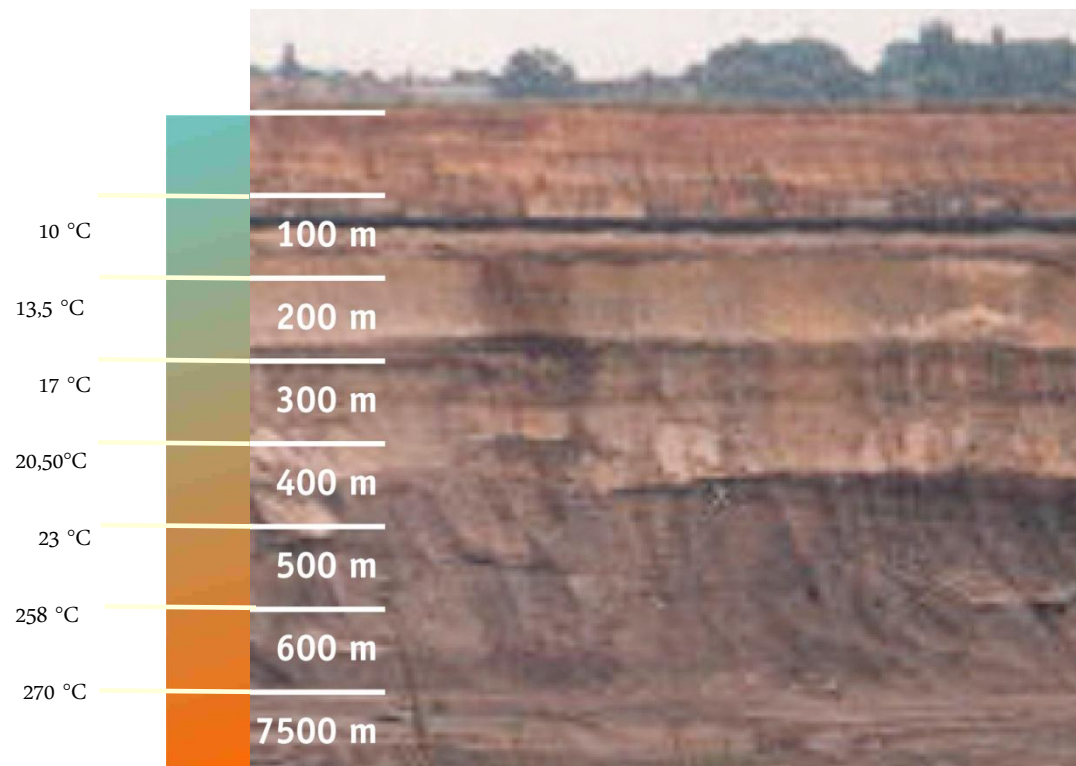
The convection is possible by the permeability available in every formation. The activation of the convection caused by the thermodynamics in the area of the drilling is absolutely necessary, because the thermal conductivity of the formation is not sufficient to reach an economically successful operation of a GEO Power plant in the on hole method.

The conductive thermal conductivity of the formation lies between 3-8 watts / mK. By the activation of a convection in the permeable formation this value can become multiplied on the bore hole wall. We have measured the thermal influenced ring space around the bore hole. The values have been controlled more than 25 years by measuring processes in many arrangements and have been proofed by neutral engineers.

We have got to win the permanently same achievement of energy for a period of more than 25 years from the one hole system on constantly circulation temperature and water volume.

Temperature Profile Earth Crust

In the first 10 metres it still comes to seasonal temperature variations. Then it comes in the younger earth's crust on average to a temperature increase of approx. 2,4-4,5°C per 100 m.



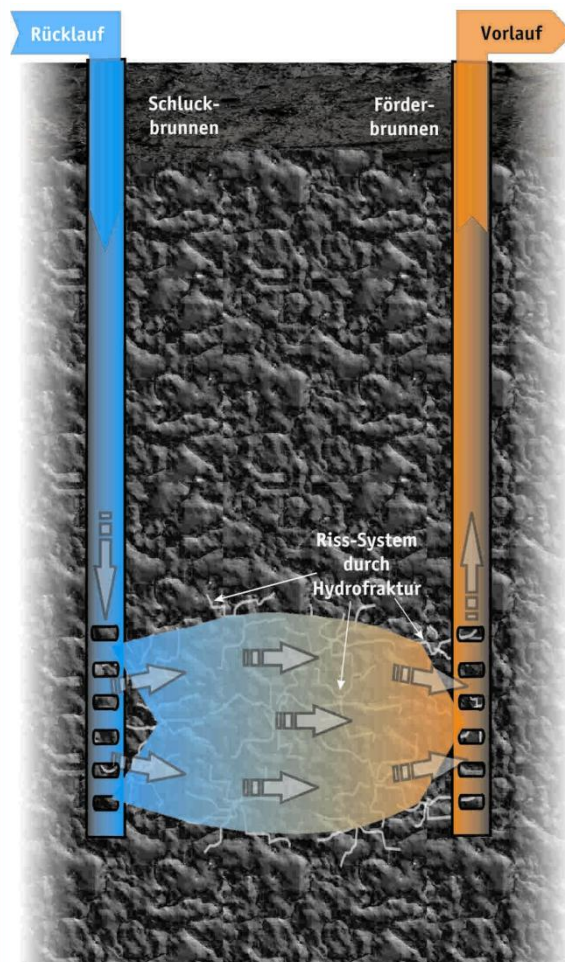
With approx. 1000 ° C the almost complete geothermal energy will be transferred into the earth's crust. On that account of the widespread same gradients, in the same formation structures, it might be assumed the radiation energy is nearly the same in the coat / crust area roughly everywhere.

The gradients sway with normal geothermal structure between 2.4 K to 4.5 K, in the formation according to thermal conductivity.

We have validated these statements by temperature measurements in many drillings. In the depth drillings Windisch-Eschenbach, 9.1 km depth and the kola island 13.2 km depth similar observations have been made.

Power Generation (Solid Rock)

HOT-DRY-ROCK System

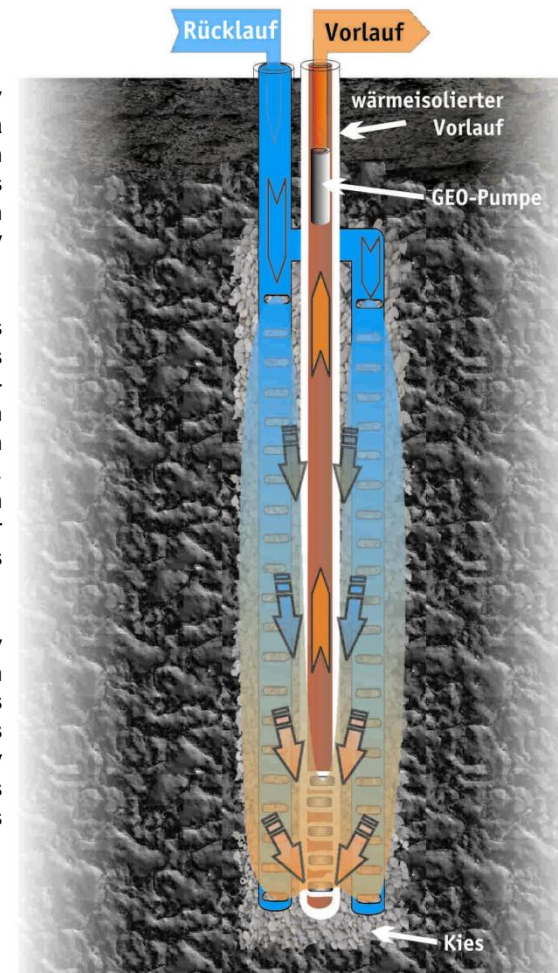


The energy system HOT Dry Rock is a 2 hole system with a withdrawal drilling and an injection drilling. It wins its geothermal energy in the open gaps between both drillings by water circulation.

One tries to connect the drillings by means of hydraulic sprayings in a depth of approx. 4.000 - 5.000 m with each other. With these sprayings it is tried to open the natural gaps in the rock. These gaps must be hit by both drillings to allow a water circulation between both drillings later after opening.

Because both drillings have only one diameter of at most 25 cm and are approx. 500 m apart, it is very difficult to reach continuous gaps, (in the majority hardly possibly). The present attempts with this technology confirm this statement.

GEO Power System



The technology with the best views of success is the one hole technology.

This technology provides a precise calculation of the water volume under consideration of the flow resistance to enable geothermal power production.

This is possible, because the water circulation takes only place within the one hole drilling system, and makes it sure not to lose water during flow.

The GEOPower one hole system activates the geothermal energy flow (due to thermodynamics reasons), released on the open bore hole wall.

Extract from the Expert Report University of Heidelberg / Stuttgart

The GEOPower method has an important advantage in comparison to the procedures known to us. The thermal transport occurs through a direct contact of the circulating water and the surrounding ground. Our model calculations have shown the advantage of this method by having made the assumption that there is a thermal flow in the formation.

Water Circulation

The one hole method grants an optimum water circulation at deep drillings with the geothermal temperature increase in the outer ring of the drilling downwards and leading the water in the inside ring by means of an isolated pipe again upwards. Besides, the problems lie in the isolation of the influx pipe. An isolation working on decades must be chosen. It must be straightened on the water column in the drilling.

By a deep well of 8,000 m more than 50-60 years 800 barometric pressure last on the isolation work permanently and the hydraulic pressure is almost compensated between inside ring and outer ring in the drilling. (Principle communicating tubes). The problem of the in the long term reliable isolation under those high temperatures and pressure terms was solved with well known international partners.

Every drilling (also 9,000 m or 13,000-m-deep drillings) in the so-called dry rock will be full of water from the level of water-gauge. This is the pore water, coming from in the formation. This result is valid for any drilling worldwide.

If the drillings were pumped off without return of the pumped off water, they would be in short time quite dry. With this we would like to express that the allegedly dry rock is fed though completely with water, but in sum it is not a big volume of water. For the activation of the thermodynamics effect around the on the drilling these quantities of water are absolutely sufficient, what has been proved over many years by more than 400 installed energy systems.

Extract from the Expert Report University for applied sciences Bochum

Bochum University has examined in February, 2005, 25 installed energy systems (one hole drilling) with regard to the earth energy achievement potential. The month of February was selected to test the continuous operation. It was a frosty phase during three weeks. Here the result of the investigations:

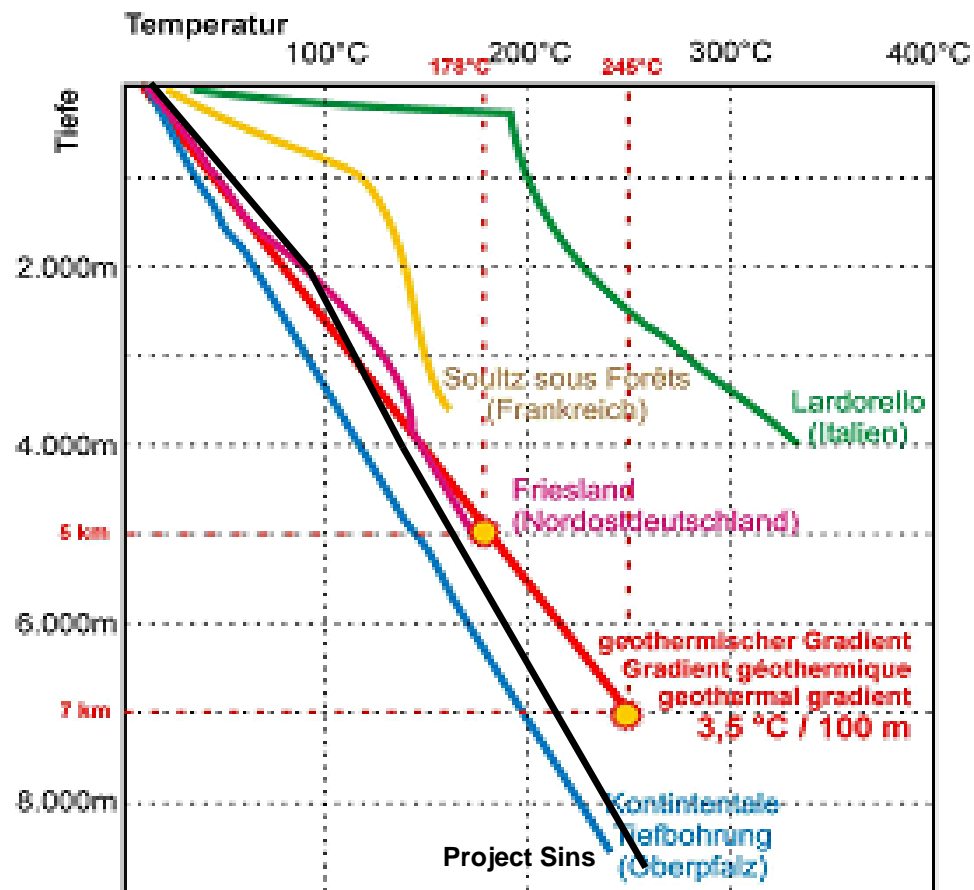
The simulation results, having done for three selected energy systems, that formation-open systems applied to the GEOPower principle computationally clearly more efficient than closed geothermal energy probe systems. The biggest difference was found at the 225-m-deep system „Hinkel Quelle 3“.

Around return temperatures same by means of closed coaxial probes,

To achieve the same heating energy (using the actual competitive probe technology) there is a need for minimum 4 standard-coaxial probes (80 mm x 25 mm) à 225 m to get the same result.

Deep Drilling Sins (Switzerland)

Drilling Sins in comparison to other deep drillings



The geothermal gradient is determined by the thermal conductivity of the formation and the following physical laws are valid:

Rock formations with low thermal conductivity cause a high geothermal gradient.

Rock formations with high conductivity have a low geothermal gradient.

Geothermal Process to generate Power

Swiss Green Geothermal Technology

Summary

The GEOPower system is an open drilling as one hole application. It activates geothermal energy flow in the formations. It needs no water flow in the rock formations.

Caused by this technology the geothermal risk to find a sufficient volume of water does not exist, the pore water volume is going to fill the borehole within a few days.

The energy expenditure for circulation pumps and the cooling is only one fraction of other technologies, because the GEOPower system works after the principle of the communicating tubes.

The construction times of the GEOPower installations are very short for following reasons:

The drilling rig installation must not be moved

None pressure applications at all (!)

Cost intensive pump tests are not necessary

Disadvantage:

Borehole depth is deeper than in competitive systems

Advantage:

Borehole itself is straight vertical and not deviated

The life cycle of GEOPower installations are also influenced positively by the activation of the geothermal flow. Installations using the same principle up to a depth 850 m proved the reliability for more than 25 years.

The technology has matured very far. It can be used worldwide almost in every location and can be adapted to the respective geology by varying the depth and technical installations.

This system is the optimal energy source for decentralized energy supply.

GEOHERMAL (GREEN) POWER IS THE FUTURE TECHNOLOGY!

