

Video 8: Giant Geothermal Power Plant

Geothermal energy is currently utilized for heating in places like Iceland and for electrical energy production, albeit not on a large scale. This is unfortunate, as geothermal energy is a clean and sustainable source.

The principle of using geothermal energy is simple. It involves two boreholes: one for injection and the other for production.

High-pressure water is injected into the first borehole, travels through the ground to the production borehole, and heats up in the process. Water or steam is then pumped up from the production borehole to generate electricity on the surface.

Such facilities are named Enhanced Geothermal Systems (EGS) and are particularly effective in areas where heat is closer to the surface, with rock layers above and below, and such power plants are already operational in several countries.

These power plants have the potential to replace coal and nuclear facilities since they can produce electricity independently of weather conditions or time of day, addressing issues faced by solar and wind energy. However, drawbacks include high borehole costs, potential changes during production, and — above all — limited production capacity.

This picture illustrates a conventional EGS system on the left and an EGS scheme constructed according to the Deep Underground concept on the right.

The system consists of numerous vertical shafts at the bottom level for conveying heat, connection tunnels and shafts, caverns for steam turbines along with generators at several levels, and water turbines along with generators.

Why is all that good?

Well, you need a certain pressure and temperature of steam to maximize electricity production. Steam loses both on the long way up, so it is good to have turbines close to the steam source.

Then, exhausted steam on the way up still has some energy, so you may increase pressure and temperature to use it again, or you could also use the steam as it is with turbines of different characteristics for that steam. When steam comes to the top, you can cool it to create water.

Having the water at such a level is ideal for using it to produce electrical energy again. It's the same concept used at water power plants. There is a dam that collects water, and water turbines below the dam generate energy. The amount of energy produced depends on the amount of water and the height difference on the way down, which is not the case for a conventional geothermal power plant.

We need to produce steam at the bottom. In this case, we don't need long boreholes, as the heat is already high. We should have a lot of production wells but only one injection well.

And finally, if you want more steam, you just need to construct additional tunnels and drill more boreholes at the bottom level, which means that increasing the power plant's capacity is easy and cheap once you are at the desired level.

So, the advantages of a geothermal power plant according to the Deep Underground concept over traditional methods are:

- More electricity produced
- Ease of increasing power when you are at the desired level
- Clean energy production
- Steady energy production, which can replace coal and nuclear power plants
- Ability to be constructed almost anywhere
- Closed system with no surface construction

If we extrapolate the time for the construction of a shaft with a length and diameter of 100 meters and 3 meters, respectively, for 100 days with a daily 1.5 cm average widening progress, a depth of several kilometers (the area of interest) can be achieved within 10 years.

The construction time and amount of excavation are within the range of the largest construction projects, such as nuclear power plants, which also cost tens of billions.

Ten years is a long time, and the starting investment is high; however, once the desired depth is achieved, adding capacity is considerably faster and less expensive. To decrease costs, some existing deep mines can be used, for example those in South Africa.

Dirty energy production is one of the biggest sources of pollution, but it is not the only one. Let's see how the Deep Underground concept can solve some traffic problems in the following video.