

Exploring the Use of Geothermal Energy in Power Generation

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What is Geothermal Energy?

In a general sense, geothermal energy can best be defined as a renewable energy source that draws its “power” from the extreme heat produced deep inside Earth’s core. The extreme heat emitting from the Earth’s core oftentimes creates steam “pockets” or “veins” underneath the surface, trapping usable geothermal energy. By knocking loose or “busting” these steam pockets, humans are able to use the steam’s immense temperature and pressure to generate usable electricity in various forms. While the current method of geothermal power production is relatively new, the concept of harnessing the heat produced deep within the Earth is not a new one. (FWS) In fact, as cited by Alberta’s Energy Heritage Department, geothermal energy is one of the oldest energy production methods utilized by humans, with the first direct use of geothermal energy coming hundreds of years ago when indigenous people used hot springs to cook their food and provide them with warm bath water. (Alberta Energy Heritage)

As defined by the University of Michigan’s Center for Sustainable Systems, “geothermal energy generation” pertains primarily to the harnessing of electricity using the heat produced by the Earth’s core. In 2022, the United States Energy Information Administration reported that 24 countries across the globe, including the US, have participated in geothermal power generation in some form or fashion. In the United States in particular, a majority of the sites where geothermal energy production takes place, known as “plants”, are located in tectonically active areas, such as Hawaii and other western US states. (University of Michigan)

How do Geothermal Energy Generation Plants Work?

Currently, around the United States, an estimated 93 geothermal power plants are operating around the clock to help light up American homes across the country. While they come in all different locations and sizes, a majority of them use the same process to harness “energy” from the Earth’s core heat. To start, workers inject water deep into cracks in tectonic-active areas via tubes known as “injection wells”. These wells allow the water to travel through areas of high pressure, causing it to become incredibly hot. Next, the workers then pump the water back to the surface and into various large tanks known as “flash tanks”. While inside these tanks, the water is heated up even more, eventually turning the liquid into steam, which is then piped into one of the facility’s turbines. The hot steam propels the turbine forward, spinning it around in circles. Nearby, a generator collects the power produced by the turbine, preparing the newly-generated electricity to enter the national power grid as needed. (U.S. Dept. of Energy)

Once the hot steam has exited the facility’s turbine, it continues travelling down a pipe into a “cooling tower”, which is a grey, cylindrical-shaped tower filled with cool water. The steam mixes with the cold water and begins to condense, making it pool down at the bottom of the tower. From here, the same water will again be pumped down an injection well and into the Earth, allowing the process to run over-and-over again without pause. On average, geothermal energy generation facilities are equipped with 2-3 of these systems on their property, but there are some exceptions. One such exception is the Geysers Geothermal Complex, located just north of San Francisco, California. This single facility has an energy capacity of 900 megawatts and operates twenty-two individual geothermal energy production systems, making this facility the largest geothermal power plant in the world. (Geysers Energy)

The Advantages of Utilizing Geothermal Energy

In short, there are plenty of reasons why geothermal energy production can appear quite attractive to investors of today. For one, geothermal energy fits into the category of ‘renewable resources’, which means the resource pool is destined not to “dry up”, so to speak. This is because geothermal energy is naturally-occurring, with new pockets of super-hot, geothermal steam being uncovered every day around the world. Earth’s tectonic activity is likely to never stop, meaning subsequent geothermal energy produced from the activity will always be there to harness, making geothermal energy production far more sustainable in the long-run than other forms of power generation. (Enbridge INC.)

Investors may also be attracted to geothermal energy as it has a stable price of production, unlike other energy resources such as oil and gas. This means if one wants to open up a geothermal energy production plant, the investor’s dividends are potentially “safer” than if they are involved in a more volatile, ever-changing business such as the oil industry. In addition to fairly reasonable start-up costs, the average maintenance costs of a geothermal energy production plant yearly are quite low, as a normal production system does not require maintenance often after installation. (Ingrams)

Perhaps the biggest advantage of using geothermal energy production is that compared to other forms of energy production, the harnessing of geothermal heat does not require the burning of fossil fuels, which means the process’ carbon footprint is quite small. In fact, small ground-source geothermal heat pumps meant to specifically serve one household have almost zero

negative environmental impacts, allowing consumers to generate power in an eco-friendly way.
(Ingrams)

The Disadvantages of Utilizing Geothermal Energy

For all of the positives that come with harnessing geothermal energy, there are a few negatives that should be highlighted as well. Earlier in this report, I talked about how many of these geothermal energy production plants exist in areas such as Hawaii and California due to the area's increased tectonic activity. Unfortunately, this also means that when constructing a new geothermal energy generation plant, the investor may be unable to find adequate land in tectonically active areas to build their facility. Additionally, while harnessing geothermal energy is indeed one of the most eco-friendly options for power generation, it doesn't come without its own set of environmental drawbacks. (U.S. EIA)

As we talked about when discussing how geothermal power plants work, part of the energy harnessing process involves continuously pumping pressurized water into pre-drilled wells in the ground. As you might assume, the act of doing this can cause additional dangerous underground plate shifts in areas considered already tectonically active. Unfortunately, this also means that in areas where geothermal power generation is taking place, residents often live with an increased risk of frequent Earthquakes. (U.S. EIA)

Also, while many scientists suggest it's only a small amount, during the extraction process of the water back up from the ground, different toxic greenhouse gases can be released from steam/air pockets underneath the Earth's surface. This means that while not a large amount, certain toxic gases can be released into the atmosphere via the generation of geothermal power.

While certainly a better choice than burning coal or natural gas, geothermal energy does present some potentially dangerous disadvantages that should be considered when thinking of constructing one of these systems. (FWS)

The Outlook on Geothermal Energy Moving Forward

Perhaps one of the largest challenges facing humanity in the coming decades is learning how to slow down and reverse the devastating effects of global warming. To help do this, many localities have opted to construct geothermal power generation facilities in hopes of producing usable electricity for their residents in an eco-friendly way. The trend of switching to the use of geothermal energy is one that has picked up steam not only in the United States but also around the globe as a whole, with investors in both the private and government sectors looking to get in on the “new wave” of power generation, so to speak. In a 2023 peer-reviewed report published by energy scientist Hasal Kulasekara and his colleagues titled “A Review of Geothermal Energy for Future Power Generation”, Kulasekara indicated what he believed to be near-certain evidence of the growing interest in geothermal energy held by investors, citing a 28% increase in expected geothermal power generation rates across the globe. (Kulasekara)

Overall, the future of geothermal power generation seems to be fairly well-secured, with localities around the world looking to harness usable electricity from the ground beneath them. While it may still have some drawbacks to consider, the process of power generation utilizing geothermal energy currently stands as one of the most viable and eco-friendly methods of generating electricity readily available to human beings today.

Sources

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