Technology: Geothermal Power Plants

Definition and description

Geothermal energy is thermal energy (heat) generated and stored in the earth. Whenever hot matter comes close to the surface - less than 4,000 m – it can be used to produce steam, which generates electricity in a turbine.

In order to produce steam, wells have to be drilled to reach the resource. These drillings are large infrastructure developments that require access roads and water supply to the drilling site. Due to its complexity a geothermal development takes several years to be executed.

Once operational, a geothermal power plant is able to deliver base load energy, meaning that it produces electricity on a continuous basis. It is also possible to reduce the power output to adapt to the demand. However, this will reduce the economy of the system.

Furthermore, in addition to steam, other gases like carbon dioxide (CO_2), hydrogen sulfide, methane and ammonia could be released. Additionally, the brine, which is the waste fluid from the separator in a geothermal power plant system, can contain trace amounts of toxics like mercury, arsenic, boron and antimony. However, modern geothermal power plants can handle those substances to minimize environmental risks.

In some cases geothermal power plants were known to have created land stability issues. Subsidence occurred in at least two places around the world.

Potential in Grenada

Grenada is of volcanic origin indicating the existence of geothermal energy. During the last three years Grenada received international assistance form the Governments of New Zealand and Japan to investigate the country's geothermal potential.

According to the 3Gs analyses – Geological, Geophysical and Geochemical studies - there is a potential to produce 30 MW of electric power in an area which is adjacent to the Mount Saint Catherine region. Assuming an annual capacity factor of 90 % up to 237 GWh of electric energy could be produced. This would be more than GRENLEC's 2016's total production of 218 GWh.

However, the results of the previous studies will have to be proven by actual drillings. To enable phase two, the Government is currently attempting to secure funding for exploratory drillings, which will consist of a three stage approach starting with temperature gradient wells (500 m), which depending on the success will be followed by slim hole wells (1,500 m) and, if successful, full size wells (up to 3,000 m).

Mitigation to climate

As mentioned in the first paragraph CO_2 is likely to be release from underground deposits during the production process. On average geothermal power plants emit approximately 0.122 kT of CO_2/GWh. With an assumed potential of 237 GWh per year this would lead to emissions of 29 kT of CO_2. At the same time a geothermal power plants with a capacity of 30

MW could reduce emissions from diesel generators by a total of 144 kT[11] of CO_2 equivalent. Consequently the total greenhouse gas mitigation potential is 115 kT of CO_2 equivalent.

Advantage(s)

- Proven, mature and reliable technology
- Baseload technology
- Job opportunities for technically skilled (tertiary education) people in the field of operation and maintenance
- Hurricane resilient

Disadvantage(s)

- Environmental and health concerns due to hazardous gases and toxics
- Limited human capacity and expertise in Grenada increasing the risk of malfunctioning systems
- Very high upfront costs
- Potential sites in virgin territory
- Major infrastructure development (roads and water supply) required

Costs and other financial requirements

The government currently plans to tender a 15 MW power plant. The installation of this plant including all required studies, permits, infrastructure work and exploratory drilling is estimated to cost approx. 130,000,000 US$.

A geothermal development is a high risk venture because until the final stages of the development there is a risk that the resource will not be sufficient. Consequently a developer will ask for high risk premiums. In order to mitigate the risk and reduce the actual price an investor will ask for per kWh of electricity generated, the Government is attempting to secure as much international financial assistance as possible to do the second phase of the project on their own.

Introducing a private investor at a later stage will potentially reduce the price per kWh significantly. Current estimates are looking for kWh prices between 0.15 US$ and 0.18 US$. This is more than the current fuel charge of approx. 0.14 US$ but with the oil price rising it should be a reasonable value to stabilize electricity tariffs.

Status of the technology in Grenada

So far there is no experience with geothermal power production in Grenada.

[11] Based on UNFCCC "Standardised baseline: Grid emission factor for Grenada".