Submission on unlocking Aotearoa's geothermal potential.

Kia Ora, my name is Lucy Child and I am writing about the geothermal potential of Aotearoa New Zealand, in favour of the proposal, provided the necessary precautions are acknowledged.

I believe that doubling the use of one of Aotearoa's renewable energy sources, that being geothermal energy (GE), could prove highly beneficial for not only the economy but our local and global whenua. During Māori arrival to Aotearoa, they shared a deep spiritual and physical connection within their communities and the geothermal elements. This connection was lost during European settlement, yet many held onto their beliefs in order to uphold relevance within the GE business. And while there are a lot of possibilities for positive results, in order to respect Mātauranga Māori and our haukāinga, the appropriate measures must be taken (Taute, N., et al., 2022).

Wairakei:
Aotearoa is already home to the worlds second oldest GE power plant (GEPP), Wairakei Unit 1 station. Generating sustainable energy since 1958, Wairakei alone generates ~8,741 Gigawatts-hour (GWh), which amounts to 19.9% of our annual electricity. The success here led to investigations in the GE potential of Ngāwhā, which became the first of Aotearoas power plants to reach a net-zero carbon standing (Jones, H.S., 2025)

Emissions and Efficiency:
GE, as previously mentioned, is renewable, sourced from the heat produced by Earths core which naturally occurs due to the decay of radioactive materials. Moreover, it has a significantly less harmful impact on our environment than fossil fuels (FFs) when properly executed. Emitting only 38 grams of CO_2 equivalent per kilowatt-hour (KWh) produced (Green Business Barbados, 2025) compared to FFs which emit ~900-1,200 grams of CO_2 per KWh (Ecological Life, 2025). Although creating much lower levels of CO_2 , some GEPPs also produce methane and hydrogen sulphide (H_2S) into condensation. Methane which is a 28x more potent greenhouse gas than CO_2 and H_2S being a toxic gas which is associated with the smell of rotten eggs. H_2S is also dangerous to health and life in high concentrations (Biology Insights, 2025). There are ways to remove said H_2S from condensation, one of which being to redirect it toward the cooling system. There the H_2S is separated and chelated iron can be added to increase the irons solubility In water. (Nagi, G. 1999) It also is possible for high sulfuric levels to be produced which could lead to the development of acid rain if not correctly monitored, however, GEPPs release 97% less sulfuric dioxide (SO_2) than FF plants (U.S. Energy Information Administration, 2020).
In terms of efficiency, studies show that fossil fuel plants remain only ~30-40% efficient due to heat waste loss when burning, whereas GEPPs display an efficiency of 90%. This is because of more direct conversion methods from heat to steam as GE is readily hot enough to boil water and some (This vs. That, 2023).

Drilling:
Drilling for fossil fuels can cause large scale damage to surrounding landscape, often leading to soil erosion, hindering plant regeneration and increasing risks of landslides.

In terms of the impacts of offshore oil drilling, spills are likely to occur, creating a trickle-down effect on our oceans, killing marine life and many species of birds. Furthermore, releasing CO_2 and CO before the process of burning even begins (Majr Resources, 2024) (New Zealand Government, n.d.).
"Drilling for GE can also cause land degradation." – While this is true since removing GE without replacement can cause indentations to the land if not returning the resource to a state of equilibrium, there are ways that this can be avoided. Through re-injection of CO_2 and H_2S in closed loops systems, the sites are more likely to remain stable, so long as the extraction rate of liquid is not outweighing the input. It is important to note here too that without allowing regeneration of GE resources, that could also influence land indentation (Kamila, Z., et al., 2021). Environmental impacts of GE offshore plants are still currently being researched but could also cause stress to marine life (Sircar, A., et al., 2022).

Habitat destruction: - If not executed properly.

- Many species of algae grow and thrive within the heat of geothermal waters. Boothroyd, I.K.G. (2019, Section 5) Discusses that in Aotearoa we have ~200 varying species of algae within just 78 of our hot springs. Algal communities ranging from cyanobacteria to diatoms, proving to play a valuable role in the last 40 years of research. Due to their tendencies to grow in the warmth of hot springs, the algae are susceptible to temperature change and possible geochemical changes which GEPPs could potentially pose a threat. If we were to disrupt the natural habitat of these algae species, we would be at risk of losing significant subjects for scientific research. Ensuring these weaknesses are acknowledged in a manner which protects the algae will play a crucial role in developing practical methods of action.
- The surroundings of geothermal sites are found to be home to endemic flora, specific to these heated environments. Due to the varying temperature of the sites, their growth rates can be slow and unpredictable. Changes in said temperature due to extraction or disruption from development could lead to loss of habitat for these unique organisms (Nishar, A., et al., 2017) (Burns, B., & Leathwick, J. n.d.).

High water usage:

- In order to keep GEPPs running smoothly, the system requires a large amount of water to provide cooling to the systems. Thankfully this water does is not required to be of drinking quality, therefore unfiltered groundwater can be used. However, opting for hybrid air cooling is the preferred strategy in avoiding overuse of water resources (Milenić, D., et al., 2010).

Successful management examples:

- Development and construction which is conscious of surrounding fauna and flora.
- Discussing plans of action with local iwi.
- Well managed closed loop systems to prevent toxic discharge.

- Ensuring successful re-injection to reduce risk of land indentation and resource deficiency.
- Developing hybrid cooling.
- Sustainable drilling which protects the integrity of surrounding whenua.

Additional pros:
- GEPPs are able to run 24/7 regardless of weather conditions unlike wind and solar energy (Mercury, n.d.).
- Combining GE with solar photovoltaics can pave the way toward net-zero energy for more GE power plants(Neves, R. et al., 2021).

Counterarguments:

“But fossil fuels are more affordable!”

While fossil fuels continue to be used as the preferred method of energy based on the fact that they present cheaper, their long-term use is more costly in regards to both currency and our environment. Due to the initial high price of ~1-5 million dollars required to set up GEPPs, they are often seen as undesirable. However, once operating, the continuing costs of maintaining GEPPs are more affordable. GE costs vary between $15 and $30 per megawatt-hour (MWh) while FFs range from ~$30-$100 per MWh, depending on the type of FF (Reality Pathing, 2025).

“Creating GE plants could reduce tourist attractions!” – Although partially true, contributing toward cleaner energy and reducing carbon emissions will ultimately play a role in the decrease of global warming and climate change, in turn hopefully leading to recovery of other natural attractions i.e. our glaciers (Jones, H.S., 2025) (Pope, K. 2023).

Conclusion:

In conclusion, doubling the use of GE in Aotearoa over the next 15 years *could* be achievable and beneficial, providing the stated concerns are addressed and avoided. Operating the plants in a closed loop system while allowing the whenua to naturally regenerate its resources alongside the support of reinjection of CO_2 would likely prove the safest option for success.

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