19 June 2023

Climate Change Commission, He Pou a Rangi

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Submission on the Draft advice on the second Emissions Reduction Plan (2026-2030)

The New Zealand Geothermal Association (NZGA) would like to thank the Climate Change Commission, He Pou a Rangi for the opportunity to comment on the Draft advice of the second Emissions Reduction Plan (2026-2030).

New Zealand Geothermal Association (NZGA)

The NZGA, incorporated in 1992, is a non-political, non-governmental and not-for-profit organisation, with a focus on fostering a sustainable future for Aotearoa New Zealand through the use, development or protection of geothermal resources. The NZGA is an affiliated member of the International Geothermal Association and the Royal Society of New Zealand. The NZGA connects with global geothermal communities and is well positioned to positively influence geothermal initiatives on the international stage.

NZGA membership comprises ca. 450 individuals, as well as 29 corporate members, representing, research organisations, Māori trusts, geothermal electricity generators, engineering consultants, technology companies and planning consultants. This diverse and skilled network of people work and live with Aotearoa's geothermal resources.

The pace of change during the second and third emissions budgets required concerted efforts from electricity generation and process heat

1. NZGA supports the key message outlined in the draft advice: "*We anticipate the need for particularly large contributions from electricity generation and process heat in the second emissions budget, and from transport in the third emissions budget. Because changes like electrifying Aotearoa New Zealand's vehicle fleet take time to accomplish, the ability to meet the third emissions budget will be strongly determined by actions taken in the second emissions budget period.*" Aotearoa New Zealand must step up as a climate leader, strengthen our emissions reduction plan and place Tiriti o Waitangi and equity at the heart of our climate response. The tools to achieve internationally significant change are within our boarders, we must be courageous to embrace them to ensure that we can meet our climate goals.

2. It is therefore important to outline the role of geothermal resources in these three keys areas where it can make meaningful impact:

    - Electricity generation and security
    - CO_2 reinjection and other uses
    - Geoheat use at regional industry applications

Electricity generation and security

3. Aotearoa New Zealand's first geothermal power station at Wairākei, near Taupō, first contributed electricity to the national grid in 1958. By 2022, 18% of New Zealand's electricity generation came from geothermal power stations (refer Figure 1).

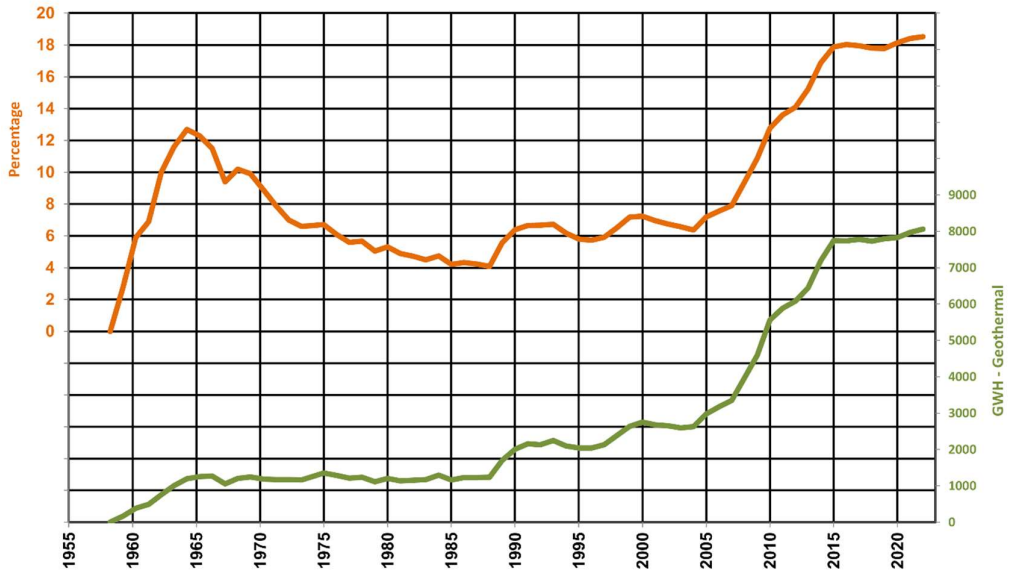

Figure 1 Geothermal generation GWh per annum (right axis; green) and geothermal percentage of total electricity generated in New Zealand (left axis; orange)[1].

4. A number of geothermal fields in the Taupō Volcanic Zone and at Ngāwhā (Te Tai Tokerau) are currently used to generate electricity. The deregulation of the electricity sector that commenced in 1987 has seen State Owned Enterprises, public companies, consumer trusts and Māori entities now involved in developing geothermal power generation facilities, with growth over time occurring particularly after 2005.

5. Two technologies for geothermal electricity generation are in use in New Zealand:

- **Condensing Steam Turbines (can be single-, double-, or triple-flash)**: steam produced from two phase geothermal fluids / produced directly from underground is supplied to steam turbine driven generators at one two, or potentially three different pressures, and

[1] Updated and amended from Kissick, D., Climo, M., Carey, B., 2021 An Overview of New Zealand's Geothermal Planning and Regulatory Framework. Traverse Environmental Limited https://www.geothermalnextgeneration.com/knowledge/new-zealands-conventional-geothermal-planning-and-regulatory-framework

- **Binary Cycle:** heat is transferred from geothermal fluids to a secondary fluid, usually an organic fluid such as N-pentane or iso-pentane. The pentane fluids are in a closed loop. These fluids accept heat from the geothermal fluids, drive the turbines, release heat to the atmosphere and then are pumped back to be reheated again in the loop.

6. Renewable energy resources are an increasing component of Aotearoa New Zealand's 2050 "zero carbon" energy portfolio, but the nation has quite some distance to go to achieve this target, with all carbon-friendly energy sources needing to significantly increase their contribution.

7. Aotearoa New Zealand's geothermal resources are already widely used (currently 18% of all generation refer Figure 1) to generate low-carbon electricity to supply for national demand, and geothermal heat is used directly to support residential, recreational, tourism, commercial and industrial scale uses regionally.

8. NZGA is confident that there is much more that geothermal resources can contribute to Aotearoa New Zealand's renewable energy and carbon goals, with further exploration and development of existing resources and the potential for deeper superhot supercritical resources, particularly within the Taupō Volcanic Zone. The challenge for the geothermal sector is to sustainably use geothermal systems to the greatest possible extent, *and* then, where possible, investigating the potential to go deeper, tapping into superhot supercritical heat resources which are expected to offer substantial additional energy potential for the nation as the technology develops.

9. In addition to the existing baseload geothermal generation of 8,060 GWh/annum, the following tables are a summary of anticipated additional geothermal generation (plant capacity in brackets):

Table 1: Projects Under Construction

Field/Project	Capacity (MWe)	OEM	Forecast COD	Developer	Comments
Tauhara	184 CST-TF	Fuji Electric	2023	Contact Energy	Commissioning to begin in June
Tauhara Te Huka U3	50 ORC	Ormat	2024	Contact Energy	Civil works and design underway.

Table 2: Projects Under Development

Field/Project	Capacity (MWe)	Forecast COD	Developer	Comments
Nga Tamariki OEC5	37 ORC	2026	Mercury (NZ) Ltd.	FEED ongoing
Ngawha OEC5	30 ORC	2025	Ngawha Generation Ltd.	FEED ongoing
Wairakei repower	45 ?	2026	Contact Energy Ltd.	WRK A & B to retire; new plant at Te Mihi; FEED ongoing
TOPP2	25 ORC	2025	Eastland Generation ltd. & Ngati Tuwharetoa Geothermal Assets	FEED ongoing

Table 3: Potential Greenfield Projects

Field/Project	Capacity (MWe)	Forecast COD	Developer	Comments
Taheke A	30	2027	Eastland Generation Ltd. & Taheke 8C Inc.	Concept design & permitting
Tikitere A	45	2028	Ormat & Tikitere Power Company	Awaiting litigation
Rotoma A	15	2029	Tuara Matata collective	Recon exploration

10. In addition to these specific projects, the Ministry of Business Innovation and Employment is funding studies on the merits of using additional geothermal resources to back-up hydro generation during dry years, as part of the "New Zealand Battery" project. The concept contemplates installing up to 400 MWe of new geothermal generation (ahead of planned market supply) for dry year operation.

Key to Abbreviations

CST–TF = condensing steam turbine – triple flash

COD = commercial operations date

ORC = Organic Rankine Cycle (binary)

FEED = front end engineering design

Geothermal Consenting Renewals: 2045 to 2055

11. In late 2022, geothermal electricity generation activities at Wairākei/ Te Mihi/ Poihipi were reconsented until 2057, including the expansion of the generation (from ~320 MW to ~400MW, enough electricity for 70,000 more homes).

12. However, eight out of 14 of the larger geothermal operational resource consents will expire during the period between 2045 to 2055[2]. This includes consents for the facilities at Ngāwhā, Rotokawa, Ngātamariki, Kawerau, Ohaaki and Tauhara. This represents a substantial portion of renewable geothermal electricity generation right at that time that the net-zero carbon target for 2050 from the Climate Change Response (Zero Carbon) Amendment Act 2019 comes into force.[3]

CO_2 reinjection and utilisation: National Greenhouse Gas Inventory

1.B.2.d Fugitive Emissions – Geothermal

13. Geothermal is low-carbon renewable energy that Aotearoa New Zealand has been able to harness reliably as base load energy[4] (>95% availability) for over 60 years. A NZGA Industry Emissions Working Group was established in 2021.

14. A framework for members to discuss, share and collaborate on issues associated with emissions from the use of geothermal energy, including: Knowledge/Mātauranga Māori, Risk and Engineering Solutions, Reinjections and Reservoir Management, Other Uses, Regulatory Matters, and Education. As of end of 2022, it involved Ngāwhā Generation (OEC1 100% reinjection), Mercury NZ (Ngatamariki, 25% reinjection), Contact Energy (Te Huka 50% reinjection).

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[2] Table 2 from Climo et al, 2022. *Commercial Arrangements Underpinning Aotearoa New Zealand's Industrial Scale Geothermal Operations*. http://www.geothermal-energy.org/pdf/IGAstandard/NZGW/2022/021.pdf

[3] https://www.nzgeothermal.org.nz/downloads/Submission-on-Proposed-National-Policy-Statement-for-Renewable-Electricity-Generation_May2023_FINAL-1.pdf

[4] Being energy that is less susceptible to external influence due to the consistency of supply, unlike wind energy for example, which is more variable with time.

Figure 2 shows the lifecycle emissions intensity of all fuels in Aotearoa New Zealand (2021 calendar year).

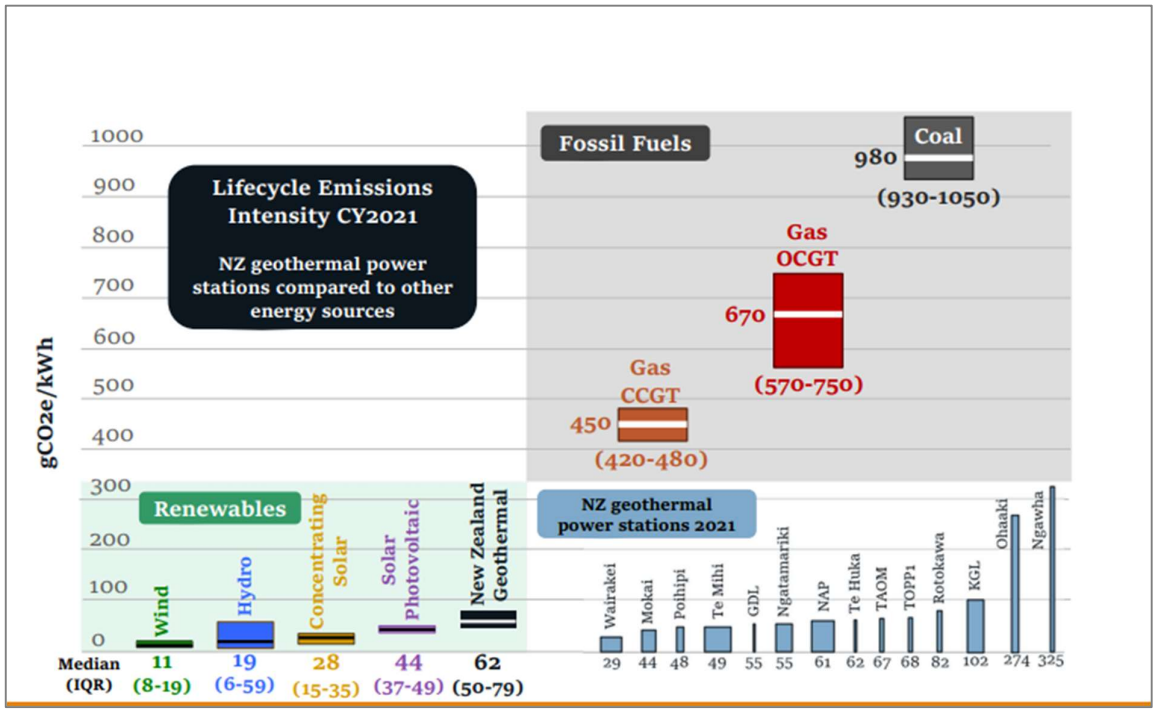

Figure 2: Lifecycle emissions intensity of all fuel types in Aotearoa New Zealand (2021)[5]

15. NZGA acknowledges, as does the Commission, that some geothermal fields have higher emissions associated with their geothermal fluids. However, as also acknowledged by the Commission, these high emitting fields have naturally degassed in recent years. The Commission's assumption that a continued reduction in emissions intensity is also anticipated by NZGA.

16. The 7-year trend of data from 2015 through to 2021 (Figure 3) shows a decline rate of 6% per year in the overall emissions intensity of the industry. Also, there will be step changes downwards, as geothermal operators have embarked upon project/programmes to return the gases back underground to where they came from, dissolved in the reinjected

[5] https://www.nzgeothermal.org.nz/downloads/CO2-Emissions-Reduction-project.pdf

geothermal water. These reinjection activities have been successful to date and are anticipated to continue, where they will come to be reflected in the emissions intensity values for those power stations. Plans are underway for similar projects in more geothermal power stations.

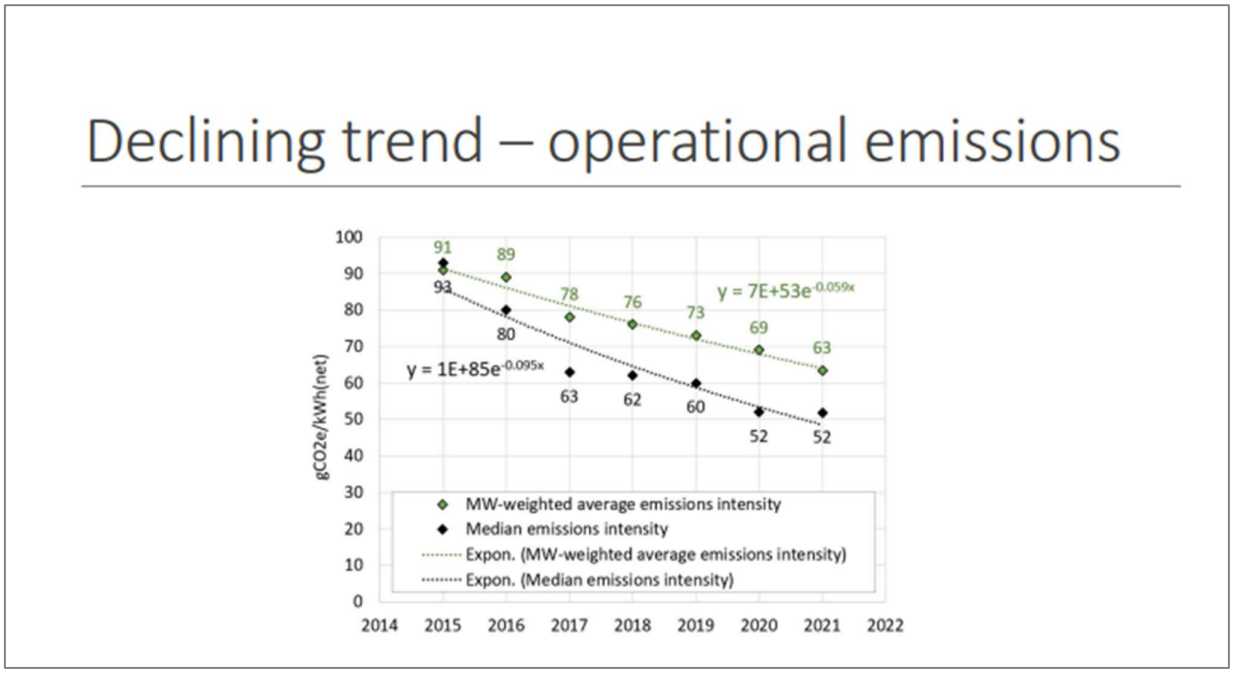

Figure 3: Geothermal emissions intensity (2015-2021)

Geoheat: direct heat use and industrial process heat: off-grid, co-locate, complementarity

17. In 2017, the Association published the Geo-heat Strategy[6] which is the primary geothermal programme in Aotearoa New Zealand focussed on increasing the use of direct geothermal energy through industrial and commercial scale applications (e.g., glasshouses, timber processing, dairy processing). The importance of this strategy is that it provides guidance and drive towards increasing uptake of geothermal direct use which can in turn displace

[6] https://nzgeothermal.org.nz/app/uploads/2017/06/Geoheat_Strategy_2017-2030__Web_Res_.pdf

heat sources that rely on carbon emissions. It also reduces demand on the national electricity grid, as it provides a heating option not dependent on electricity (otherwise a prime alternative to fossil-fuelled heating). Examples such as Nature's Flame and Te Awamutu dairy which demonstrate complementarity with other renewables. This configuration of geothermal proves as an efficient production of biomass pellets.

Figure 4 below shows a schematic diagram of different applications from direct heat use.

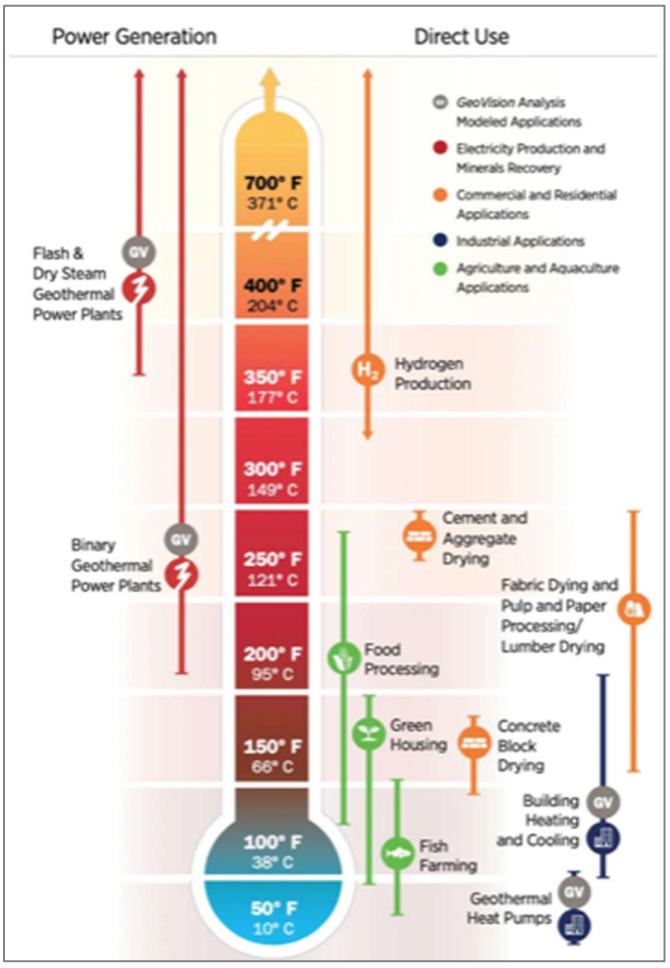

Figure 4: A schematic diagram of different applications from direct heat use.[7]

[7] https://causewaygt.com/

18. The Strategy's primary focus is to develop such resources in Northland, Waikato and Bay of Plenty regions with the goal of additional 7.5 PJ of geothermal utilisation. The secondary focus is to further push development of direct use of geothermal resources for residential scale use as well as the industrial use in other regions.

19. Every two years, we publish the bi-annual Action Plan where we celebrate our achievements and report on progress and details for the next two years. We have published the 2022-2023 Action Plan in early 2022[8].

Conclusion

Reaching net carbon zero is an enormous task that requires deep systemic change with authentic purposes.

Geothermal is a domestic energy source that will unlock net zero solutions, improve wellbeing, and improve economic standing throughout the regions.

No stone unturned, no one left behind, every carbon molecule counts!

We would be happy to answer any further queries.

Nāku noa, nā,

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[8] https://www.nzgeothermal.org.nz/downloads/2022-23-GEOHEAT_ACTION_PLAN-Spread-with-Bookmarks-1.pdf

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