14 December 2021

Attention: fsr@ea.govt.nz

Submissions

Electricity Authority

Level 7, Harbour Tower,

2 Hunter Street, Wellington Central

Submission on Consultation Paper – Consultation on the Draft report, Opportunities and challenges to the future security and resilience of the New Zealand power system

The New Zealand Geothermal Association (NZGA) would like to thank Electricity Authority for the opportunity to comment on Draft report: Opportunities and challenges to the future security and resilience of the New Zealand power system.

We would be happy to discuss this submission further.

New Zealand Geothermal Association

The NZGA, incorporated in 1992, is a non-political, non-government and not-for-profit organisation, with a focus on fostering a sustainable future for Aotearoa New Zealand through use, development, and 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 domestic and international stage.

NZGA membership comprises ca. 400 individuals, as well as corporate members, representing geothermal electricity generation, research organisations, regional economic development agencies, engineering consultants, service providers, technology companies, planning consultants and Māori trusts. This diverse and skilled association works, embraces and lives with geothermal resources in Aotearoa.

Our Key messages:

1.	**The importance of meeting our Nationally Determined Contributions: The pace of change and the three emissions budgets are lagging our net-zero target.**

2.	**The role of geothermal resources was excluded in the draft report - a massive missed opportunity.**
3.	**Geothermal resource is the heavy-lifter in transitioning to a low-carbon economy for Aotearoa New Zealand, and the geothermal community is committed to find innovation solutions to net-zero carbon.**
4.	**Electricity generation: geothermal is both a low-cost and reliable solution.**
5.	**Geothermal is the new gold and plentiful: 12,000 GWh by 2030.**
6.	**Geoheat: direct heat use and industrial process heat: off-grid, co-locate, complementarity.**

The importance of meeting our Nationally Determined Contributions: The pace of change and the three emissions budgets are lagging our net-zero target

1. The time lost due to the COVID-19 pandemic and the delay in announcing the emissions reduction plan until end of May 2022 amplify the urgency to curb our emissions. We no longer have the luxury of time to allow for a weak response in Budget Period 1. Aotearoa must step up as a climate leader (we should not be followers in this space), strengthen our emissions reduction and place Tiriti o Waitangi and equity at the heart of our climate response. The tools to achieve internationally significant change are within our borders, we must be brave and embrace them to ensure that we can meet our net-zero targets.

The role of geothermal resources was excluded in the draft report, a massive missed opportunity

2. The Draft report published by the Authority highlighted the increased contribution of renewable energy but only limited to wind and solar. We would be disappointed/think it is an error, if this view has pervaded much of the Authority's underlying analysis.

3. For meeting our net zero target, transitioning to greater use of renewable resources, geothermal energy already supplies around 18% of electricity generation in Aotearoa New

Zealand and is a low-carbon electricity solution with significant growth potential and continuous development of new sites built upon decades of best practice.

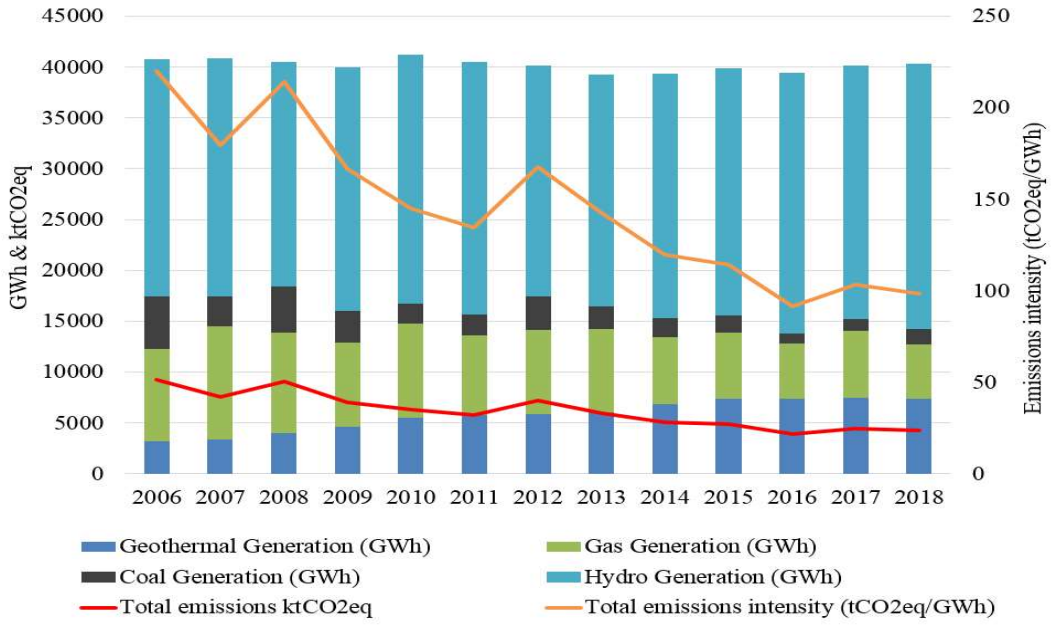
4. As the country tries to transform the energy industry through transition of industrial heating and transport to electricity-sourced energy, low-emissions geothermal energy can meet growing demand for electricity.

   We ask the Authority to include this geothermal resource in your final report and future work.

Geothermal resource is the heavy-lifter in transitioning to a low-carbon economy for Aotearoa New Zealand, and the geothermal community is committed to find innovation solutions to net-zero carbon

3. Between 2006 and 2018, increasing geothermal electricity generation by 50% has decoupled the emissions intensity in our electricity generation by 62% (see Figure 1).

Figure 1: New Zealand electricity generation by fuel types and the emissions intensity between 2006 and 2018[1].



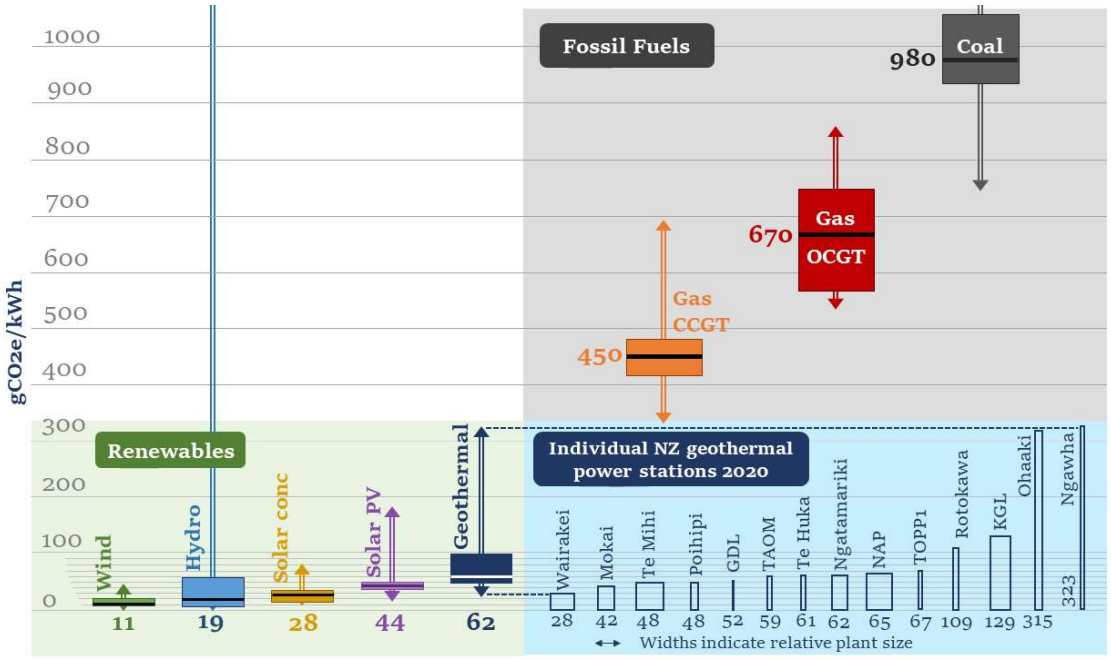
4. Unlike solar and wind, which do not produce emissions directly during operation, geothermal power stations do release CO_2e during operation. However, operational emissions are only one part of the emissions story, and there are *no zero-emission sources of energy*.

5. A full life-cycle assessment (LCA) of emissions is necessary, to include all emissions associated with materials and construction, operation, and decommissioning at the end of the project life.

[1] McLean, K. and Richardson, I. (2019): Greenhouse gas emissions from New Zealand geothermal power generation in context. Proceedings of New Zealand Geothermal Workshop, 2019.

For this reason, lifecycle emissions are used by the IPCC when comparing different energy types. All the renewable energy types, including geothermal, have lifecycle emissions at least one order of magnitude less than fossil fuels (see Figure 2 below[2]). In the case of geothermal, most lifecycle emissions come from operational releases. In the case of solar and wind, the majority are related to materials, manufacturing, and construction. Hydro is generally very low but can be quite variable, as there can be significant emissions associated with land-use change (i.e., the creation of bodies of freshwater, which emit CO_2e from breakdown of organic matter).

Figure 2: Full life-cycle emissions intensity by electricity generation fuel types (gCO_2e/kWh)



6. NZGA is currently in partnership with its corporate geothermal power plant members to establish a special project team to actively investigate reducing CO_2e emissions towards net-zero. The international geothermal industry is producing emerging technologies for CO_2e to be reinjected back to geothermal reservoirs, or captured and utilised, that could be trialled and adapted for Aotearoa New Zealand conditions.

CO_2 Emissions Reduction technology

31. The New Zealand Geothermal Association (NZGA) Emissions Working Group has been established in 2021 to facilitate cooperation, information sharing and collaboration between NZGA members to monitor, measure, manage, reduce and ultimately eliminate non-condensable gas emissions

[2] McLean, K., Richardson, I., Quinao, J., Clark, T., and Owens, L. 2021. Greenhouse Gas Emissions From New Zealand Geothermal: Power Generation and Industrial Direct Use. Proceedings 43rd New Zealand Geothermal Workshop, Wellington, NZ, 23-25 November 2021.

(CO_2, CH_4 and H_2S, which is not a greenhouse) from member organisations (owners and operators of geothermal fields).

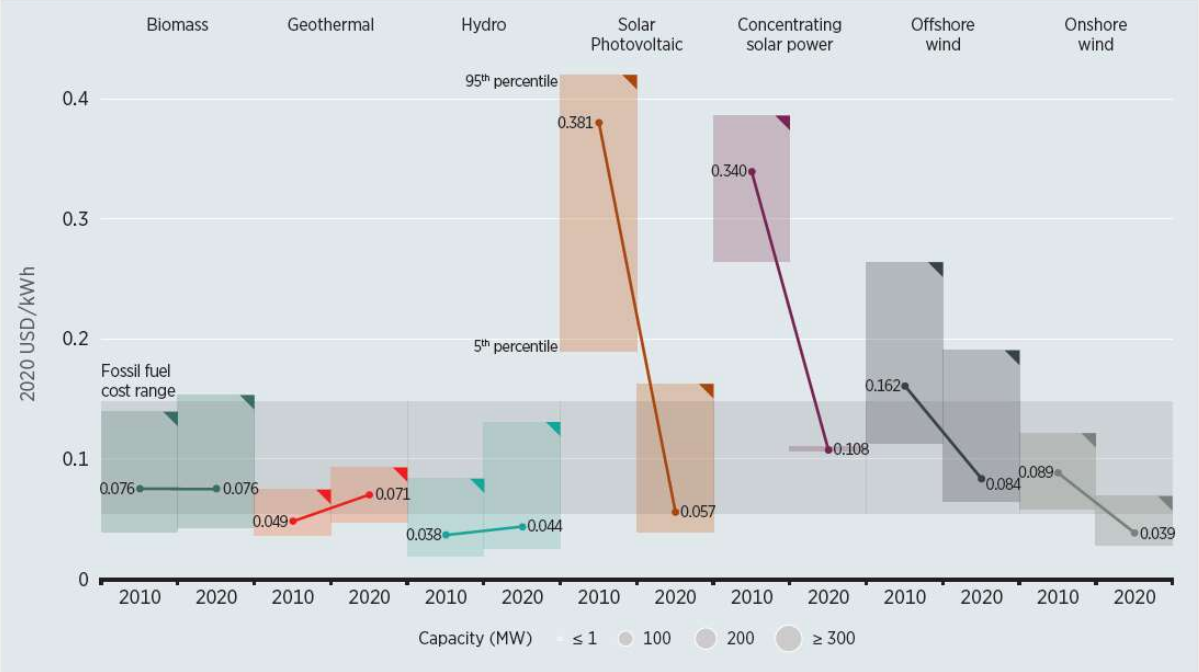
32. The Emissions Working Group provides a strong, collective industry voice and representation for the management and reduction of emissions from geothermal field operators and developers. It promotes geothermal energy use as a key renewable energy source which plays its part in meeting New Zealand's goal of net zero carbon emissions by 2050.

33. It aims to represent the interests and aspirations of the industry by applying best practice science, mātauranga Maori, engineering and technology solutions to emissions problems. The Working Group also provides a collective voice to influence and shape policy through collective industry submissions and representation to government.

Electricity generation: Geothermal is both a low-cost and reliable solution

	Total installed costs (2020 USD/kW)			Capacity factor (%)			Levelised cost of electricity (2020 USD/kWh)		
	2010	2020	Percent change	2010	2020	Percent change	2010	2020	Percent change
Bioenergy	2 619	2 543	-3%	72	70	-2%	0.076	0.076	0%
Geothermal	2 620	4 468	71%	87	83	-5%	0.049	0.071	45%
Hydropower	1 269	1 870	47%	44	46	4%	0.038	0.044	18%
Solar PV	4 731	883	-81%	14	16	17%	0.381	0.057	-85%
CSP	9 095	4 581	-50%	30	42	40%	0.340	0.108	-68%
Onshore wind	1 971	1 355	-31%	27	36	31%	0.089	0.039	-56%
Offshore wind	4 706	3 185	-32%	38	40	6%	0.162	0.084	-48%

Table 1: Total installed cost, capacity factor and levelised cost of electricity trends by technology, 2010 and 2020



Source: IRENA Renewable Cost Database

Note: This data is for the year of commissioning. The thick lines are the global weighted-average LCOE value derived from the individual plants commissioned in each year. The project-level LCOE is calculated with a real weighted average cost of capital (WACC) of 7.5% for OECD countries and China in 2010, declining to 5% in 2020; and 10% in 2010 for the rest of the world, declining to 7.5% in 2020. The single band represents the fossil fuel-fired power generation cost range, while the bands for each technology and year represent the 5th and 95th percentile bands for renewable projects.

Figure 3: Global LCOEs (Levelised Cost of Energy) from newly commissioned utility-scale renewable power generating technologies, 2010-2020 (IRENA,2021).[3]

21. Expanding geothermal generation will assist in filling the gap in electricity supply, at a time when ca. 27 petajoules of electricity generation[4] (17.5% of the current supply, for current demand) would be required if all New Zealand's fossil fuel-based plants are closed.

22. There are also opportunities to substitute electricity for fuels which currently power transport and process heat industries. World-class low carbon geothermal resources advantage New Zealand environmentally, economically, and socially. The world energy markets are showing growing interest in geothermal as a sought-after sustainable energy solution; New Zealand companies and our world-renowned experts benefit from increased global geothermal growth.

23. We believe our challenge as a nation is in ensuring that we maximise all our renewable energy resources during our transition to a low-carbon future, especially baseload renewables. Baseload geothermal energy partners with and enables other renewable energy sources, such as solar, wind, hydrogen, and biomass. Maximising geothermal development (with its high availability of 90%-99%), through a more enabling regime and policy at the national level will reduce the overbuild (and associated life-cycle emissions) likely required for ensuring reliability from variable and weather dependent energy sources, while minimising New Zealand's current reliance on

[3] https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020 (Section 4, page 5)

[4] MBIE Electricity Statistics, 2019

fossil-based sources. Increased geothermal generation will ensure that our decarbonised future will remain affordable with reliable supply.

Geothermal is the new gold and plentiful: 12,000 GWh by 2030.

24. Geothermal is an abundant energy resource in Aotearoa that the world looks to with envy. We have the second highest installed geothermal energy profile per capita in the world (second only to Iceland) and are part of the elite group of countries who have more than 1000 MWe of installed geothermal electrical capacity.

25. Aotearoa currently has more than 12 TWh by 2030 of additional geothermal electricity generation ready to be tapped, with low-carbon emission profiles. The current construction of Tauhara power station near Taupō will bring some 150 MWe online. Expansion near Rotorua is being explored at Taheke with proposals for 25MWe+, expansion at Ngawha 25 MWe+ and growth at Kawerau are the shovel-ready geothermal areas ready to contribute to our renewable energy supply.

26. Several other areas are candidates to make further contributions to the energy profile of Aotearoa, such as Tikitere, Tokaanu-Waihi-Hipaua, Reporoa, Atiamuri, Rotoma, Horohoro etc. This list includes limited development systems, and research systems where not enough is known to classify them. There are also development systems which have not been maximised (not listed). These areas all have potential for growth and expansion of geothermal resources with the additional benefit of bringing opportunities for additional industrial installation and job growth.

27. There is room for more however, as geothermal is not just industrial-scale electricity installations. There is opportunity to significantly increase the utilisation of Geoheat for industrial process heat applications and commercial operations. Heat is readily available at Taupo / Tauhara and at Kawerau. While heat is not a direct concern of the Electricity Authority, government drive for some industry to switch to electrical energy for process heat needs means that alternative heating sources such as geothermal can relieve pressure on electrical supply.

28. High-quality geothermal resources exist in Aotearoa - simply requiring the application of pilot studies, innovation, and desire to realise; the climate change emergency demands that we explore all options on the table and geothermal for all Aotearoa is one avenue to do this.

29. In the submission to Climate Change Commission (CCC), Contact Energy[5] submitted that geothermal (existing and future capacity in NZ) generation would rise to 12,000 GWh by 2030. In other words, geothermal generation would grow by 4,400 GWh from 2020 (where the total generation was 7,600 GWh). This corresponds to an increase of 462 MWe of capacity, net of any de-ratings or decommissioning.

30. The Contact Energy estimate (Table 2) represents the new generation potential provided adequate policies are in place. There are many factors that will determine how much new geothermal capacity will actually come on-line by 2030, among them: the price of carbon, the

[5] https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/submissions/organisation-submissions/

NZD exchange rate, the cost of money, project costs (including permitting), the price of wholesale electricity, the demand for electricity, and the cost of alternative generation.

31. These factors are difficult to estimate. So, the CCC's estimation, driven by the projects currently permitted and announced, represents a P50 or likely scenario, while the Contact Energy projection expresses the potential upside (P90).

32. Accordingly, NZGA acknowledges the range of potential outcomes. Clear government policy objectives will attract commercial investments to accelerate our decarbonisation pathway.

Table 2: Contact Energy 's recommendation to Climate Change Commission, March 2021

Recommendation: Model geothermal generation growth to 12 TWh by 2030	
The Climate Change Commission should factor in increased growth in geothermal. Based on our analysis, we recommend that the Commission's stated contribution of geothermal is increased to:	
2025	11 TWh
2030	12 TWh
2035	12 TWh

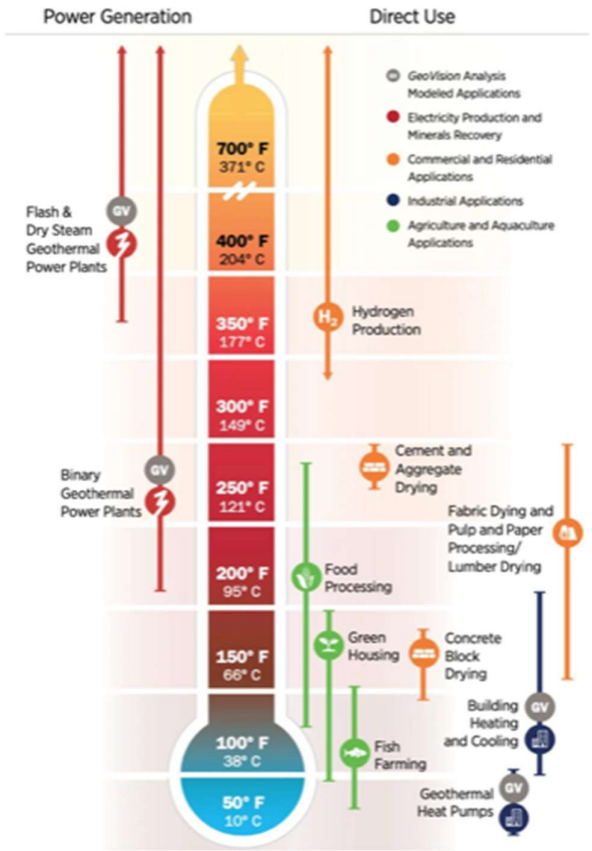
Geoheat: direct heat use and industrial process heat: off-grid, co-locate, complementarity

34. 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 heat sources that rely on carbon emissions. It also reduces demand on the national electricity grid, as it is off-grid. 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 2 below shows a schematic diagram of different applications from direct heat use.

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

Figure 2: A schematic diagram of different applications from direct heat use.[7]



35. 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.

36. Every two years, we publish the bi-annual Geo-heat Action Plan where we celebrate our achievements and report on progress and details for the next two years. We will publish the 2022-2023 Action Plan in early 2022.

[7] https://causewaygt.com/

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 and would welcome discussion with you.

Nāku noa, nā

Kennie Tsui
Chief Executive, NZGA