Attention: MDAG@ea.govt.nz

Submissions

Electricity Authority

Level 7, Harbour Tower,

2 Hunter Street, Wellington Central

16 March 2020

Submission on Issues Discussion Paper – Consultation on the Price discovery under 100% renewable electricity supply by Market Development Advisory Group

The New Zealand Geothermal Association (NZGA) would like to thank Electricity Authority for the opportunity to comment on Discussion paper: Market Development Advisory Group.

We would be happy to discuss this submission further.

New Zealand Geothermal Association

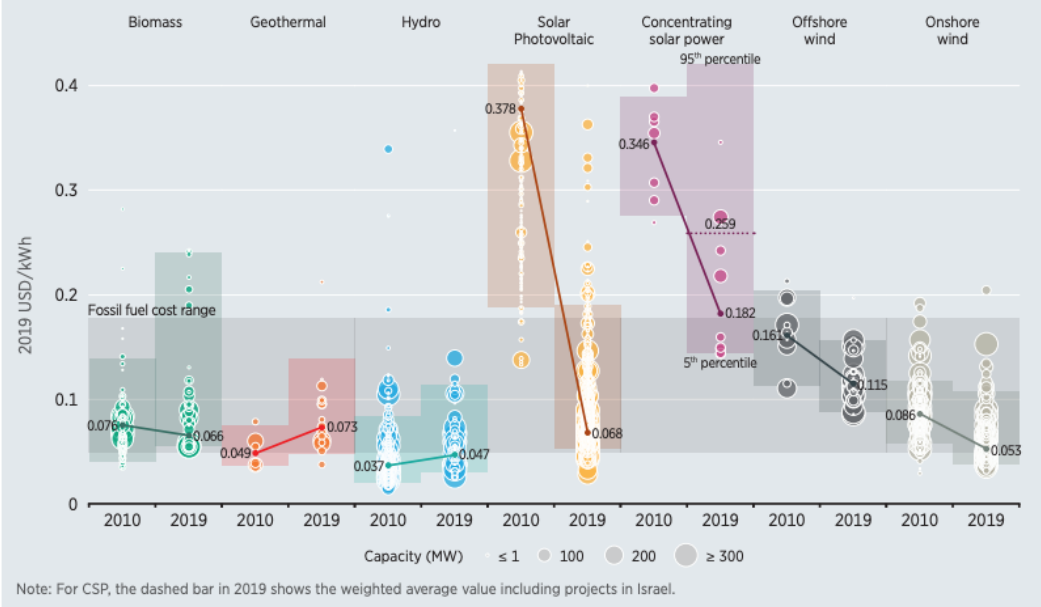
The NZGA, incorporated in 1992, is a non-political, non-government and not-for-profit organisation, with a focus on fostering a sustainable future for Aotearoa New Zealand through use, development, and protection of geothermal resources. The NZGA is an affiliated member of the International Geothermal 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, tourism, planning consultants and Māori trusts. This diverse and skilled association works, embraces and lives with geothermal resources in Aotearoa.

We agree that in order to achieve 100% renewable electricity supply a great deal of new generation and storage coupled with demand-side management will be required to meet projected demand growth and replace fossil-fuelled stations on a significant annual build for the next few decades. (para 3.5 consultation doc).

Firstly, we give background to the geothermal opportunity available.

Electricity generation: geothermal is the low-cost solution



Source: IRENA Renewable Cost Database.

Note: This data is for the year of commissioning. The diameter of the circle represents the size of the project, with its centre the value for the cost of each project on the Y axis. The thick lines are the global weighted-average LCOE value for plants commissioned in each year. Real weighted average cost of capital (WACC) is 7.5% for OECD countries and China and 10% for the rest of the world. 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 1: Global LCOEs (Levelized Cost of Energy) from newly commissioned utility-scale renewable power generating technologies, 2010-2019 (IRENA,2019).[1]

1. Expanding geothermal generation will assist in filling the gap in electricity supply, at a time when ca. 30 petajoules of electricity generation[2] (19.5% of the current supply, for current demand) would be required if all New Zealand's fossil fuel-based plants are closed.

2. 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 experts benefit from increased global geothermal growth.

3. 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

[1] ISBN 978-92-9260-244-4 Citation: IRENA (2020), Renewable Power Generation Costs in 2019, International Renewable Energy Agency, Abu Dhabi.

[2] MBIE Electricity Statistics, 2021 Quarterly electricity generation and consumption.

required for ensuring reliability from variable and weather dependent energy sources, while minimising New Zealand's current reliance on fossil-based sources. Increased geothermal generation will ensure that our decarbonised future will remain affordable.

4. With this background we bear in mind that the question was about effects on price volatility in the market.

The effects on price volatility in the electricity market (Response to Questions 1 & 2)

5. Spot market price volatility can be broken into several elements. There is a relatively small and self-cancelling effect from wind generation (and future solar generation) being roughly, but not precisely predictable in timeframes of the market. Increased wind and solar power will likely increase this effect, but it essentially creates noise around a mean. We note that the consultation document assumes that this noise will become more significant as a source of price volatility, but reserve judgement.

6. The greatest swings in market price result mainly from hydro scarcity, though temporary constraints on gas supplies have had a recent effect. Hydro has a critical role in shaping generation to match daily demand and has been our dominant form of generation through the history of our transmission grid. Rather than hydro creating a moderating effect, hydro price signals have been the principal source of volatility, particularly the big swings heading into dry years as observed in the past few decades.

7. Geothermal power and wind are offered into the market at close to a zero price (as will solar), but receive the final price needed to match total generation to total demand. So, in a 100% renewable electricity system, hydro is likely to continue to be the prime source of price signal, and therefore the source of any volatility.

8. Modelling undertaken by the EA indicates that wind and solar may be sources of short-term volatility in price. Both have a degree of predictability within the timeframes of the market allowing all offers to be set accordingly. Will wind and solar generators set their offer prices at short run marginal cost or leave them set at zero, riding out the losses until days become windier or brighter?

9. The target that is sought is 100% renewable electricity. Assuming this is achieved, consider what will happen in a year (or part of a year) when it appears excess water may be available. All generators, including hydro generators will want to ensure dispatch so offers will be lowered to try to achieve some value for generation rather than spilling generation, and very low prices will be achieved. This has been demonstrated in some of the modelling work as a background to the EA consultation. These low prices could be present for multiple years until a dry year is clearly present.

10. However, when the dry years come, the generators must use price premiums to ensure that costs of owning and maintaining generation are adequately covered. If prices in the market have been low for a long time before this, then sustained medium prices or very high peak prices will be needed to recover these costs.

11. If market interventions are introduced to suppress these peak prices, then several distortions could result:

    - Price signals that would justify new generation will not be present. If a generator cannot recover its costs for building new plant, it will not build new plant or delay new developments.
    - The suppressed wholesale price will guide consumer choices:
        - This could lead to inefficient use of electricity due to its low price and unnecessary spilling might occur or other adverse behaviours.
        - Knowing that price is suppressed, it could encourage consumers to avoid hedging, including avoiding purchase of long-term contracts that could have otherwise underwritten new generation – leaving them exposed in the dry years.
        - Positively, it could encourage the switching to electricity for process heat and transport.
        - It may encourage the proliferation of independent retailers, such that the migration of customers from the gentailers could undermine to self-hedging otherwise possible (until the dry years).

12. The EA discussion documents have covered the possibility of new capacity markets in which generators are paid to build additional generation, for which a price will be paid to have generation available but not normally generating. We note that discussion documents indicate that this could result in a greater part of the market effectively being regulated.

13. Having said that, there may be a special place for geothermal fields in a new capacity market. While geothermal operations are sustainable, the natural fields are disturbed by operation. Suggestions have been made that fields could be usefully rested after a period of use – the suggestion being to rest fields longer than they have been operating. From this perspective, the geothermal reservoir could recharge (a term that precedes any battery discussion) in a similar way to a battery. Mothballed stations or underutilised capacity could then be called upon when needed. The concept could be applied to a fully rested field for which recharge will be happening, or to a field for which capacity is capped below allowable consents so is discharging below capacity.

Market design (Response to Question 3)

14. You have asked "Do you agree that in a 100%RE system there will be many diverse and disaggregated resources to coordinate, and that a wholesale market will be the preferred mechanism to coordinate plans and actions among all the resource owners?" NZGA prefers to comment on the potential role for geothermal developments in our future generation mix rather than specifics of market design.

Ancillary services with 100% renewable electricity (Response to Question 5)

15. We note the discussion on ancillary services has inbuilt assumptions which are not correct for geothermal generation. Some papers (e.g. Dr. Batstone's Price Discovery paper) have suggested that replacement of thermal stations with RE generation will result in loss of inertia due to the non-synchronous nature of RE

generation. We point out that geothermal generators are normally synchronous, again emphasising the benefits of maximising geothermal generation.

Demand-side flexibility with 100% renewable electricity (Response to Question 9)

16. NZGA is supportive of demand-side management and flexibility overall. However, the discussion misses an important point about how the demand-side is managed. There will likely be good opportunities to reprofile load when electric vehicles become a greater part of the market, able to charge in otherwise low demand periods and feed back into systems at high load times. However, the current situation can involve use of emergency diesel generators or substitution of electric heating with fossil-fuelled heating rather than load shifting. As such, demand-side management can be a Trojan horse for inefficient high emission fossil-fuel use "hidden" on consumer premises. This type of load management would undermine the principle of the 100% RE target which we want to achieve. We would encourage EA to explore how consumers can use tools (e.g., digital monitoring) to effectively lower and manage demand when pricing signals indicate consumers need to be proactive.

Other 'lumpy' issues that warrant specific consideration in the transition to 100%RE? (Response to Question 12)

Topic (1): Potential for geothermal to generate in a load-following manner, to compensate for intermittency of other electricity sources.

17. Geothermal power plants, having high CAPEX and low OPEX, are usually operated in as close to baseload operation as possible.

18. They achieve higher capacity factors than any other type of power plant, often over 95% in Aotearoa. From a technical perspective, it is possible to operate geothermal power plants in a load following manner.

19. Generally, this is achieved as the load is reduced by diverting steam to a silenced atmospheric vent (usually a rock muffler) because the original steam source (the wells) cannot respond as quickly as conventional boilers. Steam venting can easily occur as quickly as the load change on the turbine. Obviously, the vented steam represents a loss of energy and hence a potentially significant decrease in overall thermal efficiency.

20. Following a load reduction, load increase may be slightly slower if production wells have been throttled as they will take longer to re-open without causing flow instability problems in the steam supply system (wells and separators), although if the load increase is programmed (e.g., to correspond to an expected diurnal increase in the early morning) then the throttled wells can be opened in advance of requirement.[3]

[3] https://www.mbie.govt.nz/dmsdocument/11334-future-geothermal-generation-stack

Topic (2): Potential to overbuild geothermal in a load-following manner and using excess resources to produce alternative energy sources.

21. If green hydrogen is to become a significant player in the energy of the future for Aotearoa New Zealand, it must be produced using renewable energy sources. Hydrogen provides the connecting point between renewable electricity production and transportation, storage and portable energy needs. Geothermal energy provides an affordable, clean method of generating electricity and providing thermal energy. In this regard, there is potential to overbuild geothermal in a load-following manner and using excess resources for hydrogen production and liquefaction can be proven to be effective option in the future hydrogen structure. [4]

Topic (3): Geothermal is the new gold and plentiful: 12,000 GWh by 2030.

22. 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 1,000 MWe of installed geothermal electrical capacity.

23. Aotearoa currently has more than 12 TWh additional geothermal electricity generation ready to be tapped by 2030 with low-carbon emission profiles. The current construction of Tauhara II 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.

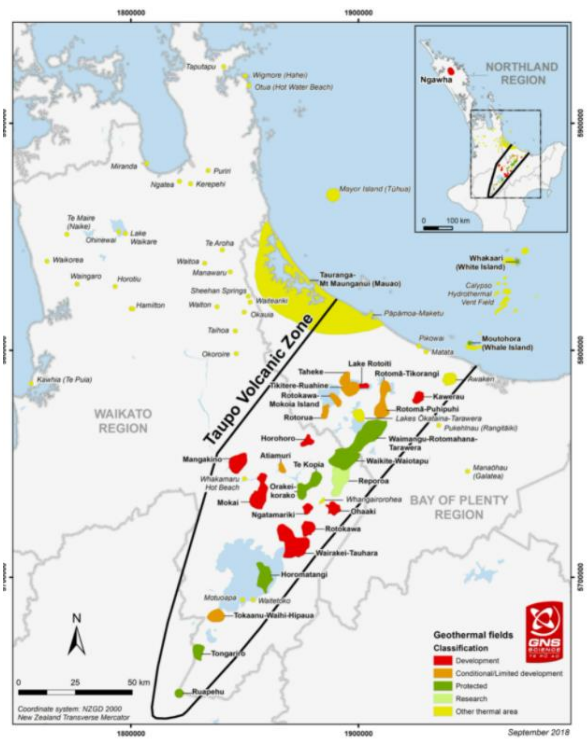
24. Several other areas are potential sites for growth such as: Tikitere, Tokaanu-Waihi-Hipaua, Reporoa, Atiamuri, Rotoma, Horohoro etc. (This list includes limited development systems, and research systems where not enough is known to classify them). There are also development systems which have not been maximised, that are candidates to make further contributions to the energy profile of Aotearoa. 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.

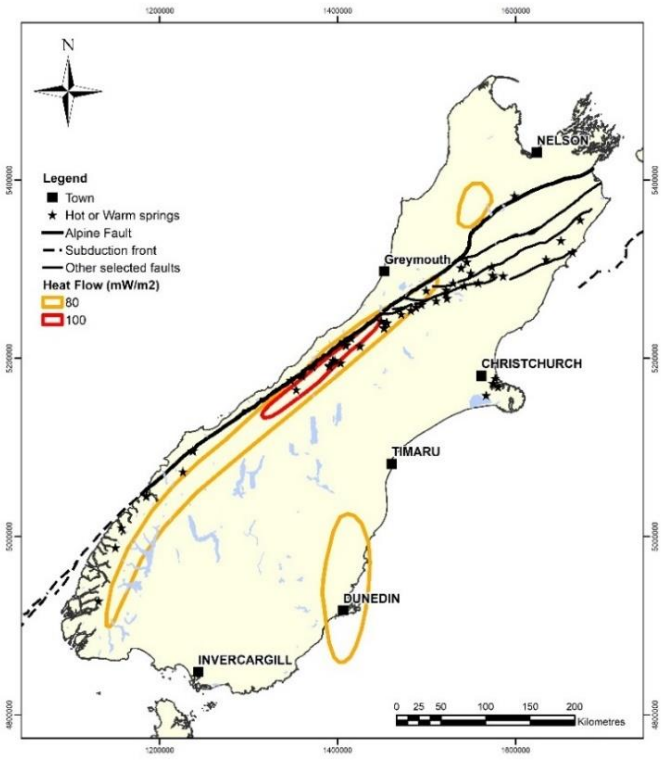
25. There is room for more however, and this is not just in industrial-scale electricity installations. There is opportunity to significantly increase the utilisation of Geoheat for industrial process heat applications and commercial operations. Heat is readily available at Taupo / Tauhara and at Kawerau. From this perspective there will be an interplay between electrification and geoheat in meeting existing and new heating needs.

26. The maps below illustrate just how high-quality a geothermal resource exists in Aotearoa, it is simply needing 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.

[4] Geothermal energy use in hydrogen production. https://jten.yildiz.edu.tr/storage/upload/pdfs/1636986334-en.pdf

Figures 1 and 2: Aotearoa geothermal heat map:





27. In the submission to Climate Change Commission, 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.

28. Contact Energy estimate (Table 1) 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 are: the price of carbon, the 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.

29. 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).

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

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

Table 1: 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

Key areas of opportunity or challenge (if any) will arise in the wholesale electricity market with 100%RE that are likely to have a significant impact in relation to achieving the statutory objective of the Authority. (Response to Question 14)

31. Geothermal developments are ideally base loaded, and yet a significant portion of our baseload demand is met with hydro supplies. Baseload generation for baseload demand makes sense and will help to minimise overbuild in a 100% RE system. This then enables hydro stations to eke out their storage for much longer.

32. If we do achieve 100% RE, as outlined in the discussion document that will mean some spillage of hydro or wind, or reduction of geothermal generation at various times and especially during a wet year. NZGA includes a number of Māori interests. We would therefore encourage active debate on whether spillage or geothermal resting constitutes waste or restoration of the mauri of the resource. Increased use of sustainable geothermal resources in Aotearoa New Zealand is a key outcome for the NZGA, and we aim to deliver to local, regional, and national targets for decarbonisation, infrastructure development, support of Māori economic prosperity, and workforce growth.

33. We note that in the case of hydro generation, (with excess generation capacity), then operational approaches may be smoothed and profiled to run-of-river operation for some periods. For wind generation, blades are often feathered in high wind situations, so spillage can be inherent in normal operation. For geothermal resources, beyond venting and throttling to enable some load-following, there is opportunity to rest fields (or parts of fields) for periods to allow a return towards undisturbed state, though such action would need to be supported with capacity payments. Such a debate is not likely to resolve to a single view, but the discussion will be valuable in bringing out the breadth of perspectives that should be considered by all those having a kaitiaki role over our resources.

Next stage of the process (Response to Question 8)

34. NZGA agrees that the Electricity Authority should take forward to the next stage of the process (options identification and analysis) the measures referred to in para 3.43. We welcome the opportunity to continue engaging with the Authority.

Conclusion

Reaching 100% renewable electricity supply by 2035 and meeting our net carbon zero target 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

Dr. Paul Siratovich

President, New Zealand Geothermal Association

16 March 2020