19 April 2024

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Submission on the Fast-Track Approvals Bill

The New Zealand Geothermal Association (NZGA) would like to acknowledge the Coalition Government for the introduction of the *Fast-Track Approval's Bill* as part of the Government's 100-Day plan.

Geothermal[1] is an Aotearoa New Zealand icon and has been part of Māori culture for generations. Geothermal is an iconic kiwi symbol. Geothermal stories and geothermal energy have been part of Māori culture for generations, and geothermal is entrenched in our modern history. Over the past 70 years, geothermal has been a vibrant, proven, indigenous renewable resource, which enables other industries to thrive and our regions to grow. Through this period the significance of the kaitiaki role of Māori of this taonga has been progressively recognised.

New Zealand Geothermal Association (NZGA)

1. 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 connects with global geothermal communities and is well positioned to positively influence geothermal initiatives on the international stage.

2. NZGA membership comprises ca. 500 individuals, as well as 34 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.

Purpose and Our recommendations:

3. We acknowledge the purpose of the Fast-Track Approvals Bill is to 'provide a streamlined decision-making process to facilitate the delivery of infrastructure and development projects with significant regional or national benefits".[2] And therefore, the outcome of the Bill should result in reduced time and cost to get infrastructure and other development projects up and running compared to the current Resource Management Act status quo.

4. In alignment with New Zealand's climate goals, geothermal resources in electricity generation and energy supply will continue to play an increasingly important role. The NZGA advocates for a balanced approach that prioritises

[1] The reference to 'Geothermal' throughout this submission is a term that is used to describe both low enthalpy resources (potentially down to ambient conditions for geothermal heat pumps), and high enthalpy conventional geothermal resources (<3.5 km deep with reservoir temperatures <350°C).
[2] Fast-Track Approvals Bill, Explanatory Note.

economic prosperity, environmental stewardship, and social wellbeing. To this end, we make the following recommendations:

- **Recommendation 1: Eligibility Criteria Enhancement**. We propose the eligibility criteria for projects should include environmental effects analysis to ensure that developments contribute to economic growth while fostering sustainability and improving wellbeing for New Zealanders for referral and approval for both Track 1 and Track 2.
- **Recommendation 2: Expert Panel Diversity**. Expert panels should include expertise on Mātauranga Māori, respecting and integrating indigenous knowledge systems into decision-making processes.
- **Recommendation 3: Final decision-makers**. It is crucial to ensure that all aspects of sustainable management (i.e. use, development and protection) are considered appropriately. To ensure a robust decision-making process and reduce litigation risks for the Crown (and applicants), we recommend that the expert panels be the final decision-makers for both Track 1 and Track 2 applications.
- **Recommendation 4: Transparency in Decision-Making:** If, contrary to Recommendation 3, Ministers remain decision makers, they should publicly disclose their final decisions, along with reasons for any divergence from expert panel recommendations based on legal grounds. This transparency ensures impartiality and foster rigorous scrutiny during the decision-making process.

Conclusion

Recognising and harnessing the vast potential of Aotearoa New Zealand's geothermal resources is critical to addressing the key challenges outlined in the consultation document.

We would be happy to answer any further queries.

Yours sincerely | Nāku noa, nā,

Kennie Tsui

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Acknowledgements

The New Zealand Geothermal Association wish to express our gratitude to all those who guided us in preparing for this submission. We would like to thank those who provided information, data, knowledge during meetings, discussions, and reviews. The insight and expertise have been invaluable to us.

Appendix 1.1 Geothermal baseload electricity generation for over sixty years.

Reliable, renewable, low carbon baseload generation

5. Geothermal has been decarbonising the New Zealand electricity sector for over sixty years, operating at close to 90% capacity factor. It therefore provides reliable, renewable, low carbon baseload generation, producing power at a constant rate regardless of weather or climatic conditions.

6. Over the decade from 2006-2016, the overall greenhouse gas emissions intensity of New Zealand's electricity sector approximately halved, due to displacement of fossil-fuel based generation, primarily by geothermal. [3]

7. To enable further decarbonisation of the electricity grid, with geothermal energy acting as the potential primary renewable electricity baseload option, replacing gas/coal, and thus (unlike other renewables) does not require an overbuild of infrastructure or massive storage assets to ensure reliability.

Significant Geothermal generation potential

8. 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 2: Projects Under Construction

Field / Project	Capacity (MWe)	OEM	Forecast COD	Developer	Comments
Tauhara	184 CST-TF	Fuji Electric	Q3 2024	Contact Energy	Commissioning began in Q2 2024
Tauhara Te Huka U3	50 ORC	Ormat	2024	Contact Energy	Civil works and design underway

[3] McLean and Richardson, 2019: GREENHOUSE GAS EMISSIONS FROM NEW ZEALAND GEOTHERMAL POWER GENERATION IN CONTEXT, NZGW conference paper

Table 3: Projects Under Development

Field / Project	Capacity (MWe)	Forecast COD	Developer	Comments
Nga Tāmariki OEC5	50 ORC	2026	Mercury (NZ) Ltd	Financial Investment Decision achieved in Oct 2023
Ngāwhā OEC5	32 ORC	2028	Ngāwhā 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	25 ORC	2025	Eastland Generation Ltd & Ngāti Tūwharetoa Geothermal Assets	FEED ongoing

Table 4: Potential Greenfield Projects

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

Key to Abbreviations

CST–TF = condensing steam turbine – triple flash

COD = commercial operations date

ORC = Organic Rankine Cycle (binary)

FEED = front end engineering design

Appendix 1.2. Reducing Geothermal lifecycle emissions by capturing CO_2 and reinjection towards zero emissions geothermal power plant

9. The MWe-weighted average operational emissions intensity of the 14 geothermal power stations in the below Table 5 is **63 gCO2-e/kWh(net) for CY2022**.

10. The full lifecycle CO_2-e emissions from New Zealand geothermal power stations for CY2022 are also estimated in Table 5. The full lifecycle emissions for geothermal can be estimated by adding 10 gCO2e/kWh(net) to account for emissions associated with materials and construction, maintenance, and decommissioning[4].

11. The overall MWe-weighted average lifecycle emissions intensity is 73 gCO_2-e/kWh(net). Other sources of energy are compared on the basis of median lifecycle emissions intensity, which is 64 gCO2-e/kWh(net) for NZ geothermal in 2022 (Table 5). This compares to lifecycle emissions from other renewables of 44 for solar photovoltaics, 19 for hydro and 11 for wind (median lifecycle emissions intensity). Fossil fuels have median lifecycle emissions intensities an order of magnitude higher, of 450 gCO2e/kWh(net) for gas combined cycle plants and 980 for coal (McLean and Richardson, 2021). Figure 2 compares the lifecycle emissions intensity of all fuels in Aotearoa New Zealand (2022 calendar year).

[4] Fridriksson, T., Merino, A.M., Orucu, A.Y. and Audinet, P. (2017): Greenhouse Gas Emissions from Geothermal Power Production. Proceedings 42nd Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 13-15, 2017.

Table 5 Full lifecycle CO2-e emissions from NZ geothermal power stations for CY2022

Year - 2022								
	DATA INPUT							
Station	Total Steam, t	UEF t CO2e/t stm	Net Generation GWh	Average MW for CY2021	Total Em. t CO2e/an	Emissions rate t CO2e/day	Operational emissions intensity gCO2e/kWh(net)	Estimated lifecycle emissions intensity (operational E.I. +10) gCO2e/kWh(net)
Wairakei A&B and binary	8,575,775	0.0022	1013.1	116	18,867	52	19	29
Te Mihi	11,502,092	0.0044	1384.1	158	50,609	139	37	47
Poihipi	2,487,258	0.0049	317.1	36	12,188	33	38	48
Ohaaki	2,686,088	0.0333	317.2	36	89,447	245	282	292
Te Huka	1,331,899	0.0073	199.4	23	9,723	27	49	59
Rotokawa	1,161,833	0.0119	244	28	13,826	38	57	67
Nga Awa Purua	7,121,629	0.00871	1114	127	62,029	170	56	66
Mokai	4,716,085	0.00418	778	89	19,713	54	25	35
Ngatamariki	4,071,925	0.00728	735	84	29,644	81	40	50
Kawerau	6,679,817	0.0169	896	102	112,889	309	126	136
TOPP1	912,708	0.0102	126	14	9,310	25	74	84
TAOM	1,088,322	0.0106	194	22	11,536	32	60	70
GDL	304,734	0.0119	68	8	3,626	10	53	63
Ngawha (OEC1-3)	697,890	0.0442	191	22	30,847	84	162	172
						MEDIAN	54	64
						25th PERCENTILE	39	49
						75th PERCENTILE	70	80
						MW WEIGHTED AV	**63**	**73**

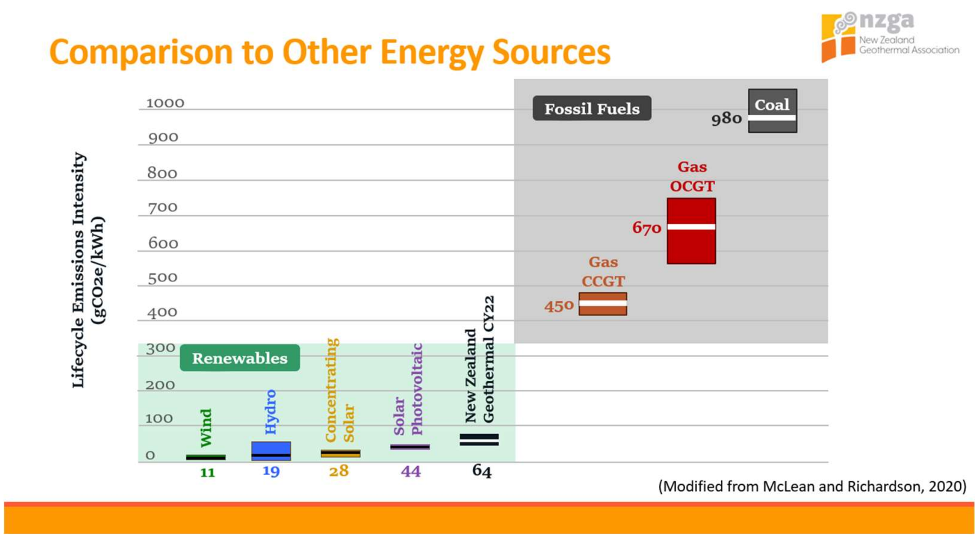

Figure 2: Lifecycle emissions intensity of all fuel types in Aotearoa New Zealand (CY2022)[5]

12. Geothermal emissions intensity in New Zealand has an ongoing declining trend. The 8-year trend of data from 2015 through to 2022 shows a decline rate of **6% per year** in the overall emissions intensity of the industry (Figure 3).

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

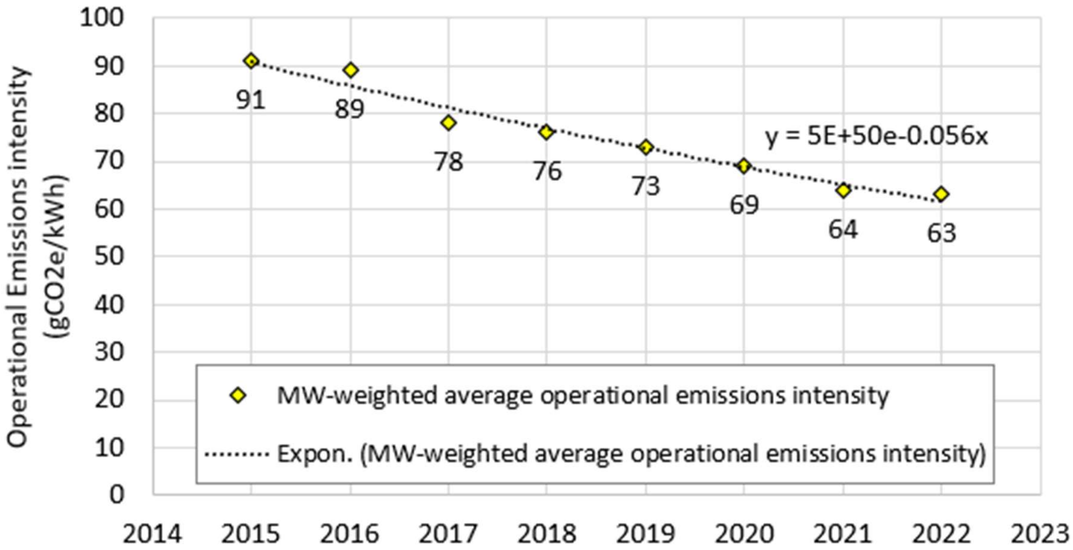

Figure 3 Steady decline of MWe-weighted average emissions intensity for seven years from 2015 to 2022

13. Also there will be step changes downwards, as geothermal operators have embarked upon projects/programmes to return the gases back underground to where they came from, dissolved in the reinjected geothermal water.

14. The CO_2 reinjection technology diverts the CO_2 gas stream (along with CH_4 and H_2S) from venting to the atmosphere and instead dissolves the gases in water (separated geothermal water and/or condensate) where is carried back underground to where it came from, via the usual reinjection system.

15. All the major geothermal companies in New Zealand have active trials, or plans for, CO_2 reinjection since 2021. This includes Mercury Energy, Contact Energy, Ngāwhā Generation and Eastland Generation, which together represent 96% of New Zealand's geothermal electricity generation. These trials have been successful to date and are anticipated to continue into the future, where they will come to be reflected in the emissions intensity values for those power stations.

16. Plans are underway for similar projects in more geothermal power stations.
    - Contact Energy's trial of CO_2 reinjection at the Te Huka power station became fully operational in November 2022. The plant is currently reinjecting 100% of emissions with no detrimental effect on the plant or reservoir. When CO_2 reinjection is not being utilised the emissions from Te Huka are around 8,000 tonnes of CO2-e annually.
    - Ngāwha Generation has 100% CO_2 reinjection at Stations 1 and 2 (OEC1-3), which came into operation from May 2022 to January 2023. The new Station 3 (OEC4) has been at 70% reinjection since April 2023 and will transition to 100%.
    - Eastland Generation plans to transition to CO_2 reinjection at its Te Ahi O Maui power station and TOPP1 by 2025.
    - Mercury Energy Ltd commenced a trial of CO_2 reinjection at Ngā Tamariki Power Station near Taupō in October 2021, the first trial in NZ. This involved full injection of gas emissions from one of the four OEC units (therefore

a ¼ reduction in emissions), added into the brine-condensate reinjection fluid, and reinjected. One quarter of the emissions from Ngā Tamariki represents around 9,000 tonnes of CO_2e annually. This trial proved successful, with the ongoing carbon reinjection process showing no disruption to power generation or detrimental effect on the underground reservoir environment and geothermal well performance[6]. Mercury is now evaluating whether a similar technology can be extended to more units at Ngā Tāmariki and to Mercury's other geothermal power stations.

17. Another opportunity exists to utilise CO_2 from geothermal power plants to enhance growing conditions in greenhouses. For example, during 2022 the Rohe Hothouse scheme successfully won consent for 18Ha of glass-house capacity at Ohaaki geothermal field. This greenhouse will use heat and CO_2 from the Ohaaki Power Plant to enhance growing conditions.

18. NZGA Industry Emissions Working Group was established in 2021. This provides 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 2023, it involves all of the owners/operators of geothermal power stations in NZ.

Appendix 1.3 Geoheat: direct heat use and industrial process heat: always-on, off-grid, co-location, complementarity

Geo-heat Strategy and Action Plan objectives

19. In 2017, the NZGA published the Geo-heat Strategy[7] 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).

20. About 60% of process heat demand in Aotearoa New Zealand is supplied from fossil fuels, mainly coal or natural gas (MBIE 2019). Therefore, in order to meet the 50% economy-wide target for renewables by 2035, considerably more progress is needed in the industry sector. The importance of this Strategy therefore, is that it provides guidance and drive towards increasing uptake of geothermal direct use which can in turn displace heat sources that rely on fossil fuels and produce carbon emissions.

21. In 2018, The Interim Climate Change Committee was established to consider how New Zealand could transition to 100% renewable electricity and a low-emissions energy future. It concluded that achieving the goal of 100% renewable electricity, especially the last few per cent, could be costly.

22. It recommended that New Zealand should instead pursue an electricity system 90-95% based on renewables and prioritise decarbonisation of industrial process heat and transport. The modelling behind the report included scenarios with ambitious levels of electrification of process heat to 2035.

[6] Ghafar, S.A., Allan, G., Ferguson, A., Siega, F., Rivera, M. and Murphy, B. (2022): *Non Condensable Gas Reinjection Trial at Ngatamariki Geothermal Power Plant*. Proceedings 44th New Zealand Geothermal Workshop, 23-25 November 2022, Auckland, New Zealand.
[7] https://nzgeothermal.org.nz/app/uploads/2017/06/Geoheat_Strategy_2017-2030__Web_Res_.pdf

23. 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. It should be noted here that the **South Island**, although lesser known for geothermal resources, **does in fact have geoheat resources** and several geothermal direct use applications including Christchurch Airport geothermal heating and cooling, pools and spas for bathing. For example, Maruia Hot Springs on the West Coast, and Hanmer Springs Canterbury.

24. 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]. The Strategy and associated Action Plans are designed to be directive, yet flexible, incrementally evolving as efforts reveal the next best steps in the rapidly changing business and energy sectors in New Zealand.

25. There are many success stories of Geoheat use in Aotearoa New Zealand and, by increasing uptake, we envisage that Aotearoa New Zealand can continue to be a market-leader in geothermal innovation and sustainable utilisation of this native energy resource.

Diverse range of applications

26. Geoheat can deliver temperatures from chilled (4 ˚C) to around 220 ˚C and is on point with particularly relevant characteristics for energy requirements in today's energy sector environment, being: renewable, low carbon, cost-effective, always available, proven at scale and low risk.

27. Fostering Geoheat uptake is primarily associated with geothermal operations in the Taupō Volcanic Zone in the Kawerau, Taupō and Rotorua Districts, where there are existing developed geothermal reservoirs. A diverse range of operations in these districts already use Geoheat, including timber processing, pulp & paper products, dairy product manufacturing, large-scale hothouses and aquaculture.

28. Geoheat examples such as Nature's Flame demonstrates complementarity with other renewables. Nature's Flame produces biofuel pellets from wood waste residue. it is co-located with developed geothermal industry in the Taupō District and they converted their heat processes from using waste biomass to Geoheat in 2020. This highlights the potential for Geoheat to not only supply heat energy to co-located processing and production industries, but to also be used to produce other renewable energy sources that can be exported.

29. Even more widespread use could be made of geothermal heat pumps as highly efficient heat providers almost anywhere in New Zealand. These systems are effective in supplying greater than 3 units of heat (or cool) for one unit of electricity, they are being adopted extensively in Europe as part of the energy transition being pursued by the European Commission. In some circumstances and for larger facilities they can provide some support for grid stability and line capacity management through central control of some of the operations.

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

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

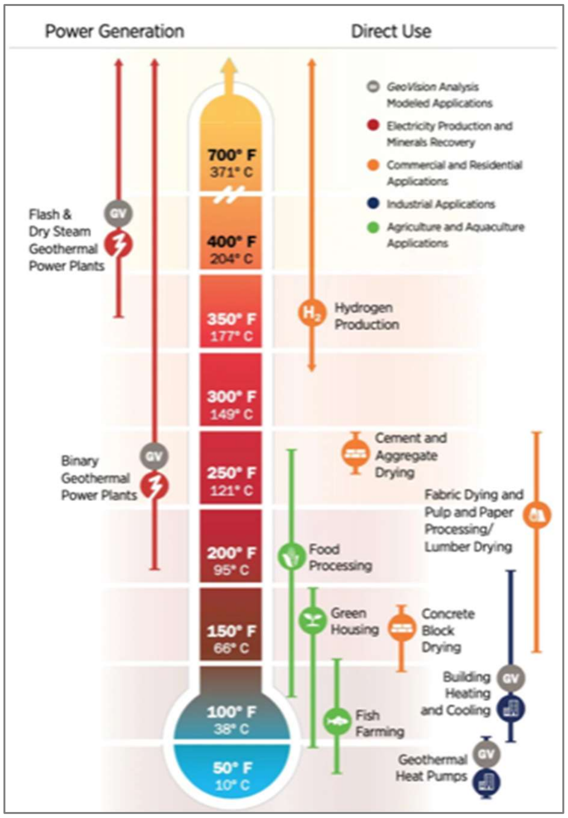

Figure 4: A schematic diagram of different applications from direct heat use.[9]

Cost-effective, sustainable solution

30. Geoheat is available now at many locations in Aotearoa New Zealand, and is a cost-effective, sustainable solution for industrial applications ranging from small (few megawatt) to large (100 megawatt) scale and should be considered as a viable alternative to traditional fuel sources whether for new ventures or decarbonising established operations. The Geoheat Strategy has been firmly embraced as an enabler by the economic development agencies in the Bay of Plenty Region (Bay of Connections) and the Taupō District (Amplify) which are actively involved, as are a range of Māori-owned entities, consultants, commercial businesses, research organisations and government agencies.

31. The food and beverage industry is New Zealand's largest export sector. Provision of geoheat to the agri-food sector in New Zealand prevents the agri-food businesses being subjected to high energy prices if the heat was otherwise run on fossil gas or electrified. Geoheat - the direct use geothermal energy - is the lowest cost of any fuel type in delivering energy to an industrial process in New Zealand, as highlighted in the table below.

Table 6 Cost of fuel types in delivering energy to an industrial process in New Zealand

Fuel Type	$/GJ	Carbon Factor tCO2e/GJ	Carbon costs[1]	Conversion Factor[9]	Total Cost $ / GJ Delivered
Geothermal - Direct	**8**	**0.0070**[2]	**$0.60**	**0.83**[3]	**$10.36**
Biomass	8	0	$0.00	0.64	$12.50

[9] https://causewaygt.com/

Electricity - Heat Pump	45	0.0265[4]	$2.25[5]	3.5	$12.86
Gas	9	0.054[7]	$4.59	0.85	$15.99
Wood Pellets	14	0	$0.00	0.81[8]	$17.28
Coal	6	0.0944[6]	$8.02	0.81	$17.31
Electricity - Heat Pump	45	0.0265[4]	$2.25[5]	2.5	$18.00
Electricity - Resistance	45	0.0265[4]	$2.25[5]	1	$45.00

1 Carbon units at $85/tonne – Jarden Securities limited - https://www.commtrade.co.nz/ Downloaded 5 September 2022.
2 Kawerau Industrial emissions factor (steam) from Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 Geothermal p74 Table 6 Part A - 0.0194 times 1000/2780 to convert to t/GJ
3 Using Geothermal steam - computed from geothermal steam (2780j/g) condensed to 100 C liquid (461j/g)
4 MBIE data for 2019 – 157.75 PJ of electrical energy and 4,181.26 kt CO2 equivalent emitted– Carbon factor is 0.0265 tCO2e/GJ
5 Carbon cost associated with electricity is included in the purchase price for electricity. User does not pay this as an additional charge under the Emissions Trading Scheme.
6 Emissions factor for lignite from the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 (SR 2009/285) p73 Table 2
7 Emissions factor for natural gas from the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 (SR 2009/285) p75 Table 10
8 Wood pellet conversion efficiency set to be the same as coal
9 Factor applicable for delivery of heat energy and not for conversion to electricity

The basic data for the table was assembled in late 2021 with an update in electricity, natural gas and the unit carbon price as of September 2022. Base fuel pricing is currently quite dynamic as different fuels experience different demand and supply pressure.

Co-location

32. A new industrial estate is being developed in Taupō, called He Ahi, the Tauhara Clean Energy Park. Users will have the opportunity to tap into geothermal energy to power their activities. The 45-hectare site is located in the existing industrial area on the northern edge of Taupō town. The land is co-owned by several local iwi groups and is subdivided into numerous sections. Each site will be specifically designed and built to meet the requirements of the tenant. Contact Energy Ltd. will supply geothermal energy to the tenants from the existing infrastructure associated with the nearby Te Huka geothermal power station.

Reliable data

33. Low awareness is a substantial barrier to increasing the diversification of geothermal resource use in New Zealand[10]. Showcasing existing applications is one way to raise awareness, promoting potential business uses and opportunities. Successful implementation of direct use development also requires financial data on economic viability, market drivers and sound business cases to be developed by the potential user. Moreover, reliable data is necessary on both energy use and employment for projects established to track progress of the geoheat strategy. More detail on the Geoheat Strategy and the implementation approach can be found in Climo et al., (2020)[11].

34. Furthermore, the quantification of geothermal resources economic value[12] provides policy makers with a framework for considering the impact of resource management decisions and assists economic development agencies and investors to better understand the opportunities. Direct use data can be used to support economic studies, as well as the creation of multipliers for industries where quantitative information is less readily available, for example, horticulture, fish farming and honey processing.

[10] Carey, B., Climo, M., *Watt? A Geoheat Strategy For New Zealand*. Proceedings of the NZ Geothermal 34th Workshop, 19-21 November 2012, Auckland (2012)
[11] Climo, M., Blair, A., Carey, B., Bendall, S. Daysh, S. *Driving the Uptake of Geothermal Direct Use in New Zealand: Successful Strategies, Empowered Champions, and Lessons Learnt Along the Way.* Proceedings World Geothermal Congress 2020, Reykjavik, Iceland, April 26 – May 2, 2020. (2020)
[12] Barns and Luketina, 2011; Conroy and Donald, 2013; Luketina et al., 2016

35. Historically, geothermal research and data collection in New Zealand has focused on high temperature resources and electricity generation, while direct use and lower temperature geothermal research has been more ad-hoc[13].

36. A fundamental limitation to reporting, past reviews and geothermal energy use assessments in New Zealand, has been that the direct use data sets are incomplete, much is estimated, and the data is of variable quality. The most accurate data is associated with the larger use industrial installations, where flow (and energy) metering are often linked to industrial/commercial supply contracts and/or resource consent monitoring. Commercial, domestic, and small mineral bathing uses are the least well defined, less monitored, with estimates often based on consented take, coupled with known resource and use characteristics. Smaller users are often unaware of the thermal capacity or the daily to annual energy delivery from their heat producing facilities. Also, for 'Permitted' uses (or any other uses that are unconsented), there is usually no requirement to submit monitoring data[21].

37. Geothermal resource consent applications require the developer to pay the costs of exploration to acquire data required for the resource consent application. A thorough investigation must be undertaken but with no right of priority or access. Since geothermal exploration carries no rights of priority, there is a strong incentive for the data collected to remain confidential. In these cases, data is commercially sensitive and can be treated as such under New Zealand law, and therefore will not be readily available. However, if consent data could be integrated directly with the database, it would provide the most accurate and timely measure of direct use nationally. This would require agreed protocols with regional councils around data reporting and aggregation, and subsequent processes put in place to feed data into a centralised database.

[13]M. Climo, S.D. Milicich, P. Doorman, S.A. Alcaraz, A. Seward and B. Carey, 2021 *[*New Zealand Direct Geothermal Use Inventory Update Data, Visualisation and Information (geothermal-energy.org)*]*