# New Zealand
## Geothermal Energy Market Overview

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## Abstract:

Geothermal energy utilisation has a long history in New Zealand (NZ). The country is today a member of the 1 GW club of geothermal countries with an installed geothermal power generation capacity of 1,038 MW. The country's Wairakei geothermal plant started operations in November 1958 and was one of the first commercial geothermal power plants in the world. Today the country has a total of 23 geothermal plants with 51 units and is the no. 5 in the global rankings of geothermal power generating countries. The two largest operators in the country, Mercury and Contact Energy are among the largest geothermal operators worldwide. The geothermal resources of the country are mostly found on the North Island of the country.
Geothermal energy contributes around 18% of the electricity generated in New Zealand, but also finds increasing use in direct use applications. From bathing, milk dehydration, extraction of minerals and more, utilising geothermal energy beyond electricity has also seen an increasing interest.
New Zealand also has played an important role in international geothermal development with strong support of geothermal development (e.g. in Indonesia and other parts of the world). With a new large-scale geothermal development now kicked off, development continues in the country. The government continues to highlight the important role geothermal energy plays in New Zealand reaching its climate targets.


## Key Facts

- Installed geothermal capacity 1,038 MW
- New Zealand is no. 5 worldwide in total installed geothermal power generation capacity
- New 150 MW geothermal project under development
- Increasing attention to direct use opportunities
- Estimated geothermal resource potential of around 3,600 MW


# Country Overview

The energy mix in New Zealand is still dominated by fossil fuels, namely oil and natural gas, which represent more than 50% of the primary energy supply of the country. Geothermal energy contributes around 22% of the energy supply, followed by hydropower.

The New Zealand government has set ambitious climate targets with a zero carbon emissions target by 2050. Geothermal energy today has the largest share of renewable energy technologies in the electricity generation. Around 13% of the annual electricity production goes to one single smelter.

Interest in geothermal energy development goes back to the early days of the first geothermal power plant starting operation in Italy in 1916. The main driver of interest was the country's dependency on imported fuel. In the 1940s the NZ government intensified efforts on geothermal energy and an extensive drilling program to explore the Wairakei geothermal field was initiated in 1950. Different from in Italy, the geothermal resource at Wairakei produced west steam resulting in research on how to separate the water from the steam to be able to utilise the resource for power generation. Based on the research, engineers from New Zealand became leaders in geothermal steam water separation methods that are in use all around the world. The first geothermal plant started operations in 1958 with a second unit then commissioned in 1963.

At the same time, engineers from the country were active in supporting geothermal development ambitions internationally and later in the 1970s with an emphasis on New Zealand, Chile and the Philippines. With the NZ geothermal workshop the country has also one of the longest running geothermal workshops.

# The Country's Energy Market

In 2020, the total installed power generation capacity in New Zealand was 9,107 MW, of which hydropower represented 5,389 MW or around 60%. Gas is the second largest contributor to power generation with around 14% of the total capacity, followed by geothermal and a capacity share of 11%.

With regards to electricity generated, the picture looks a bit different. Hydropower and gas represent around 70% of the electricity generated and geothermal represents 18%.

Over a third of the electricity demand of the country is from the various industrial sectors, the majority thereof is from the wood, pulp, paper and printing sectors and the basic metals sector. The Tiwai Point aluminium smelter is the largest single user of electricity in the country representing around 13% of the total electricity demand in New Zealand. The announcement of the operator Rio Tinto in 2020 to shut the smelter down

was therefore a big blow to New Zealand's energy sector. Yet, it was then announced that its operation will be extended through 2024.

There are five major electricity generators in New Zealand that supply more than 90% of NZ's electricity. The main geothermal operators based on installed capacity are Mercury and Contact Energy.

# Geothermal resources and potential

New Zealand has a number of high-temperature fields, most of them located in the Taupo Volcanic Zone on the North Island and one at Ngawha. There are also a large number of lower and very low-temperature systems scattered across the country, mostly on the North Island, but also some on the South Island of the country.

There are 129 geothermal areas identified in New Zealand, 14 of which have a temperature in the range of 70 to 140 °C, seven in the 140 to 220 °C range, and 15 beyond 220 °C. A 2002 study by J. Lawless provided an assessment of 21 fields pointing to an initial potential additional geothermal power generation capacity of between 2,500 and 5,000 MW.

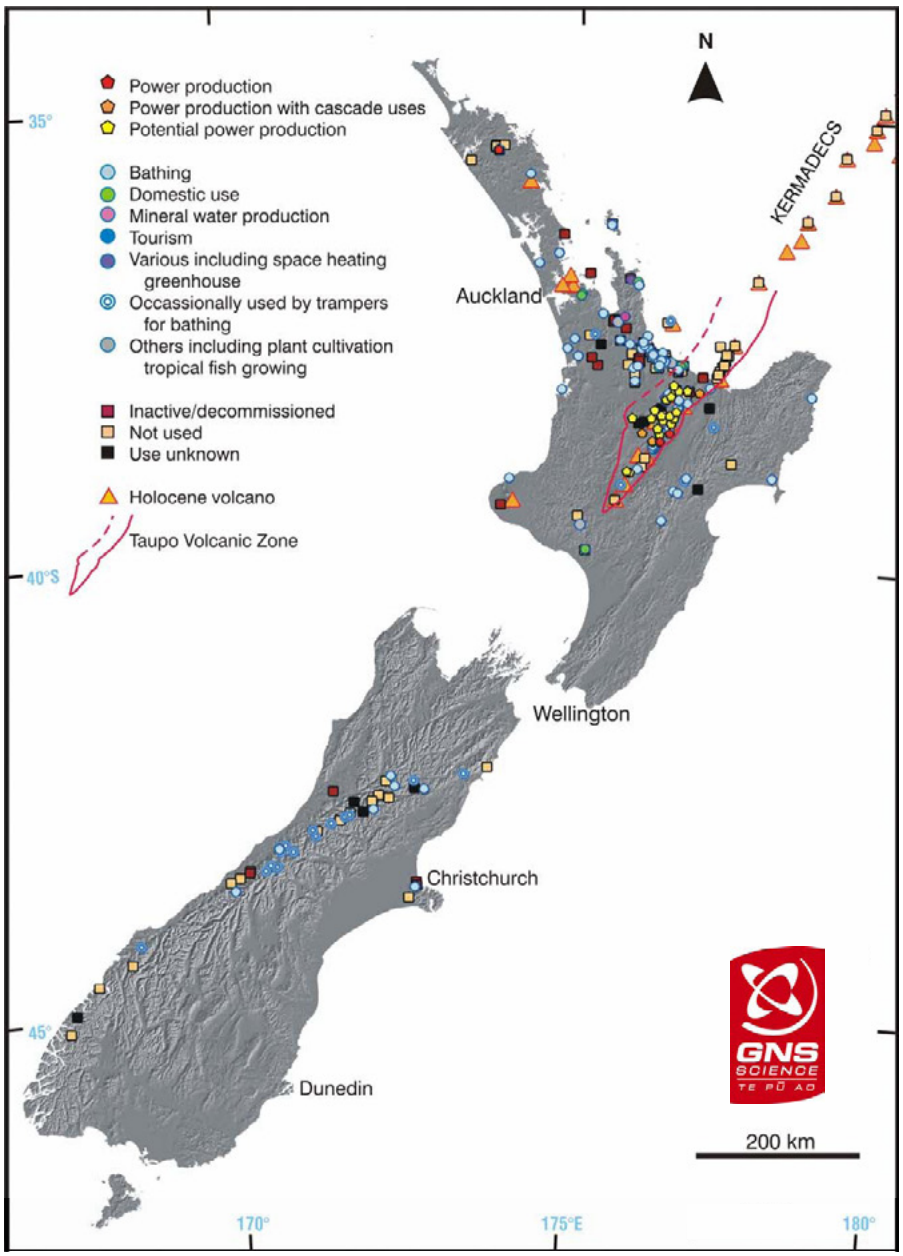
There are a number of factors that could limit the actual development potential – economic indicators and environmental constraints among them – so the early estimates were cut down substantially. Looking at the "restricted geothermal potential" and considering the different development constraints, the author still estimated a development potential for the different fields of 3,580 MW, and taking environmental limitations into account, a capacity of 2,068 MW.

Considering capacity already installed in New Zealand, and projects planned or in development, there is a conservative potential of an additional 700 MW capacity.

# Regulatory framework

Under the Electricity Act of 1992, the NZ government established an Electricity Commission which was replaced with the Electricity Authority in November of 2010 to narrow the focus of regulatory

**Map showing the main uses of geothermal fluids in New Zealand**




**From: Reyes, A.G. (2006) Geyserlands. In: Graham, I. (ed) GSNZ monograph.**

oversight on industry competition, reliability and efficiency in the New Zealand Electricity Market. The Authority acts as "an independent Crown entity responsible for the efficient operation of the New Zealand electricity market."

In its key functions, it registers industry participants, develops and administers the Electricity Industry Participation Code, monitors and enforces compliance with the Code, acts as a market administrator, contracts providers of market operations services, and facilitates market performance.

There are, though, several functions that are reserved for other bodies. Consumer protection in the energy market falls under the scope of the Ministry of Consumer Affairs, and electricity efficiency is monitored by the Energy Efficiency and Conservation Authority.

Monitoring of reserve energy, emergency planning and security of supply information are tasks performed within the state-owned transmission company Transpower.

While the Treaty of Waitangi of 1840 is today widely accepted to be a constitutional document establishing and guiding the relationship between the government of New Zealand and Maori natives, certain controversies remain. The partial sale of Mighty River Power by the NZ government raised debates over land and water rights with conflicting legal positions held by Maori groups and the NZ government.

Legislation, and in particular the Resource Management Act of 1991, is helping to blend in the perspectives of native groups on geothermal development. To this day, geothermal resource ownership is still not possible under the Common Law in New Zealand. The Waitangi Tribunal in 1993 provided some protection and rights to Maori on "surface features" as "treasured possessions," providing Maori groups certain powers towards proposed development.

Various large Maori tribes hold some prime geothermal land in New Zealand, but a limited number of Maori groups have developed projects utilising their geothermal resources. In some cases, they have teamed up and established a joint ownership model with companies such as Contact Energy and Mercury (formerly Mighty River Power) in the development of geothermal power plants on Maori land. This seems to have assisted in combining Maori interests and the interest of power companies, such as Mercury and Contact Energy, to develop geothermal power plants to provide New Zealand with renewable base-load geothermal power.

# Geothermal Energy Utilisation today

Today, geothermal energy contributes around 18% of electricity supply to New Zealand, but there is also a significant direct use of geothermal energy.

There is direct use of geothermal for heating pools, hotels and houses in several locations throughout the country. Industrial use of geothermal heat though currently only occurs in the Central North Island in the Taupo and Bay of Plenty regions. The Tasmpan Pulp and Paper Company established a mill at the Kawerau industrial site, mostly due to the readily available geothermal steam as a source of heat and electricity.

In Taupo, a new milk powder plant was established utilising geothermal heat, as well as additional sawmills utilising heat for timer drying. Additional examples are various geothermal spas and baths.

There are also efforts under way to extract valuable minerals, such as silica and lithium from geothermal brine.

# Geothermal Market & Industry

With early geothermal energy activities dating back to the 1950s, New Zealand gradually built up its capabilities to develop the country's geothermal resources. The early years of development built up immense capabilities in exploration, drilling and other engineering skills.

Since the commissioning of New Zealand's first geothermal power plant at Wairakei, geothermal development has come in waves and NZ geothermal experts have contributed greatly to international development efforts.

Market reforms in the mid 1980s lead to the privatisation of some of the state agencies or state-owned enterprises. The generating companies were still state-owned so development remained under the control of the government.

There are today 8 geothermal operators and developers with the top three representing nearly 90% of the total geothermal power generation capacity. There are numerous private sector consultancies and independent consultants providing their services to the geothermal industry. The Geological Nuclear Sciences (GNS) is a government-owned consultancy also operating as a science research institution. On the policy and regulatory side, as well as international promotion, the New Zealand Geothermal Association (NZGA), and Geothermal New Zealand work together with various other players from New Zealand.

On the consulting side, there are various individuals and firms that have been serving the global geothermal market for the past 30 or more years. The regional focus of these activities seems to have been somewhat on the Asia-Pacific market, but NZ geothermal expertise has been at play globally, notably in Africa, as well as Central and South America.

# Current Project Development

The past few years have seen limited development efforts and big plans were put on hold with the uncertainty of the continued operation of the Rio Tinto smelter. But there is continued interest and ongoing activities in geothermal development. The most recent addition has been the 32 MW Ngawha 3 geothermal plant by Top Energy, which also plans a further expansion for this geothermal field. Contact Energy has now kicked off work on the 150 MW Tauhara geothermal project, the largest geothermal development since the Nga Awa Purua geothermal plant in Rotokawa.

# Outlook

The kick off of the Tauhara geothermal project has been a big relief for the geothermal sector in New Zealand and highlights the continued interest and efforts on development in New Zealand. Paired with the ongoing international work of consultants from New Zealand internationally, partly supported by the New Zealand government clearly highlights the continued important role of the country in geothermal development worldwide.

With additional efforts on geothermal direct use, extraction of minerals from geothermal brine and research efforts on deep critical-temperature resources, New Zealand remains an elementary player in the geothermal world.

## Sources

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New Zealand Geothermal Update WGC2020
New Zealand Geothermal Association (NZG) Website
Ministry of Business, Innovation & Employment – Electricity Statistics (2021)

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