ACTION PLAN 2026-2027

Geoheat Strategy for Aotearoa NZ

Earth Sciences New Zealand

Ara Ake Future Energy Development

FOREWORD

Earth Sciences New Zealand

It is my real pleasure to introduce you to the 2026 – 2027 Geoheat Action Plan. This is particularly so in 2026, the year that the New Zealand Government released its Geothermal Strategy *"From the Ground Up"*. Earth Sciences New Zealand (ESNZ) is proud to support the delivery of geothermal outcomes for Aotearoa New Zealand with this Action Plan having been developed to assist in furthering the uptake of Geoheat as an enabler, assisting NZ to move to 2050 net zero.

Geoheat is available widely across New Zealand, it is effective for a range of industrial and commercial applications ranging in size from sub megawatt to megawatt scale and is a viable alternative to fossil sources whether for new ventures or decarbonising established operations.

Decarbonisation interest and activities are ramping up in a number of regions, with interest in Taranaki, the Bay of Plenty, Waikato, Auckland and more. The Bay of Plenty Regional Energy Transition Accelerator released in 2024 has been influential in raising the awareness of Geoheat resulting in the Tauranga Geothermal System being in focus for further technical study.

There has been interest from the Ministry for Primary Industries and the covered crop sector in low temperature geothermal as that sector navigates away from fossil fuel sourced heat.

Working together with Ara Ake and interested participants we will work to champion the Strategy, the Action Plan and associated activities. Please join us, share the vision, and dedicate time and resources to actively grow geothermal heat use for the benefit of Aotearoa New Zealand.

Dr Isabelle Chambefort
General Manager – Energy
Earth Sciences NZ Ltd

Ara Ake

As New Zealand's energy innovation centre, Ara Ake sees significant potential for Geoheat innovation and development throughout Aotearoa, and we are proud to be partnering with Earth Sciences New Zealand on the 2026 - 2027 Geoheat Action Plan.

Combined with the Government's Geothermal Strategy *"From the Ground Up"*, the action plan represents a pathway toward further developing Geoheat as a meaningful contributor to New Zealand's low emissions future.

Energy innovation is central to New Zealand's transition, and the work we do now will shape the social, economic and environmental outcomes for generations to come. Ara Ake's role in this partnership is to accelerate that work by supporting innovators, connecting them with opportunity, facilitating industry engagement, and helping bring together the collaboration needed to move Geoheat from potential to commercial reality.

The Geoheat Strategy and Action Plan represents exactly this kind of future thinking. It is a signal of intent, that we want to see Geoheat innovation spread across the motu and unlock regional opportunity. We are excited about what this next chapter holds, and eager to build it alongside the innovators, industries and communities who will bring it to life.

Sophie Braggins
Chief Executive Officer
Ara Ake

GEOHEAT INNOVATIVE REPURPOSING

Moturoa Petroleum Company No-1 well, New Plymouth, in the 1930's. Photo courtesy of Puke Ariki (PHO2009-358).

EXECUTIVE SUMMARY

Geoheat is a future energy solution, available today, supporting New Zealand's low carbon energy transition. Geoheat is the use of geothermal heat energy beyond electricity generation. It is a proven, sustainable, secure source of low / no carbon process heat, delivering temperatures from chilled (4°C) to around 220°C.

In 2017, to proactively increase uptake, a Geoheat Strategy 2017-2030 was released outlining a vision for the future of Geoheat in New Zealand. Targets where to double Geoheat energy use by 2030, an increase of 7.5 PJ, with an associated 500-plus new jobs created.

Two-yearly Action Plans have been developed to support the vision. A review of effectiveness through the most recent period of the 2024-2025 Action Plan documented in this plan identifies a very satisfactory level of goal achievement.

The 2026 - 2027 Action Plan canvasses both well-established Geoheat technologies and innovative approaches now being developed that are extending both the range of the resources able to be used and the applications. Innovation features in this Action Plan, including in four of the five case studies.

- In 2025 **Essity, Kawerau,** commissioned a world first with the Yankee dryer drum and hoods on one of their paper machines being fully heated using steam produced from geothermal energy replacing what traditionally are fired by natural gas. The Action Plan front cover image is of the removal of the old Yankee dryer drum as part of the conversion.
- **Ara Ake** are actively investigating the heat potential of legacy petroleum assets through the **Taranaki Geoheat Discovery Challenge**.
- And to extend the ideas on Geoheat, innovation from **Drammen, Norway** where the **Fjell Skole** has installed an effective low temperature in ground heat energy storage system that enables heat collected in the summer to be stored and recovered in winter to heat the facility.
- Similarly in **Cadaujac, France** there is a heat network that services a 67 residential dwelling subdivision that uses an underground heat energy store to collect heat and seasonally load balance the energy supplied to the residences.

Importantly for New Zealand, in March 2026, the Government released its first ever Geothermal Strategy, *"From the Ground Up"*. Geoheat has a prominent position in the Strategy Vision and Actions:

From the Ground Up

Vision

GOAL 3: Advance knowledge and uptake of existing geothermal technologies and Geoheat opportunities

Expanding the use of lower enthalpy geothermal technologies, such as heating and horticultural applications, offers significant economic and environmental benefits. Accelerating uptake will help businesses reduce energy costs, cut emissions and unlock new opportunities for growth.

The Government will support this transition through targeted education and feasibility assessments and exploring demonstration projects to ensure businesses have the tools and confidence to adopt Geoheat solutions. Working with industry partners and public-private collaborations, we will showcase the value of Geoheat to encourage wider adoption across New Zealand.

Actions

Horizon 1, 2026-2027,

- Promote the role of Geoheat in the energy transition from 2026;

Horizon 2, 2028-2029,

- Explore mechanisms to pilot technology for commercial and residential developments; and
- Explore transitioning government users to geothermal technologies.

The Geoheat Action Group goals for 2026-2027 are purposefully aligned with the Governments 2026 – 2027 Horizon 1 Action. The Action Group will **POSITION**, **SUPPORT**, **DEMONSTRATE** and **ENABLE**, with the ultimate goal of establishing **NEW PROJECTS** that use Geoheat.

Geoheat technologies have the potential to reduce atmospheric carbon emissions between 80% to 100% relative to fossil fuels where the geothermal solution can meet the required temperature duty of the application.

Reassessment of energy costs for process heat has been undertaken in preparing this plan which continues to show that geothermal is the lowest cost fuel per GJ, including the cost of carbon at $45 per tonne for industrial supply at sites such as Kawerau and Tauhara. Geothermal is well positioned to further improve this leading cost-effectiveness, particularly when stability returns to the carbon market and charges under the Emissions Trading Scheme (ETS) increase in the future as might reasonably be expected.

The changing energy transition landscape has Government policy placing greater emphasis on market-led investment with the Emissions Trading Scheme playing a central role. Broader insights into industry readiness suggest that while awareness of climate-related risks is increasing, capability gaps remain. The Institute of Directors indicates that fewer than half of Boards of Directors consider themselves well-equipped to manage the risks and complexities associated with climate change, with further development of governance capability and confidence going to be important to support climate appropriate investment, including solutions such as Geoheat.

In mid-2025 the New Zealand Geothermal Association (NZGA) and the Energy Efficiency and Conservation Authority (EECA) released a Geoheat Business Guide in Aotearoa New Zealand: Navigating Technology Options & Resource Management.

The covered cropping sector represents a notable opportunity for Geoheat with increasing sector interest in geothermal driven by both emissions reduction potential and the opportunity to reduce exposure to volatile energy prices.

The 2026-2027 Geoheat Action Plan continues the focus on low and ambient temperature geothermal opportunities with their broad geographical spread that encompasses most of New Zealand. Four goals have been set for the 2026-2027 Action Plan period.

2026-2027 Ambitious Goals

- Targeting 5 new projects using Geoheat, each with a capacity greater than 500kW, in planning or operational.
- Active involvement in at least 10 workshop / conference events raising the profile of Geoheat in New Zealand, including events in the South Island.
- Visit five sites where Geoheat applications are operational or under development, demonstrating, connecting and building knowledge for industry, innovators, investors, and government.
- At least 10 published reports, conference papers and case studies highlighting Geoheat's potential and application.

Collaboration will be fostered, innovation and investigation activities supported, along with showcasing, demonstrating and advocacy seeking to further support and enable the uptake of Geoheat use.

Realising Geoheat's enormous potential requires us all to work together.

We invite you to join us on this mission to realise Geoheat's potential to support New Zealand's transition to a net carbon zero future and look forward to supporting you on yours.

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Bibliographic Reference

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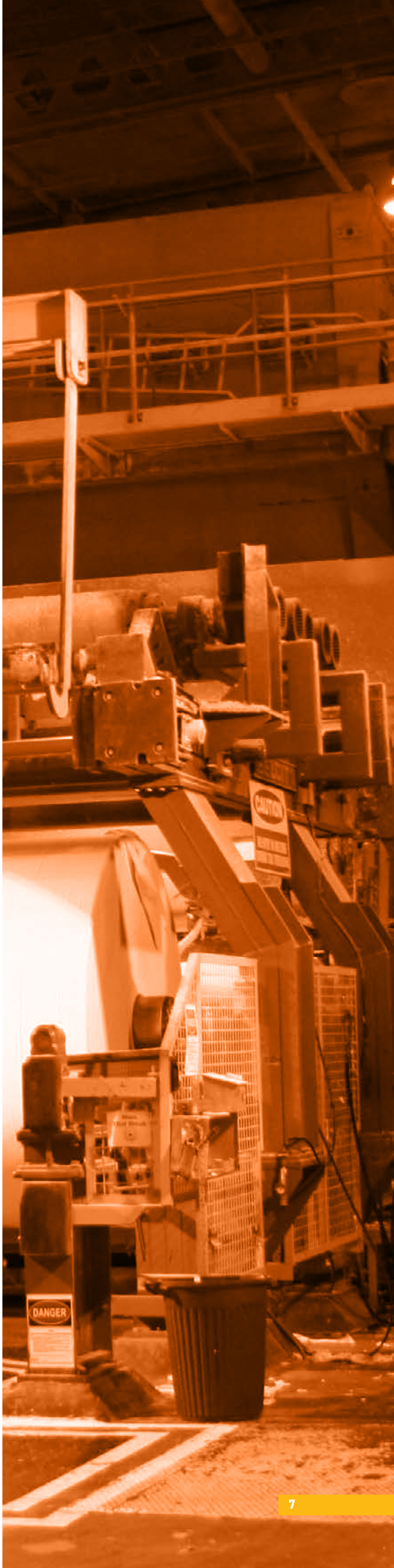
Brief Description

This is the fifth Geoheat Action Plan in the series fostering the uptake of direct geothermal heat use (and cool) in industrial and commercial businesses. The 2026 – 2027 Action Plan considers a broad range covering ambient, low and high temperature geothermal energy use using appropriate technologies. This has potential for broader application across all of New Zealand, in sectors such as covered crops, space heating, pool heating and other applications that are looking for low carbon heat solutions as an alternative to fossil energy.

The Geoheat Action Group that drives this Geoheat Action Plan meets every two months. If you would like to be involved with the group, please email geoheat@earthsciences.nz



THE CHANGING LANDSCAPE

New Zealand's Geoheat landscape has been evolving through a combination of increasing strategic recognition, evolving market conditions, policy settings, and government priorities. Government policy is placing greater emphasis on market-led investment, with the Emissions Trading Scheme expected to play a central role, although current carbon price signals remain relatively weak. At the same time, there is clear and growing acknowledgement of geothermal energy within national strategy, including an explicit goal to significantly expand its use.

Activity at the regional level, particularly in areas such as the Bay of Plenty and Taranaki, demonstrates that there is both technical potential and institutional momentum to support greater uptake of Geoheat throughout Aotearoa. Sector-specific opportunities, such as in covered cropping and industrial heat applications, further reinforce this potential. However, translating this into widespread deployment will depend on addressing a range of challenges, including early-stage project risk, market confidence, and capability within industry to identify and act on viable opportunities.

Since the 2023 general election, New Zealand's energy and climate landscape has undergone a material shift to a more market-led transition towards net-zero 2050. There is growing recognition of geothermal energy, particularly Geoheat, as a strategic opportunity against a national background of significantly reduced natural gas reserves, particularly impacting the industrial and commercial gas outlook.

At a high level, the landscape is characterised by:

- A renewed reliance on the Emissions Trading Scheme (ETS) as the primary decarbonisation mechanism;
- Reduced direct government subsidies for industrial decarbonisation;
- Targeted investment to de-risk geothermal development; and
- Increasing regional and sector-led momentum for Geoheat deployment.

GOVERNMENT AWAKENING TO GEOTHERMAL

Like a number of governments around the globe, the NZ Government is awakening to the opportunities that geothermal energy can provide and in March 2026 released a geothermal strategy, "*From the Ground Up*" (NZG 2026).

"From the Ground Up"

On 17th March 2026 the Government released New Zealand's first Geothermal Strategy; "From the Ground Up - A strategy to unlock New Zealand's geothermal potential" (NZG,2026), developed through deep stakeholder collaboration and feedback.

The vision is for New Zealand to become a global leader in sustainable geothermal development, delivering innovation, resilience and inclusive growth for future generations. Overarching is a goal to double geothermal energy use by 2040.

Geoheat is well represented in the Strategy including recognition of the potential to use lower temperature geothermal resources. To advance knowledge and uptake of existing geothermal technologies and Geoheat opportunities, the Government's strategy sets out actions across:

- Horizon 1, 2026-2027, Promote the role of Geoheat in the energy transition from 2026;
- Horizon 2, 2028-2029, Explore mechanisms to pilot technology for commercial and residential developments; and
- Horizon 2, 2028-2029, Explore transitioning government users to geothermal technologies.

The NZ Government official statistic for aggregated direct geothermal heat use for the 2024 year was 7.38 PJ (NZG 2026).

The Geoheat Business guide in Aotearoa New Zealand (2025).

In July 2025 NZGA and EECA released a Geoheat Business Guide (EECA, 2025a) that provides practical advice to businesses in New Zealand seeking to understand and apply Geoheat for heating and cooling. The guide focuses on low and medium-temperature (<150°C) applications and addresses two key areas:

- the range of available technology options, and
- resource management and consenting processes under the Resource Management Act 1991.

GOVERNMENT POLICY AND STRATEGIC DIRECTION

Following the formation of the coalition government in November 2023, climate policy has shifted toward market-based mechanisms, with an expectation that private sector investment will lead the transition. The Resource Management Act and regulations are being reformed with new legislation expected to pass mid-2026. The new framework is signalling a more streamlined approach to regulation, led by strong national direction and an emphasis on standardisation and the need for fewer, quicker consents. Environmental limits are proposed as the key tool for managing natural resources; air, freshwater, coastal water, land, soils and indigenous biodiversity. In regard to energy, the approach is technology neutral, seeking accelerated use of renewables, along with improving energy security and affordability.

The policy environment is placing greater responsibility on industry to identify and invest in viable decarbonisation solutions, including Geoheat.

Table 1 The shift to more Market Based Climate Policy

Area	Change	Detail	Implications for Geoheat
Emissions Trading Scheme (ETS)	Reaffirmed as primary tool	Identified (Dec 2023) as the key mechanism for emissions reduction	Strengthens long-term price signals for fuel switching
Government approach	Market-led transition	Emphasis on reducing “red tape” and limiting subsidies	Geoheat must compete on commercial merit
GIDI Fund	Closed (Dec 2023)	~$600m in unallocated funds returned to government	Reduced grant support for industrial conversion
Climate Emergency Response Fund (CERF)	Closed (May 2024)	ETS revenue redirected to general taxation	Less dedicated climate investment funding
Climate Strategy (2024)	Introduced July 2024	Five pillars including clean energy, resilience, innovation	Aligns with scalable Geoheat opportunities
Climate Change Response Act	Under review (2025–2026)	Streamlining planning, reporting, consultation	Potentially faster project delivery
Nationally Determined Contribution (NDC2)	Updated (January 2025)	51–55% emissions reduction by 2035 (vs 2005)	Maintains pressure for industrial decarbonisation

KEY PROGRAMMES AND PROJECTS DRIVING GEOHEAT DEVELOPMENT

Significant Geoheat activity is underway across government programmes, regional initiatives, and industry partnerships (Table 2).

Table 2 Geoheat in key programmes

Programme / Project	Lead Organisations	Focus	Key Outcomes / Insights	Date
EECA RETA – Bay of Plenty	EECA, GNS Science, GeoExchange NZ, Dobbie Engineers	Commercial and industrial Geoheat conversion	89–93% emissions reduction potential; optimal fuel in EECA MAC analysis	Released May 2024
Tauranga Geothermal System (TGS)	BOPRC, Priority One, GeoExchange NZ, ESNZ	Characterisation of the resource, sustainable management and regional industrial decarbonisation.	Significant low-temperature resource. Several focus sites identified.	Mid 2024 and ongoing
MPI – SFFF Decarbonising Covered Crops with Geoheat Project	MPI, GNS Science, GeoExchange NZ, Vegetables NZ[1], Tomatoes NZ	Greenhouse heating	Web-based Geoheat screening tool; supporting site selection	November 2024 to November 2026
BRANZ Embodied Carbon of Geoheat technologies	BRANZ, GNS Science, GeoExchange NZ	Lifetime Carbon assessment methodology	Builds confidence in Geoheat vs fossil alternatives	May 2025 to November 2026
Geoheat Business Guide (2025)	NZGA, EECA	Market guidance	Supports adoption; addresses technology and consenting	July 2025
Ara Ake Taranaki Geoheat Discovery Challenge	Ara Ake, ESNZ, GeoExchange NZ	Regional opportunity assessment	Includes oil & gas repurposing potential	April 2026

1 Vegetables NZ and Tomatoes NZ merged to become Covered Cropping NZ from 1 April 2026.

Regional Opportunities

Bay of Plenty – Tauranga Geothermal System (TGS)

The Tauranga Geothermal System (TGS) has emerged as a significant Geoheat opportunity. The Bay of Plenty Regional Energy Transition Accelerator (RETA) was released in 2024 (EECA 2024). In addition a range of organisations, including the Bay of Plenty Regional Council, Priority One (Western Bay of Plenty's Regional Development Agency), GeoExchange NZ and ESNZ, have contributed to a coordinated programme of workshops, studies (BOPRC 2023, GeoExchange NZ 2024a, BOPRC 2024, Carden et al 2024, Allan 2025) and stakeholder engagement (refer the Activity Timeline for key events).

This work has highlighted the TGS is underutilised for Geoheat and there is strong potential for low-temperature geothermal resources to support energy security and industrial decarbonisation, particularly in the Mount Maunganui industrial area, where reliance on natural gas and constraints in the electricity network present challenges for electrification. Ongoing planning, monitoring and consent-related data collected by the Bay of Plenty Regional Council has provided an important evidence base supporting the work on the TGS.

Canterbury – Christchurch

Christchurch has been a leader in low temperature Geoheat in New Zealand with the first aquifer water energy systems installed to heat and cool buildings in the 1970/80s (Seward and Carey 2021). The Christchurch Airport established an aquifer water energy system in 1997, with many more installations established in the city since the devastating 2010 and 2011 earthquakes. There are now more than 20 commercial / council / government facilities in the broader city area that use aquifer water for heating and cooling. More information on Geoheat use in Christchurch is included in the Case Study section of this Action Plan.

Taranaki – Investigating regional Geoheat potential, and the scope to repurpose petroleum infrastructure for Geoheat development.

Ara Ake commissioned work in 2025 to assess Geoheat opportunities in Taranaki, drawing on existing petroleum industry data to explore the potential of repurposing oil and gas infrastructure, specifically wells, for Geoheat development. A scoping study completed by ESNZ and GeoExchange NZ in early 2026 (Seward et al 2026) considered a range of applications, including the reuse of existing oil and gas infrastructure as they reach the end of their productive life.

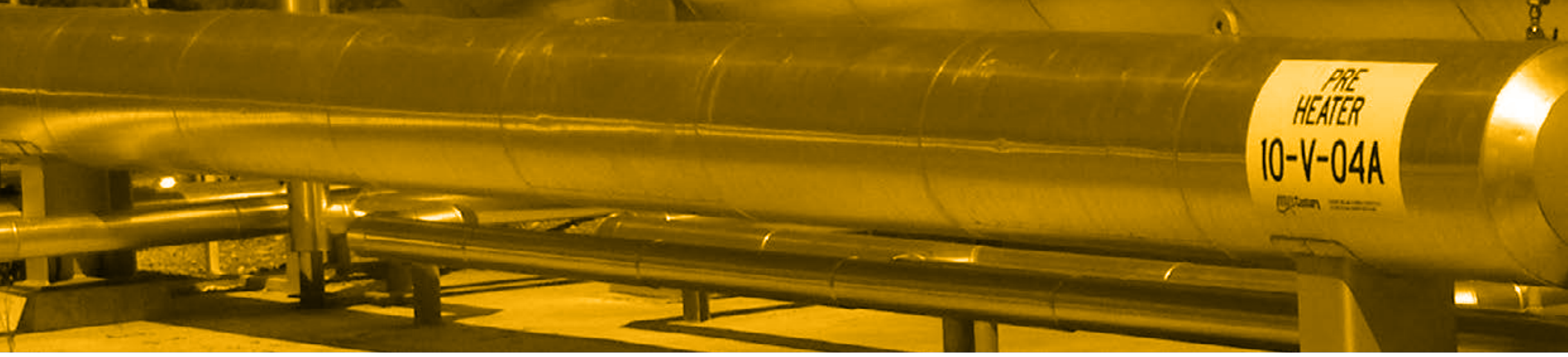
This project aligns with a broader international trend of assessing legacy energy infrastructure for lower-emissions uses. This study has now progressed to the Taranaki Geoheat Discovery Challenge, which is actively evaluating Geoheat potential in legacy petroleum wells and mapping out possible pathways for development across the region. Refer to the Case Study section for more information.

Sector-Level Opportunities and Readiness

The use of aquifer water energy in building services is understood to be effective in New Zealand. This Geoheat use has been adopted in facilities in a number of locations across New Zealand where the context is appropriate, with Christchurch having the most installations in one area. A number of engineering and hydrogeology consulting companies are experienced in assessment and design of aquifer water energy systems.

The covered cropping sector represents a notable opportunity for Geoheat uptake in New Zealand. With about 310 hectares of greenhouses nationwide (RNZ 2025), peak winter heating demand is estimated at around 460 MW_{th}, with total annual energy use of ~800 GWh_{th}. There is increasing interest within the sector in transitioning to geothermal heat, driven by both emissions reduction potential and the opportunity to reduce exposure to volatile energy prices. Industry engagement has grown through workshops and collaboration with organisations such as Vegetables NZ and Tomatoes NZ, alongside technical input from GeoExchange NZ and ESNZ. While geothermal heating is widely used in greenhouse operations internationally, its adoption in New Zealand remains limited despite the availability of suitable low-temperature resources in several regions.

At the same time, broader insights into industry readiness suggest that while awareness of climate-related risks is increasing, capability gaps remain. Research from the Institute of Directors indicates that fewer than half of Boards of Directors consider themselves well-equipped to manage the risks and complexities associated with climate change (IOD, 2025). This suggests that, although there is an expectation that businesses will lead the transition to a low-emissions economy, further development of governance capability and confidence will be important to support investment in solutions such as Geoheat.



PROCESS ENERGY IN NEW ZEALAND

Decarbonisation and transition of stationary process energy (e.g. for boilers, furnaces and kilns, space heating, and drying) in New Zealand continues. The cost of delivered energy from a given fuel is a function of:

- The base fuel price;
- The efficiency of the conversion or the heat transfer process used to deliver the energy to the application;
- The carbon charges associated with the fuel type; and
- The cost of carbon (CO_{2e}).

The sections below provide information on natural gas, electricity, coal and biomass with the focus on a comparative cost analysis of different fuel options (Table 3 page 15) for business and organisations considering energy transitioning.

COMMERCIAL AND INDUSTRIAL NATURAL GAS AND ELECTRICITY

Figure 1 plots the cost of commercial and industrial natural gas and electricity with time since 1979. The data is from the Ministry for Business, Innovation and Employment (MBIE) website with the costs all exclusive of goods and services tax (GST).

The relevant industrial rate for electricity is NZD62 / GJ (2025 data) and for natural gas NZD13.8 / GJ (Being the average for the first three quarters of 2025).

Observed in Figure 1 is the rapidly rising price of gas (red and green lines) since 2021. This is a consequence of the near end of life for most NZ gas fields, with only short-term contracts being negotiated with off takers when they are renewing their contracts, making for uncertainty in the gas market.

Also observed is the increasing cost of electricity from NZD 43 to NZD 62 / GJ for industrial electricity (purple line) over the period 2023 to 2025.

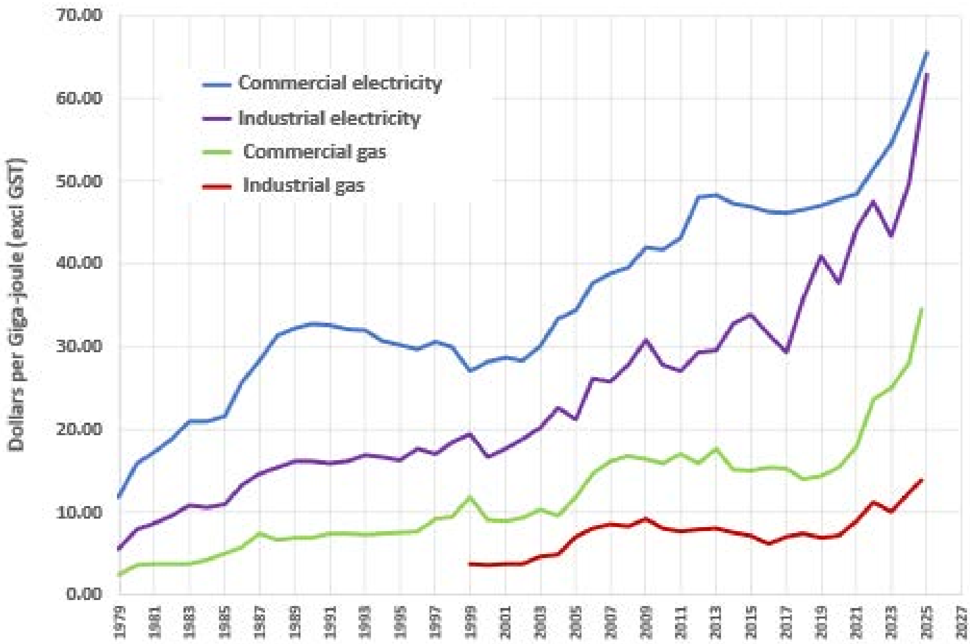


Figure 1 *MBIE commercial and industrial electricity (nominal data) and natural gas energy cost data (NZD per GJ) since 1979.*

COAL

The coal price for sub-bituminous has ranged from ~100 to ~130 USD per tonne through the period 2025 to March 2026 (data from Trading Economics). The EECA sub-bituminous coal conversion factor for a tonne to GJ is 21.59 and using a price of 130 USD / tonne, the sub-bituminous coal energy price is about NZD 10 / GJ at 1.7 NZD to USD.

Prohibition of Coal Fired heat production for applications requiring temperatures less than 300°C

Through the Resource Management Regulations (RMR 2023) the installation of new coal boilers producing heat for applications requiring heat at less than 300°C is prohibited. This came into effect in July 2023 and existing coal boilers are to be phased out by 2037.

BIOMASS ENERGY

In New Zealand biomass energy is essentially based on residues from forestry and timber processing operations. Data from the EECA Waikato RETA has biomass at NZD 13 / GJ (EECA 2025b page 24).

Foresta at Kawerau is planning the establishment of a torrefied wood pellet production operation that is targeting replacing coal in facilities such as the Huntly Power Station with torrefied pellets. They are investigating using geothermal energy from the Kawerau geothermal field to use for feedstock drying. A first stage producing 60,000 tonnes per annum is being considered followed by a second stage producing 160,000 tonnes per annum. The cost of wood pellet fuel is taken as NZD 16 per GJ which is the term sheet price under the 10 year agreement for the Foresta wood pellet supply to Tailored Energy & Resources Ltd (TERL) signed in 2023 (Foresta 2023). TERL are an energy distribution company who supply solid fuels particularly in the South Island.

GEOTHERMAL ENERGY FOR PROCESS HEAT

With the regulatory thrust to reduce coal utilisation, the increasing volatility and uncertainty in the natural gas sector, the volatility in the cost of carbon and the increased greenhouse gas regulatory requirements are all resulting in a growing interest in geothermal, particularly in ambient and low temperature geothermal energy which is available widely across New Zealand.

Geothermal Innovation - International Trends

Internationally, Geoheat is emerging as a key solution for decarbonising low- to medium-temperature heat demand across industry, buildings, and agriculture. There is growing deployment of geothermal heat in applications such as district heating, industrial processes, and greenhouse operations as it is a local, secure heat source. The incresing uptake is supported by advances in low-temperature systems and heat pump integration. These developments are significantly expanding the application range, enabling Geoheat to be applied in a much wider range of geographical locations, including regions without traditional higher temperature geothermal resources.

Innovation is improving the commercial viability and scalability of Geoheat projects. Advances in subsurface modelling and drilling techniques are helping to reduce exploration risk, while the repurposing of existing oil and gas infrastructure is emerging as a practical pathway in some regions. New delivery models, such as heat-as-a-service, alongside increasing policy focus on energy security and heat decarbonisation, are further supporting uptake. Together, these trends are positioning Geoheat as a credible, scalable and increasingly investable option for decarbonising heat globally.

There is notable international activity in collecting and storing low temperature heat in the subsurface for later use. The concept of making your own Geoheat has been demonstrated in two different applications, one in France and the other in Norway. These are included in the Case Study section of this Action Plan.

ThermBooster high temperature heat pump.
Image courtesy of SPH Sustainable Process Heat GmbH.

WHY GEOHEAT?

Geoheat is a future energy solution available today, with well-established technologies able to support New Zealand's transition to low carbon energy by 2050. It is renewable, recognised as such in New Zealand law (RMA 1991). Sustainable management of geothermal resources provides an underpinning ethos for industrial and commercial businesses seeking to future-proof process energy supply and energy for facilities heating and cooling, with ready availability and sustainability credentials.

Geothermal has low or no atmospheric carbon emissions, making it an ideal future energy source as New Zealand transitions from fossil fuels. Being a local energy source geothermal is removed from the volatility experienced in other global fuel markets.

Relative to natural gas, unabated geothermal has the potential to reduce emissions by more than 81%, and for coal by more than 88% (Table 3). Data for geothermal steam, two examples of geothermal two-phase geothermal fluid mixtures and geothermal water are tabulated on the next page in Table 3. The comparison with fossil heat can be made where a geothermal solution can meet the required duty temperature.

GEOHEAT LOW EMISSIONS PROFILE

Table 3 Emissions profile for different fuel types

Type		tCO_{2e}/t	GJ/t	tCO_{2e}/GJ	Emissions Reduction per GJ compared to	
Coal	Sub-bituminous			0.09043	Natural Gas	Coal
Natural Gas	National Average			0.054		
Geothermal						
Steam	Geothermal Steam (default)	0.03	2.78	0.01079	81%	88%
	Kawerau Industrial - Steam	0.0174	2.78	0.00626	89%	93%
Two Phase	Tauhara - Two Phase	0.0009	1.2	0.00075	99%	99%
	Mokai - Two Phase	0.0009	1.6	0.00056	99%	99%
Water	Geothermal Water	0	0.4	0	100%	100%

The table uses updated emissions factors from the Climate Change Stationary Energy and Industrial Processes Regulations 2009 as at 1 January 2026. Note that carbon emissions associated with grid electricity required to operate a given application are excluded from the calculations.

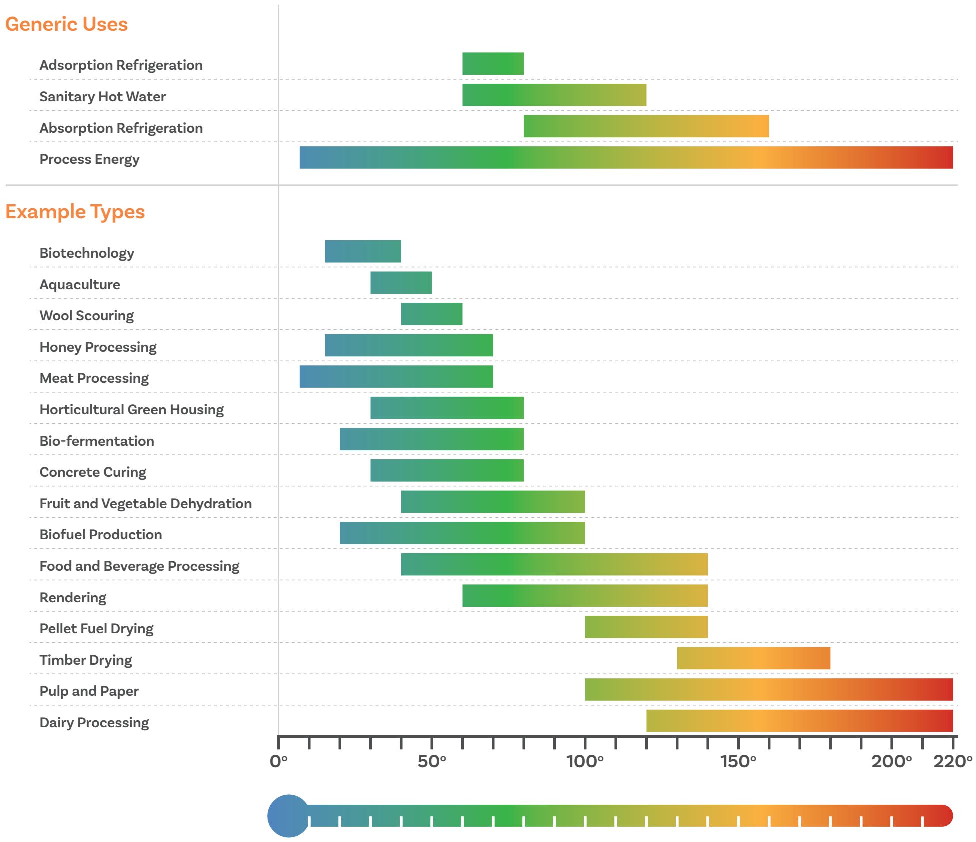


Figure 2 *Temperature range for different Geoheat Uses – both Generic and Example types shown*

Geoheat options available to New Zealand include high, low and ambient temperature heat depending on location. These cover a broad range of temperatures from 5°C to 220°C as shown in Figure 2.

Some of the similarities, differences and benefits of these are summarised in the material that follows.

HIGH TEMPERATURE GEOHEAT

High temperature geothermal resources in the Taupō, Rotorua and Kawerau districts deliver Geoheat across a range of scales up to 10's MW_{th} and temperatures up to 220°C, with energy drawn from wells up to 3.5km deep. Geoheat utilisation at a number of the sites has been developed alongside geothermal electricity generation infrastructure.

Benefits of high temperature Geoheat include:

- **Renewable**
- **Low carbon**
- **Cost effective**. Commercially available now, with delivered energy supplied at ~$12 / GJ (including the cost of carbon), cheaper than other renewable options and fossil fuels.
- **Readily available in site specific locations**
- **Low price volatility energy source**
- **Proven at scale**. Geoheat use at individual supply capacities up to 100 MW_{th}, supplying up to 3PJ of energy per annum.
- **Low-risk**. Geoheat technology has been in use in New Zealand since the late 1950s and is backed by a wealth of established engineering expertise able to support plant design, installation, maintenance and ongoing operations.

Table 4 Delivered fuel cost comparison for different fuel types – carbon at $45 / tonne

Fuel Type	$/GJ	Emissions Factor tCO_{2e} /GJ	Carbon costs[1]	Conversion Factor[2]	Total Cost $ / GJ Delivered
Kawerau Geothermal - Steam	10[3]	0.00626[4]	$0.28	0.85[5]	$12.10
Biomass	13[10]	0	$0.00	0.8[9]	$16.25
Electricity - Heat Pump COP 3.5	62[6]	0.0281[7]	$1.26[8]	3.5[9]	$17.71
Wood Pellets	16[12]	0	$0.00	0.9	$17.78
Coal	10[11]	0.09043[14]	$4.07	0.78[9]	$18.04
Gas	13.8[6]	0.05499[13]	$2.47	0.85[9]	$19.15
Electricity - Resistance	62[6]	0.0281[7]	$1.26[8]	0.99[9]	$62.63

1 Carbon units at $45/tonne in March 2026 https://www.mynativeforest.com/carbon-price-nz. Accessed 3 March 2026.
2 Factor applicable for delivery of usable heat energy and not for conversion to electricity.
3 Nominal Kawerau geothermal steam price supplied by NTGA pers comms March 2026.
4 Kawerau Industrial emissions factor from Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 (SR 2009/285) Version 1 Jan 2026. Geothermal p75 Table 6 Part A - 0.0174 times 1000/2780 to convert to t/GJ.
5 Using Geothermal steam - computed from geothermal steam (2780j/g) condensed to 100 C liquid (461j/g).
6 MBIE data for 2025 for industrial electricity and for industrial gas from energy price data set https://www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/energy-prices/
7 2024 Data from the Ministry for the Environment 2025 Emissions Factors Workbook.
8 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.
9 Net calorific value to useable heat data provided by EECA (December 2023).
10 EECA Waikato RETA (EECA 2025b) Data from Figure 11 page 24.
11 4 March 2026 Thermal coal futures price out of Newcastle Port of USD 130 per tonne converted to NZD per GJ.
12 Nominal pricing from Foresta 2023 terms sheet for supply of torrefied wood pellets at scale to Tailored Energy & Resources Ltd (Foresta 2023).
13 Emission factor for natural gas (Calculated all field average) from the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 (SR 2009/285) Version 1 Jan 2026 p77 data in Table 10.
14 Emission factor for sub-bituminous from the Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 (SR 2009/285) Version 1 Jan 2026. p74 Table 2.

LOW / AMBIENT TEMPERATURE GEOHEAT

Low temperature geothermal is well understood internationally and extensively used in many nations, but less developed and quite underutilised in New Zealand.

It is mature technology that can be used in both shared infrastructure and standalone installations. Two nations are noted here; France, and the Netherlands both having adopted significant targets for geothermal energy from lower temperature conditions.

France's 2024 shallow geothermal utilisation from depths of less than 200m below the ground surface is 17 PJ and 8 PJ from deep geothermal in the depth range 400 to 3000m.

By **2030** the French Geothermal Action plan (Ferracci, 2025) is targeting:

- **30 PJ/a from shallow geothermal resources, temperatures less than 30°C**
- **21 PJ/a from deep geothermal resources, temperatures less than 200°C**

By **2035** the targets are:

- **54 to 64 PJ/a from shallow geothermal**
- **28 to 36 PJ/a from deep geothermal**

The **2030** target is a 110 and 160 percent increase respectively from the 2024 geothermal energy production levels.

The Netherlands have a Master Plan for Geothermal Energy (EBN, 2018) targeting **50 PJ/a by 2030** and **200 PJ/a by 2050**. The geothermal energy production in the Netherlands has risen from zero in 2007 to ~8 PJ/a in 2024 (noting that this is similar to the total current Geoheat use in New Zealand). The Dutch are targeting temperatures of 90°C at depths up to 2000m and 120°C at depths of up to 4000m. The 2030 target is a greater than 500% percent increase relative to the 2024 geothermal energy production.

Sixty percent (30 PJ/a) of the 2030 target is anticipated to be used in green housing.

Closer to home, low temperature Geoheat has gained traction through the Christchurch rebuild after the 2010 / 2011 earthquakes (Seward and Carey, 2021). Commercial buildings, City Council facilities, the Justice Precinct, St Georges Hospital, the airport, and buildings at Canterbury University with heat requirements ranging up to about 4 MW utilise energy from aquifers under the city at a temperature of about 13ºC. In these facilities ambient temperature groundwater is the thermal energy source and sink. Heat pump augmentation raises the temperature of the energy, typically to less than 80ºC, as might be required. A number of the facilities also use the aquifer water directly for cooling (free cooling). There is more information on Christchurch in the Case Study section.

The potential application of low temperature Geoheat in other regions of New Zealand is being explored. Covered cropping operations are considering Geoheat for transitioning from fossil fuel supplied heat, particularly in the Waikato, Auckland and Bay of Plenty regions where Vegetables NZ, Tomatoes NZ and MPI have and are co-funding studies.

There have been a range of studies completed in the broader Tauranga area over the last two to three years, with interest in pursuing exploratory work for a possible energy / heat network in the area of the Port of Tauranga. The use of a high temperature heat pump was investigated for an application at Dominion Salt, Mount Maunganui, as part of the EECA RETA BOP work (Carey et al 2024a).

With high temperature heat pump innovation and further development being driven internationally at pace, temperatures up to about 150ºC are achievable now and temperatures up to 300ºC are anticipated within the next five years (Richter 2025). EECA's Very High Temperature Heat Pump Activator Initiative (2025-2026) provides support for the installation of high temperature heat pumps, that produce outlet temperatures exceeding 85ºC, to showcase this technology seeking to further foster uptake in New Zealand.

2026-2027 GEOHEAT ACTION PLAN

The re-aligned focus in the 2024-2025 Action Plan to include ambient and low temperature Geoheat has been very successful and this will continue to be an important aspect of the 2026-2027 Action Plan.

Geoheat Action Plan activities are intended to support energy users needing information, advice and connections to explore, design and implement the transition whether it be to high or low temperature Geoheat.

The Geoheat Action Plan builds on priorities identified in the 2024-2025 Geoheat Action Plan (Carey et al 2024b), which was the latest in a series of Action Plans intended to progress the Geoheat Strategy for Aotearoa NZ 2017-2030 (Climo et al 2017).

2017-2030 Geoheat Strategy Goals

- Increase the uptake of Geoheat in New Zealand by 7.5 PJ by 2030.
- Create an additional 500 new jobs associated with new Geoheat projects by 2030.

Actions identified in this plan are for the Geoheat Action Group to collectively progress, over and above the efforts of individual companies, in advancing the uptake of Geoheat in New Zealand.

The Geoheat Action Group is open to individuals from all stakeholder groups. You are welcome to join us, please email geoheat@earthsciences.nz if you wish to be involved.

2026 – 2027 Focus

The 2026 – 2027 Geoheat Action plan will have a particular focus on:

- Ambient and low temperature geothermal because of the potential for its wide application across most of New Zealand and the work that is already underway.
- Geoheat technology innovation – focusing on innovations to leverage Geoheat, as well as innovation in its use and development.
- Promoting the role of Geoheat in the energy transition from 2026. This fully aligns with the Horizon 1 Geoheat Action Plan Goals in the Government's geothermal strategy, *From the Ground Up*, for the 2026-2027 period.

Showcase
Investigate New Collaborate Innovate
Demonstrate Projects Support
Advocate Communicate

2026 - 2027 ACTION GROUP GOALS

GOAL 1 The ultimate goal of the Geoheat Strategy is the establishment of **NEW PROJECTS** using geothermal energy for process heat. The target is 5 new projects using Geoheat, each with a capacity greater than 500kW, in planning or operational through the 2026 – 2027 Action Plan period.

GOAL 2 **POSITION** Geoheat so that it is widely acknowledged as a viable and sustainable process heat option for industrial and commercial operations in New Zealand. The Geoheat Action Group will support efforts by organisations, agencies, and businesses in advancing Geoheat uptake. This will include involvement in at least 10 events / workshops / conferences throughout New Zealand raising the profile of Geoheat, including in Te Waipounamu (South Island).

GOAL 3 **SUPPORT** the development of and **DEMONSTRATE** innovative Geoheat technologies, systems, and business models to accelerate adoption of low-emissions Geoheat innovations. This includes five site visits to demonstrate Geoheat in operation or under development, aimed towards connecting and building knowledge for innovators, investors, government and industry. These visits to be arranged primarily by the relevant Economic Development Agencies and the New Zealand Geothermal Association. It is anticipated that Ara Ake and ESNZ will also organise some visits.

GOAL 4 Further **ENABLE** Geoheat uptake by ensuring information, case studies, web application tools and results from exploration activities are available to businesses and investors giving them knowledge and confidence and assisting with de-risking Geoheat investment. At least 10 pieces of written material on Geoheat including reports, conference papers and case studies are published in the public domain. It is anticipated that ESNZ will take a lead in facilitating the preparation of the published material. The planning or completion of at least two significant Geoheat derisking investigations, with Ara Ake and GeoExchange NZ anticipated to be key contributors.

2024 – 2025 EFFECTIVENESS REVIEW

Overall, there has been a very satisfactory level of goal achievement in the 2024-25 Geoheat Action Plan period. A qualitative assessment of the achievement for the period is shown as a percentage by goal below (Figure 3).

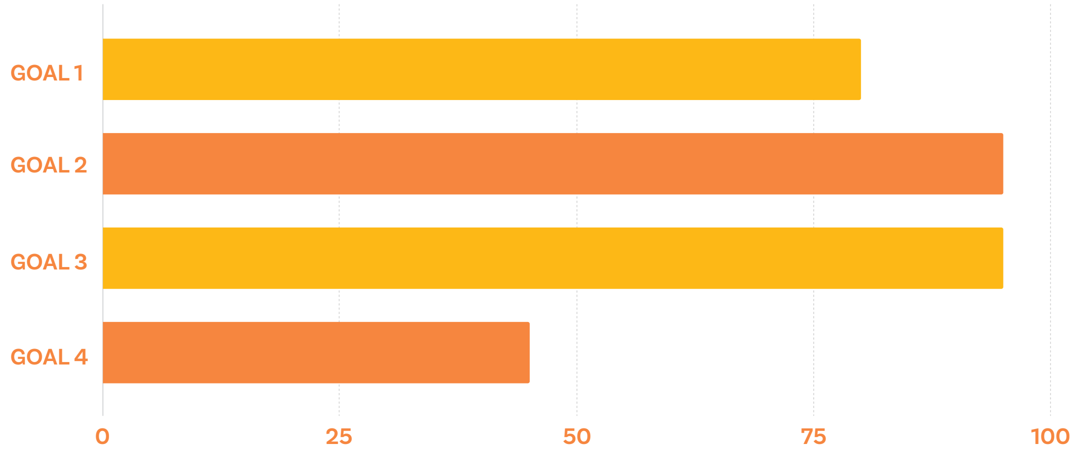


Figure 3 *Goal achievement for the 2024 – 2025 Action Plan period as a percentage*

Additional commentary on each of the four goals is on the next page.

GOAL 1

The establishment of **NEW PROJECTS** using geothermal energy for process heat. Target for the 2024-25 period was: At least seven new Geoheat ventures or projects announced and / or completed. These will ideally be comprised of:

- One new major industrial high temperature venture announced and / or completed.
- 3 new SME high temperature ventures announced and / or completed.
- 3 new or fuel-switching low temperature ventures announced and / or completed.

ASSESSMENT *Satisfactory Achievement*

Two high temperature projects:

- Completion of the Essity, Kawerau, NZD 20 million conversion of the drying section on paper machine number 3 from natural gas to geothermal. This included installing a new Yankee drum. This was fully operational in March 2025.
- Foresta Group Holdings, Kawerau, torrefied wood pellet plant is in the planning phase. A 30-year land lease was signed on the 9th February 2026. The plant is likely to use Geoheat to dry the residue wood feed stock.

Four lower temperature projects:

- He Ahi eco-business park. Fertiliser manufacturer TNUE fully operational in March 2024 using Geoheat for drying,
- Taupō Hospital installed a second geothermal well, ahead of the complete removal of the backup coal fired boiler in April 2024.
- Networked aquifer water heat pump system supplying 68 Arrowtown residences commissioned in May 2024 at the Queenstown Lakes Community Housing Trust Tewa Banks development.
- Nature's Flame at their Taupō plant expanded their wood pellet production capability to 180,000 tonnes per year in 2024. Geoheat is used for feed stock drying.

GOAL 2

POSITION Geoheat so it is widely acknowledged as a viable sustainable process heat option for industrial and commercial operations in New Zealand. Within this, the Geoheat Action Group will support efforts by geothermal process heat and technology solution providers.

ASSESSMENT *High Level of Achievement*

Geoheat has been raised to be on the government agenda and included in the NZ Government Geothermal Strategy (NZG 2026). EECA have funded Geoheat studies as part of their RETA programme. MPI have co-funded Geoheat work focussed on covered crop opportunities. The Bay of Plenty Regional Council has been progressing the development of the Tauranga System Management Plan to enable sustainable use, and with Priority One are raising the awareness of the Geoheat opportunities in the TGS. BRANZ, Ara Ake, Vegetables NZ and Tomatoes NZ are all engaged with Geoheat studies.

GOAL 3

Further **ENABLE** Geoheat by ensuring information and case studies are available to operators and investors, giving them knowledge, networks and confidence to invest in Geoheat.

ASSESSMENT *High Level of Achievement*

Refer to the Activity Timeline to see the extensive output through the period of the 2024-25 Action Plan.

GOAL 4

Provide access to Geoheat facilities that **DEMONSTRATE** the technologies, which operators and investors can visit firsthand. This is to demonstrate Geoheat infrastructure and associated processes in established businesses, providing confidence and peer networks to prospective Geoheat adopters. As part of this, establish a group of "Leading Geoheat Adopters" keen to share their stories and learnings.

ASSESSMENT *Partial Achievement*

Visits to Geoheat facilities have been able to be set up by appointment with the various businesses and there were visits to Nature's Flame and TNUE organised in conjunction with the 2024 and 2025 Geothermal Week events and a field trip to Kawerau as part of the 2024 Geothermal Week event. The Action Group was however unable to establish a Leading Geoheat Adopters group.

Above: Essity's Tork brand is celebrating over 70 years of manufacturing at the Kawerau Mill with commissioned artwork by Indigenous artist Sarah Hudson. These designs include the Whakatupu leaf to represent growth, and the Korohū Mutunga Kore spiral form to represent the transformation of geothermal energy into power. These designs are featured on two of Essity's products along with messaging to inform consumers how the product is made.

"The geothermal reservoir and the infrastructure in place through Ngāti Tūwharetoa Geothermal are unique to Kawerau, and we are so pleased to invest more into this smart, natural solution. Beyond the positive environmental impact, the project also delivers socio-economic benefits to the local economy with the partnership helping to fund local marae, housing, and education initiatives."

Sid Takla
Australasia Managing Director, Essity

CASE STUDIES

This section includes case studies from Kawerau, Christchurch, Taranaki, and two international case studies; one from Norway and the second from France.

KAWERAU

ESSITY TISSUE MANUFACTURING

Essity, previously known as Asaleo Care, is New Zealand's only in country manufacturer of tissue paper used in some of New Zealand's best known hygiene products. Product images are shown at the bottom of the page.

Essity, achieved a significant milestone in their decarbonisation journey in March 2025 with the official opening of the paper machine number 3 which has been completely converted from using natural gas fired heat to geothermal energy.

The earlier part of their journey, that commenced in 2010, is written as a Success Story in the 2020-2021 Geoheat Action Plan (Climo et al 2020) and it continued in November 2021 when Essity was awarded a GIDI grant for NZD 1.65 million for a project that would redesign and convert the drying section on paper machine number 3 from a natural gas fired drum and hoods to steam hoods using geothermal energy.

"Without the funding, it would have been much more difficult for a project like this to stack up as a business case," says Paul Honey, Executive General Manager for Supply. **"The GIDI grant enabled us to make a compelling case to our parent company in Sweden and helped get the project across the line."**

The project is unique, being the first paper machine in the world to have the Yankee dryer drum and hoods heated using steam produced from geothermal replacing what traditionally are natural gas fired. The completed project cost was NZD 20 million (Tork 2025), with estimated annual carbon emissions reduction of 6450 tonnes.

The project involved replacing the headbox, replacing gas heated hoods with steam heated hoods, installing a new steel Yankee drum and upgrading other equipment including the suction press roll. Figure 4 is a schematic that identifies the changes made to the paper machine.

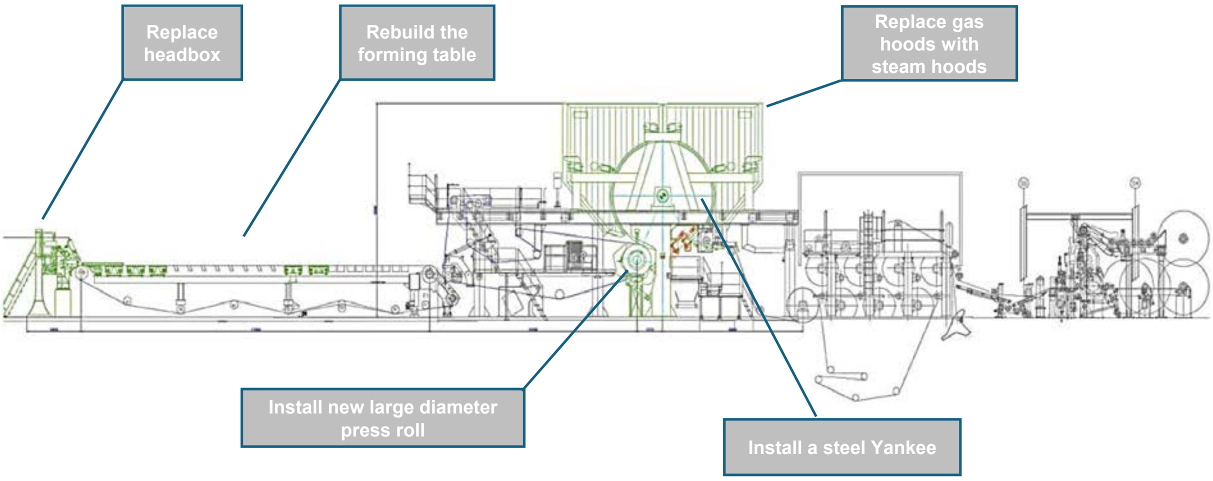


Figure 4 *Essity Kawerau Paper Machine 3 rebuild schematic (Shepherd 2022). The components shown in green and identified by the grey text boxes were part of the rebuild.*

In transitioning to geothermal from natural gas, the hood temperature reduced from 350°C to 180°C without reducing production capability. As well as the emissions reductions achieved from fuel switching, the rebuild reduced the annual pulp required by 1300 tons, reduced waste production, improved the paper machine's efficiency and enlarged its product range capability. The rebuilt paper machine was fully operational as of 3 March 2025 (Tork 2025).

Essity are currently exploring replication of this geothermal project on their other paper machine at their Kawerau facility. This final energy transition to geothermal would result in complete elimination of natural gas use at the Essity, Kawerau site.

CHRISTCHURCH

RECONSTRUCTION INCLUDING GEOHEAT FACILITIES

Christchurch has been a hub for ambient temperature Geoheat activity in New Zealand since 1970/80s. From 2014, the number of installations increased significantly as the benefits of the aquifer water energy systems became better known, along with rebuilding of a number of mid to larger sized commercial and council facilities post the 2010-2011 earthquakes which enabled these types of systems to be adopted as part of reconstruction.

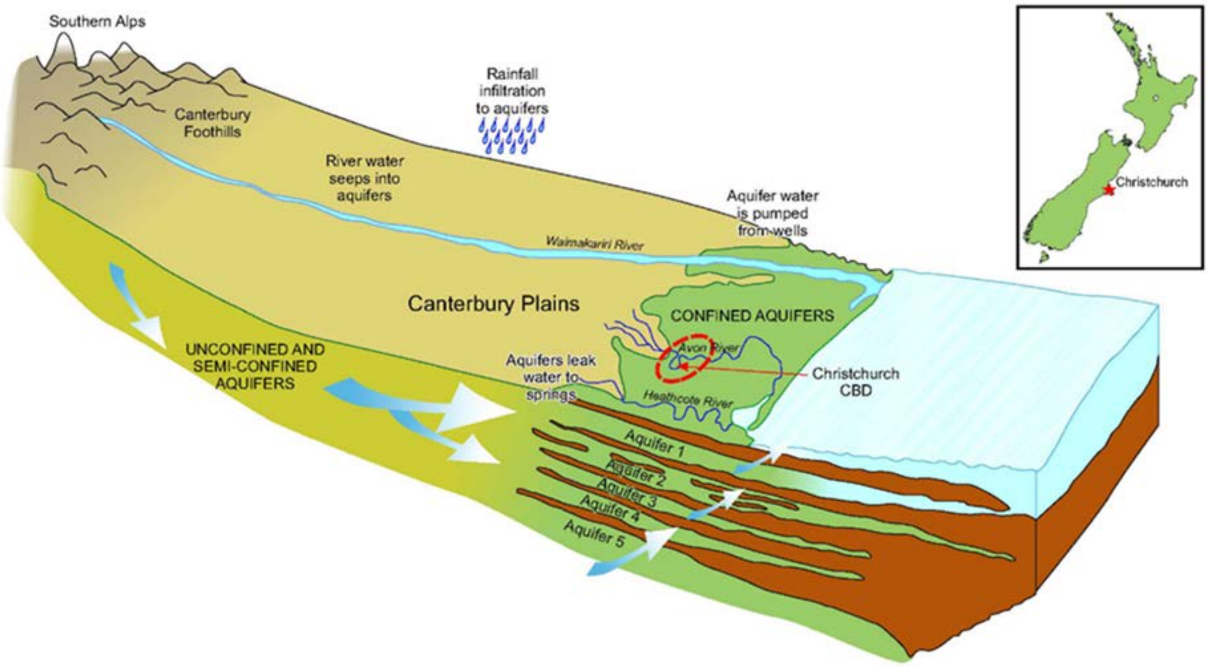


Figure 5 *Conceptual diagram showing the groundwater flow from the foothills of the Southern Alps to the confined aquifers under Christchurch city. Image redrawn from Weeber (2008)*

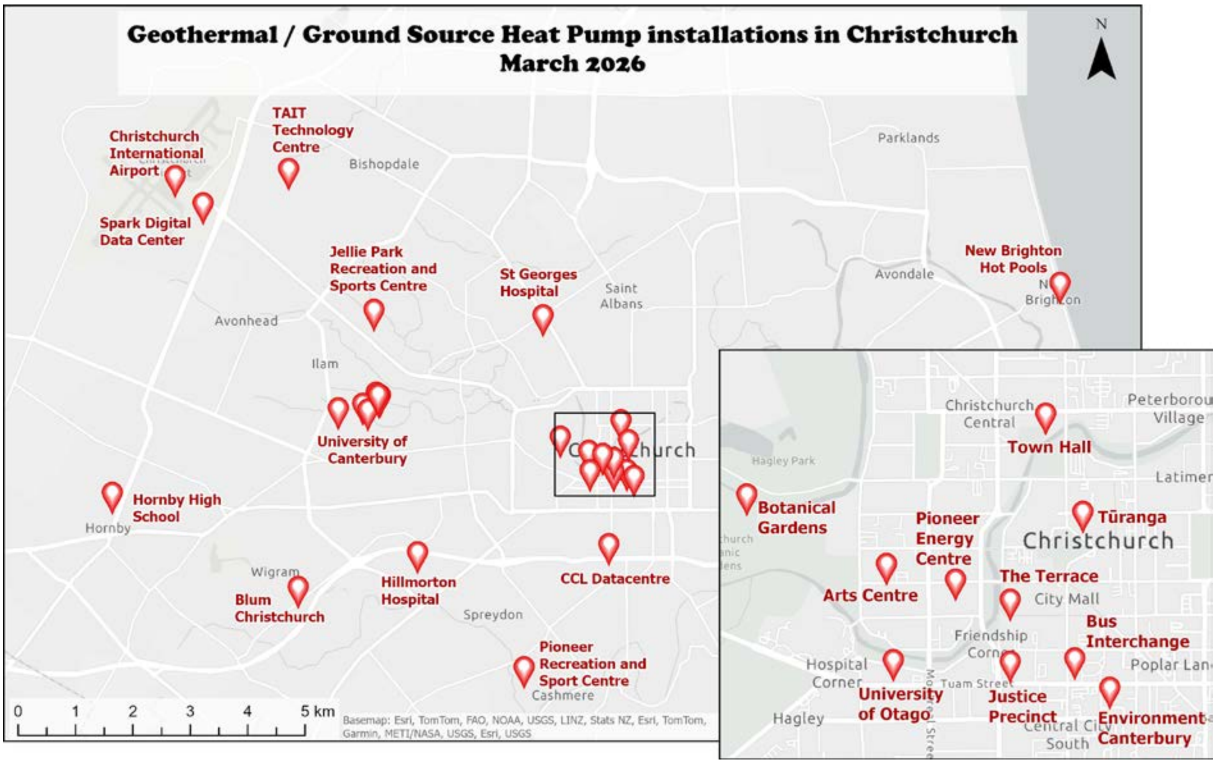


Figure 6 *Christchurch facilities using geothermal heat pump aquifer energy systems as of March 2026.*

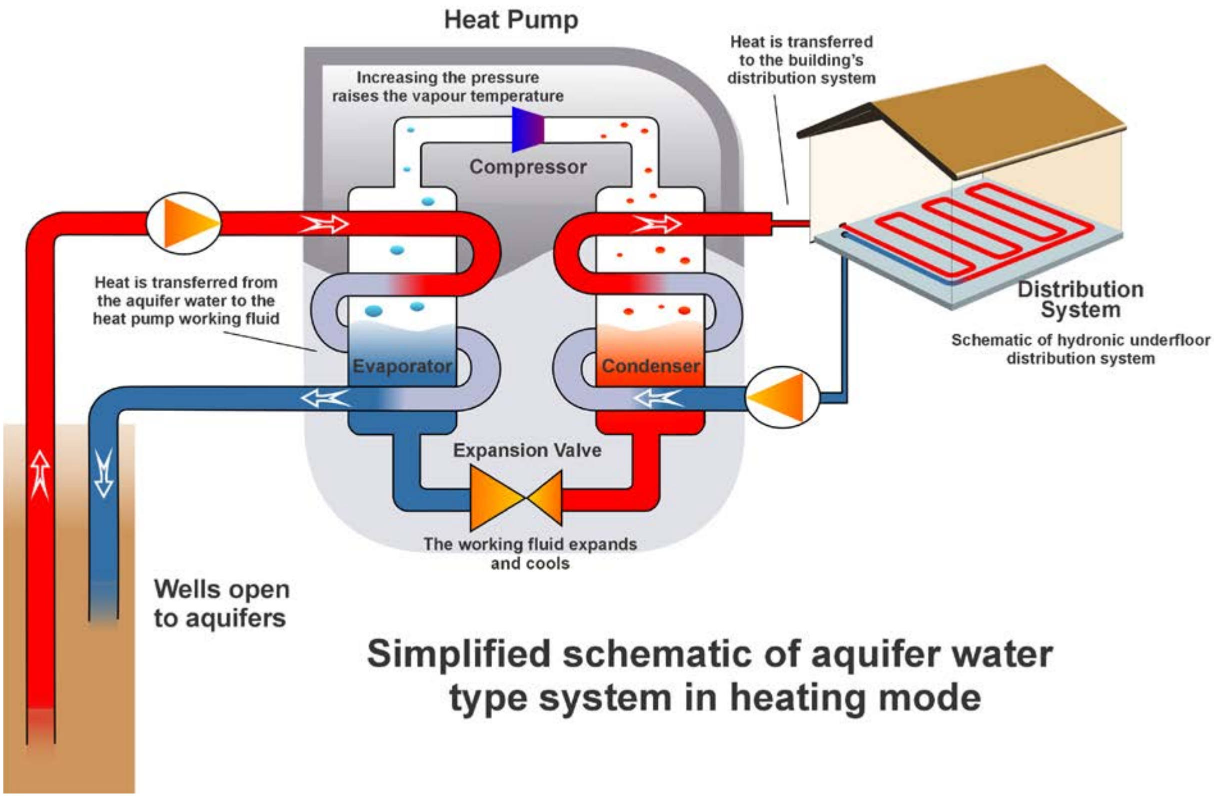


Figure 7 *Simplified schematic of an aquifer water geothermal / ground source heat pump*

There are now more than 20 significant facilities in Christchurch City using ambient temperature, 12 to 14 °C aquifer water as the source and sink for facilities heating and cooling (Figure 6). Many of them are in the central city area where permitted activity groundwater energy use rules are operative, subject to meeting specified conditions. The capacity of the systems range from 100's kW to a few MWs.

Seasonal performance co-efficients are excellent and a number of these facilities have been assessed using the NABERSNZ Energy Base Building star rating. In April 2023 Ngāi Tahu Property's Te Urutī Building at the King Edward Barracks site, which uses Geoheat from the Pioneer Energy Centre, became the first building in Te Waipounamu to receive the highest 6 star rating.

Papers by Seward et al (2017 and 2021) identify the aquifers and provide more detail on some of the systems including energy delivery to and from the aquifers. A GNS Science poster on the Arts Centre developed in 2017 also contains technical material on the installed geothermal / ground source heat pump system at the Centre, including the geological logs and well screen depths.

Rutter et al (2025) updates information on the systems installed in Christchurch.

Dust rising from central Christchurch from 22 February 2011 earthquake.
Photo Credit: Gillian Needham (www.earthquakephoto.co.nz).

TARANAKI

HEAT POTENTIAL IN LEGACY PETROLEUM ASSETS - THE TARANAKI GEOHEAT DISCOVERY CHALLENGE

The Challenge is a collaborative project led by Ara Ake, investigating geothermal heat opportunities across a region with moderate Geoheat potential, and a breadth of petroleum infrastructure and incidental Geoheat information. It has two aims: to assess the Geoheat potential of legacy petroleum wells, and to identify greenfield Geoheat opportunities across Taranaki.

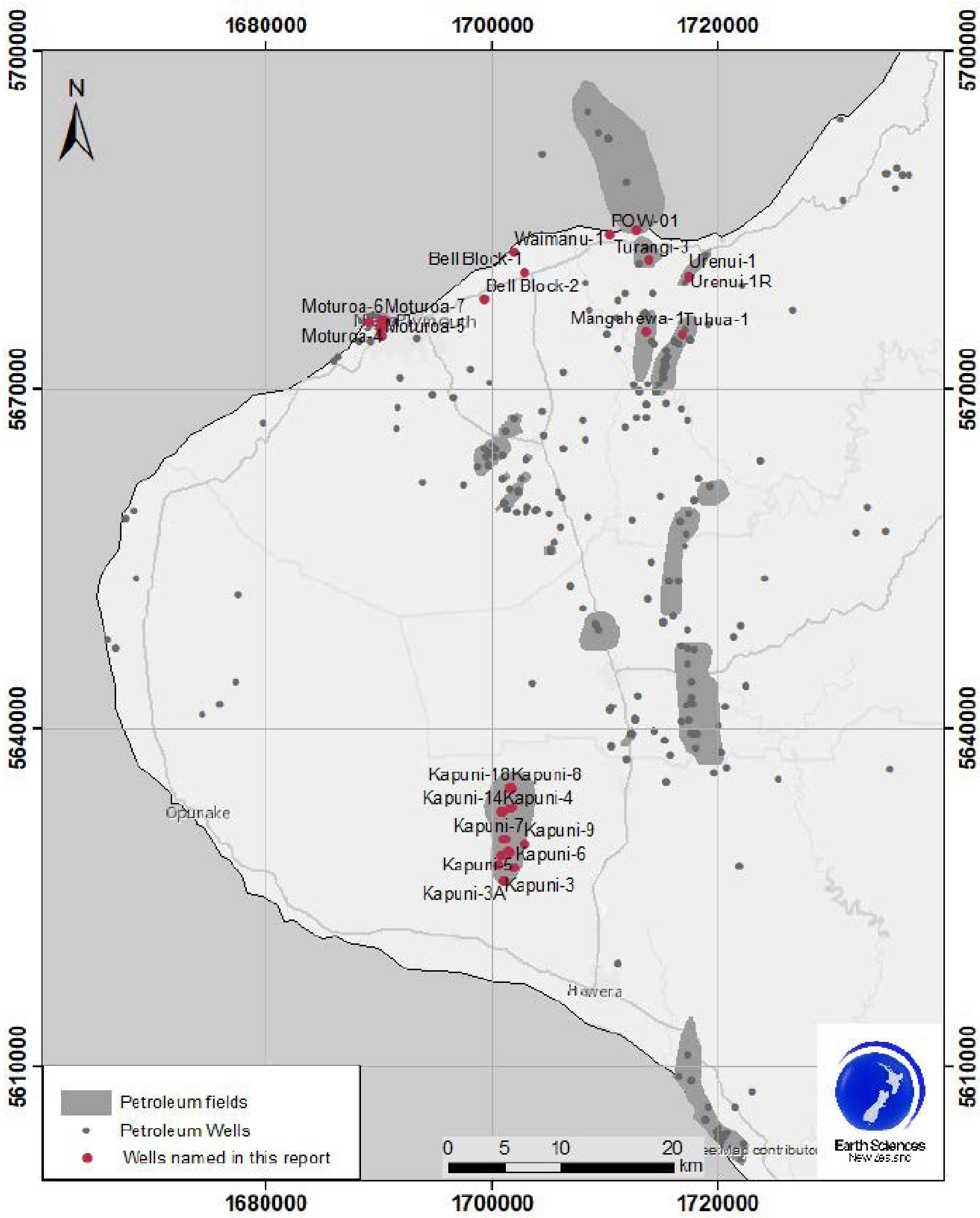


Figure 8 *Petroleum Wells in Taranaki – Wells identified in red are included in Seward et al (2026a).*

Grounding information

A baseline understanding of the potential to establish Geoheat in Taranaki is being developed through commissioned studies:

- A scoping study (Seward et al 2026a), completed by ESNZ and GeoExchange NZ in early 2026 reviewed and compiled preexisting data to unpack Taranaki's Geoheat potential, possible roadblocks and opportunities, and exemplar case studies.
- A detailed literature review was conducted on the repurposing of petroleum wells for Geoheat, covering relevant technologies, innovations and international projects. Its findings were incorporated into the selection of Geoheat development opportunities explored in the Challenge.
- A review of the legal and regulatory challenges and opportunities associated with the redeployment of petroleum infrastructure, including a review of how these may impact deployment in Taranaki.
- A tangata whenua view and recommendations around the opportunity to repurpose petroleum wells for Geoheat development.

De-risking Development and Use Opportunities

This work has progressed into an 18–24 month Taranaki Geoheat Discovery Challenge, aimed at developing a cohesive understanding of Geoheat development and use opportunities. The Challenge focuses on repurposing petroleum infrastructure—particularly wells—and leveraging existing subsurface data to reduce development risk.

Up to four priority opportunities will be selected and progressed through targeted work programmes, with the objective of maturing these toward pilot, testbed, or early-stage commercial demonstration.

International Petroleum Well Redeployment for Geoheat

There is increasing international focus on the potential to repurpose existing oil and gas infrastructure for Geoheat development. Key benefits of redeploying petroleum assets include reduced capital expenditure and accelerated project timelines through avoided drilling, extended asset life of existing infrastructure, and reduced subsurface uncertainty through the use of pre-existing geological and operational data.

Key international reference projects include:

- CeraPhi petroleum reuse project (U.K.): CeraPhi Energy is repurposing end-of-life oil and gas wells to deliver low-carbon, industrial-scale heat using closed-loop downhole heat exchangers. A commercial pilot at the Third Energy KMA site in North Yorkshire has demonstrated the feasibility of converting legacy wells into geothermal energy hubs, supporting larger-scale deployment.
- TRANSGEO (Central Europe): TRANSGEO is a European Commission-funded initiative investigating the repurposing of abandoned oil and gas wells for geothermal heat production and storage. The project is developing feasibility assessments, validated methodologies, and a transnational action plan to support deployment across Central Europe.
- DOE "Wells of Opportunity" (U.S./Global concept): This approach focuses on identifying and assessing decommissioned or soon-to-be-abandoned wells as candidates for geothermal heat extraction. It leverages existing wellbores to reduce exploration costs while evaluating well integrity, thermal gradients, and infrastructure adaptability for industrial and community-scale applications.

Building on the scoping study and literature review, the Challenge now focuses on developing a portfolio of Geoheat development and use opportunities in the Taranaki region. In collaboration with key stakeholders, up to four high-potential Development and Use Opportunities (DUOs) will be selected for further advancement, alongside the design and implementation of targeted work programmes to further de-risk these opportunities.

The overall objective is to establish Ara Ake-supported Geoheat and petroleum reuse pilots, testbeds, and demonstration projects in Taranaki.

NORWAY

THE STONE THERMOS

Fjell Skole, a 780 student school in Drammen, Norway, has set up a heat store in the crystalline rock under the school car park. This innovative Geoheat store is charged up with heat energy in the summer and then the heat is extracted to heat the school during the winter. The heat is collected directly from solar collectors and from waste heat generated from cooling the school in the summer (~100 MWh/a) along with heat taken from the ambient atmosphere (~370 MWh/a) using a heat pump delivering heat to the store at up to 60°C. The heat pumps are powered by solar PV and grid electricity. The borehole thermal energy store (BTES), operating at up to 50°C, was installed in 2018 –19 and was first charged up in the summer of 2020.

Drammen climate

The average monthly temperature range for Drammen is -3 to 17°C.

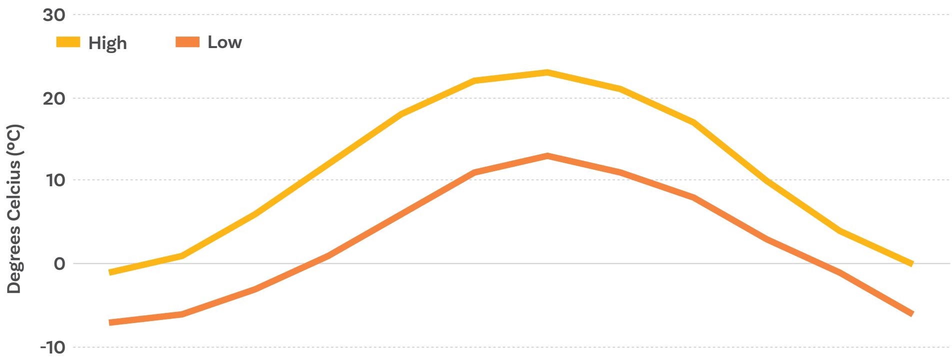
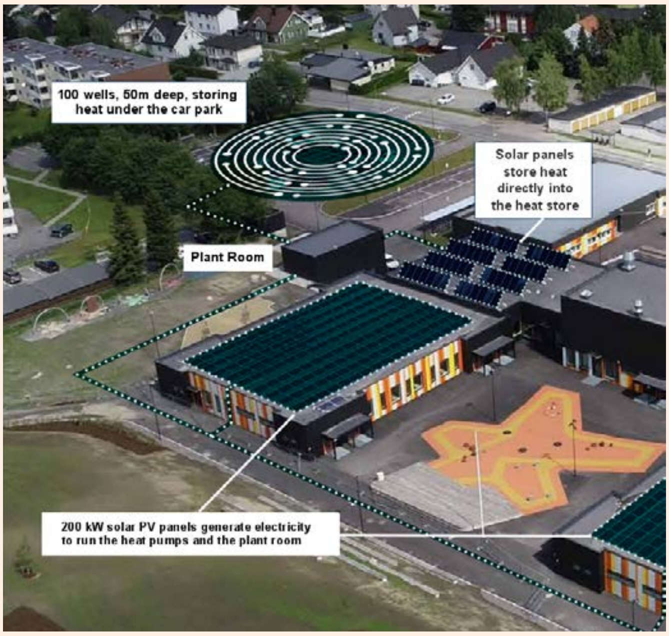


Figure 9 *Average monthly temperature data (high and low) for Drammen, Norway.*

NTNU
Norwegian University of Science and Technology

"We live on a heat source that we haven't utilised well enough."

Dr Randi Kalskin Ramstad
Associate Professor at the Norwegian University of Science and Technology



Fjell Skole - Energy System Schematic.

Building energy requirements

Floor area of the school	10,000 m²
Base heat load	80 kW
Peak heat load	300 kW
Annual heat demand	~250 MWh.

- Actual data for 12 months during 2021-2022, which includes the winter period measured 240 MWh of onsite energy produced and 25 MWh of grid electricity.
- For the 2022-2023 period 234 MWh of onsite produced energy and 20 MWh of grid electricity.

Heat is supplied to the school building interior through a 30°C underfloor hydronic piping network.

Borehole thermal energy store

The BTES was constructed and the car park reestablished on top of the heat store.

Figure 10 *Top of the BTES. 11 fiber optic string locations shown on the LHS diagram in the small orange circles. RHS supply and return piping from the bore holes in the BTES covered over with the car park on top when it was completed.*

The BTES consists of 100 boreholes each 50 m deep arranged in a cylindrical pattern with the boreholes spaced laterally at 4m. the central part of the heat store operates at up to 50°C.

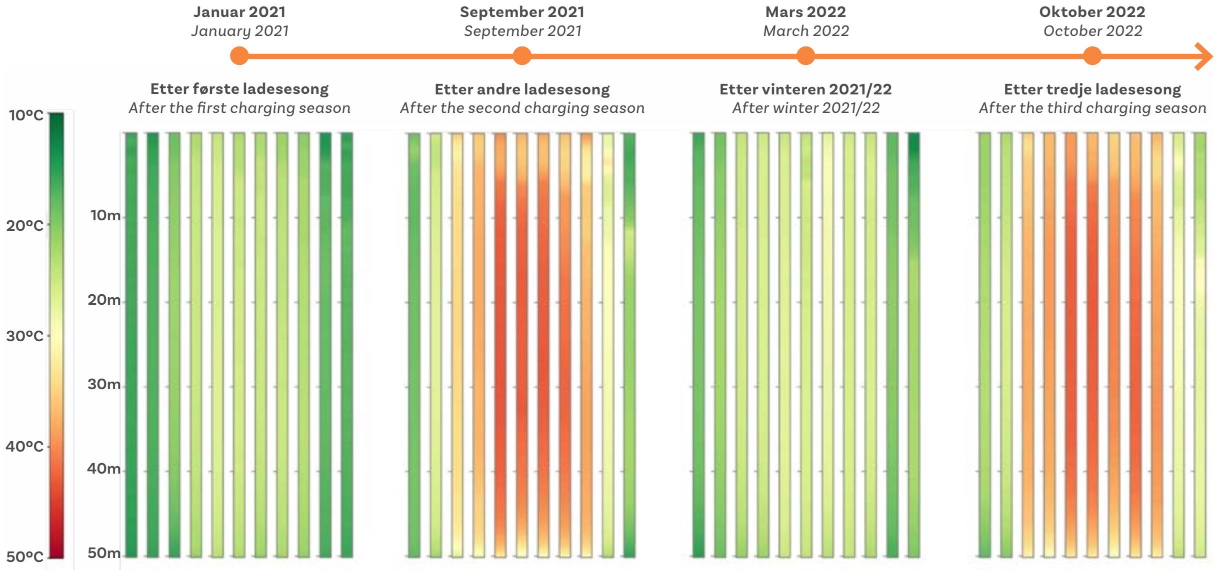


Figure 11 Measured temperatures in the BTES. Thermal profiles through the seasons from the 11 fibre optic strings shown in Figure 10.

Fjell Skole in winter (left) and summer (right).

CADAUJAC, FRANCE

ECO-SUBDIVISION BOREHOLE THERMAL ENERGY STORE

An eco-subdivision in Cadaujac, France, uses 940m^2 of solar heat collectors and an innovative underground borehole thermal energy store to provide heat to a 67 residential dwelling complex supplied through an 840m long district heating network. The system supplies all of the heating needs including the domestic hot water (DHW).

Figure 11 *Eco-subdivision Cadaujac, France. Solar panels in the foreground with residential buildings behind*

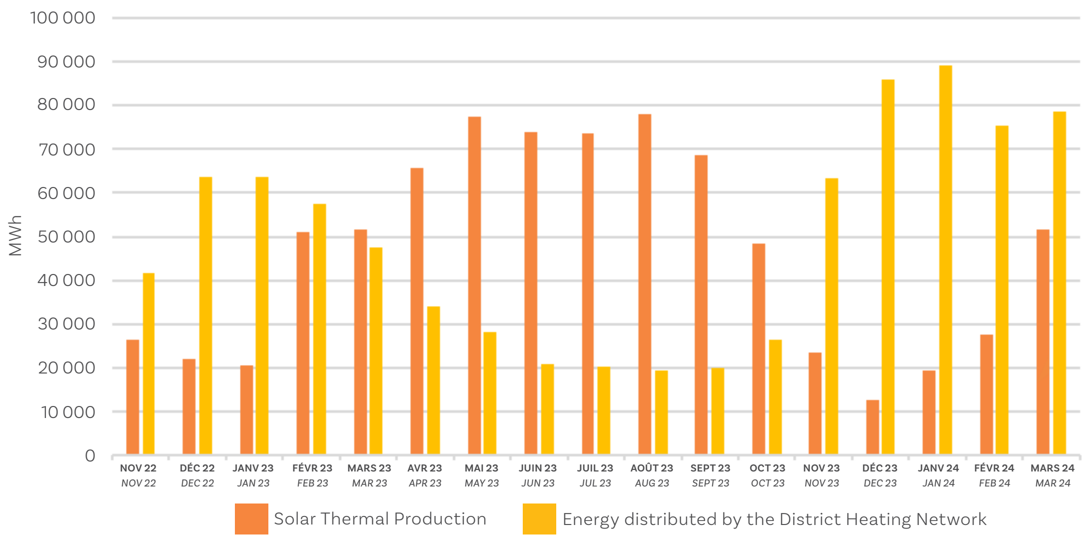


Figure 12 *System energy by month. Solar thermal production (orange) and energy delivered to the district network (yellow).*

There are two operating modes supplying a total of 500 MWh/year:

- Free heating mode, supplying 140 MWh/year, with the solar energy supplying all of the domestic hot water whilst also raising the temperature in the BTES. The free heating mode doesn't need the heat pump to operate.
- Heat pump augmentation mode, supplying 360 MWh/year, with the heat pumps providing the buildings heating and DHW requirements. Solar energy is used as available with the balance provided from the BTES. The heat pump is an AERMEC 310 kW double compressor unit.

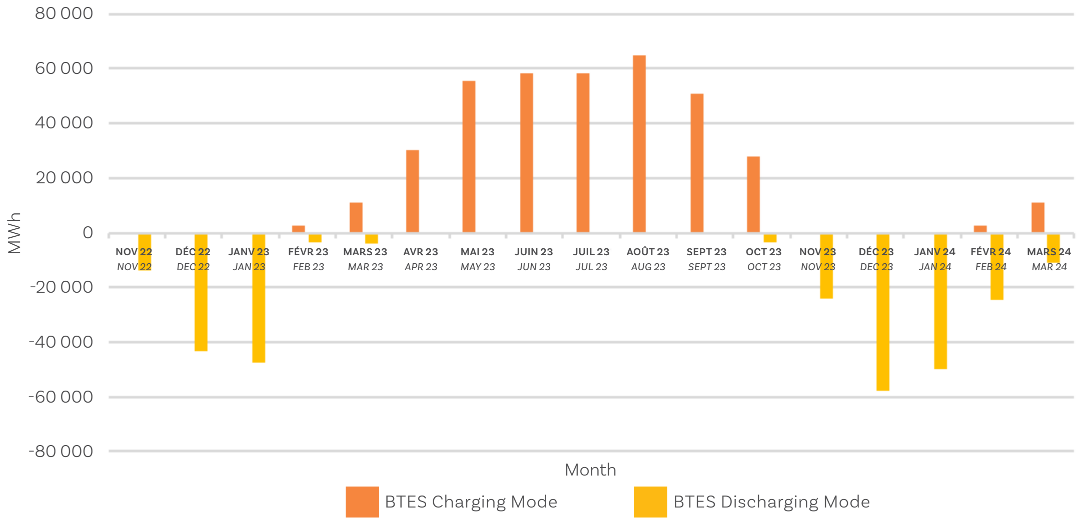


Figure 14 *BTES charging (orange) and discharging (yellow) energy by month. Note in the cross-over months both charging and discharging of the BTES occurs.*

The BTES comprises 60 boreholes 32m deep spaced 2m apart making up a storage volume of 10,000m^3. The temperature in the BTES increases through the summer raising the underground storage volume to hotter than 50°C. In winter the underground thermal battery is discharged. The efficiency of the BTES is 50%, defined as the energy retrieved relative to the energy delivered into the store.

Figure 15 *Top of the BTES awaiting cover placement*

In 2023 this innovative ground based thermal energy system was awarded the Pole AVENIA “Innovative technology” certification.

An IEA Geothermal case study has more information.

GEOHEAT ACTIVITY TIMELINE

Geoheat activities from 4th quarter 2023 through 1st quarter 2026. Note the list is not fully comprehensive.

2023

23·11·2023
17th Otago Energy Research Centre (OERC) Symposium 2023. Decarbonising industries with geothermal - a pathway to greater direct use. Celia Wells, GNS Science.

07·11·2023
EECA RETA Bay of Plenty report back session in Rotorua, including GNS Science Geoheat Report. Event hosted by Bay of Connections.

12·2023 Link
Release of the BOPRC Tauranga Geothermal System Science Summary Report (BOPRC 2023).

15·12·2023 Link
EECA managed GIDI fund closed to new applications with the fund returning over NZD 600 Million of unallocated GIDI appropriations to the Government.

2024

15·03·2024 Link
Fertiliser manufacturer TNUE, commenced production using Geoheat at the He Ahi eco-business park, Taupo.

15·04·2024 Link
Taupo Hospital installed a second geothermal well (NZD 200K in total, funded 40% by EECA) enabling removal of the backup coal fired boiler.

05·2024 Link
Networked aquifer water heat pump system supplying 68 Arrowtown residences commissioned at the Queenstown Lakes Community Housing Trust Tewa Banks development.

15·04·2024 Link
Public Release of the EECA RETA Bay of Plenty work including the GNS Science Geoheat Report.

24·04·2024 Link
Public Release of the NZGA 2024 - 2025 Geoheat Action Plan (Carey et al 2024b).

28·05·2024
Brian Carey, as stand in presenter, lodged a Geoheat Abstract for the Carbon and Energy Professionals conference in Christchurch.

02·07·2024 Link
GNS Science - What is our Potential Workshop - Presentation on Ambient and Low Temperature Geothermal by Yale Carden

03·07·2024 Link
NZGA 2024 Seminar Keynote - Geoheat: Every Day, Everyone, Everywhere - C Percy GNS Science CEO

NZGA 2024 Seminar - Decarbonising vegetable growers around New Zealand - Ellery Peters (Vegetables NZ):

NZGA 2024 Seminar - Regional Energy Transition Accelerator (RETA) Bay of Plenty Geothermal Assessment – Glenn Wellington, EECA

10·07·2024 Link
Anya Seward and Brian Carey on GeoTV – Episode 2 “Walk the Talk” interview / discussion on geothermal direct use in New Zealand.

2024

22·07·2024 Link
Release of the BOPRC report Preliminary Scoping Study for the Geoheat Potential of the Tauranga Geothermal System and associated factsheets, authored by GeoExchange NZ in collaboration with BOPRC (GeoExchange NZ 2024a).

10·09·2024 Link
Carbon and Energy Professionals Webinar - Geothermal in New Zealand - an overlooked carbon friendly energy source presentation by Brian Carey.

25·09·2024
National Geothermal Association of the Philippines (NGAP) conference. Presentation by Kennie Tsui (NZGA) that included Geoheat material.

NGAP conference. Presentation by Rob Reeves and Mark Gibson (GNS Science) that included Geoheat material.

17·10·2024 Link
BOPRC Draft Tauranga Geothermal System Management Plan (BOPRC 2024) open for submissions until 31 January 2025. Multiple public engagements and presentations.

27·10·2024
Geothermal Rising Conference, Hawaii, USA. Low Carbon Geothermal Heat Energy – Geoheat for New Zealand Advancing decarbonisation of industrial, commercial and covered crop process heat paper presented by Samantha Alcaraz

05·11·2024
Ministry of Primary Industries Sustainable Food and Fibre Futures (SFFF) programme. Decarbonising the covered crop industry with Geoheat. In collaboration and co-funded with GNS Science, GeoExchange NZ, Vegetables NZ and Tomatoes NZ. Two year programme with total funding of NZD 289K, led by Anya Seward (GNS Science).

07·11·2024 Link
Priority One Information Seminar -Geothermal Heat for Residential, Commercial & Industrial Use including low temperature Geoheat presentation by Celia Wells and Yale Carden, GeoExchange NZ (GeoExchange NZ 2024b). Overview of BOPRC's role in Geothermal by Dean Howie.

08·11·2024
Priority One, Tauranga, presentation on Decarbonising the covered crop industry with Geoheat

11·11·2024
GNS Science NZ Japan workshop on solid-state technology for low-enthalpy energy harvesting - Geoheat presentation by Brian Carey

12·11·2024
BOPRC Tauranga System Management Plan public workshop. Presentations included an Introduction to the Tauranga Geothermal System (Penny Doorman, BOPRC) and Low temperature opportunity and technology (Yale Carden and Celia Wells, GeoExchange NZ)

20·11·2024 Link
Paper Investigating the Geoheat Potential of the Tauranga Geothermal System, Carden, Wells, Wolpmann, Doorman, Howie. Proceedings 46th NZ Geothermal Workshop. 20-22 November 2024 (Carden et al 2024).

21·11·2024
18th Otago Energy Research Centre (OERC) Symposium 2024, What is the role of Geoheat in NZ's low carbon energy future? Presentation by Anya Seward.

2024

11·12·2024
Horticulture Industry Forum, official launch of the MPI Decarbonising the covered crop industry with Geoheat programme. Anya Seward (GNS Science) & Antony Haywood (Vegetables NZ) presenting.

18·12·2024 Link
GNS Science Geothermal Heat (Geoheat) webpages went live.

23·12·2024
Assent of Fast Track Approvals Act with the Foresta Pine Chemicals and Wood Pellet Plant (Kawerau) listed in Schedule 2 for projects with significant regional or national benefits.

2025

01·12·2025
Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 including revision to the geothermal emission factors from the January 2023 version of the regulations.

07·01·2025
Tomatoes NZ attended the Fruit Logistica event in Berlin, Germany. Celia Wells, GeoExchange NZ, organised a tour of the Berlin aquifer thermal energy storage (ATES) PUSH-IT research project.

08·01·2025 Link
Geoheat Video released by GNS Science.

15·01·2025 Link
Media release by Vegetables NZ on the web based Geoheat tool (Grower2grower, 2025).

12·03·2025 Link
Essity, Kawerau, paper Machine 3 drying stream conversion to geothermal officially opened. This is the first fully geothermal heated tissue paper machine in the world (Tork 2025).

14·04·2025 Link
NZ Energy Conference 2025, Auckland University. Geothermal as a Thermal Demand Tool in the Energy Transition. Presentation by Yale Carden. (Page 28 of digital abstract).

01·05·2025
BRANZ research funded collaboration with GNS Science (Anya Seward) and GeoExchange NZ (Yale Carden). Development of a methodology to assess embodied carbon implications of Geoheat and other decarbonisation technologies as a successor to fossil fuel heating systems. May 2025 to Nov 2026

06·05·2025
Mt Industrial Accord, Priority One workshop, Mt Maunganui. Geoheat presentation by Brian Carey

08·05·2025 Link
NZ Government announces disestablishment of the New Zealand Green Investment Finance (NZGIF) bank.

06·2025
BOPRC and Toi Kai Rawa - Understanding Māori Values and Uses of Low Temperature Geothermal in Tauranga Moana (Preliminary Findings).

28·07·2025
GNS Science Workshop - from the Extreme Heat to a Little Bit Cool. This included material on low temperature Geoheat.

Geothermal Week panel on Decarbonising the covered crop industry with Geoheat as part of GNS Science input.

30·07·2025 Link
Presentation by Oliver Howitt, EECA, How much Heat Does NZ Need? Introducing the NZGA Geoheat Business Guide prepared by GeoExchange NZ and Traverse Environmental Ltd.

EECA / NZGA Geoheat Business Guide Released.

NZ Government Draft Geothermal Strategy 'From the Ground Up' released for consultation.

2025

05·08·2025
Hamilton covered crop regional stakeholder meeting Decarbonising the Covered Crop Industry with Geoheat.

21·08·2025 Link
Priority One launch the Western Bay of Plenty Energy Strategy - Our Energy Future – Energy in the Western Bay of Plenty Subregion. This includes a Geoheat component (Allan 2025).

25·08·2025
Wellington Decarbonising the Covered Crop Industry with Geoheat workshop / stakeholder meeting.

23·09·2025
Vegetables NZ Energy and Efficiency Conference. GeoExchange NZ presence as part of the MPI greenhouse project

26·09·2025
Ara Ake commissioned Earth Sciences NZ and GeoExchange NZ to Review Geoheat opportunities in Taranaki. The work included consideration of oil and gas repurposing to Geoheat and four other Geoheat applications in the Taranaki Region.

16·10·2025 Link
Western Bay of Plenty's Regional Energy Summit - Priority One - Geothermal and Geoheat featured.

11·11·2025
New Zealand Geothermal Workshop 2025, Rotorua Five Geoheat related papers presented.

Link
Māori values and use of low temperature geothermal use in Tauranga Moana – Doorman and Ngatuere.

Link
What to expect when you're not expecting - Drilling in the Tauranga Geothermal System – Gardner and Rosenberg.

Link
Wider benefits from ambient and low temperature Geoheat - Why don't we get it? - Carey, Seward, Burnell, Wells, Carden.

Link
Combining low grade geothermal heat with heat pumps, an opportunity to decarbonise industrial districts – Wells and Carden.

Link
Development of a web-based tool to identify Geoheat opportunities for covered crops – Seward, Heywood, Wells, Carden, Barnes, Cohen, Viskovic, Taves, Coup, Zoeller, Rice, Wild.

11·12·2025 Link
Presentation by Timothy Allan, Priority One, on the Western Bay of Plenty Energy Strategy which includes low temperature geothermal energy (starts at timestamp 27:42 in the video).

19·12·2025
Portal closed for papers for the 2026 World Geothermal Congress. Four NZ papers / posters with information on Geoheat were submitted, including Alcaraz et al (2026) and Seward et al (2026b). Both will be presented orally at the Congress.

2026

01·01·2026 Link
Climate Change (Stationary Energy and Industrial Processes) Regulations 2009 including revision to the geothermal emission factors from the January 2025 version of the regulations.

05·03·2026
Vegetables Big Day Out in Pukekohe and reveal of Geothermal for Greenhouses webtool.

17·03·2026 Link
Release of New Zealand Government Geothermal Strategy "From the Ground Up" (NZG 2026).

GLOSSARY

Ambient temperature Geoheat	Geothermal energy in the ground at a temperature less than 30°C
BOPRC	Bay of Plenty Regional Council
Brownfield (Development)	A proven resource and producing geothermal field with geothermal development infrastructure in place
Carbon	Used generically and interchangeably with CO_{2e} in this document
Direct Use / Direct Geothermal Use	The use of geothermal energy or fluid directly. Essentially, this is any application using geothermal heat for a purpose other than generating electricity.
EECA	Energy Efficiency and Conservation Authority
ESNZ	Earth Sciences New Zealand Limited
Geoheat	Thermal energy sourced from underground
GIDI	Government Investment in Decarbonising Industry
GJ	Giga Joule, a unit of energy equal to 10^9 Joules.
Greenfield (Development)	A geothermal area with no existing geothermal development infrastructure
GSHP	Geothermal or ground source heat pump
High temperature Geoheat	Geothermal energy in the ground at a temperature above ~150°C
HTGSHP	High temperature ground source heat pump
Low temperature Geoheat	Geothermal energy in the ground at a temperature between 30 to ~150°C
MPI	Ministry for Primary Industries
NTGA	Ngāti Tuwharetoa Geothermal Assets
NZGA	New Zealand Geothermal Association
NZGIF	New Zealand Green Investment Fund
PJ	Peta Joule, a unit of energy equal to 10^{15} Joules.
Primary Geothermal Energy	The total amount of geothermal energy supplied to a process. This will be greater than the amount of energy consumed in the process.
Renewable Energy	Energy produced from solar, wind, hydro, geothermal, biomass, tidal, wave, and ocean current sources. Definition from the Interpretation section of the RMA (1991).
RETA	Regional Energy Transition Accelerator
SFFF	Sustainable Fibre & Farming Futures, an MPI fund.
SME	Small and medium sized enterprise
TGS	Tauranga Geothermal System

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Photography:

Front and back cover: Photo of the craning out of the old Yankee Drum from paper machine 3 as part of the conversion to Geoheat. Image courtesy Essity.

Page 6 and 16: Tomatoes in the Frutura Thermal-Gemüsewelt greenhouse, Bad Blumau, Austria. Image courtesy Brian Carey.

Page 7: Paper drum on an Essity paper machine. Image courtesy Essity.

Page 9: Gerberas in the PlentyFlora glasshouse at Horohoro that is heated by Geoheat. Image courtesy PlentyFlora.

Page 12 and 13: Preheaters at the Mokai geothermal to process steam plant. Image courtesy Brian Carey.

Page 20: Capsicums. Image courtesy Gourmet Mokai.

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DOCUMENT LINKS

Links to Geoheat Strategy and Action Plan Documents and Associated Materials:

Resource	Hyperlink
Geoheat Action Plan, 2024 - 2025	Link
Geoheat Action Plan, 2022 - 2023	Link
Geoheat Action Plan, 2020 - 2021	Link
Geoheat Action Plan, 2018 - 2019	Link
Geoheat Strategy for Aotearoa New Zealand, 2017 – 2030	Link
Geoheat Strategy Launch Video, 2017	Link

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