Government Leadership

Regional Energy Transition Accelerator (RETA)

Bay of Plenty – Summary Report

May 2024

TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY

Mā te whakamahi tika i ngā hangarau kei a tātou, kua whai hua nui te whakawhitinga atu ki ngā rawa whakahou ki roto i ngā pākihi ā-rohe. — Mā tēnei whakawhitinga atu, ki ngā rawa whakahou, kua tōkeke haere ngā ahuatanga whakaputa hua, kei te kite hoki i ētahi ara tiaki taiao i roto i ēnei whakahaeretanga.

He mea whakahirahira te mahi ngātahi kia whakamahia rawatia ngā rawa whakahou ki te taumata tiketike ka taea. Heoi, kia tutuki i tēnei whainga matua, me mātua tūhono i ngā tukutuku kōrero me te pae tawhiti a Bay of Plenty Regional Energy Transition Accelerator (RETA), kia honohia rawatia ngā kaihoko rawa me ngā kaituku rawa i tēnei wā o te whakarite i tēnei kokenga whakamua.

Ko te pae tata o RETA, ko te waihanga i tētahi rautaki whakaheke waro puha, e aropū ana ki ia o ngā rohe. Ka pēnei a RETA mā te aro tōtika ki ngā angitū me ngā ārai e noho motuhake ana ki ia o aua rohe. Ko tā rātou hoki, ko te āta tiro ki ngā hiahia a ngā kaihoko rawa, e pai ai te kuhu ki ngā tini kaupapa pēnei i te rautaki mo te motu whānui.

Mā te whakaiti haere i te whakamahinga o ngā koranehe, te hinu me ngā mātātoka, ka kite tātou i te hekenga rawa o tō te motu whānui whakapaunga kora. E tata ana ki te 25% ō tā te motu whakaputa waro puha, ka puta i ngā whare ahumahi waihangahanga ki te mahi tīkākā.

Nā ngā kitenga o te rīpoata a RETA, e mārama ana i tā te nui o te kora ka ahu atu ki ngā mahi tīkākā, ā, he pēhea hoki te nui o te rawa whakahou ka taea te whakarite. Nā ēnei mōhioranga, kua pai ake ngā whakatau haumi me ngā āhuatanga penapena.

Kei roto hoki i tēnei rīpoata, ngā kōrero e pā ana ki ngā āheinga rerekē ka kitea i te rohe o Te Moana-a-Toihei, i a rātou e whakarite ana i ngā rawa whakahou, pēnei i te papatipu koiora me te pūngao ngāwhā. Kua tīmata kē ētahi o ngā pakihi o te rohe ki ngā tikanga whakaiti i ngā puha haukino, ā, e whakaatu atu ana i te āheinga a ngā pakihi ki te whakawhiti atu ki tēnei tūmomo rawa hinuhinu.

Ko ngā whakamahinga pai o ngā kora me ngā rawa whakahou a Te Moana-a-Toi ka kaha ākina i tēnei rīpoata. E pēnei ana nā te kite atu i ngā pakihi kua mahia kētia, i ngā pakihi e anga pērā atu ana mā te mahitahi atu ki a EECA. Ko te waimarie nui he tauira ēnei e ngākau tūwhera ana ki te katoa, ā, e pīrangi ana ki te wānanga me te tuari i ō rātou wheako.

Kua kaha nei tā mātou piri atu ki ngā pakihi, ngā kamupene, ngā mātanga me ngā pūtahi ā-rohe, ā, e hīkaka tonu ana mātou kia koke whakamua ngātahi mā te tautoko i te rohe nei.

E whakahīhī ana mātou i te mahitahitanga atu ki a 'Bay of Connections,' rāua tahi ko 'Priority One'. — E rere ana i ngā mihi ki a Te Pūtahi Whakawhanake Ohaoha ā-rohe, ngā 'EDB' ā-rohe, Horizon Energy, Powerco and Unison Networks, Transpower, ngā kamupene tope rākau ā-rohe, ngā kaipunenga rākau, ngā kaituku hikohiko me ngā kaihokohoko, ki ngā mātauranga ngao ngāwhā a GNS Science oti noa atu, te mihi ki ngā wāhi māori, nunui hoki e whakamahi nei i ngā rawa whakahou, rawa whakahikohiko. E mihi atu ana ki ēnei o ngā rōpū whakahaere i a rātou tukutuku whakaaro, tukutuku ngao anō hoki.

E haere tonu ana tā mātou hāpai i tēnei rohe me te hīkaka ki te tūhura i ōna pūmanawatanga.

1 Foreword

Achieving energy efficiency and fuel switching at scale requires good information alongside strong regional collaboration. The Bay of Plenty Regional Energy Transition Accelerator (RETA) is designed to help energy users and suppliers along this journey.

Heat used in manufacturing and in the processing of primary products currently makes up around 25% of our country's energy-related emissions, and so reducing our reliance on fossil fuels – like gas and coal, will have a big impact.

The goal of RETA is to support a well-informed, coordinated, localised approach for regional decarbonisation by helping identify unique region-specific opportunities and barriers.

The culmination of the planning phase of the programme, this report forecasts and maps regional stationary heat energy demand – at the medium to large end, and renewable energy supply. And it highlights the benefit of aligning decisions made on a regional level. This will help decision makers with asset and infrastructure investments, ultimately reducing costs.

The analysis looks at the potential in the Bay of Plenty for renewable geothermal energy and related investment. It highlights that the region also is in a great position to move fast on demand reduction projects. Alternative low-emissions fuels like biomass are found to be readily available – which means local businesses can make the switch and be confident there is supply.

It is important to recognise that the RETA programme builds on energy efficiency and fuel switching work already happening in the region. Several businesses in Bay of Plenty have already successfully completed projects or have a low-emissions pathway mapped out with EECA. They are an example of what can be achieved, and their efforts and willingness to share what they have learned with others has been valuable to this process.

Surfacing the insights has involved working closely with Bay of Connections and Priority One – the Regional Economic Development agencies, local EDBs Horizon Energy, Powerco and Unison Networks, Transpower, regional forestry companies, wood processors, electricity generators and retailers, GNS Science, and medium to large industrial energy users. A big thank you to these organisations for their input and enthusiasm.

We are looking forward to continuing to support the region as we work together to unlock its potential.

Dr Marcos Pelenur
Chief Executive, EECA

2 Acknowledgements

This RETA project has involved a significant amount of time, resource and input from a variety of organisations. We are especially grateful for the contribution from the following organisations:

- Process heat users throughout the Bay of Plenty region
- Bay of Plenty Inc, Regional Economic Development Agency
- Local electricity distribution businesses Horizon Energy, Powerco, and Unison Networks
- National grid owner and operator Transpower
- Regional forestry companies
- Regional wood processors
- Electricity generators and retailers

This RETA report is the distillation of individual workstreams delivered by:

- **DETA** – process heat demand-side assessment
- **Indufor** – biomass availability analysis
- **Ergo Consultants** – electricity network analysis
- **EnergyLink** – electricity price forecast
- **GNS Science** – geothermal availability analysis
- **Wayne Manor Advisory** – report collation, publication and modelling assistance

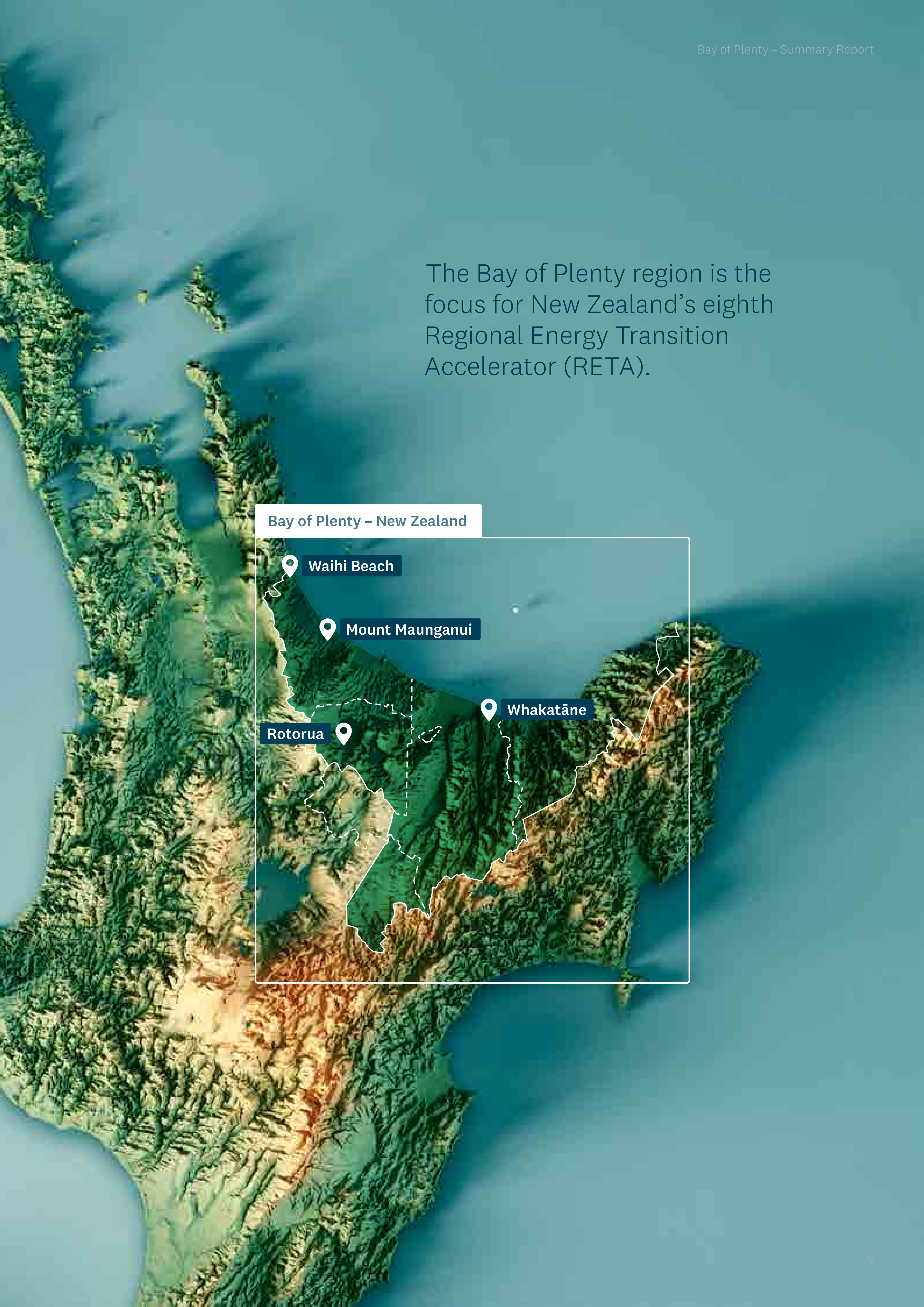
View of Mt Maunganui from Mauao Summit Walk. Credit – Bay Of Plenty Regional Council

> *"The region is in a great position to move fast on demand reduction projects. Energy efficiency, demand reduction and fuel flexibility are key parts of the process for the Bay of Plenty."*

Dr Marcos Pelenur, Chief Executive, EECA

3 Table of contents

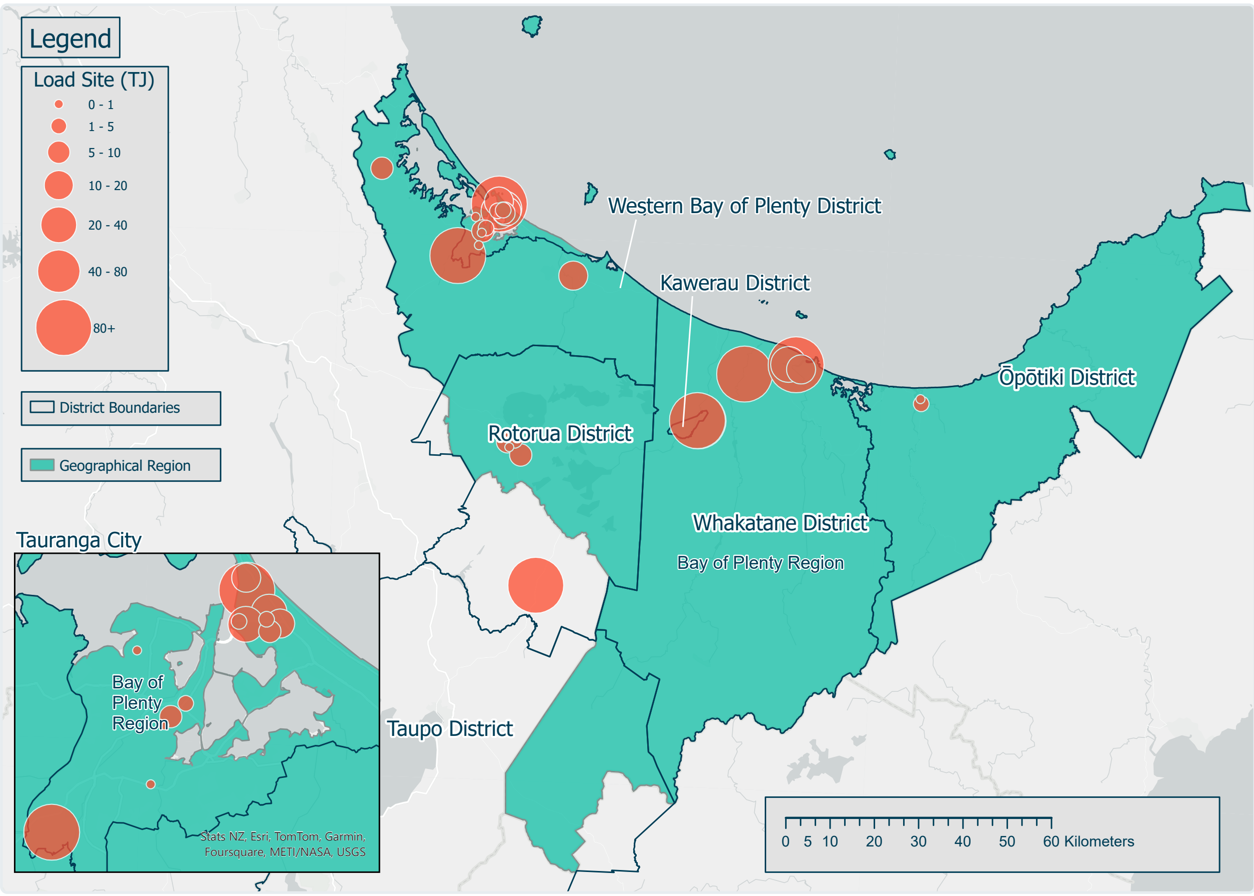
The Bay of Plenty region is the focus for New Zealand's eighth Regional Energy Transition Accelerator (RETA).



4 Bay of Plenty overview

This region covers the Bay of Plenty districts (Figure 1).

Figure 1 – Map of area covered by the Bay of Plenty RETA



The Bay of Plenty RETA brings together information about process heat decarbonisation plans from EECA's Energy Transitional Accelerators (ETAs) with individual organisations and data from the Regional Heat Demand Database (RHDD) completed by local electricity distribution businesses, Transpower and EECA. While ETAs focus on the decarbonisation pathways and plans of individual organisations, the RETA expands this focus to consider barriers and opportunities for regional supply-side infrastructure (e.g. networks and regional resources) to better support decarbonisation decisions.

This report is the culmination of the RETA planning phase in the region and aims to:

- Provide process heat users with coordinated information specific to the region to help them with making more informed decisions on fuel choice and timing.
- Improve fuel supplier confidence to invest in supply side infrastructure.
- Surface issues, opportunities, and recommendations.

The next phase of a RETA focuses on implementing recommendations from phase 1 that remove barriers or accelerate opportunities for decarbonisation of process heat.

The 28 sites covered span the dairy, industrial and commercial[1] sectors. These sites either have fossil-fuelled process heat equipment larger than 500kW (i.e. process heat equipment details have been captured in the Regional Heat Demand Database) or are sites for which EECA (Energy Efficiency and Conservation Authority) has detailed information about their decarbonisation pathway[2]. Together, these sites collectively consume 14,741TJ of process heat energy, primarily in the form of piped fossil gas, by-products (waste oil and black liquor), and geothermal, and currently produce 281kt pa of carbon dioxide equivalent (CO_2e) emissions.

Table 1 – Summary of Bay of Plenty RETA sites fossil fuel process heat demands and emissions

Sector	Sites	Thermal capacity (MW)	Thermal fuel consumption (GWh/yr)	Process heat demand today (TJ/yr)	Process heat annual emissions (kt CO_2e/yr)
Dairy	3	80	330	1,190	64
Industrial	15	466	3,717	13,381	208
Commercial	10	26	47	170	9
Total	**28**	**572**	**4,095**	**14,741**	**281**

Aerial Mauao view. Credit – Bay Of Plenty Regional Council

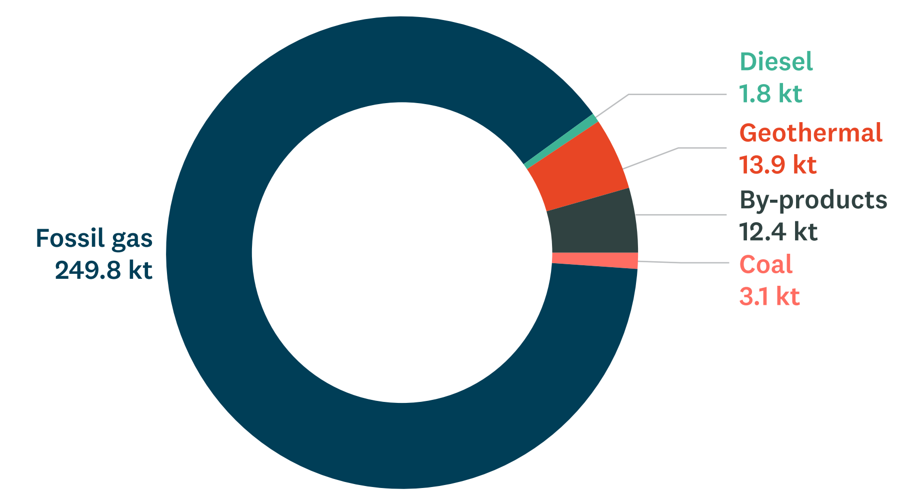
1 The commercial sector includes schools, hospitals, and accommodation facilities.

2 For example, process heat equipment details have been captured in an ETA opportunities assessment report.

Only 4,719TJ of this demand relates to the consumption of fossil fuels. Most of the demand is met from by-products (8,039TJ), with another 1,984TJ coming from geothermal. Most Bay of Plenty RETA process heat emissions come from fossil gas (Figure 2).

Figure 2 – 2020 annual emissions by process heat fuel in Bay of Plenty RETA. Source: EECA

Bay of Plenty RETA sites: emissions
kt CO_2e per year



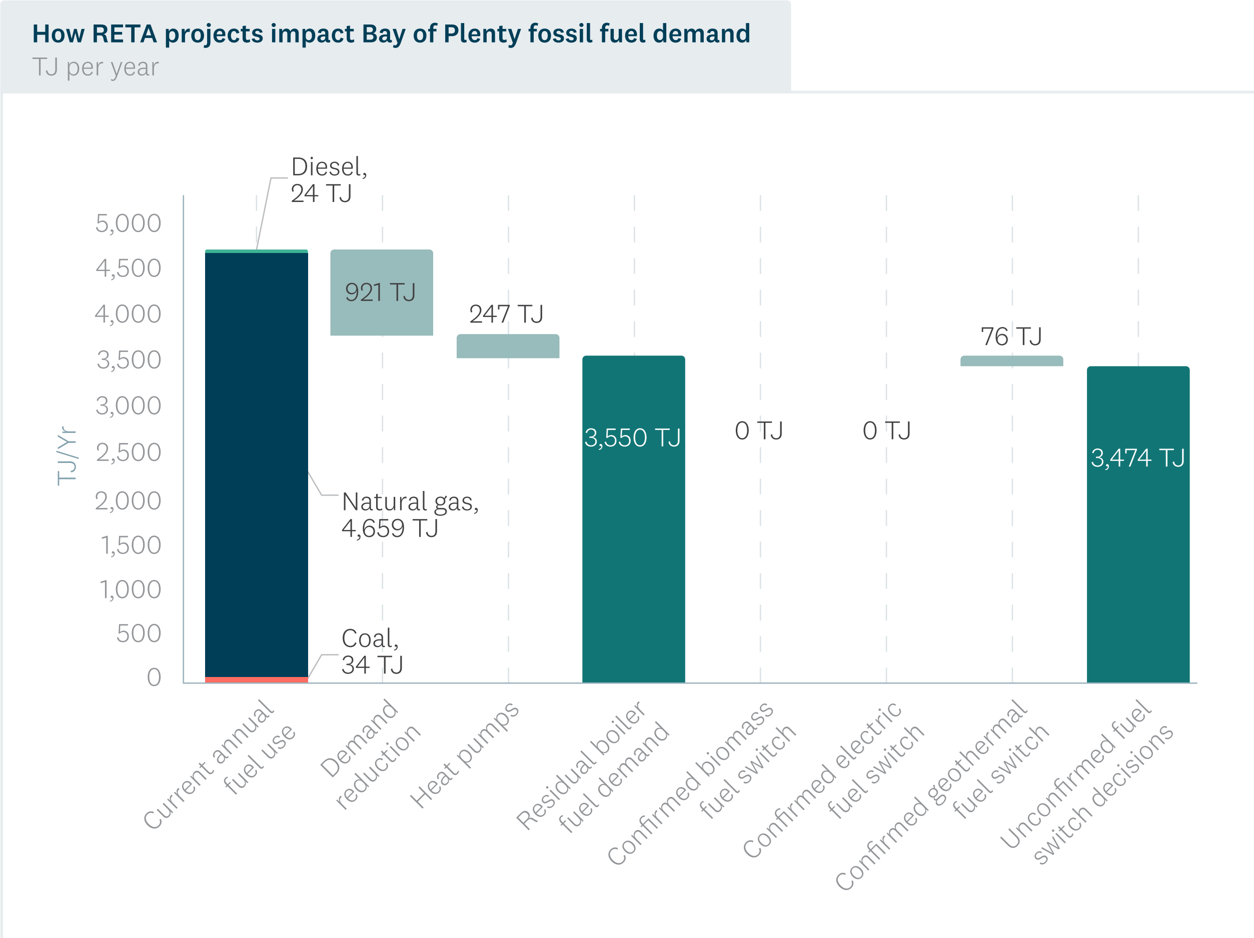
The objective of the Bay of Plenty RETA is to eliminate as much of these process heat emissions as possible. It does this by supporting organisations in their consideration of:

- Demand reduction (for example reducing heat demand through process optimisation).
- Thermal efficiency (for example installation of highly efficient heat pumps).
- Switching away from fossil-based fuels to a low-emissions source such as biomass and/or electricity.


Solar Panels on Whakatane office roof. Credit – Bay Of Plenty Regional Council

Figure 3 illustrates the potential impact of RETA sites on regional fossil fuel demand, both as a result of decisions where investment is already confirmed, and decisions yet to be made.

Figure 3 – Potential impact of fuel switching on fossil fuel usage, 2023-2050. Source: EECA



As explored below, this RETA looks at a number of pathways by which the 3,474TJ of unconfirmed fuel switching decisions could occur. Both biomass and electricity are considered as potential fuel sources. EECA's assessments of biomass and electricity focus on the key issues that are common to all RETA process heat sites contemplating fuel switching decisions. This includes the availability and cost of the resources that underpin each fuel option, as well as the sufficiency of the networks required to ensure that the fuel can be delivered to the process heat users' sites. This assessment is unique to the Bay of Plenty region. The availability and cost of supply resources and connection can then be used to simulate RETA sites' collective decisions about fuel switching under different sets of assumptions. This provides valuable information to individual process heat decision makers, infrastructure providers, resource owners, funders, and policy makers.

4.1 RETA site summary

As outlined above, there are 28 sites considered in this study. Across these sites, there are 67 individual projects spanning the three categories discussed above – demand reduction, heat pumps and fuel switching.

Table 2 shows the status of the Bay of Plenty RETA process heat projects. Three have been confirmed by the process heat organisation (i.e. the organisation has committed to the investment and funding allocated) but is not yet completed. The other 64 projects are unconfirmed, in that the process heat organisation is yet to commit to the final investment.

Table 2 – Number of projects in Bay of Plenty RETA: confirmed vs unconfirmed. Source: Lumen, EECA.

Status	Demand reduction	Heat recovery	Fuel switching	Total
Confirmed	2	0	1	3
Unconfirmed	20	10	34	64
Total	**22**	**10**	**35**	**67**

Demand reduction and thermal efficiency are key parts of the RETA process and, in most cases, enable (and helps optimise) the fuel switching decision. This RETA report has a greater level of focus on the fuel switching decision, due to the higher capital and fuel intensity of this decision.

Below we show the expected remaining fuel demands from each site in the Bay of Plenty RETA, after any demand reduction projects and/or heat pump projects are accounted for. We present biomass demands both in TJs and green tonnes (55% moisture content) and report the peak demand from the boiler should it convert to electricity.

Rotorua Hospital Geothermal Well. Credit – Bay of Plenty Regional Council

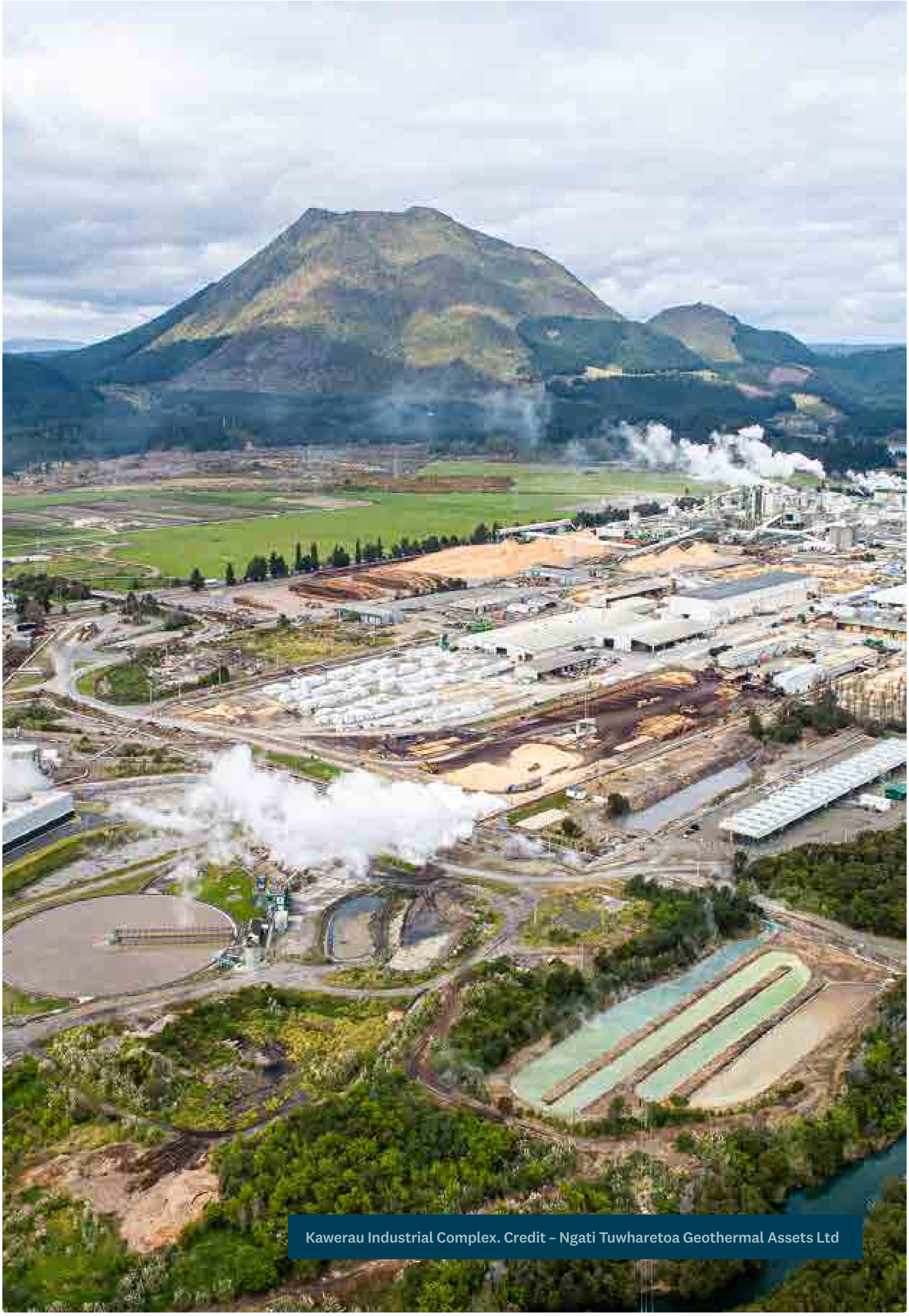
Table 3 – Summary of Bay of Plenty RETA sites with fuel switching requirements. Orange shading indicates confirmed projects; green highlighting indicates the preferred fuel option according to a commercial decision making criteria explained below.

Site name	Industry	Project status	Bioenergy required TJ ('000t)/yr	Geothermal requirements (TJ/yr)[3]	Electricity peak demand (MW)
Essity Mill, Kawerau – Stage 1	**Industrial**	**Confirmed**		**76.1 (Direct)**	
Ministry of Health, Whakatane Hospital	Commercial	Unconfirmed	21.4 (3.0)	**17.1 (GSHP)**	1.04
Fonterra Edgecumbe	Dairy	Unconfirmed	**608.2 (84.7)**		29.71
Whakatane Mill Limited	Industrial	Unconfirmed	**557.3 (77.6)**		36.00
Oji Fibre Solutions, Tasman Mill	Industrial	Unconfirmed	**661.7 (92.1)**		
Ministry of Education, Opotiki College	Commercial	Unconfirmed	**1.5 (0.2)**		0.30
Essity Mill, Kawerau – Stage 2	Industrial	Unconfirmed	95.1 (13.2)	**76.1 (Direct)**	
Whakatane Growers, Whakatane	Industrial	Unconfirmed	44 (6.1)	**35.2 (GSHP)**	2.53
AFFCO Rangiuru	Commercial	Unconfirmed	**31.4 (4.4)**		2.51
Bakels Edible Oils, Mt. Maunganui	Industrial	Unconfirmed	**54.1 (7.5)**		2.61
Ballance Agri-Nutrients Ltd, Mt. Maunganui	Industrial	Unconfirmed	**9.1 (1.3)**		0.44
Ministry of Health, Tauranga Hospital	Commercial	Unconfirmed	**10.0 (1.4)**		1.18
Dominion Salt, Mt. Maunganui	Industrial	Unconfirmed	226.5 (31.5)	**20.7[4] (GSHP)**	10.62
Mt. Eliza Cheese, Tauranga	Dairy	Unconfirmed	**14.4 (2)**		0.67
Ministry of Education, Otumoetai College	Commercial	Unconfirmed	**1.5 (0.2)**		0.30
Ministry of Education, Tauranga Boys' College	Commercial	Unconfirmed	**2.1 (0.3)**		0.42
Ministry of Education, Tauranga Girls' College	Commercial	Unconfirmed	**1.4 (0.2)**		0.17

[3] The geothermal energy used by the site is shown here. For geothermal sites, we also denote whether these sites were selected to use ground-sourced heat pumps (GSHP) or direct use. Ground-sourced heat pumps will also have an electricity requirement.

[4] For Dominion Salt, the geothermal project can only replace part of the site's load. Hence a choice between biomass and electricity is still required to meet the balance of the site's demand.

Site name	Industry	Project status	Bioenergy required TJ ('000t)/yr	Geothermal requirements (TJ/yr)[3]	Electricity peak demand (MW)
Lawter, Tauranga	Industrial	Unconfirmed	**53.6 (7.5)**		2.23
Winstone Wallboards GIB, Tauranga	Industrial	Unconfirmed	**702.0 (97.7)**		49.38
Pure Bottling	Industrial	Unconfirmed	**1.1 (0.2)**		0.75
Ministry of Health, Rotorua Hospital	Commercial	Unconfirmed	**3.0 (0.4)**		0.15
Fonterra, Reporoa	Dairy	Unconfirmed	333.6 (46.5)	**266.9 (Direct)**	16.80
Scion, Rotorua	Industrial	Unconfirmed	**10.5 (1.5)**		2.82
Alsco, Rotorua	Industrial	Unconfirmed	**15.4 (2.1)**		2.16
Downer, Mt. Maunganui	Industrial	Unconfirmed	**15.9 (2.2)**		0.72
Fulton Hogan, Mt. Maunganui	Industrial	Unconfirmed	**31.4 (4.4)**		1.77
Ingham, Mt. Maunganui	Commercial	Unconfirmed	**25.9 (3.6)**		1.02
Higgins Contractors Ltd, Mt. Maunganui	Industrial	Unconfirmed	**8.5 (1.2)**		-
Whakatōhea Mussels Ōpōtiki (WMOL)	Commercial	Unconfirmed	**5 (0.7)**		0.54



Kawerau Industrial Complex. Credit – Ngati Tuwharetoa Geothermal Assets Ltd

5 Simulated decarbonisation pathways

There are a range of decision criteria that individual organisations may use to determine the timing of their decarbonisation investments. Decisions are impacted by available finance, product market considerations, strategic alignment, and other factors. It is challenging to incorporate many of these into a single analysis of the likely decision by each process heat user.

Rather than attempt to include all these factors, we present a range of different potential Bay of Plenty-specific pathways reflecting different decision-making criteria that process heat users (who have not confirmed their fuel choice) will use.

Two pathways present ‘bookends’ that focus exclusively on one of the two fuel options (biomass or electricity) for unconfirmed projects. Two others use a global standard ‘marginal abatement cost’, or MAC, to quantify the cost to the organisation of decarbonising their process heat. This is expressed in dollars per tonne of CO_2e reduced by the investment. A MAC value allows us to:

- Determine the lowest cost fuel option for the process heat user (i.e. biomass, electricity or geothermal).
- Determine the timing of this investment as being the earliest point when a decarbonisation decision saves the process heat user money over the lifetime of the investment – the point in time that the MAC of the project is exceeded by the expected future carbon price.

For all pathways, the following constraints were applied to the methodology:

- All low to medium temperature (<300°C) coal boiler decarbonisation projects are executed by 2037 in line with the National Policy Statement (NPS) for greenhouse gas emissions from industrial process heat that came into effect in July 2023, which prohibits greenhouse gas emissions from existing medium temperature (<300°C) coal boilers after 2036[5].
- All other unconfirmed projects are assumed to occur in 2049 in line with New Zealand’s target of net zero greenhouse gas emissions by 2050 in the Climate Change Response (Zero Carbon) Amendment Act. This means that any projects that are still not ‘economic’ using our MAC criteria by 2049, are assumed to be executed in 2049.

5 See https://environment.govt.nz/acts-and-regulations/national-policy-statements/national-policy-statement-for-greenhouse-gas-emissions-from-industrial-process-heat/. The new National Environmental Standard which supports the NPS also places increased restrictions on process heat boilers burning fossil fuels other than coal.

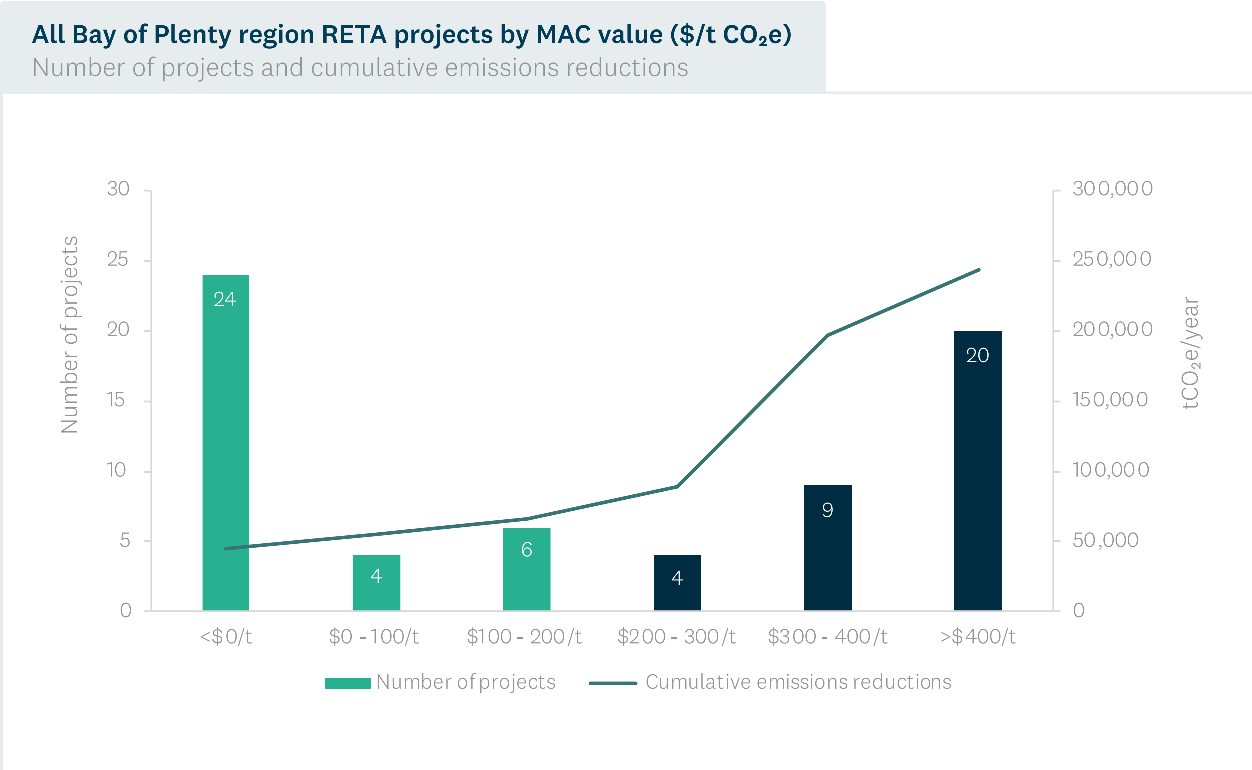
Pathway name	Description
Biomass Centric	All unconfirmed site fuel switching decisions proceed with biomass where possible, with timing set based on the criteria above.
Electricity Centric	All unconfirmed fuel switching decisions with electricity where possible, with timing set based on the criteria above.
BAU Combined	All unconfirmed fuel switching decisions (i.e. biomass, electricity or geothermal) are determined by the lowest MAC value for each project, with the timing based on the criteria in the fuel-centric pathways above.
MAC Optimal	Each site switches to a heat pump or switches its boiler to the fuel with the lowest MAC value for that site. Each project is timed to be commissioned in the first year when its optimal MAC value first drops below a ten-year rolling average of the Climate Change Commission's Demonstration Path of future carbon prices. If the MAC does not drop below the ten-year rolling average, then the timing based on the fuel-centric pathway criteria is used.


Te Huka Geothermal Plant. Credit – Rachel Mataira

5.1 At expected carbon prices, 24% of emissions reductions will be economic by 2028[6]

Figure 4 summarises the resulting MACs associated with each decision, and the emissions reduced by these projects.

Figure 4 – Number of projects by range of MAC value. Source: EECA



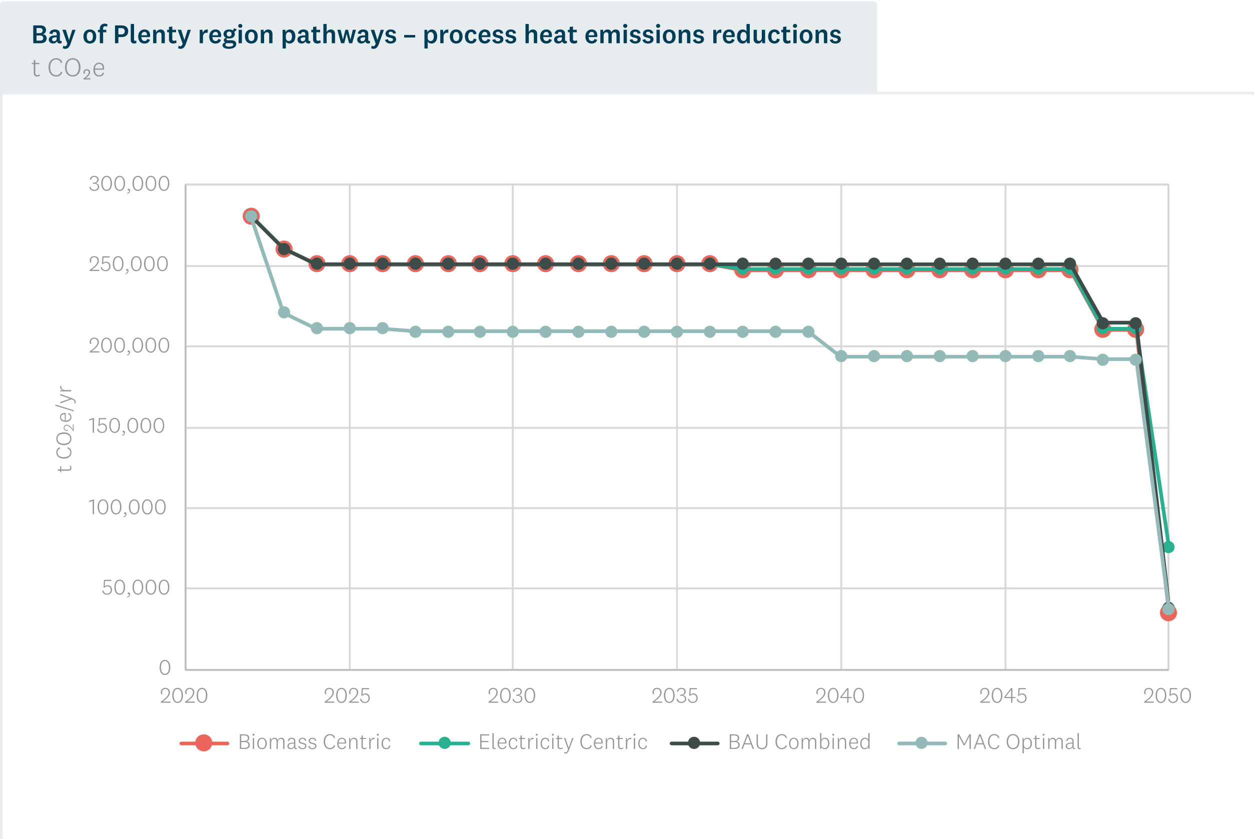
Out of 281kt of process heat emissions from Bay of Plenty RETA organisations, 66kt (24%) have marginal abatement costs (MACs) less than $200/tCO$_2$e. Based on an expectation the carbon prices will follow the Climate Change Commission's Demonstration Pathway, these emissions reduction projects would be economic prior to 2028. Twenty four of these projects would be economic without any carbon price at all.

Compared to a scenario where each of these projects was executed based on the organisations' current plans (a BAU pathway), the MAC Optimal scenario would accelerate decarbonisation, and reduce the release of long-lived emission by a cumulative 1.1Mt over the period of the RETA analysis to 2050 (Figure 5[7]).

[6] By 'economic', we mean that at a 6% discount rate these projects would reduce costs for the firms involved over a 20-year period (i.e. the Net Present Value would be greater than zero, at the assumed trajectory of carbon prices).

[7] Note that the Electricity Centric and Biomass Centric pathways are obscured in the chart by the BAU Combined pathway.

Figure 5 – Simulated emissions using Electricity Centric, Biomass Centric, BAU Combined and MAC Optimal pathways. Source: EECA



Under the MAC Optimal pathway, around 40kt of emissions reductions are accelerated from 2048 (in the BAU and fuel-centric pathways) to 2024.

We tested a range of sensitivities on this modelling – higher and lower electricity prices, different decision-making metrics, and higher network upgrade costs for electrification options. While the pathway of emissions reduction was relatively unaffected, the ‘low’ electricity cost scenario changed the fuel choice for one process heat user, from biomass to electricity.

We also assessed how much the cost of biomass and the retail price of electricity would have to reduce to achieve more accelerated emissions reductions than achieved by the MAC Optimal pathway with base-case assumptions. While it required a significant reduction in the electricity price to achieve even modest increases in emissions reductions before 2050, a 40% reduction in the cost of biomass accelerated reductions of around 111kt CO_2e (28% of regional process heat emissions) by at least a decade.

Figure 6 – Impact on emissions reductions of a 40% reduction in biomass fibre costs. Source: EECA

However, this pace could be constrained by practical matters such as:

- The ability of process heat users to secure funding and commit to these investments in this timeframe.
- The ability of forest owners and bioenergy aggregators to make sufficient resource reliably available.

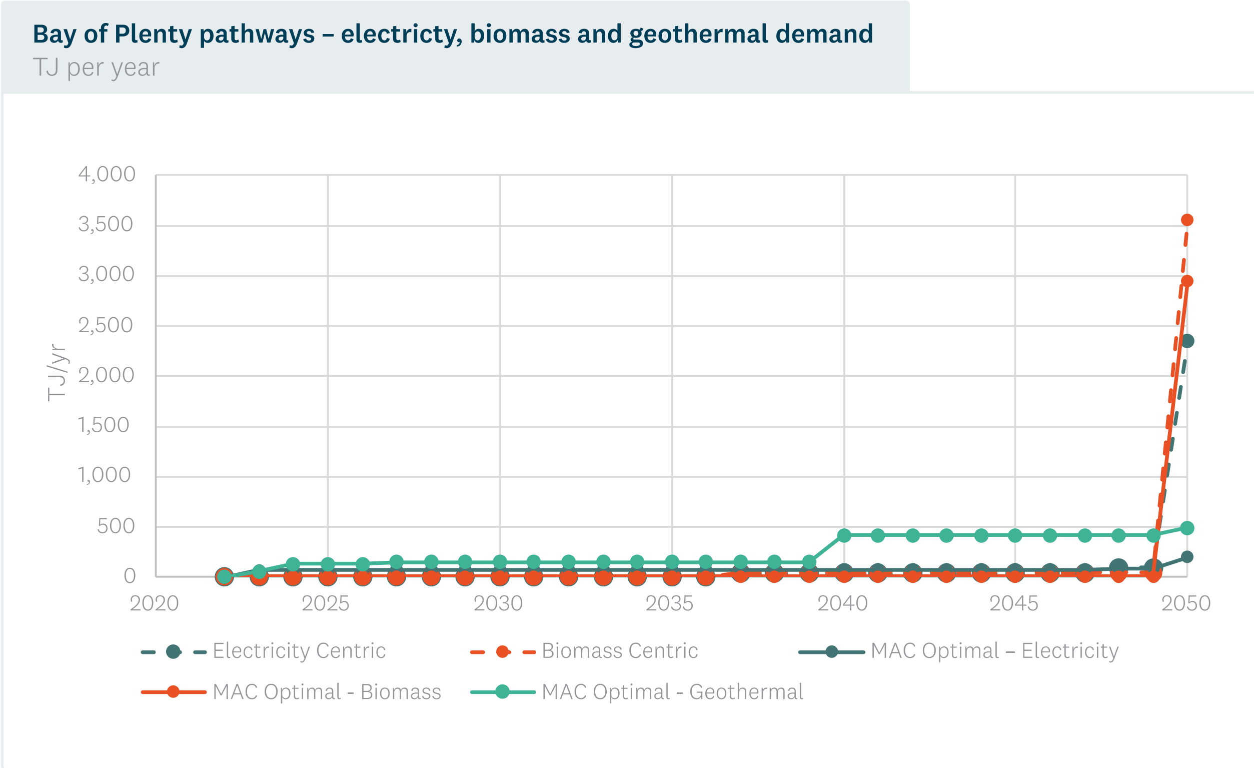
5.1.1 Pathway implications for electricity, geothermal and biomass demands

The MAC Optimal pathway sees fuel decisions that result in 6% of the energy needs in 2050 supplied by electricity, 13% by geothermal and 81% supplied by biomass (Figure 7). The sheer dominance of biomass reflects its lower overall cost as a fuel for large industrial and dairy projects which require high temperature boilers for their process heat[8]. Compared to sites analysed in the South Island, biomass in Bay of Plenty is lower cost, due to the plentiful forestry resources. Further, the retail cost of electricity is higher than in the South Island, due to less favourable fuel-switching 'special pricing' deals being available from electricity retailers.

We expand further on these fuel switching outcomes in the next sections.

[8] That is, they can't fuel switch using high efficiency heat pumps alone.

Figure 7 – Electricity and biomass demand in MAC Optimal pathway. Source: EECA



Before doing so, it is important to recognise the significant impact that demand reduction and heat pump efficiency projects have on the overall picture of Bay of Plenty process heat decarbonisation. As shown in Figure 3, investment in demand reduction and heat pumps meets 25% of today's Bay of Plenty energy demands[9] from process heat users, which in turn reduces the necessary fuel switching infrastructure required: thermal capacity required from new biomass and electric boilers would be reduced by 75MW if these projects were completed. We estimate that demand reduction and heat pumps would avoid investment of $75M to $112M in electricity and biomass infrastructure[10].

9 This is true for both energy consumption and also the peak thermal demand required from biomass or electric boilers.

10 On the assumption that 1MW of electrode boilers, and associated network connections, or 1MW of biomass boilers, cost on average between $1M-$1.5M.

6 Biomass – resources and costs

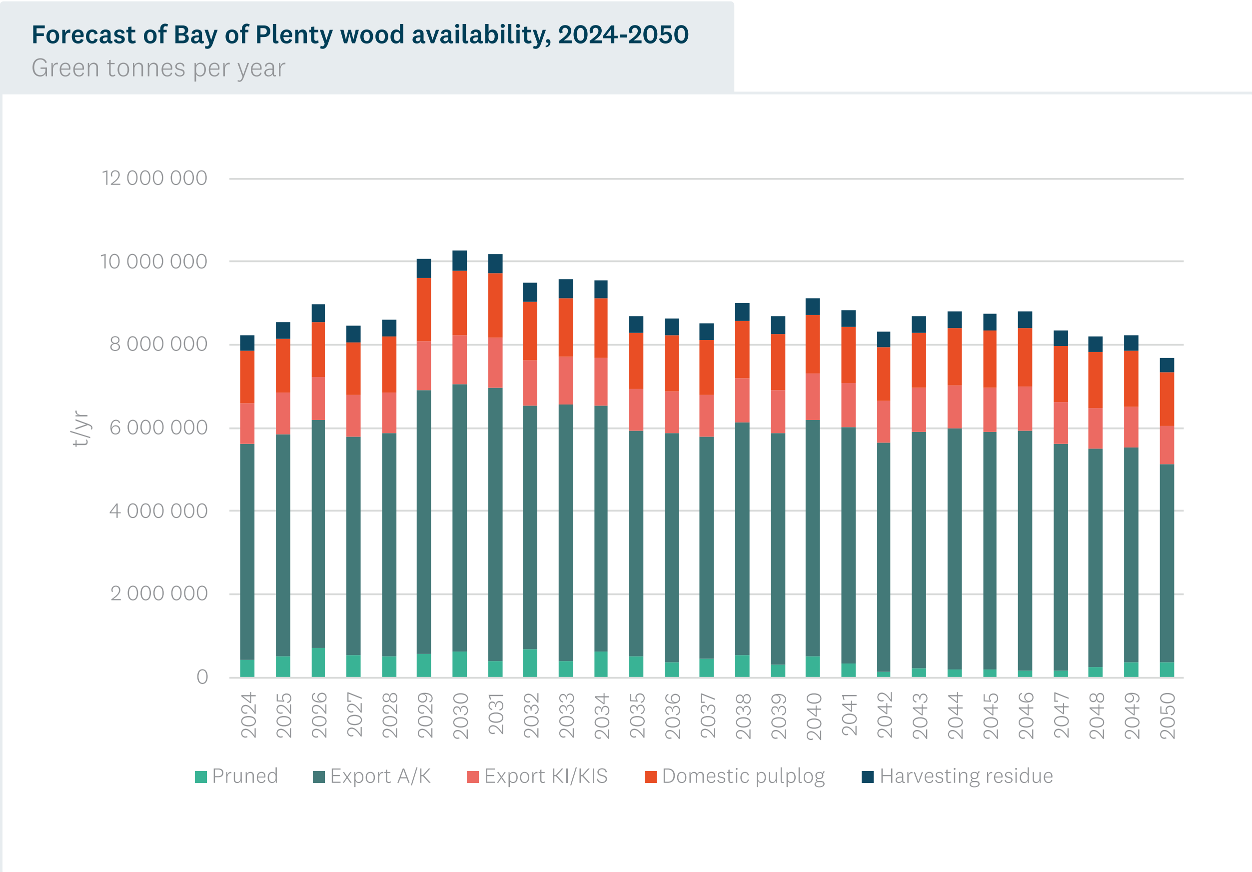
The use of woody biomass for bioenergy requires careful consideration of emissions and sustainability – for example, depending on the source, the diversion of wood to bioenergy may change the timing of the release of emissions by a significant period (compared to the natural decomposition of biomass). Suppliers and consumers of biomass for bioenergy need to be confident they understand any wider implications of their choices. No formal guidelines or standards exist in New Zealand at this point, and EECA recommends one is developed for the New Zealand context, drawing on international standards and experience.

A good sense of the total availability of harvestable wood in the Bay of Plenty region requires both a top-down and bottom-up analysis (based on interviews with major forest owners), as forest owners' actual intentions will often deviate from centralised forecasts due to changes in log prices and other dynamic factors. The bottom-up analysis also provides an assessment of where the wood is expected to flow through the supply chain – via processors to domestic markets, or export markets, as well as volumes that are currently being utilised for bioenergy purposes. It also allows us to estimate practical levels of recovery of harvesting residues.

A top-down analysis shows that there is some variation in the level of harvested wood in the Bay of Plenty region over the next 27 years (Figure 8). There is a visible increase in Export A/K volumes (sawlog) over the 2029-2031 period. The annual variation occurs due to the age distribution of the existing forests, and yield assumptions combined with assumptions on how forests are harvested.

Red Stag Timber mill. Credit – Graeme Murray

Figure 8 – Wood resource availability in Bay of Plenty region, 2023-2050.

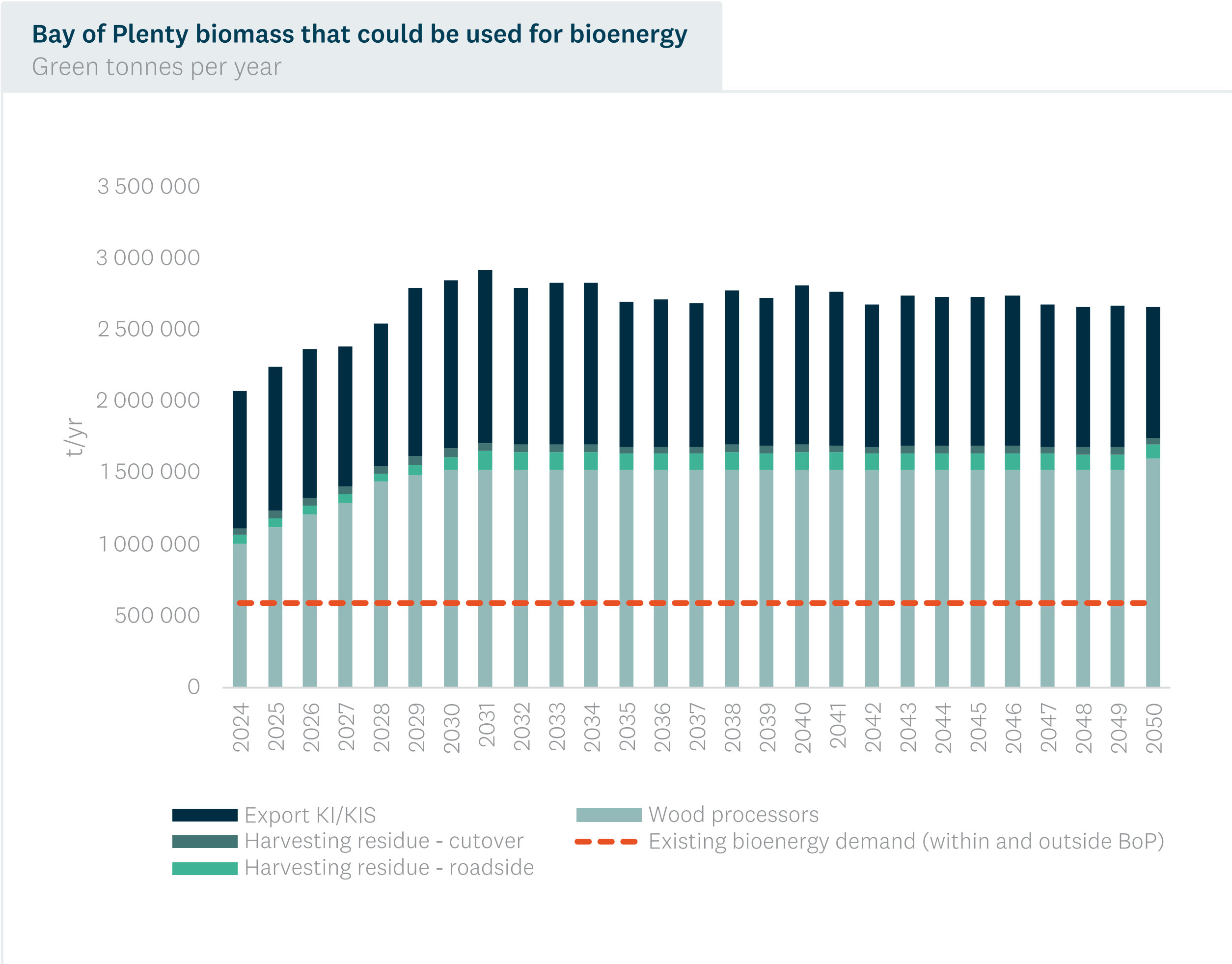


A more comprehensive view of resource availability, that combines the top-down and bottom-up analyses, reveals the potential volumes that could be available for bioenergy. This analysis:

- Considers the potential volumes arising as residues from processing sawlogs for the domestic market.
- Removes volumes that are currently contracted to domestic timber markets.
- Takes a more realistic approach to estimating the potential harvesting residues (binwood, salvage wood and cutover) than the theoretical potential used in Figure 7.
- Overlays the existing demand for bioenergy, that already draws on these resources.

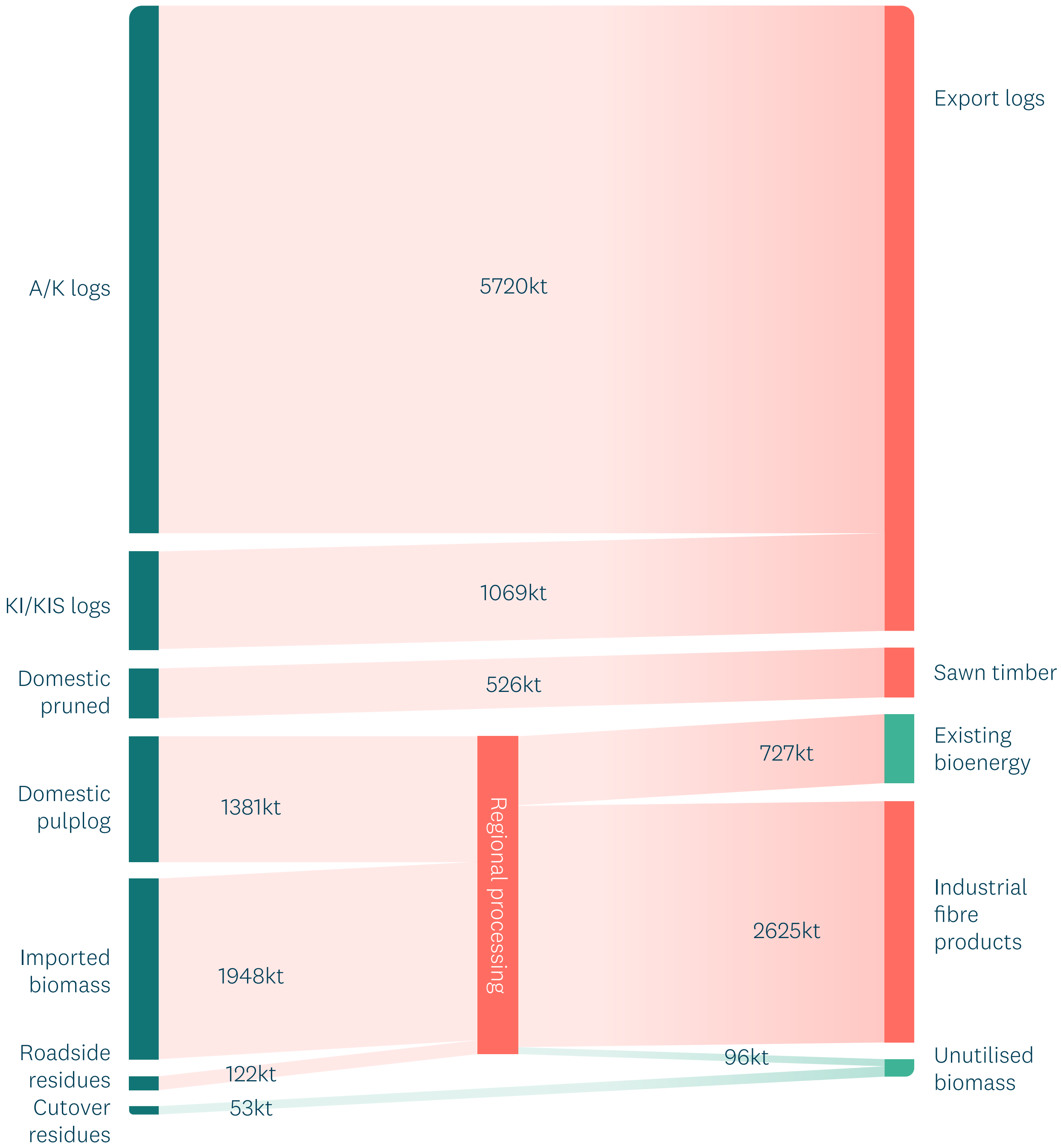
The resulting potential volume for bioenergy is shown in Figure 8.

Figure 9 – Assessment of available Bay of Plenty woody biomass that could be used for bioenergy.



The overall analysis of the Bay of Plenty region is summarised in Figure 10. Wood flows that could – in part or in full – be diverted to new bioenergy demand from process heat are shown in green.

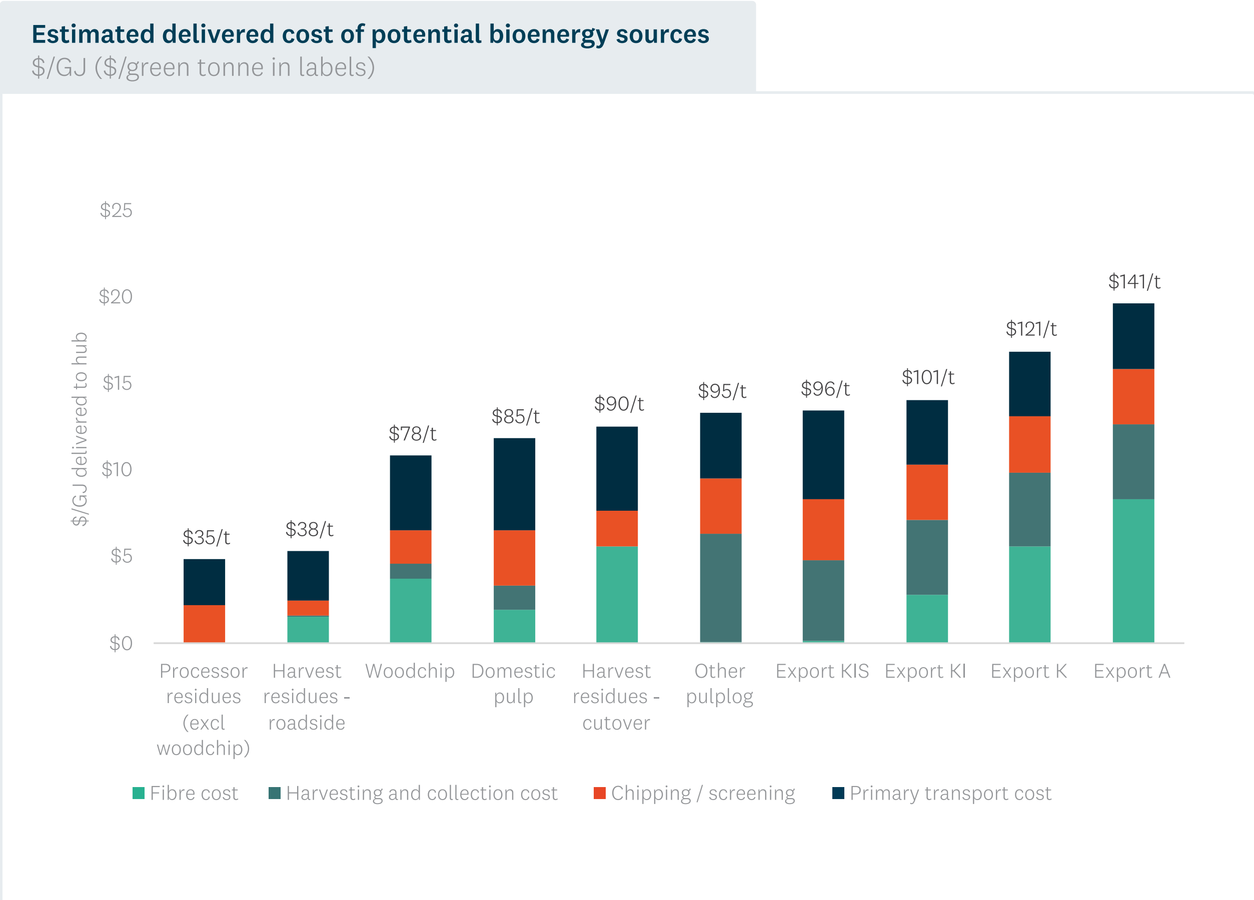
Figure 10 – Wood flows in the Bay of Plenty region, 2024-2037 average. Source: Indufor



Overall, EECA estimates that, on average over the next 15 years, approximately 148kt per year (1,061TJ) of Bay of Plenty woody biomass is currently unutilised and could be recovered for new boiler demands without disrupting low grade export markets or existing bioenergy consumers.

The costs of accessing this biomass, and delivering it to a central processing hub, is presented in Figure 11.

Figure 11 – Estimated delivered cost of potential Bay of Plenty bioenergy sources. Source: Ahikā, Margules Groome



We retain export grade A and K logs in the analysis to represent 'scarcity values' if our scenario analysis below should indicate that other more plausible and sustainable sources of bioenergy are insufficient. We do not believe these are sustainable or practical sources of bioenergy.

The degree to which these resources are used is a commercial decision, which would include a comparison with alternatives in terms of cost, feasibility, and desirability. Our expectation is that available biomass will be processed into products that suit the size of the Bay of Plenty process heat user. Depending on the process heat users' preference of fuel type some types of resources may not be suitable. In some situations, higher cost pellets may be required, which in turn require higher-grade raw material.

In our modelling, we assume that the available volumes in Figure 10 can be processed into woodchip and delivered to process heat users for $20/GJ ($244 per tonne of dried woodchip), while pellets will cost $22/GJ ($386/t).

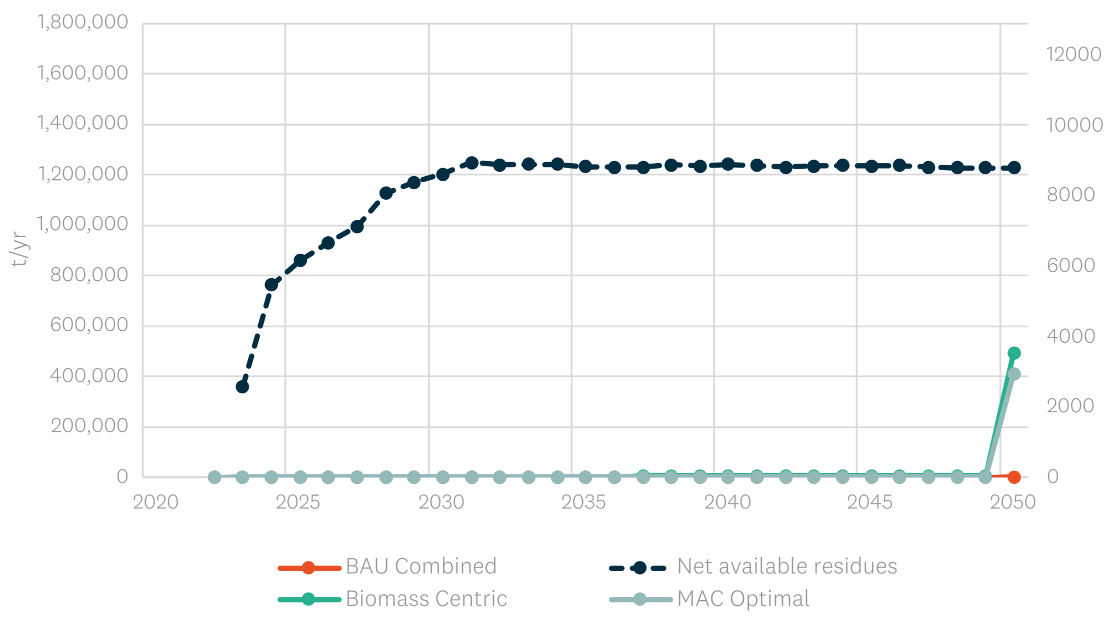
6.1 Impact of pathways on biomass demand

Our pathway analysis below shows the growth in biomass demand (in both tonnes and TJ per year) arising from each of the pathways (Figure 12). The different pathways are broadly similar for the majority of the period considered in our analysis.

The pathways also show that the availability of harvesting and processing residues is expected to be more than sufficient for the demand arising from any pathway.

Figure 12 – Growth in biomass demand from Bay of Plenty pathways. Source: EECA

Bay of Plenty region pathways – biomass demand and available residues
Green tonnes and TJ per year



Based on the biomass cost figures provided above, our analysis suggests that, in 2050, the MAC Optimal process heat market demand for these residues could be around $29M (on a cost basis[11]).

[11] Cost of 6,600TJ of biomass collected and delivered to a hub for $14/GJ (wet wood), not including costs associated with processing into dried wood chips or secondary transport from the hub to each process heat user.

7 Electricity – network capacity and costs

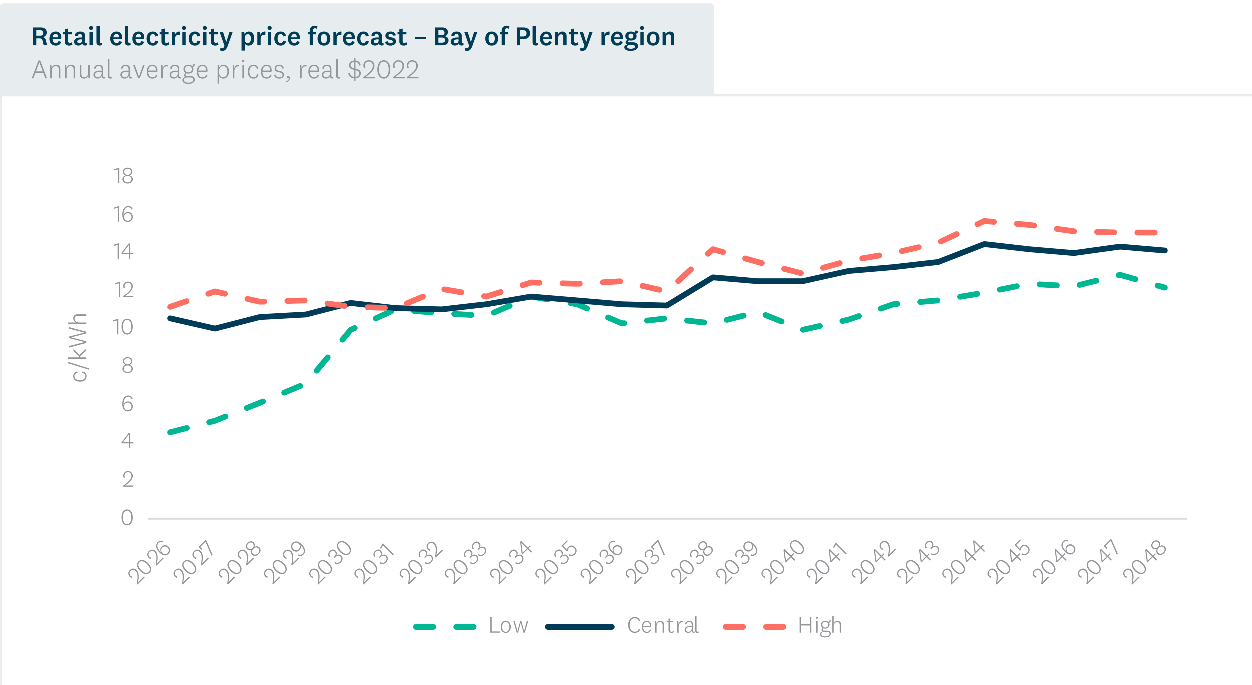
The availability of electricity to meet the demand from process heat users is largely determined at a national 'wholesale' level. Supply is delivered to an individual RETA site through electricity networks – a transmission network owned by Transpower, and a distribution network, owned by electricity distribution businesses (EDBs), that connects individual consumers to the boundary of Transpower's grid (known as grid exit points, or GXPs). There are three EDBs serving the Bay of Plenty region – Horizon Energy, Powerco, and Unison Networks.

The price paid for electricity by a process heat user is made up of two main components[12]:

- A price for 'retail electricity' – the wholesale cost of electricity generation plus costs associated with electricity retailing.
- A price for access to the transmission and distribution networks.

As shown in Figure 13, the forecast price of retail electricity (excluding network charges) is expected to increase (in real terms) from 10c/kWh in 2026 to 12c/kWh in 2040 under a 'central' scenario. However, different scenarios could see real retail prices higher or lower than that.

Figure 13 – Forecast of real annual average electricity price for large commercial and industrial demand in the Bay of Plenty region. Source: EnergyLink



[12] Other smaller components include metering and regulatory levies.

Beyond 2037, this forecast sees more significant increases in electricity prices. However, it is difficult to predict pricing out to 2050. Some New Zealand market analyses suggest real prices may remain constant after 2035, due to the downward pressure on generation costs (especially solar and wind) as technology and scale increases. Other analyses see continued increases. We cannot be definitive about electricity prices 20 years into the future and suggest business cases consider a range of scenarios.

EDBs charge electricity consumers for the use of the existing distribution network. In addition, where the connection of new electric boilers requires EDBs to invest in distribution network upgrades, the cost of these can be paid through a mix of ongoing network charges, and an up-front 'capital contribution'. Each EDB maintains policies that govern the degree of capital contribution, and process heat users need to discuss these with their respective EDBs.

In addition, process heat users who connect new electric boilers directly to Transpower's grid will face equivalent transmission charges, as determined under the Transmission Pricing Methodology (TPM). Process heat users who connect to the EDBs networks will also face a share of these transmission costs, as determined by the EDBs pricing methodologies.

An approximation of the potential charges faced by process heat users who electrify is presented in Table 4. These are based on each of the EDB's announced prices for the year 2023/24.

Table 4 – Estimated and normalised network charges for Bay of Plenty's large industrial process heat consumers, by EDB; $ per MVA per year.

EDB	Distribution charge	Transmission charge	Total charge
Horizon Energy	POA[13]	$73,000[14]	POA
Powerco	$105,000	$80,000	$185,000
Unison Networks	$87,000	$29,000	$116,000

13 Horizon Energy set their distribution charges for major customers (>1.5MVA) based on the specific assets used to supply the connection, as well as the use of shared assets. As such, distribution prices will vary per site. For the major Horizon Energy sites considered in RETA, this was calculated to be between $30,000 - $41,000 per MVA per year.

14 Estimated pass-through of Transpower's charges based on Horizon Energy's 2023-2024 pricing methodology.

Transpower and the EDBs are experiencing an increasing need for investment as a result of continued population and business growth, distributed generation, and the electrification of transport[15] and process heat. The timing of demand growth (that drives this investment) is uncertain, which results in a challenging decision-making environment for network companies. As we recommend below, it is important that process heat users considering electrification keep EDBs abreast of their intentions.

The primary considerations for a process heat user considering electrification are:

- The current 'spare capacity' (or headroom) and security of supply levels in Transpower and the EDBs' networks to supply electricity-based process heat conversions.
- The cost of any upgrades required to accommodate the demand of a process heat user, taking into account seasonality and the user's ability to be flexible with consumption, as well as any other consumers looking to increase electricity demand on that part of the network.
- The timeframe for any network upgrades (e.g. procurement of equipment, requirements for consultation, easements and regulatory approval).
- The price paid for electricity to an electricity retailer (or direct to the wholesale market, for large sites), and any other charges paid by electricity consumers (e.g. use-of-network charges paid to EDBs and Transpower).
- The level of connection 'security' required by the site, including its ability to tolerate any rarely occurring interruptions to supply, and/or the process heat user's ability to shift its demand through time in response to a signal from the network or the market. This flexibility could reduce the cost of connection, and the supply costs of electricity.

For most sites considering electrification, the 'as designed' electrical system can likely connect the site with minor distribution level changes and without the need for substantial infrastructure upgrades. Our estimates suggest most of these minor upgrades would have connection costs under $1M (and many under $300,000) and experience connection lead times of less than 12 months.

More substantial upgrades to the distribution network are required for seven of the sites, with commensurately higher estimated costs (mostly between $1M and $20M) and longer lead times (12-48 months).

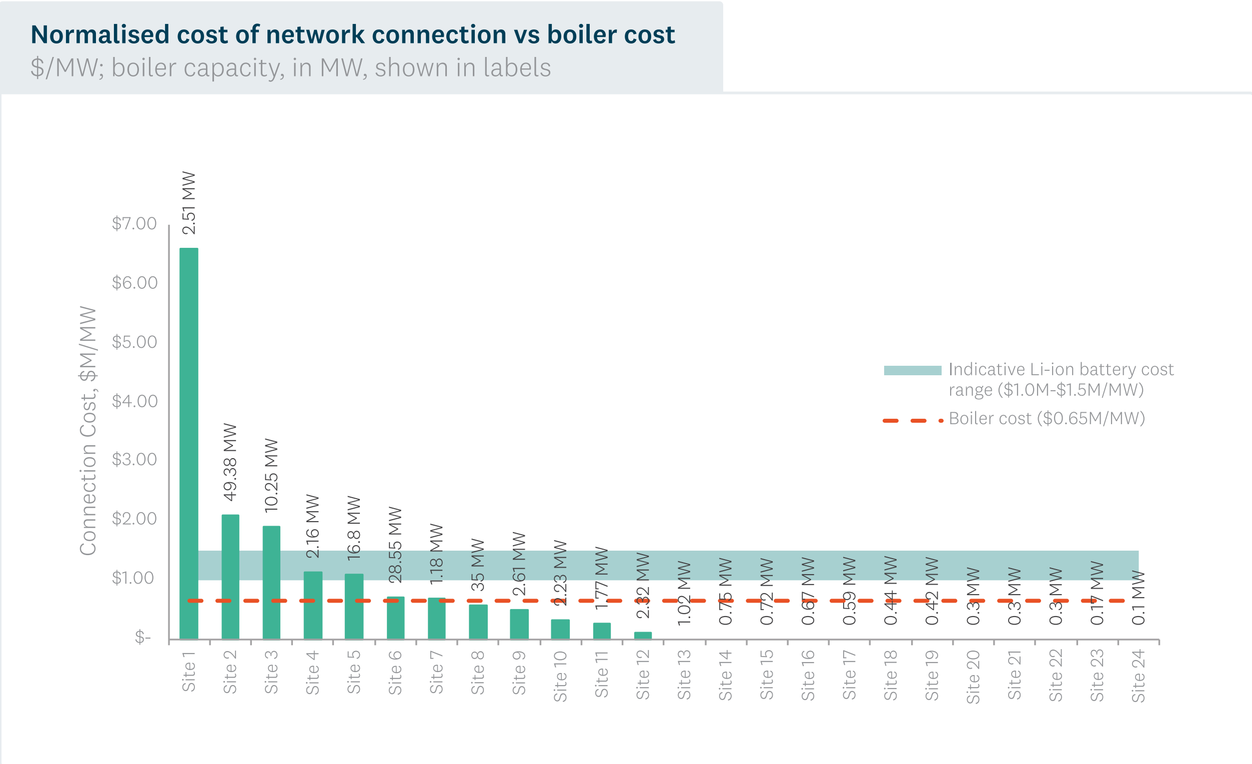
One site may require major distribution and transmission upgrades, depending on the number of boilers that are converted to electricity, and the level of network security required. The estimated cost of the upgrades may reach $86M and take up to 48 months to execute. However, the EDB (Powerco) have noted that as the new substation provides benefits to existing and future customers, both in terms of security of supply and improved reliability, they (Powerco) will cover most of the cost of the project.

[15] While this RETA analysis only examines demand from process heat electrification, and public EV charging facilities where this information is available to EECA, this broader context of potentially rapid growth in demand is important to understanding the challenges associated with accommodating new load.

The costs of connection can be a significant part of the overall capital cost associated with electrifying process heat demand, and process heat users need to engage with EDBs to discuss connection options and refine the cost estimates we have included in this report.

Figure 14 shows each site's connection costs expressed in per-MW terms, i.e. relative to the capacity of the proposed boiler.

Figure 14 – Normalised cost of network connection vs boiler cost, Bay of Plenty RETA sites. Source: Ergo, EECA



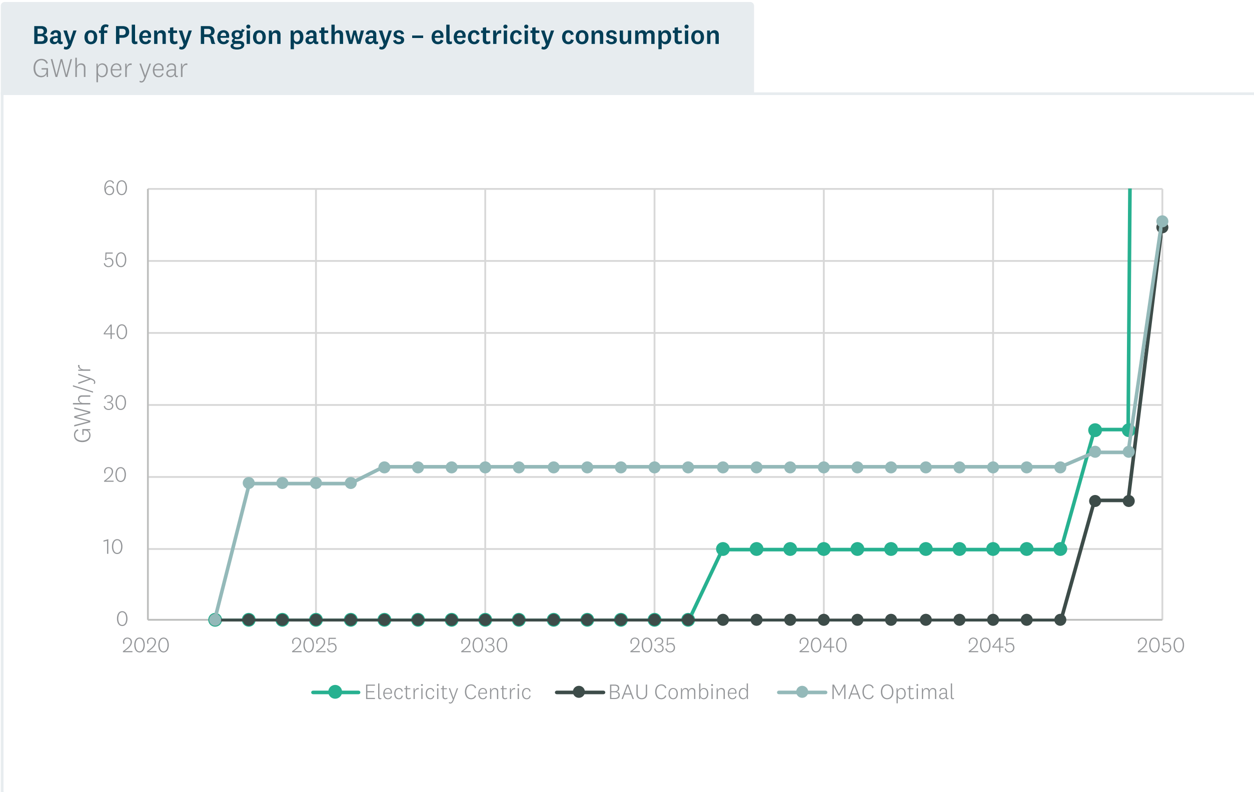
The red dashed line in Figure 13 compares these per-MW costs to the estimated cost of an electrode boiler ($650,000 per MW). The figure shows not only a wide variety of relative costs of connecting electrode boilers, but that for twelve sites, the connection cost more than doubles the overall capital cost associated with electrification. We note that these costs represent the total construction costs of the expected upgrades. The degree to which process heat users need to make capital contributions to these upgrades depends on a variety of factors and needs to be discussed with the relevant EDB.

The timeframes for connection above assume these investments do not require Transpower or the EDBs to obtain regulatory approval. We note that if connections also rely on wider upgrades to the network, the EDB would have to seek regulatory approval for these investments, which could also add to the timeline.

The costs provided above are indicative and appropriate for a screening analysis. They should be further refined in discussion with network owners, and the final costs in some situations will depend on the collective decisions of several RETA sites who require access to similar parts of the network.

7.1 Impact of pathways on electricity demand

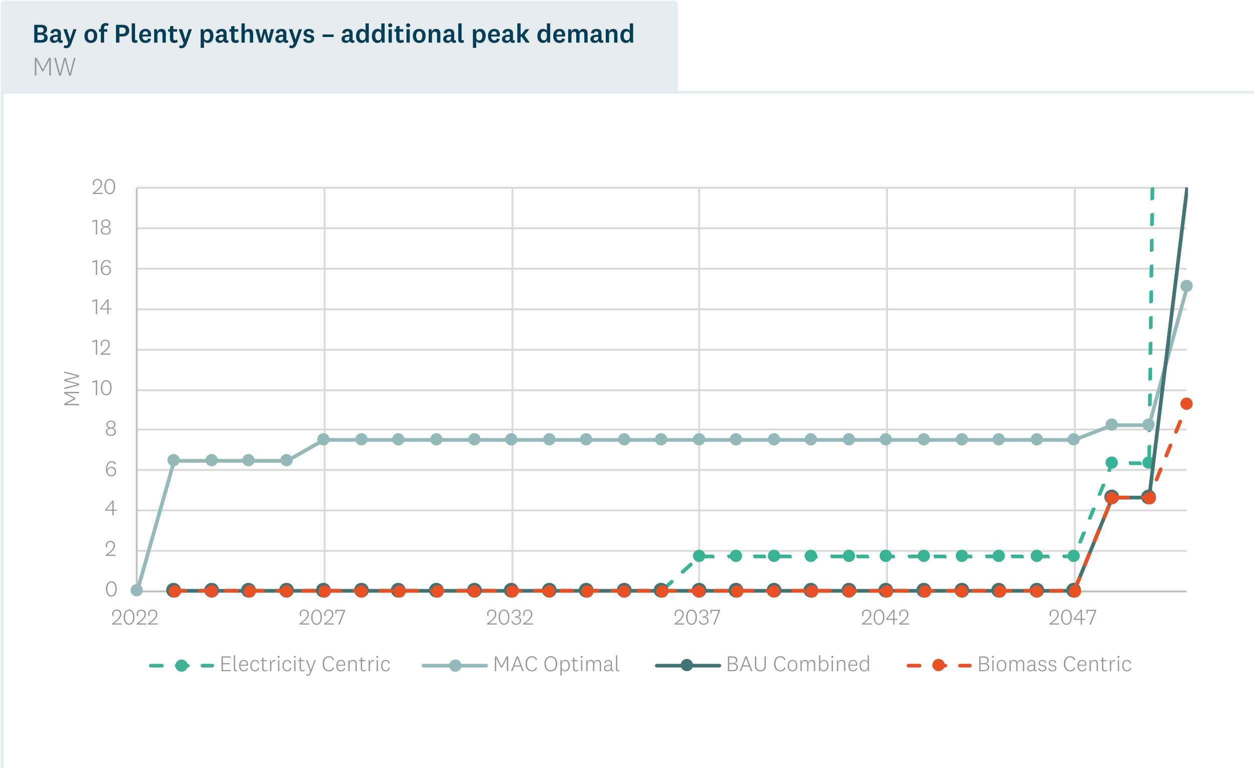
Figure 15 – Growth in Bay of Plenty electricity consumption from fuel switching pathways. Source: EECA



The Electricity Centric pathway, where all unconfirmed sites choose electricity, would result in a 30% increase in the annual consumption of electricity in the region, although this wouldn't occur until 2050 (and is unlikely to occur all at once, as shown in Figure 14). In the MAC Optimal and BAU Combined pathways, electricity consumption in Bay of Plenty would only grow by 3%. In the MAC Optimal pathway, most of this growth would be observed in the next few years.

EDBs' investments will be driven more by increases in peak demand than by growth in consumption over the year. Figure 15 shows how the different pathways affect potential peak demand across the three networks.

Figure 16 – Potential Bay of Plenty peak electricity demand growth under different pathways.



The electricity demand from new electrode boilers and heat pumps is at most 7.5MW[16] between now and 2049, with a further 9MW increase in 2050 under the MAC Optimal pathway. We have truncated the vertical axis in Figure 15 to help illustrate the pathways in the earlier years; as a result, the Electricity Centric peak demand increase to 163MW in 2050 is hidden.

The potential increases in peak demand in Figure 15 likely over-state the true impact, due to our assumption that all individual projects will reach their maximum output at the same time. Due to the natural diversity in electricity demand patterns between the projects, the overall peak demand impacts of these projects is likely to be less than this.

Table 5 shows how process heat connections potentially affect each EDB's network investment between now and 2050. Note that these costs are only the upgrades required to accommodate each process heat user in isolation of demand growth from other process heat users, or wider growth from transport electrification or 'normal' growth. They do not include a share of the cost of any investments deeper in the network that might be triggered by this collective growth picture.

[16] Between 5% and 12% of the three EDBs combined peak demand today.

Table 5 – New connections (MW) and customer-driven connection costs under Electricity Centric and MAC Optimal pathways.

EDB	Electricity Centric pathway		MAC Optimal pathway	
	Connection capacity (MW)	Connection cost ($M)	Connection capacity (MW)	Connection cost ($M)
Horizon Energy Distribution	69.3	$4.7	4.5	$0.2
Powerco	74.4	$3.3	6.0	$0.1
Unison Networks Ltd	21.9	$8.8	4.7	$2.3
Total	**165.6**	**$16.8**	**15.1**	**$2.5**

Table 5 shows that, Powerco will experience the largest increase in process heat-related electricity demand in the MAC Optimal pathway results. EECA's estimates suggest between $2.5M and $16.8M will be spent connecting new process heat plant to the local networks, depending on the pathway.

Note that the network upgrade costs presented in Table 5 may not necessarily reflect the connection costs paid by RETA organisations, as they may be shared between the EDB and the new process heat user. The degree of sharing ('capital contributions') depends on the policies of individual EDBs.

7.2 Opportunity to reduce electricity-related costs through flexibility

There is a potentially significant opportunity for process heat users considering electrification to reduce the costs of connection, and the total costs of purchasing electricity, by enabling flexibility in their consumption. This could take the form of being able to shift demand by a relatively small number of hours; allowing for a very small probability of interruption to their electricity supply; or maintaining a standby supply of fuel to be used in prolonged period of high electricity prices. The lowest cost way for flexibility to be enabled is for it to be designed into the electrification investment. Several service providers provide this expertise.

Red Stag Timber mill. Credit – Graeme Murray

8 Geothermal opportunities

The Bay of Plenty has rich geothermal resources, which are already being utilised across the region. For example, there are many businesses utilising direct steam in the Kawerau district, and many indirect or low temperature uses in Rotorua, Tauranga and Whakatane. Due to the potential of Bay of Plenty geothermal resources to provide low emissions energy to process heat users, it is the first RETA region that EECA have chosen to include geothermal energy.

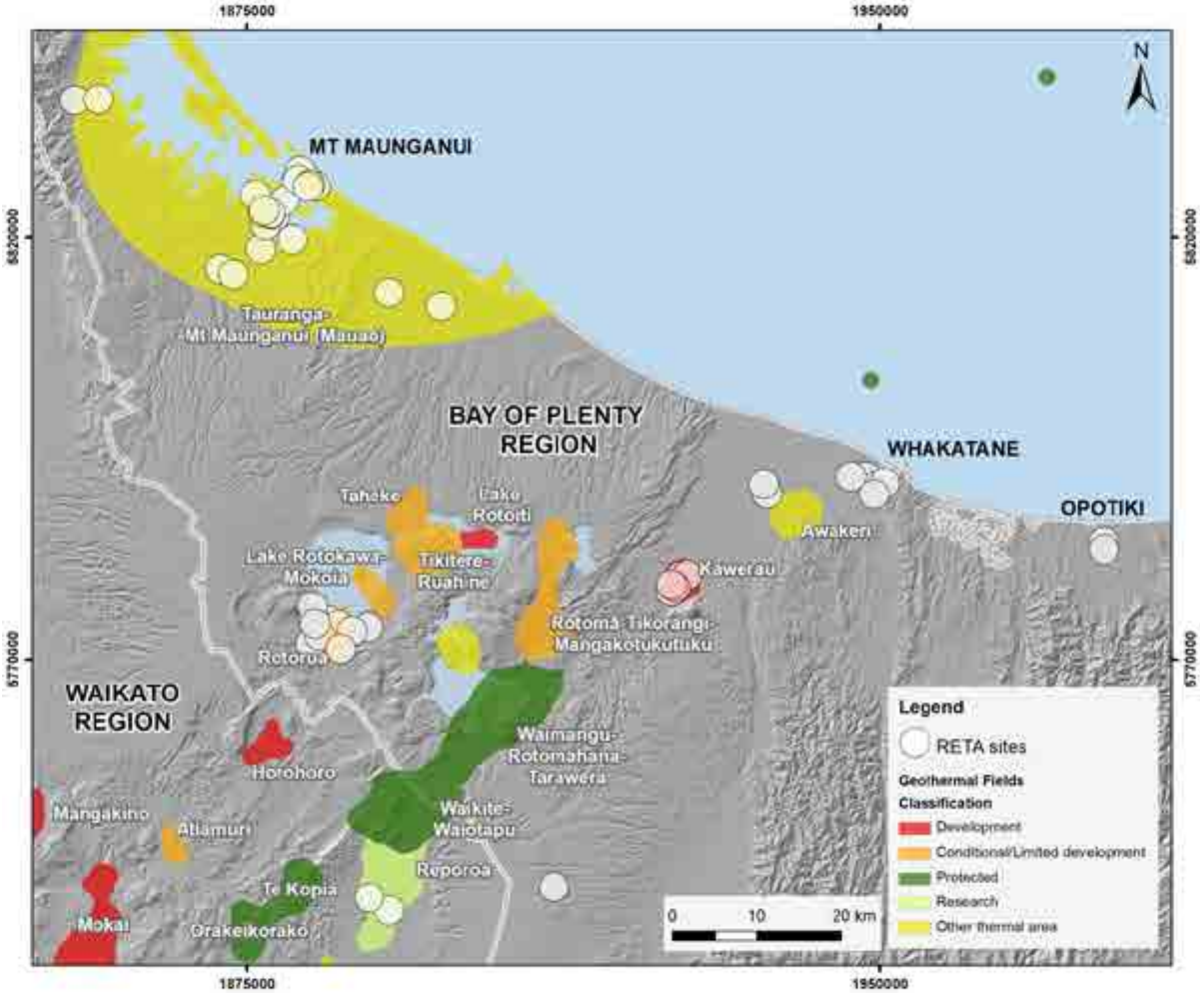
The known geothermal systems and low temperature resources in the Bay of Plenty RETA area include:

- Kawerau – High temperature geothermal system (>150°C)
- Rotorua – High temperature geothermal system (>150°C)
- Tauranga – Low temperature geothermal system (<150°C)
- Awakeri – Low temperature geothermal system (<150°C)
- Whakatane – Ambient groundwater system
- Opotiki – Ambient groundwater system
- Reporoa (Waikato) – High temperature geothermal system (>150°C)

These areas are shown in Figure 17.

Te Mihi geothermal plant. Credit – Rachel Mataira

Figure 17 – Location of Bay of Plenty RETA sites in the context of geothermal fields. Source: GNS



Geothermal technology encompasses various types and applications, each designed to harness the Earth's heat for different purposes and from varying depths and temperatures within the Earth's crust. The choice of technology depends not only on the characteristics of the geothermal resource itself but also factors like the specific energy needs, location and environment of the facility.

Our focus on geothermal in the Bay of Plenty RETA is on the following ways of using geothermal energy:

- **Direct use** – the geothermal energy is at a temperature that is useable in the process or facility, enabling the geothermal energy to be supplied directly (through heat exchange technologies).
- **Indirect use** – the geothermal energy is at a temperature below (or above in the case of cooling) the temperature required by the process or application[17]. Equipment (a heat pump, or chiller) is used to raise (or lower) the temperature to match the user's requirements. To differentiate from **air source heat pumps** (ASHPs) commonly used for heating and cooling in homes and commercial facilities, we use the term **ground source heat pump** (GSHP) where the ground is used as the energy source or sink. The in-ground component of these systems can also be referred to as a geothermal or ground heat exchanger (GHX).

17 While some ground or groundwater temperatures may be geothermally increased (through the transfer of heat from deeper geothermal systems), often this increase is relatively mild – generally speaking, ground or groundwater temperatures are approximately 2°C above the average annual ambient air temperature for a given location.

Geological, hydrogeological, and operational complexities of geothermal direct and indirect use installations make it challenging to develop accurate rule of thumb calculations that can be universally applied. Site-specific assessments and feasibility studies are required to prepare concept design and early cost estimates for geothermal applications and projects.

Four sites were analysed by GNS Science for their geothermal potential and included in the economic analysis of fuel switching. These sites are shown in Table 6.

Table 6 – Description of geothermal technology for the selected Bay of Plenty RETA sites. Source: GNS

Site	Geothermal fuel used	Technology
Whakatane Growers (heating)	Matahina Aquifer (low temperature groundwater)	GSHP[18] - requiring three abstraction wells and four injection wells, approximately 350m deep, are expected to be required to supply 50%-100% of site peak heating load.
Whakatane Hospital (heating and cooling)	Matahina Aquifer (low temperature groundwater)	GSHP – requiring three abstraction wells and four injection wells, approximately 350m deep.
Dominion Salt – Mount Maunganui	Waiteariki Ignimbrite Aquifer (geothermally enhanced groundwater, ~45°- 55°C at 300m deep)	High temperature GSHP - requiring two abstraction boreholes and three injection boreholes, approximately 350m deep.
Fonterra Reporoa	Reporoa Geothermal System[19]	High Temperature direct use of steam – production and reinjection wells assumed to be within 2km of site.

The cost to access geothermal energy is very site dependent – based on what temperatures are available at what depth. Due to timing and resource constraints, this study was only able to assess geothermal options for four sites which had costs developed. The 'MAC' for geothermal for each of these sites was lower than the other pathways, and most other sites in this study are located on or near known geothermal reservoirs. While geothermal is a plentiful natural resource, there are some barriers to entry – for example, proximity to site, consenting requirements and the cost to drill. Pending more feasibility studies, it is anticipated that geothermal has the potential to play a big role. Businesses are encouraged to explore their own geothermal options.

18 In the event that there is insufficient heat from the Matahina Aquifer, a hybrid GSHP and air-sourced heat pump system could be used.

19 The Reporoa Geothermal System is classified by the Waikato Regional Council as a 'research' system, which limits the amount of resource able to be extracted. Changing the categorisation from 'research' to 'development' is not insurmountable but there would be significant investment in exploration required to do this. The level of steam take required to undertake exploratory well testing would be classified as a discretionary activity under the Waikato Regional Plan.

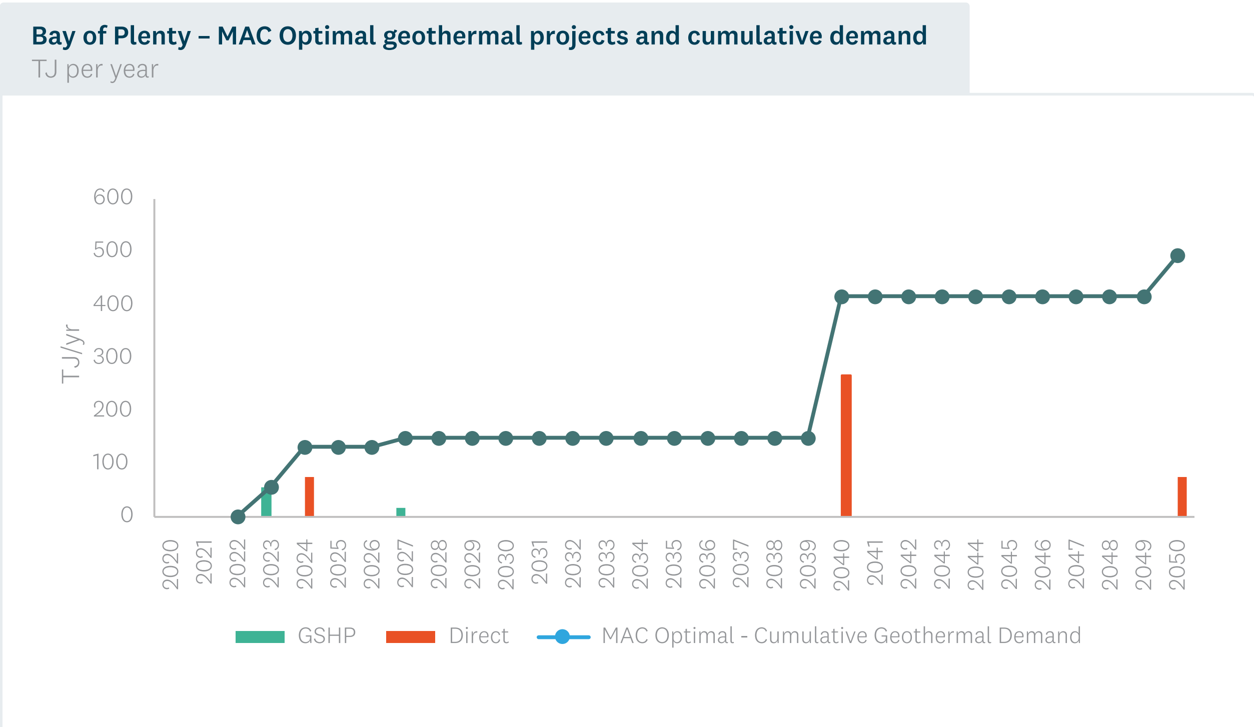
8.1 Impact of pathways on geothermal demand

In our pathways, we included the four sites that GNS assessed, as well as Essity in Kawerau[20]. Because geothermal was only analysed in detail for this subset of the RETA sites, we did not include a 'Geothermal Centric' pathway.

We did, however, calculated MAC values for the five unconfirmed geothermal projects that were included in the pathways, which allowed geothermal to be considered alongside electricity and biomass as fuel switching options.

In the MAC Optimal pathway, geothermal was the optimal fuel for all five unconfirmed fuel switching decisions, delivering 492TJ of energy to these process heat users (Figure 18). The three sites that selected GSHPs also have an associated electricity demand (to power the heat pump), which is included in the MAC Optimal electricity pathway discussed above.

Figure 18 – MAC Optimal pathway for geothermal – technology used and cumulative demand (TJ/year). Source: EECA



The relatively early timing of GSHP projects in Figure 18 reinforces their commercial attractiveness that comes about due to the significant efficiencies achieved by heat pump technology, combined with the stable groundwater temperatures over the year (which better match the heat demand profile than air-sourced heat pumps).

20 The relatively early timing of GSHP projects in Figure 18 reinforces their commercial attractiveness that comes about due to the significant efficiencies achieved by heat pump technology, combined with the stable groundwater temperatures over the year (which better match the heat demand profile than air-sourced heat pumps).

9 Recommendations

Our analysis has highlighted a range of opportunities and recommendations which would improve the overall process heat decarbonisation 'system'. These recommendations are summarised here.

Recommendations to improve the use of biomass for process heat decarbonisation:

- **While information is improving since the commencement of the RETA programme (nationally), there may still be opportunities to refine the understanding of residue costs, volumes, energy content (given the potential susceptibility of these residues to high moisture levels) and alternative methods of recovering harvesting residues.**
- **Work should be undertaken with forest owners to understand the logistics, space and equipment required for harvesting residues.**
- **The development of an 'energy- grade', or E-grade would greatly assist in the development of bioenergy markets. Further, clarity regarding the grade and value of biomass should help the 'integrated model' of cost recovery, outlined above, achieve the best outcomes in terms of recovery cost and volumes.**
- **Analysis is required to determine the impact of recovering harvesting residues on soil quality, carbon sequestration, the risk of forest fires and what actions may be required to offset this.**
- **Mechanisms should be investigated and established to help suppliers and consumers to see biomass prices and volumes being traded and have confidence in being able to transact at those prices for the volumes they require. These mechanisms could include standardised contracts which allow longer-term prices to be discovered, and risks to be managed more effectively.**
- **National guidance or standards should be developed, based on international experience tailored to the New Zealand context regarding the sustainability of different bioenergy sources, accounting for international supply chain effects, biodiversity, carbon sequestration and the risk of forest fires.**
- **Wood processors are encouraged to explore the production of pellets locally, based on the likely demand provided in this report.**

Recommendations to improve the use of electricity for process heat decarbonisation:

- **EDBs should proactively engage on process heat initiatives to understand their intentions and help process heat users obtain a greater understanding of required network upgrades, cost, security levels, possibilities for acceleration, use of system charges and network loss factors. EDBs should ensure Transpower and other stakeholders (as necessary) – at an early stage – are aware of information relevant to their planning.**

- **Process heat users should proactively engage with EDBs, keeping them informed of their plans with respect to decarbonisation, and providing them with the best information available on the nature of their electricity demand over time (baseload and varying components); the flexibility in their heat requirements, which may allow them to shift/reduce demand, potentially at short notice in response to system or market conditions; the level of security they need as part of their manufacturing process, including their tolerance for interruption; and any spare capacity the process heat user has onsite. While the costs associated with network connection used in this report have been estimated based on the best publicly available information available to us, when process heat users provide the information above, it will allow EDBs to provide more tailored options and cost estimates.**
- **EDBs should develop and publish clear processes for how they will handle connection requests in a timely fashion, opportunities for electrified process heat users to contract for lower security, and how costs will be calculated and charged, especially where upgrades may be accommodating multiple new parties (who may be connecting at different times).**
- **EDBs and process heat users should engage early to allow the EDB to develop options for how the process heat user's new demand can be accommodated, what the capital contributions and associated network charges are for the process heat user, and any role for flexibility in the process heat user's demand.**
- **To support this early engagement, EDBs should explore, in consultation with process heat users and EECA, the development of a 'connection feasibility information template' as an early step in the connection process. This template would include a section for process heat users to provide key information to EDBs, and a network section where EDBs provide high-level options for the connection of the process heat user's new demand. Information provided by EDBs would include the potential implications of each option for construction lead times, capital contributions, network tariffs and the use of the customer's flexibility.**
- **Retailers, flexibility aggregators, EDBs and the Electricity Authority should assist by sharing information that helps process heat consumers model the benefits of providing flexibility.**
- **The electricity sector and process heat users should collaborate to explore and demonstrate flexibility. This is consistent with steps in the FlexForum's Flexibility Plan.**
- **EDBs and retailers should ensure that the tariffs they offer process heat users are incentivising the right behaviour.**
- **EECA should expand future iterations of regional analyses to include transport as a decarbonising decision that will compete for electrical network capacity and biomass.**

Recommendations to improve the use of geothermal energy for process heat decarbonisation:

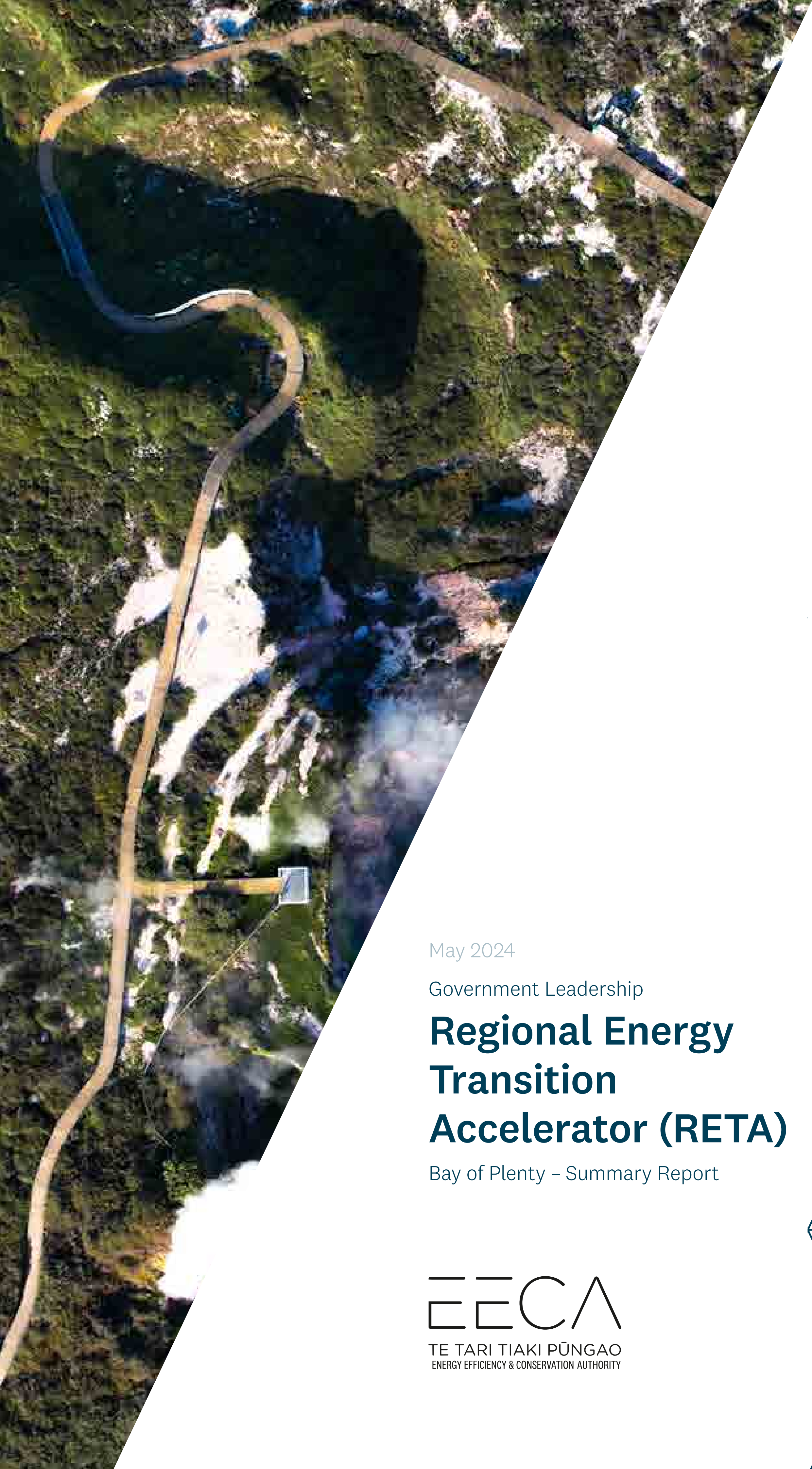
- **More case studies should be conducted and evaluated to highlight opportunities for low-temperature geothermal around the country.**
- **Pairing ground-source heat pumps (GSHP) and high temperature GSHP with low temperature resource should be included in regional economic strategies. Such strategies will also ensure effective environmental management is developed.**

- **Funding should be pursued for the exploratory activity necessary to enable the Reporoa Geothermal Field to be further investigated as an energy source for industrial use.**
- **National guidance on consenting process and subsurface management for GSHP low temperature geothermal technologies should be commissioned.**
- **More economic analysis should be undertaken on the opportunities for co-location or shared investment of geothermal deep wells, heat transportation over extended distances, and GSHP district infrastructure in New Zealand.**
- **A drilling insurance scheme, similar to the French model, should be investigated for New Zealand to de-risk geothermal applications and accelerate decarbonisation targets.**

Recommendations to assist process heat users with their decarbonisation decisions:

Ministries (such as Ministry for the Environment) need to work with reputable organisations to develop scenario-based carbon price forecasts that decarbonising organisations can incorporate into their business cases.

Poihipi geothermal plant. Credit – Rachel Mataira



May 2024

Government Leadership

Regional Energy Transition Accelerator (RETA)

Bay of Plenty – Summary Report

EECA
TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY