Government Leadership

Regional Energy Transition Accelerator (RETA)

North Canterbury – Summary Report

November 2023

TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY

1 Foreword

Reducing emissions and moving off fossil fuels and onto new energy sources, by industry, requires good information and a proactive, well-balanced energy system.

To create a regional pathway, understanding unique region-specific needs, opportunities and barriers is critical. EECA's Regional Energy Transition Accelerator (RETA) programme aims to develop and share a well-informed and coordinated approach to help a region fast-track the switch to low-emissions technology through demand reduction, thermal efficiency, and fuel-switching.

The RETA work leverages the site-specific decarbonisation pathways developed for organisations across the region through EECA's energy transition accelerator (ETA) programme. This is invaluable and highlights the importance of reducing energy demand individually and collectively, as a first step. It demonstrates how the collective effect of fuel switching decisions impacts investment in these regional resource and infrastructure systems and streamlines energy supply and generation.

This North Canterbury RETA report provides a common set of information to all regional businesses considering decarbonising their process heat, and to renewable energy suppliers. The process seeks to unlock infrastructure investment, capacity, the phasing of activity and realise cost efficiencies where possible.

Real progress requires working together across government, councils, economic development agencies, business, and community. We are proud to have worked collaboratively to develop this North Canterbury RETA report with ChristchurchNZ, Enterprise North Canterbury, Transpower, Mainpower and Orion, regional forestry companies and wood processors, electricity generators and retailers, and medium to large industrial energy users.

Our analysis shows that most emissions reductions could be achieved by 2028 – but only if investment and infrastructure decisions are made soon. Many businesses have already mapped out a pathway with EECA or have switched to low emissions technology. But there is significant potential to reduce the reliance on coal and build grid resilience with proactive and engaged process heat users in North Canterbury.

We look forward to providing continued support to the region as it continues its journey.

Nicki Sutherland
Group Manager Business, EECA

EECA

Photo: Rangiora, Canterbury, New Zealand. Credit - MainPower.

> ***The RETA process seeks to unlock infrastructure investment, capacity, the phasing of activity and realise cost efficiencies where possible.***
>
> Nicki Sutherland , Group Manager Business, 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 North Canterbury
- ChristchurchNZ & Enterprise North Canterbury
- Local Electricity Distribution Businesses (EDBs) Mainpower and Orion
- 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:

- **Lumen** – process heat demand-side assessment
- **Ahikā and Margules Groome** – biomass availability analysis
- **Ergo Consultants** – electricity network analysis
- **EnergyLink** – electricity price forecast
- **Wayne Manor Advisory** – report collation, publication and modelling assistance

The North Canterbury region is the focus for New Zealand's fifth Regional Energy Transition Accelerator (RETA).

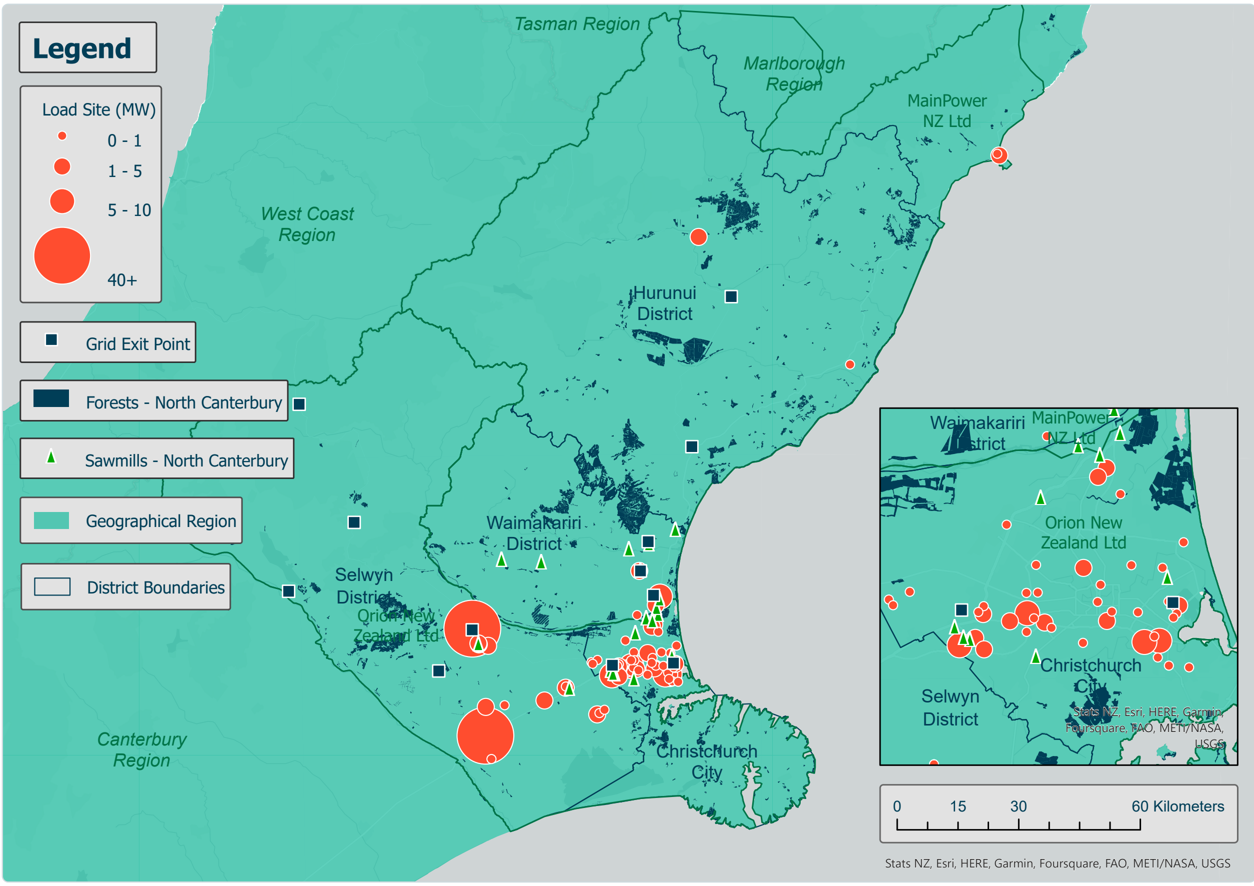
3 Table of contents

Avon River, Canterbury, New Zealand. Credit - Christchurch City Council.

4 North Canterbury overview

This region covers the northern part of the Canterbury region, including and north, of Christchurch (Figure 1). For the purposes of this report, we refer to this region as 'North Canterbury'.

Figure 1 – Map of area covered by the North Canterbury RETA



The North Canterbury 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 80 sites covered span the dairy, meat, industrial and commercial[1] sectors. These sites either have 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 has detailed information about their decarbonisation pathway[2]. Together, these sites collectively consume 4,267TJ of process heat energy and currently produce 372kt per year of carbon dioxide equivalent (CO_2e) emissions.

Table 1 – Summary of North Canterbury 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	5	149	719	2,589	234
Meat	6	20	29	106	8
Industrial	34	96	242	871	69
Commercial	35	92	195	701	61
Total	**80**	**357**	**1,185**	**4,267**	**372**

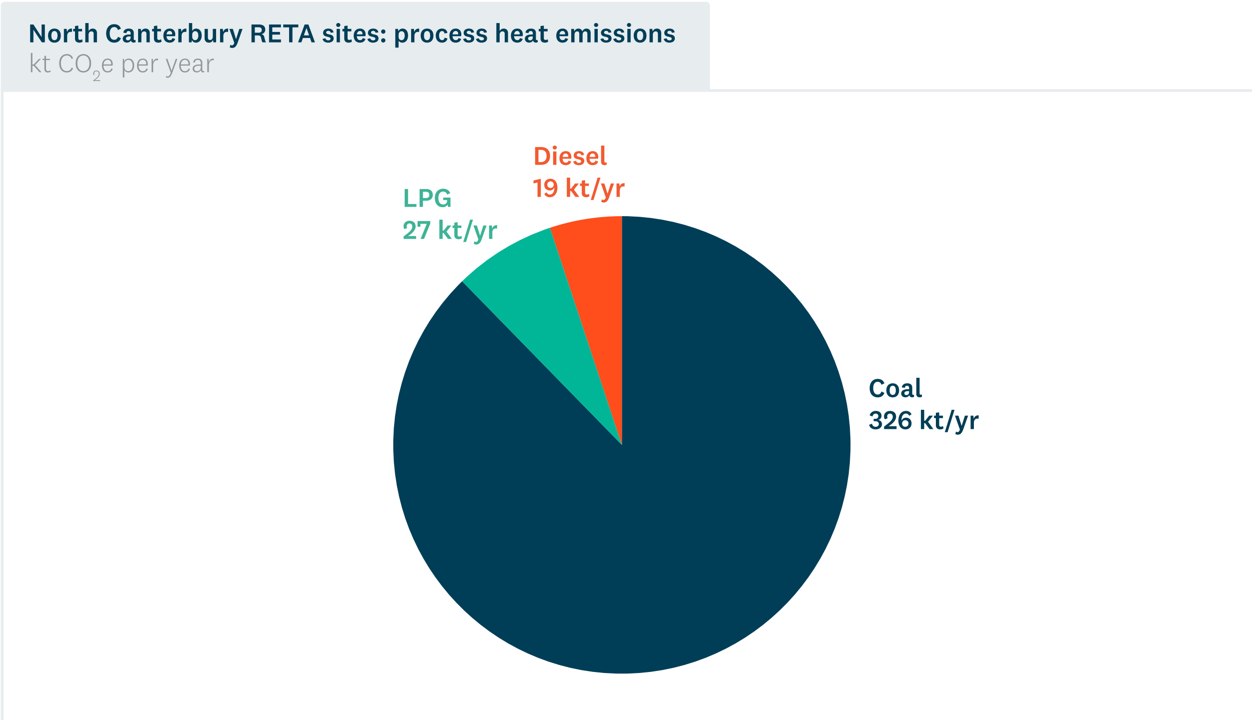
Hanmer Springs, Canterbury, New Zealand. Credit - MainPower.

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

[2] That is, process heat equipment details have been captured in an ETA opportunities assessment report.

The majority of North Canterbury RETA process heat emissions come from coal (Figure 2).

Figure 2 – 2020 annual emissions by process heat fuel in North Canterbury RETA. Source: EECA



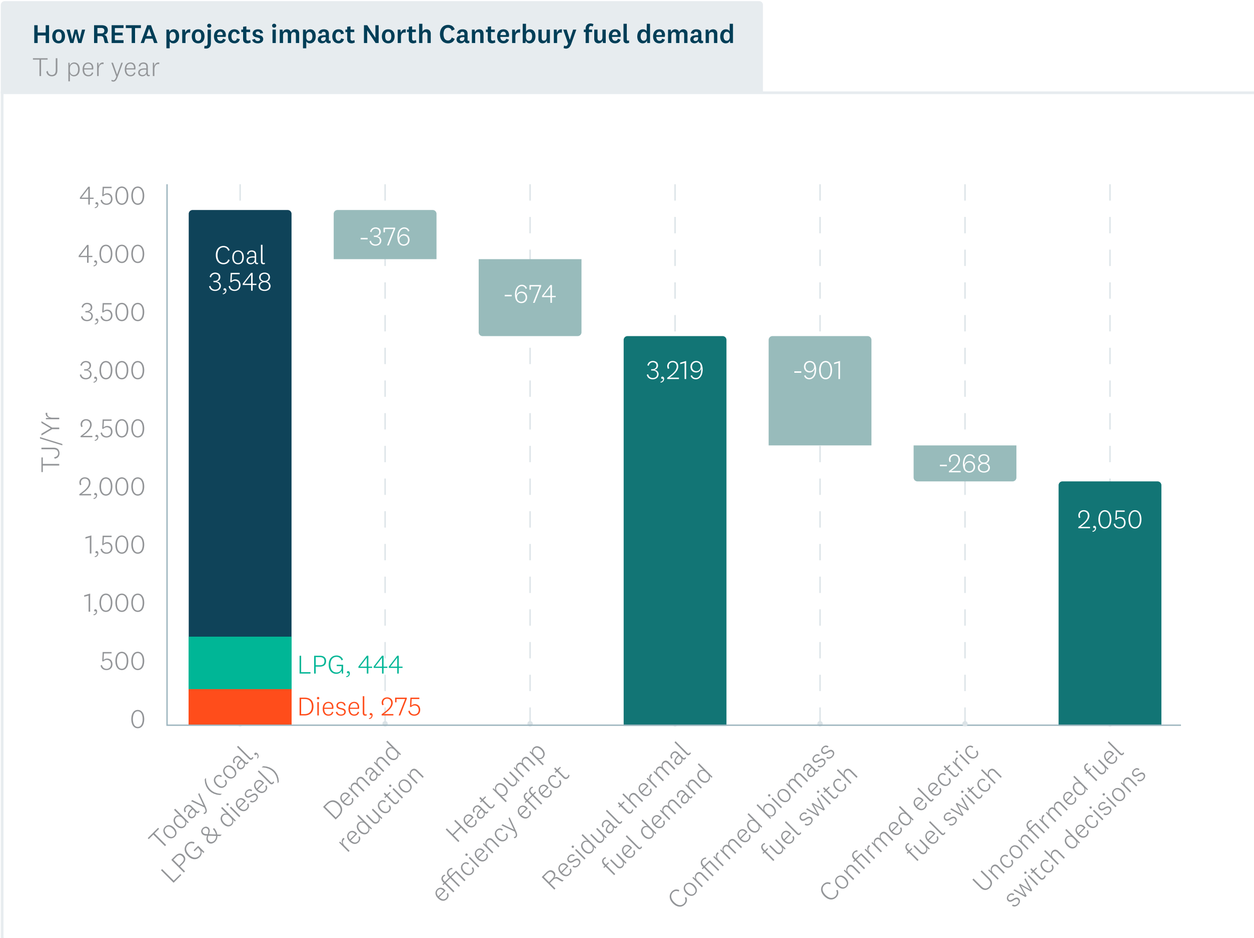
The objective of the North Canterbury RETA is to eliminate as much of these process heat emissions as possible. It does this by supporting organisations in their consideration of:

- 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.

Hanmer Springs, Canterbury, New Zealand. Credit - MainPower.

Figure 3 illustrates the potential impact of RETA sites on regional 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 North Canterbury fossil fuel usage, 2022-2037. Source: EECA



As explored below, this RETA looks at a number of pathways by which the 2,050TJ 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 North Canterbury 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 80 sites considered in this study. Across these sites, there are 164 individual projects spanning the three categories discussed above – demand reduction, heat pumps and fuel switching.

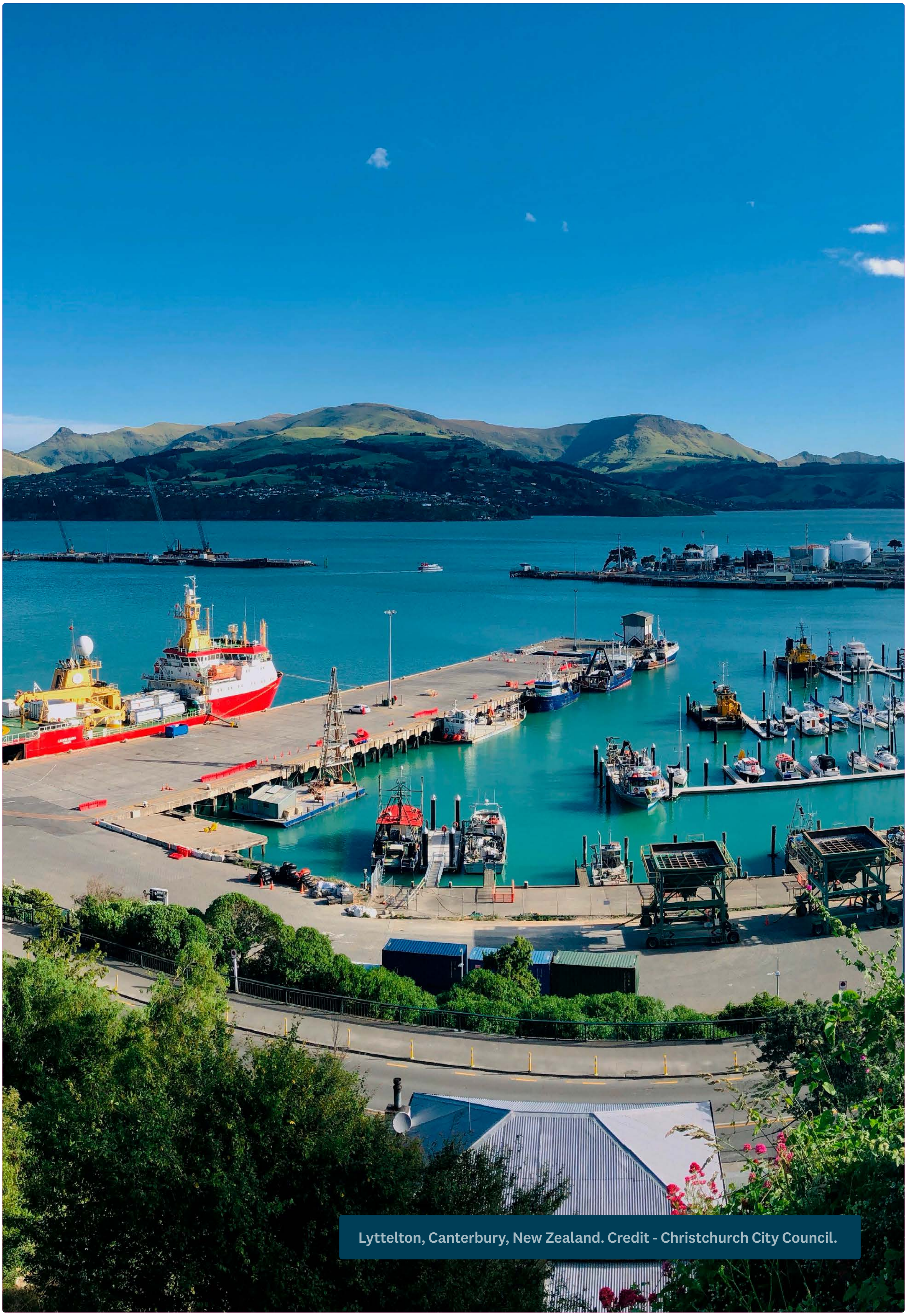
Table 2 shows the current status of the North Canterbury RETA process heat projects. Some have been confirmed by the process heat organisation (i.e. the organisation has committed to the investment and funding allocated) but are not yet completed. Over 90% of the 164 projects are unconfirmed, in that the process heat organisation is yet to commit to the final investment.

Table 2 – Number of projects in North Canterbury RETA: Confirmed vs Unconfirmed. Source: Lumen, EECA.

Status	Demand reduction	Heat pump efficiency	Fuel switching	Total
Completed	-	7	9	16
Unconfirmed	66	53	29	148
Total	**66**	**60**	**38**	**164**

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 North Canterbury 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.



Lyttelton, Canterbury, New Zealand. Credit - Christchurch City Council.

Table 3 – Summary of North Canterbury RETA sites with fuel switching requirements. Green shading indicates confirmed projects; orange 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	Electricity peak demand (MW)
Meadow Mushrooms Hornby	**Meadow Mushrooms**	**Confirmed**	**N/A**	**4.75**
Hamilton Jet Christchurch	**High Temperature Manufacturing**	**Confirmed**	**N/A**	**1.26**
Synlait Milk Dunsandel	**Dairy Processing**	**Confirmed**	**419.76 (58.43)**	**6.06**
Christchurch Hospital	**Hospitals (with Surgery)**	**Confirmed**	**208.91 (29.08)**	**N/A**
University of Canterbury Ilam Campus	**Education**	**Confirmed**	**207.22 (28.84)**	**N/A**
Gladfield Malt Dunsandel	**Food & Beverage**	**Confirmed**	**39.71 (5.53)**	**N/A**
Darfield High School	**Education**	**Confirmed**	**2.42 (0.34)**	**N/A**
Amuri Area School	**Education**	**Confirmed**	**0.35 (0.05)**	**N/A**
Opawa School	**Education**	**Confirmed**	**0.35 (0.05)**	**N/A**
Fonterra Darfield – Stage 2	Dairy Processing	Unconfirmed	546.84 (76.12)	**45.56**
Fonterra Darfield – Stage 1	Dairy Processing	Unconfirmed	465.12 (64.74)	**15.15**
Synlait Milk Dunsandel – Stage 2	Dairy Processing	Unconfirmed	252.47 (35.14)	**15.15**
Synlait Milk Dunsandel – Stage 3	Dairy Processing	Unconfirmed	**10.35 (1.44)**	14.14
G L Bowron Company Christchurch	Pet food & rendering	Unconfirmed	149.00 (20.74)	**7.29**
Goodman Fielder Christchurch	Dairy Processing	Unconfirmed	98.10 (13.66)	**11.33**
Hexion Hornby	High Temperature Manufacturing	Unconfirmed	89.68 (12.48)	**2.37**
Winstone Wallboards Christchurch	High Temperature Manufacturing	Unconfirmed	87.88 (12.23)	**5.48**
Canterbury Clay Bricks Darfield	High Temperature Manufacturing	Unconfirmed	78.52 (10.93)	**2.37**
McAlpines Rangiora	Sawmill	Unconfirmed	63.11 (8.78)	**4.61**
Kraft Heinz Christchurch	Food & Beverage (with drying)	Unconfirmed	**35.50 (4.94)**	4.57
Mitchell Bros Sawmillers Darfield	Sawmill	Unconfirmed	33.97 (4.73)	**1.16**
Hellers Kaiapoi	Pet food & rendering	Unconfirmed	**22.09 (3.08)**	3.10

Site name	Industry	Project status	Bioenergy required TJ ('000t)/yr	Electricity peak demand (MW)
Higgins Christchurch	High Temperature Manufacturing	Unconfirmed	**16.65 (2.32)**	15.36
Alsco New Zealand Christchurch	Laundry	Unconfirmed	**15.24 (2.12)**	3.69
Valmont Christchurch	High Temperature Manufacturing	Unconfirmed	**12.73 (1.77)**	3.46
Tegals Food Ltd Christchurch	Food & Beverage (with drying)	Unconfirmed	**12.40 (1.73)**	2.64
Westland Milk Products Rolleston	Dairy Processing	Unconfirmed	**9.79 (1.36)**	2.91
Farmlands Rolleston	High Temperature Manufacturing	Unconfirmed	**6.37 (0.89)**	0.99
Kisco Foods Christchurch	Food & Beverage (with drying)	Unconfirmed	**5.20 (0.72)**	0.72
Expol Rolleston	High Temperature Manufacturing	Unconfirmed	**5.17 (0.72)**	1.19
Woolston Foundry Christchurch	High Temperature Manufacturing	Unconfirmed	4.87 (0.68)	**0.49**
St Georges Hospital Inc	Hospitals (with Surgery)	Unconfirmed	**3.22 (0.45)**	0.59
Apparelmaster Christchurch	Laundry	Unconfirmed	**2.64 (0.37)**	0.77
Ardex Christchurch	High Temperature Manufacturing	Unconfirmed	**2.55 (0.35)**	0.84
Meadow Mushroom Giggs Farm	Meadow Mushrooms	Unconfirmed	**2.07 (0.29)**	0.55
Southern Cross Healthcare Christchurch	Hospitals (with Surgery)	Unconfirmed	**1.97 (0.27)**	0.24
Paua Co. Bromley	High Temperature Manufacturing	Unconfirmed	**1.39 (0.19)**	1.48
Barry's Bay Cheese	Dairy Processing	Unconfirmed	**0.28 (0.04)**	0.26

Nine sites have already confirmed their fuel of choice, representing a demand for 901TJ (125,000t[3]) of biomass and 268TJ (74GWh) of electricity that will materialise soon.

[3] Wet tonnes (55% moisture content) and assuming a boiler efficiency of 80% (compared to coal at 78%).

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 North Canterbury-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). 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 and allows us to determine the timing of the 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.

Hanmer Springs, Canterbury, New Zealand. Credit - Mainpower.

The pathways were then developed as follows:

Pathway name	Description
Biomass Centric	All unconfirmed site fuel switching decisions proceed with biomass at the timing indicated in the organisation's ETA pathway. If not indicated, timing is set at 2036.
Electricity Centric	All unconfirmed fuel switching decisions with electricity as the sole fuel at the timing indicated in the organisation's ETA pathway. If not indicated, timing is set at 2036.
BAU Combined	All unconfirmed fuel switching decisions (i.e. biomass or electricity) are determined by the lowest MAC value for each project; timing of commissioning as indicated in the organisation's ETA pathway. If not indicated, timing is set at 2036.
Linear	Each site switches to the fuel with the lowest MAC value for that site; projects ordered and timed to achieve a relatively constant annual level of emissions reduction and growth in electricity/biomass consumption (within reason)[4].
MAC Optimal	Each site 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 future carbon prices in their Demonstration Path.

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

- Coal boiler conversions involving facilities owned by the Ministry of Education, Ministry of Health or the Department of Corrections are all assumed to occur by the end of 2025.
- All RETA 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]. This means that any projects that are still not 'economic' using our MAC criteria by 2036, are assumed to be executed in 2036.

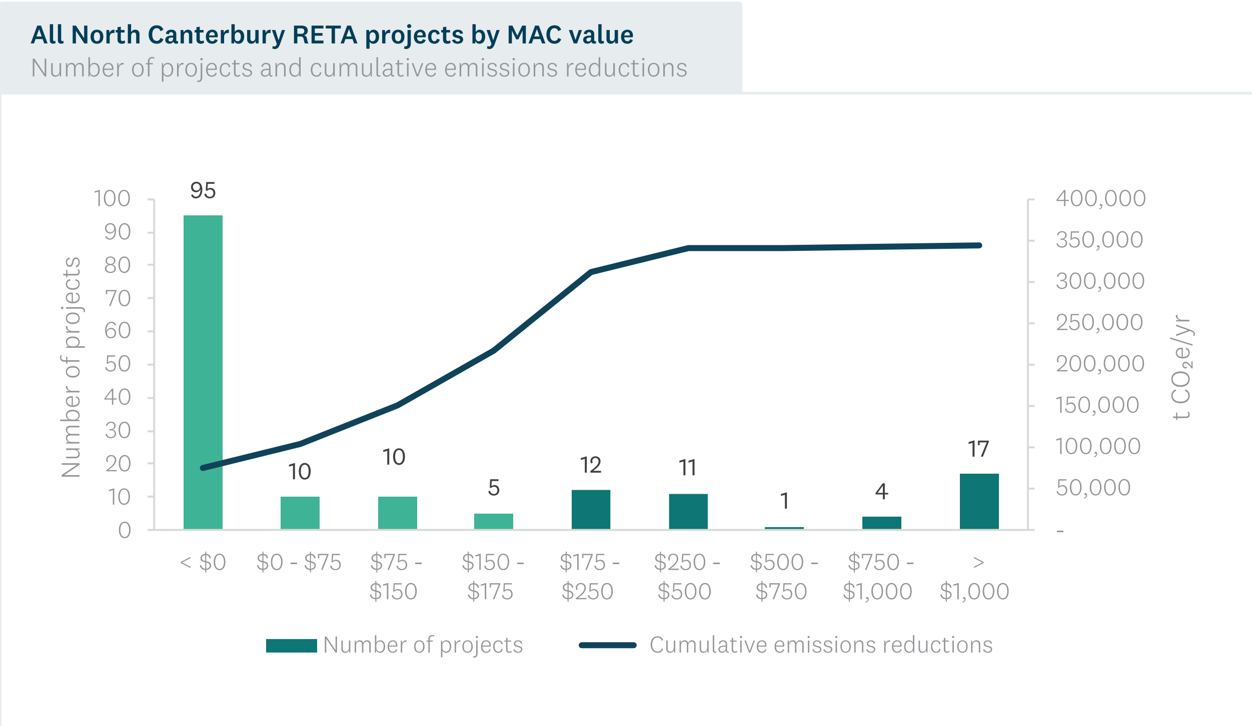
4 There could be a range of ways this could be observed. We suggest it could be thought of as organisations desiring to take a MAC Optimal approach, but being slowed by capital constraints, the effect of uncertainty, a more gradual emergence of biomass resources, and/or the realities of constraints on Transpower and EDBs ability to deliver network upgrades as a result of regulatory requirements, construction capacity etc.

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. We assume that all RETA process heat fossil fuels will convert to a low emissions equivalent by 2037.

5.1 At expected carbon prices, 58% of emissions reductions are economic[6]

Using the biomass and electricity costs presented in Section 6 and Section 7, 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



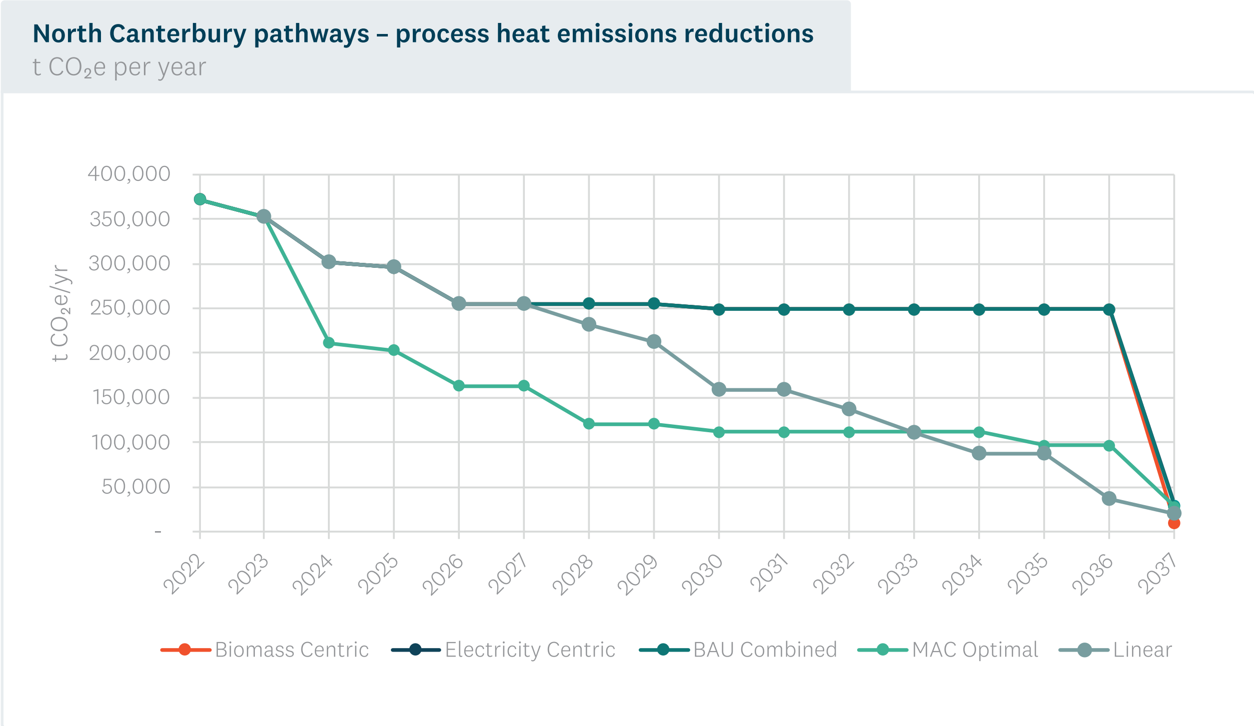
Out of 372kt of process heat emissions covered in the North Canterbury RETA, 216kt (58%) have marginal abatement costs (MACs) less than \$175/tCO_2e. Based on an expectation the carbon prices will follow the Climate Change Commission's Demonstration Pathway, these emissions reduction projects would be economic prior to 2037. However, 95 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), executing these projects using a commercial MAC decision-making criteria (MAC Optimal) would accelerate decarbonisation, and reduce the release of long-lived emission by 1,633kt over the 15-year period of the RETA analysis (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



The MAC Optimal pathway proceeds faster, with the majority of emissions reductions achieved by 2028. However, this pace is likely to be constrained by practical matters such as:

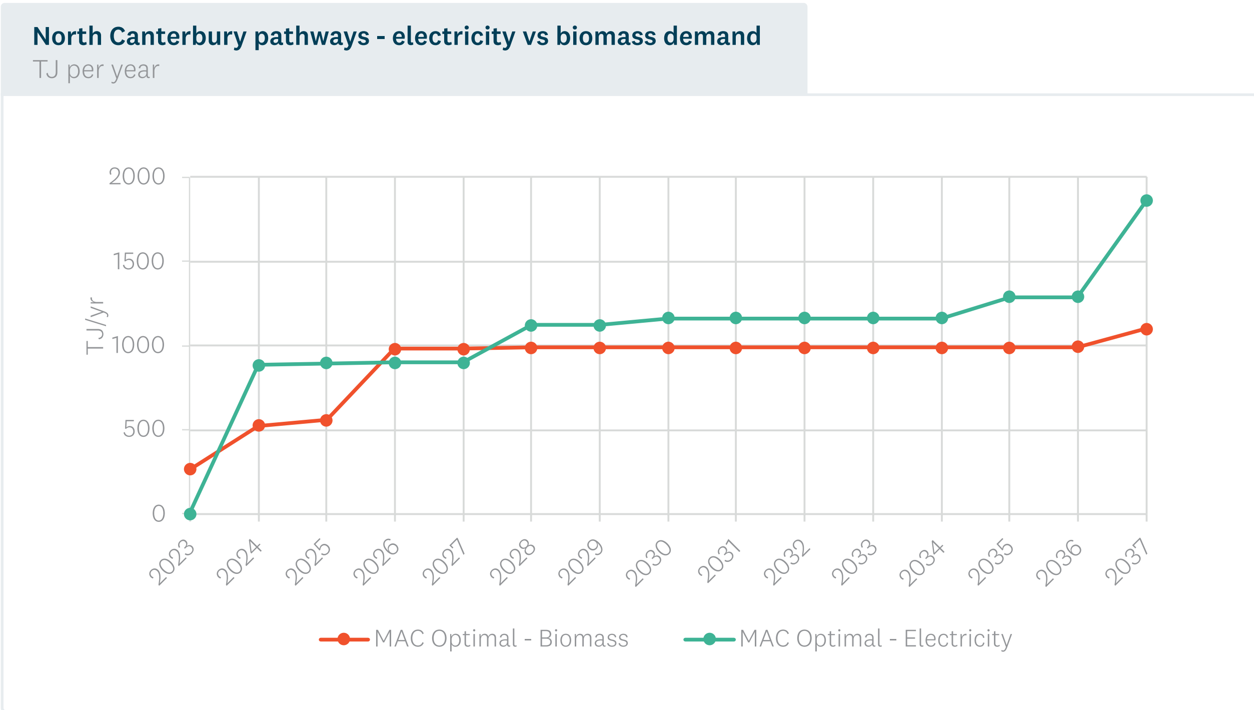
- The ability of process heat users to secure funding and commit to these investments in this timeframe.
- The ability of infrastructure providers to deliver the necessary network upgrades.
- The ability of forest owners and bioenergy aggregators to make sufficient resource available.

Pihi Farms, Canterbury, New Zealand. Credit - Enterprise.

5.1.1 Pathway implications for electricity and biomass demands

The MAC Optimal pathway sees fuel decisions that result in 62% of the energy needs in 2037 supplied by electricity, and 38% supplied by biomass (Figure 6). We expand further on these outcomes in the sections below.

Figure 6 - 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 North Canterbury process heat decarbonisation. As shown in Figure 3, investment in demand reduction and heat pumps meets 25% of today's North Canterbury energy demands[8] 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 113MW if these projects were completed. We estimate that demand reduction and heat pumps would avoid investment of $113M to $170M in electricity and biomass infrastructure[9].

The MAC values – and therefore the timing of each decarbonisation project – are based on a number of inputs that are uncertain (for example future electricity prices and biomass costs). The expectations that organisations hold about future carbon prices also has an effect. Factors beyond pure project economics (such as internal constraints on capital) will continue to significantly impact organisations' decisions.

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

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

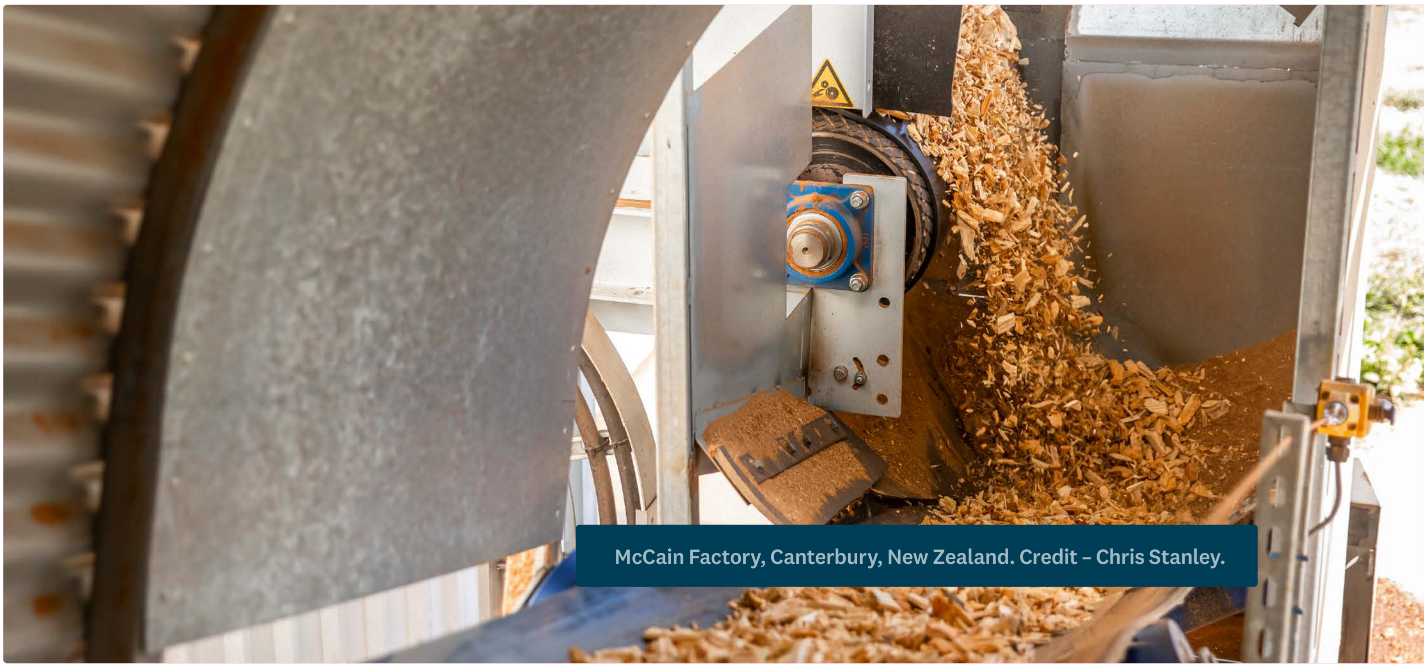
Lyttelton, Canterbury, New Zealand. Credit - Christchurch City Council.

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.

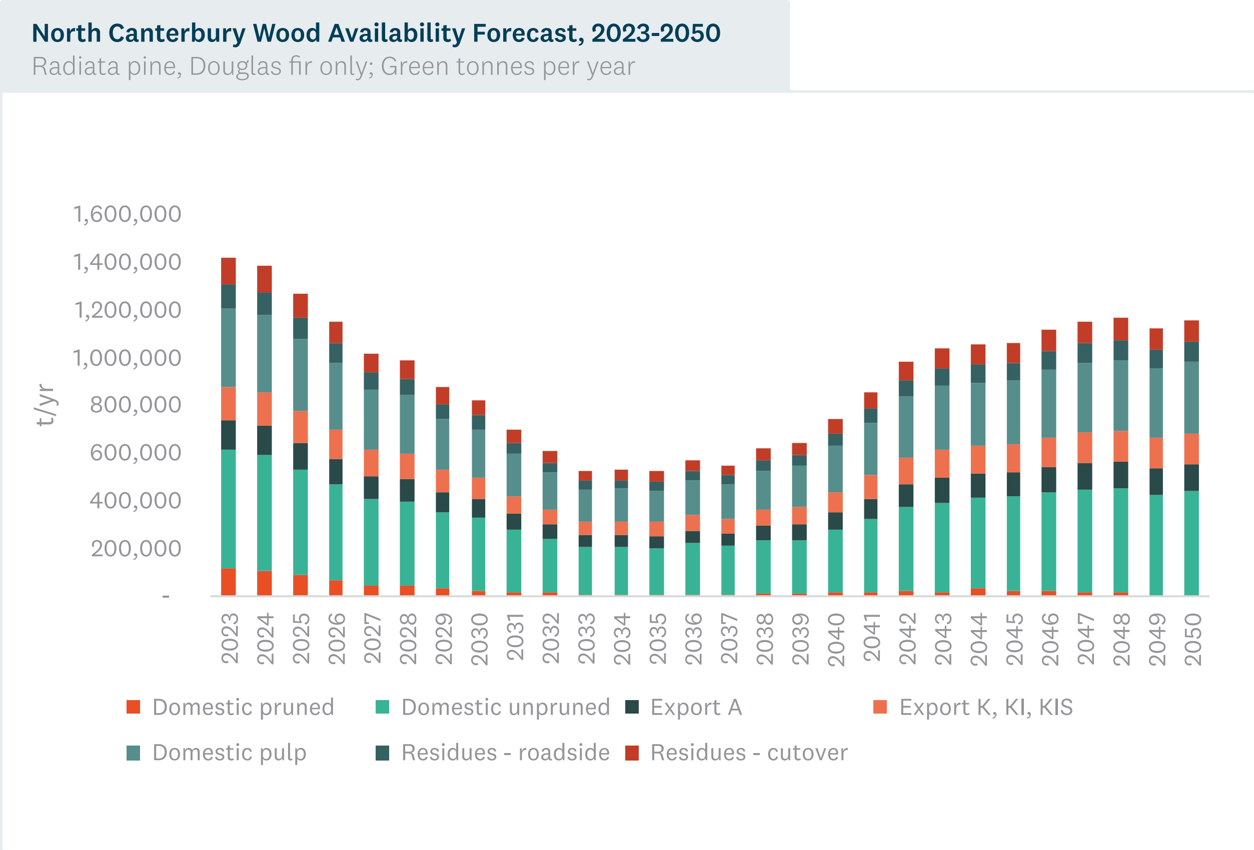
A good sense of the total availability of harvestable wood in the North Canterbury region requires both a top-down and bottom-up analysis (based on interviews with major forest owners), as forest owners' actual intentions will often deviate from centralised forecasts due to changes in log prices and 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 the level of harvested wood in the North Canterbury region will vary considerably over the next 15 years (Figure 7). There will be a significant decline from 1.4M tonnes to around 0.6M tonnes between now and 2034, recovering thereafter to over 1M tonnes.



McCain Factory, Canterbury, New Zealand. Credit – Chris Stanley.

Figure 7 – Wood resource availability in North Canterbury region, 2023-2050. Source: Ministry of Primary Industries

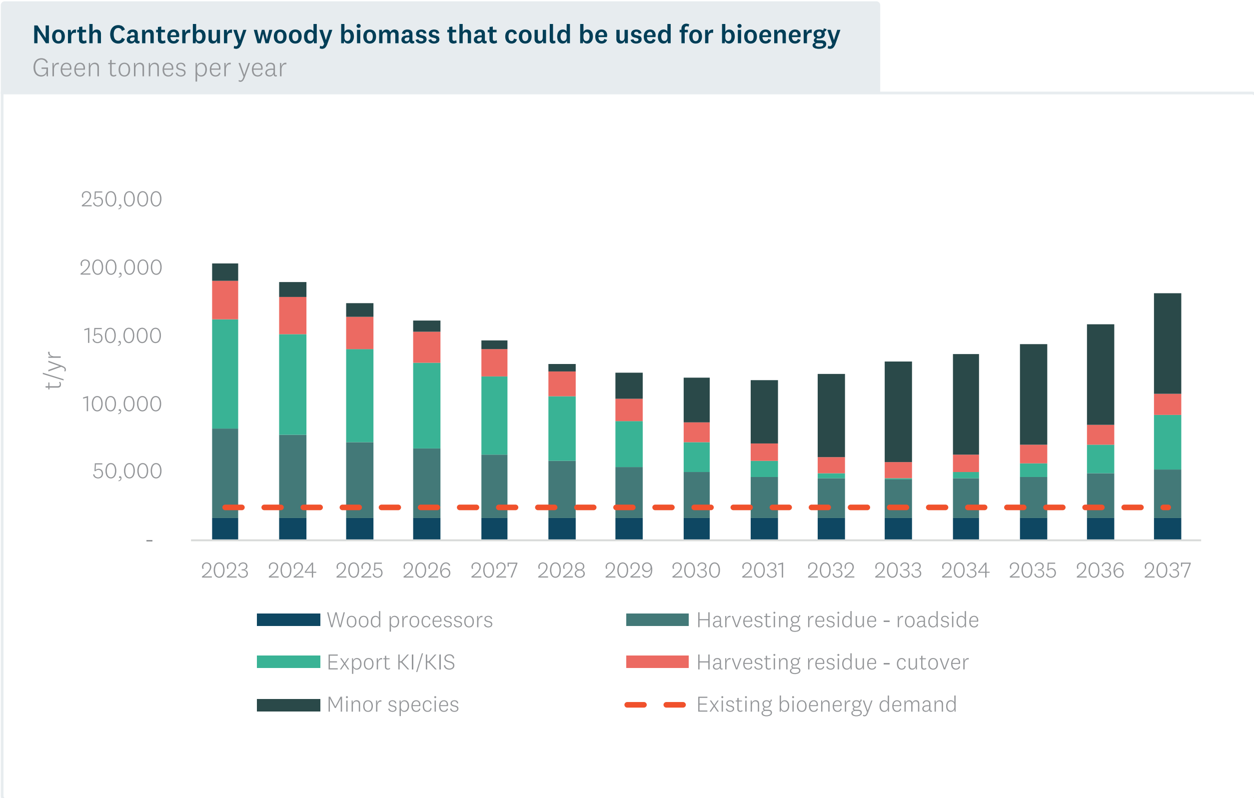


A more comprehensive view of resource availability, that combines the top-down and bottom-up analyses, reveals the potential volumes that could be available for bioenergy. This analysis:

- Includes minor species (e.g. cypress and eucalyptus) that isn't accounted for in Figure 7.
- Removes volumes that are currently contracted to domestic markets, including the use of domestic pulp for MDF production.
- Takes a more realistic approach to estimating the potential harvesting residues (roadside and cutover) than the theoretical potential used in Figure 7.
- Considers the potential volumes arising as residues from processing sawlogs for the domestic market.
- Overlays the existing demand for bioenergy, that already draws on these resources.

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

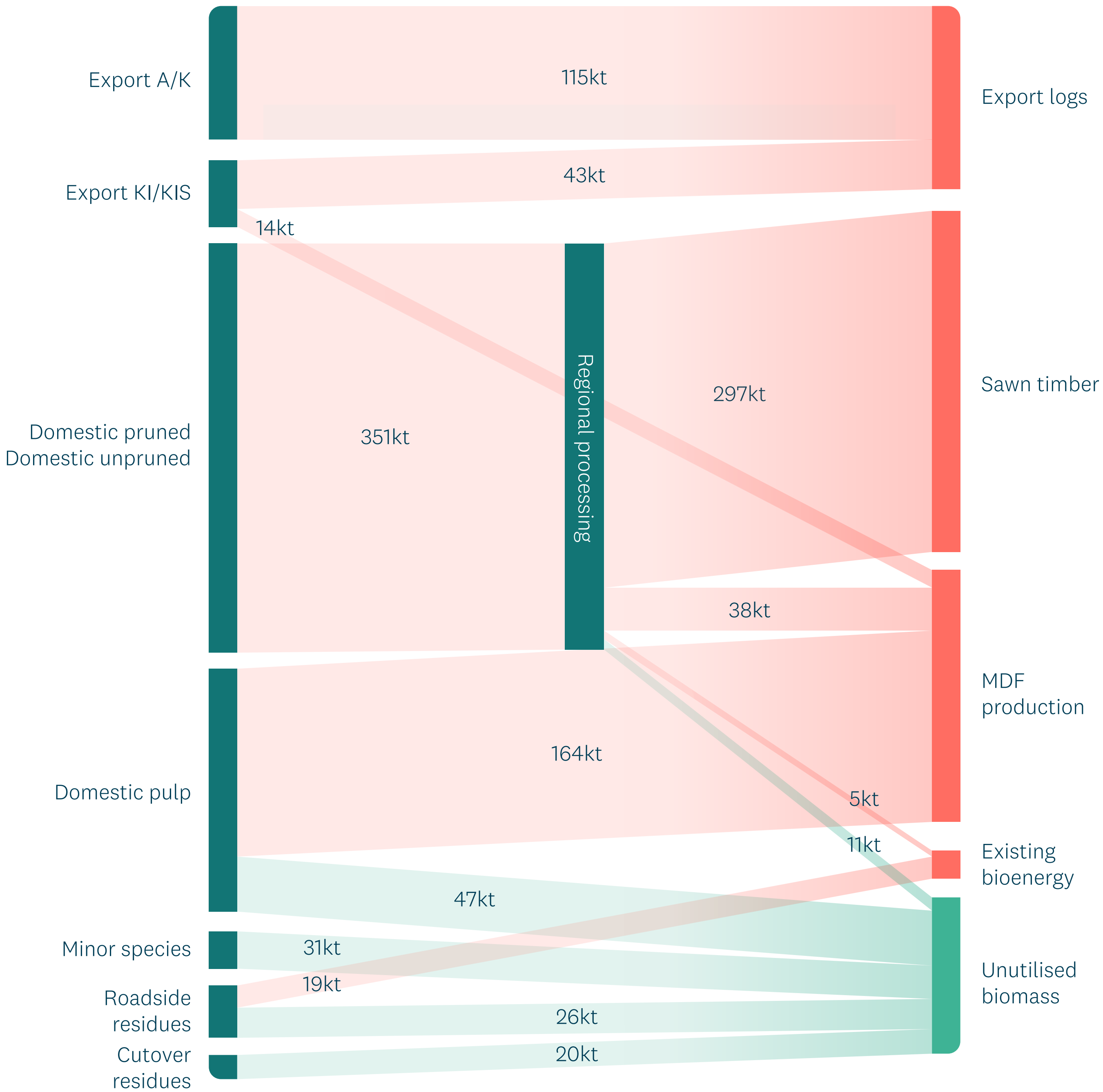
Figure 8 – Assessment of available North Canterbury woody biomass that could be used for bioenergy.



The overall analysis of the North Canterbury region is summarised in Figure 9. Wood flows that could – in part or in full – be diverted to new bioenergy demand from process heat are shown in green.

Waimate Biomass, Canterbury, New Zealand. Credit - Chris Stanley.

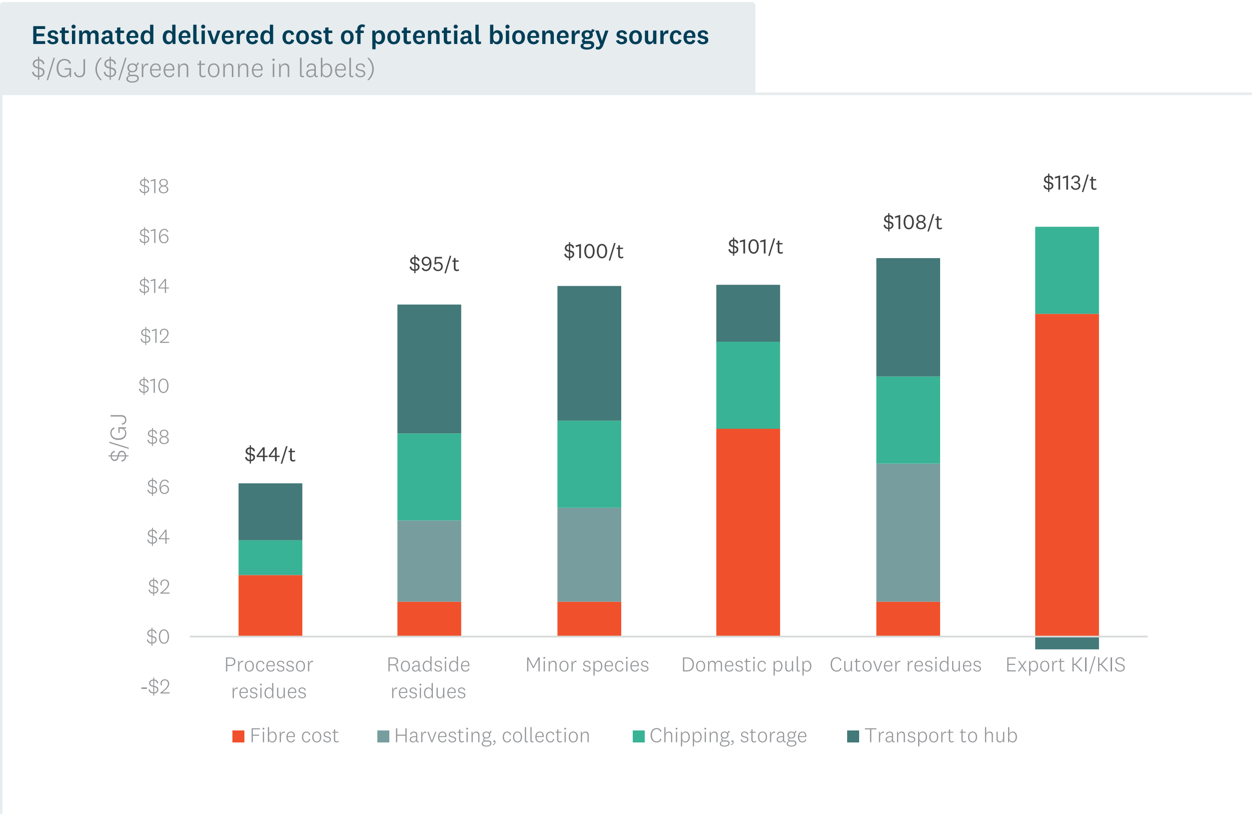
Figure 9 – Average wood flows over 15 years in North Canterbury region. Source: Ahikā, Margules Groome



Overall, EECA estimates that, on average over the next 15 years, approximately 124,000t per year (890TJ) of North Canterbury woody biomass is currently unutilised and could be recovered for new boiler demands without disrupting low grade export markets or existing bioenergy consumers. However, this average disguises the significant variance in the annual availability described above.

The costs of accessing this biomass, and delivering it to the process heat user's site, is presented in Figure 10.

Figure 10 – Estimated delivered cost of potential bioenergy sources. Source: Margules Groome (2023), average value 2023-2037



We retain export grade A 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.

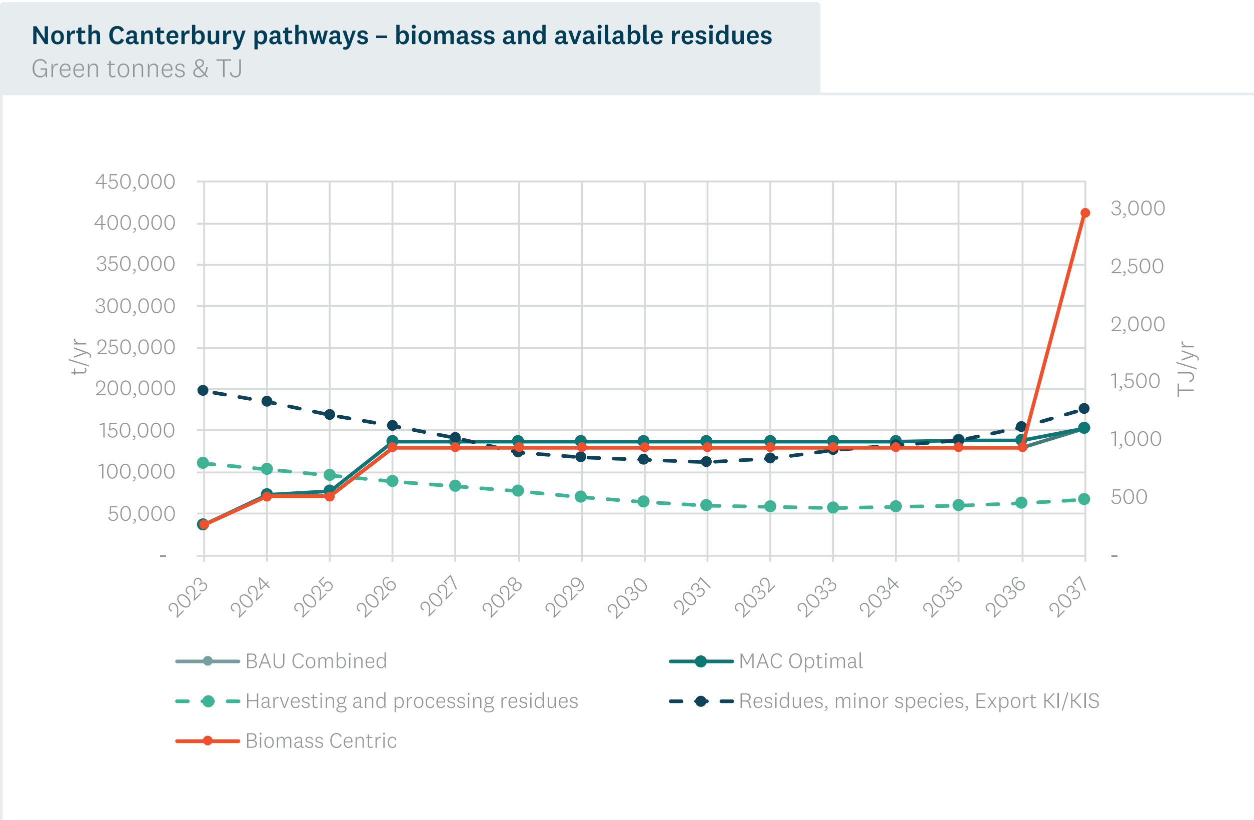
Our assumption is that available biomass will be processed into dried woodchip for North Canterbury process heat customers. In our modelling, we assume that the available volumes in Figure 8 can be processed and delivered to process heat users for $25/GJ ($315 per tonne of dried woodchip), while any volumes required in addition to this will cost $28/GJ ($350/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 11). The MAC Optimal and BAU Combined pathways result in less than a third of the final demand from the Biomass Centric pathway.

More critically, the pathways show that the supply of harvesting and processing residues will be insufficient to meet the demand for biomass arising from any pathway. Even adding in minor species and lower grade export logs still results in a shortfall between 2028 and 2035. In order to meet the demand for biomass over this period, these volumes would need to be supplemented by bioenergy sourced from outside the North Canterbury region. This would have an impact on cost and emissions, as a result of the transport of biomass. This will be considered in a future RETA report for the South Island as a whole.

Figure 11 – Growth in biomass demand from North Canterbury pathways. Source: EECA



Based on the biomass cost figures provided above, our analysis suggests that, over the next 15 years, the MAC Optimal process heat market demand for these residues could be $180M (on a cost basis[10]).

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. 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.

10 Cost of biomass collected and delivered to a hub for $17/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).

The price paid for electricity by a process heat user is made up of two main components[11]:

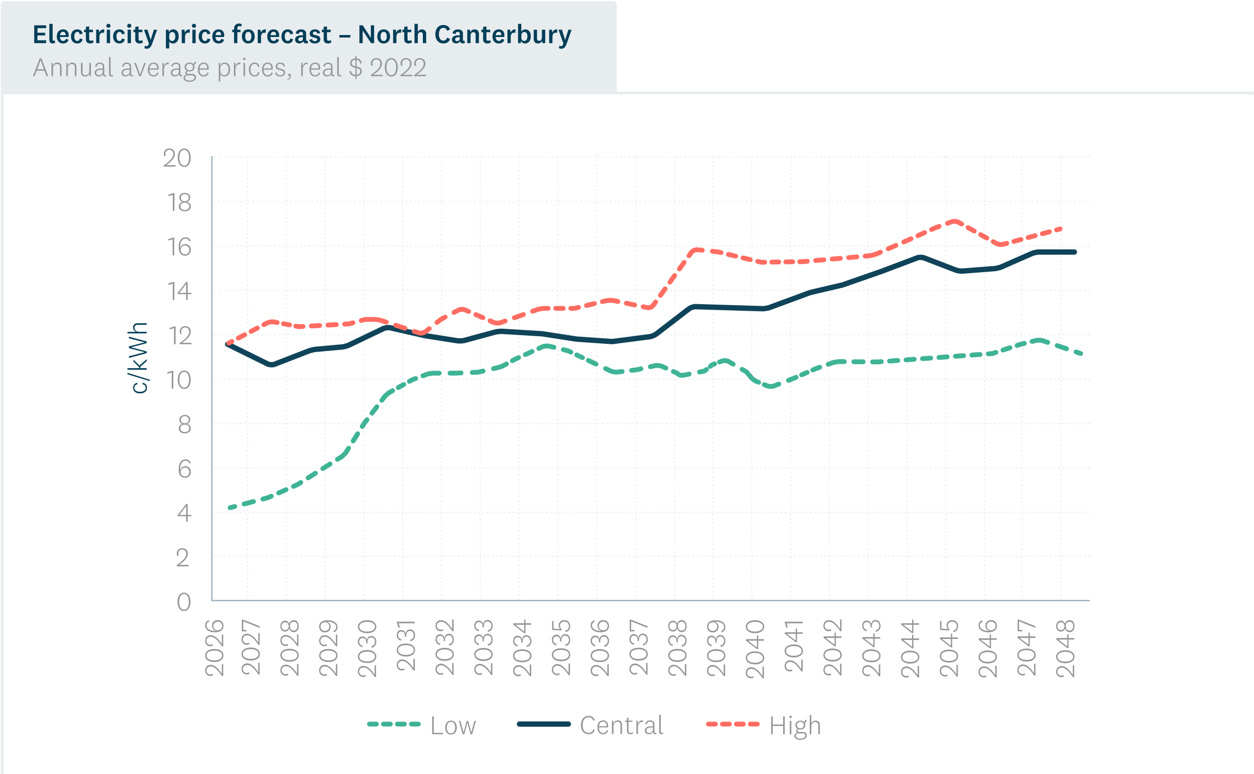
- A price for 'retail electricity' – the wholesale cost of electricity generation plus costs associated with electricity retailing.
- A price for access to the transmission and distribution networks.

As shown in Figure 12, the forecast price of **retail electricity** is expected to rise (in real terms) around 10% between 2027 and 2037 (to ~13c/kWh) under a 'central' scenario. However, different scenarios could see real retail prices higher or lower than that level by 2037.

Kaikōura, Canterbury, New Zealand. Credit - Christchurch City Council.

11 Other smaller components include metering and regulatory levies.

Figure 12 – Forecast of real annual average electricity price for large commercial and industrial demand in the North Canterbury region. Source: EnergyLink



Beyond 2037, this forecast sees more significant increases in electricity prices. However, it is difficult to predict pricing beyond the end of the RETA period. 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.

The EDBs serving the North Canterbury region are Orion and Mainpower. EDBs charge electricity consumers for the use of the *existing* distribution network. 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 of the network charges in the table above, and an up-front 'capital contribution'. Each EDB maintains policies that govern the degree of capital contribution, and process heat users should 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 North Canterbury's large industrial process heat consumers, by EDB.

EDB	Distribution charge	Transmission charge	Total line charge
Mainpower[12]	N/A	N/A	N/A
Orion	$78,000	$38,000	$116,000

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[13] 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.

The analysis suggests that work required to accommodate the new demand from the majority of RETA process heat sites is relatively minor in complexity. The estimated costs of the equipment required to connect these sites is <$0.6M per site, and these would take between 6-12 months. These sites place relatively low demands on the network.

However, for sites with higher peak demands, the connections increase in complexity. If these more complex connections do not require upgrades to Transpower's network, indicative costs are between $1M and $7M, with one project requiring $20M of upgrades. These upgrades are expected to take between 12 to 48 months.

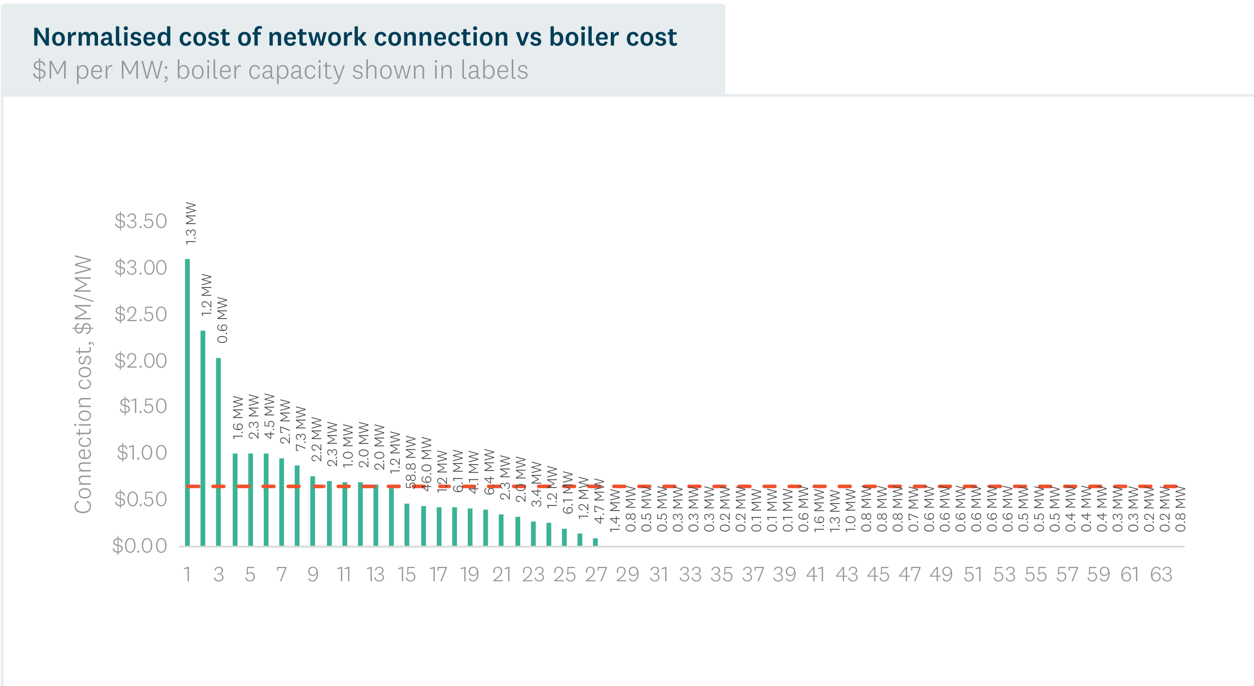
12 Mainpower's charges are not provided as their pricing for industrial consumers is only available on request.

13 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.

One large industrial facility required changes to the transmission network, and the associated cost was $27M.

The costs of connection can be a significant part of the overall capital cost associated with electrifying process heat demand. Figure 13 shows each site's connection costs expressed in per-MW terms, i.e. relative to the capacity of the proposed boiler.

Figure 13 – Normalised cost of network connection vs boiler cost, North Canterbury 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.

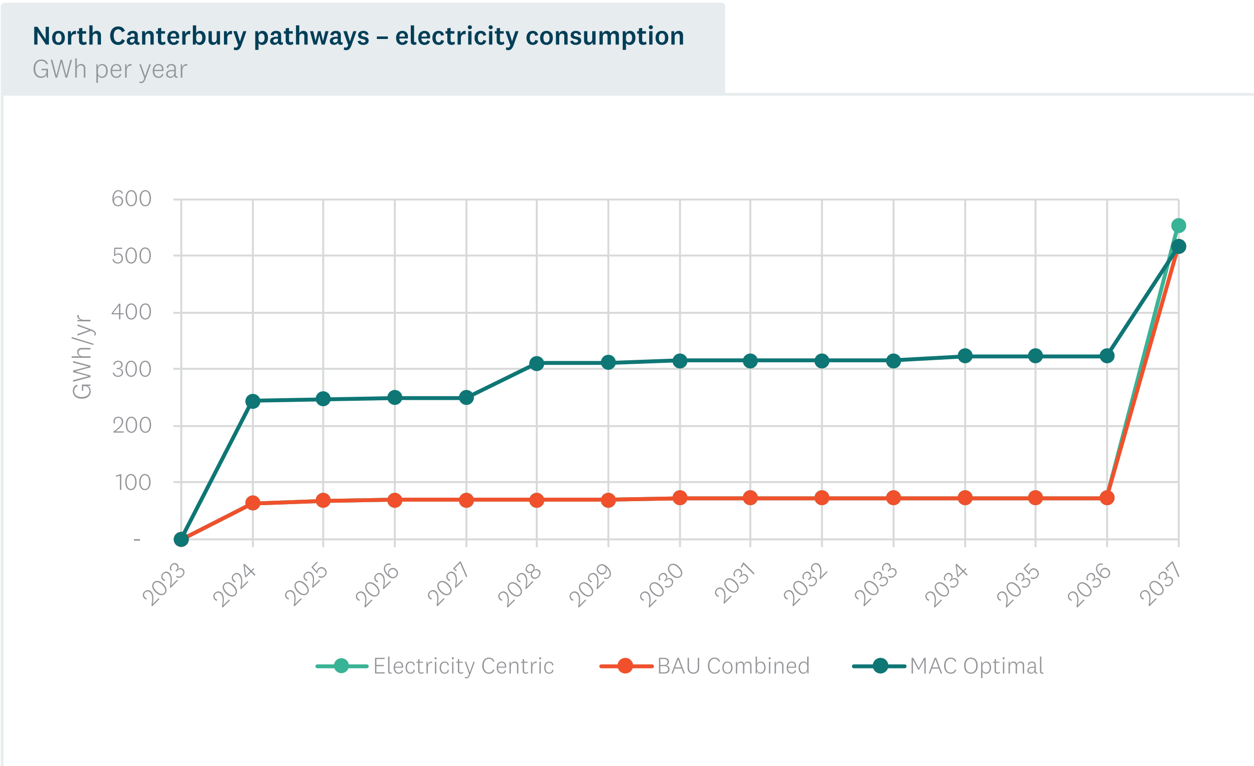
The timeframes for connection above assume these investments do not require Transpower or EDBs to obtain regulatory approval. We note that if connections also rely on wider upgrades to the network, the EDB would have to seek regulatory approval for these investments, which could also add to the timeline.

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 a number of RETA sites who require access to similar parts of the network.

7.1 Impact of pathways on electricity demand

Figure 14 shows the pace of growth in electricity consumption under the different pathways.

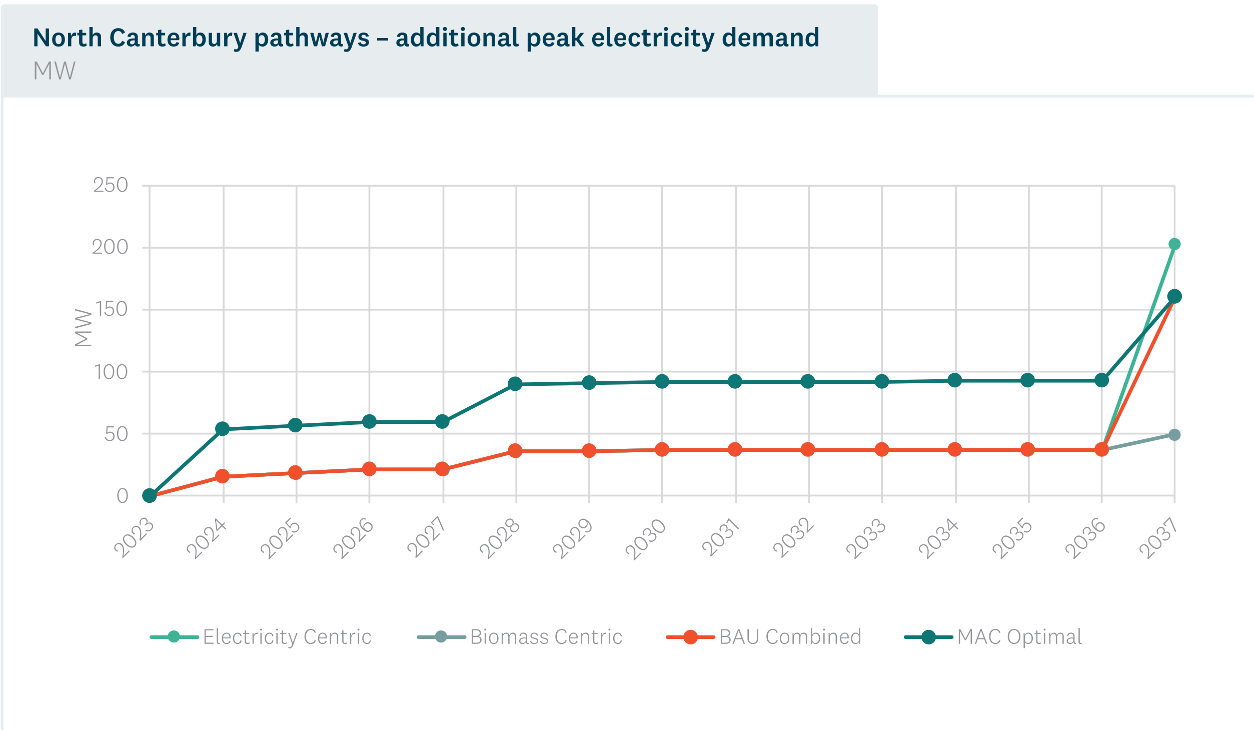
Figure 14 – Growth in North Canterbury electricity consumption from fuel switching pathways. Source: EECA



In all pathways, electricity consumption in North Canterbury would grow by around 13% between now and 2037. Around half of this growth would be observed in the next two years in a MAC Optimal pathway.

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 peak demand across the two networks.

Figure 15 – Potential North Canterbury peak electricity demand growth under different pathways.



The difference between the pathways through time is significant – between 40MW and 100MW[14] between now and 2036, with a further material increase in 2037[15].

Table 5 shows how process heat connections potentially affect each EDB's network investment between now and 2037. 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.

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)
Orion	181	$38.4	142	$22.4
Mainpower	21	$1.6	18	$0.8
Total	**202**	**$40**	**160**	**$23.2**

14 Between 5% and 15% of EDBS combined peak demand today (774MW).

15 Recall that the increase in 2037 is a result of our pathways 'forcing' any process heat users who haven't decarbonised by 2037, to do so in that year – see above for discussion on the National Policy Statement on process heat.

Table 5 shows that, understandably, Orion's large network will experience the largest increase in process heat-related electricity demand, irrespective of whether the electricity-centric or MAC Optimal pathway results. Between $23M to $40M 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.

Gondola, Canterbury, New Zealand. Credit - Christchurch City Council.

8 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:

- **More analysis, and potentially pilots, should be conducted to understand costs, volumes, energy content (given the potential susceptibility of these residues to high moisture levels) and 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 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:

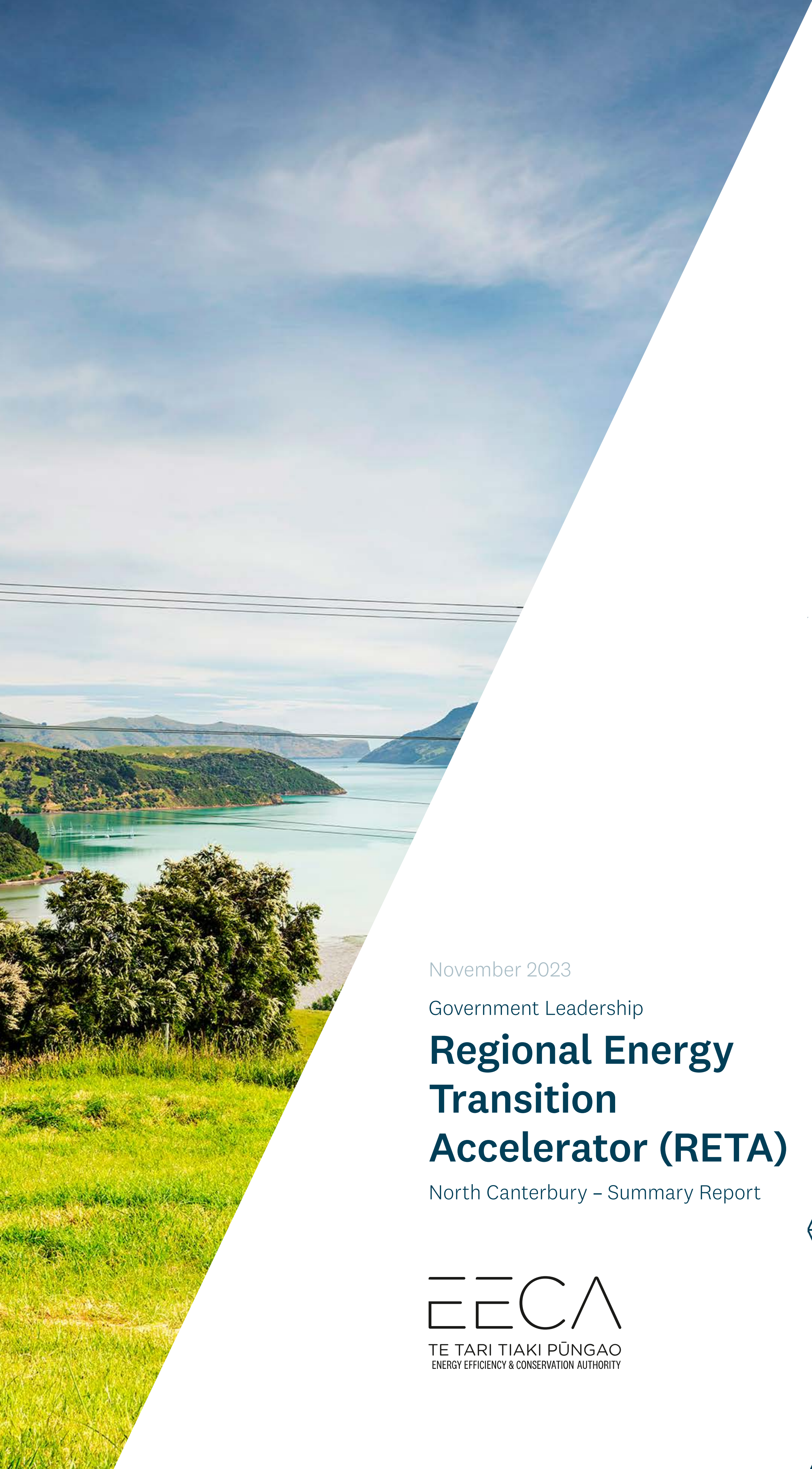
- **EDBs should proactively engage on process heat initiatives to understand their intentions and help process heat users obtain a greater understanding of required network upgrades, cost, security levels, possibilities for acceleration, use of system charges and network loss factors. EDBs should ensure 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.

- **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. Orion's CPD (Control Period Demand) charge is an example of a network charge that rewards process heat users for enabling and using flexibility in their demand. Understanding the overall picture of capital upgrades and network charges allows both EDBs and process heat user to find the overall best investment option.**
- **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.**
- **EECA believes there is merit in obtaining a greater level of transparency of where fossil fuelled plant is being used to offset CPD charges, to help highlight where greater use of peak demand charges may be leading to unintended consequences, counter to decarbonisation imperatives. Monitoring changes in the use of diesel generators could be achieved through a stricter consenting regime via the regional council, or as part of EDB disclosures.**

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.**
- **Where decarbonisation projects are economic, EECA encourages organisations to explore the potential for self-funded acceleration.**



November 2023

Government Leadership

Regional Energy Transition Accelerator (RETA)

North Canterbury – Summary Report

TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY