Government Leadership

Regional Energy Transition Accelerator (RETA)

Mid-South Canterbury - Summary Report

June 2023

TE TARI TIAKI PŪNGAO
ENERGY EFFICIENCY & CONSERVATION AUTHORITY

1 Foreword

Climate change is the most urgent environmental challenge of our time. Right now, energy accounts for about 40% of New Zealand's emissions. Around a third of New Zealand's overall energy use is creating heat for processing – and 60% of this is fossil-fuelled.

EECA's second Regional Energy Transition Accelerator (RETA) programme, for Mid-South Canterbury, aims to develop and share a well-informed and coordinated approach to help fast-track regional decarbonisation. Our analysis has shown that 75% of potential emissions reductions in the region are economic before 2025 – with various barriers like the availability of infrastructure preventing this occurring at the speed that it should.

RETA seeks to support organisations in Mid-South Canterbury to eliminate as much as possible of their process heat emissions through demand reduction, thermal efficiency, and fuel-switching. The work leverages the site-specific decarbonisation pathways developed for organisations across the region through EECA's Energy Transition Accelerator (ETA) programme.

Understanding unique region-specific needs, opportunities and barriers is critical. Decisions about investment in infrastructure that meets future demands requires coordination that takes into account the collective impact of decisions across multiple individual sites.

This phase one Mid-South Canterbury RETA report has provided a common set of information to all organisations considering process heat decarbonisation or who have the potential to support the transition through scaling supply of renewable energy. It clearly demonstrates that the collective effect of customers' fuel switching decisions will have significant effects on investment in these regional resource and infrastructure systems, including how this investment is prioritised and staged.

EECA believes that true progress requires working together across government, council, economic development agencies, business, and community. And the outlook is positive, with industry in the wider region highly engaged.

We are proud to have worked so collaboratively with Venture Timaru and several key groups including our RETA workstream leads, Transpower, Electricity Ashburton, Alpine Energy and Network Waitaki, Ngāi Tahu, regional forestry companies and wood processors, electricity generators and retailers, and medium to large industrial energy users, to develop this Mid-South Canterbury RETA report.

We must commit to doing more, faster, to meet what is the biggest challenge of our time. For the public good first and foremost but also, to help businesses and regions across New Zealand get ahead of the curve and thrive in a low emissions economy.

There is significant carbon reduction potential in Mid-South Canterbury – given the reliance on coal, a budding biomass industry and proactive and engaged process heat users – many of whom have already mapped out a pathway with EECA. We look forward to walking alongside the region as it continues its journey.

Nicki Sutherland
Group Manager Business, EECA

Photo: Port of Timaru - Canterbury, New Zealand. Credit - Venture Timaru.

> ***There is significant carbon reduction potential in Mid-South Canterbury***
>
> Nicki Sutherland , Group Manager Business, EECA

2 Acknowledgments

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 Mid-South Canterbury
- Venture Timaru
- Local lines companies Electricity Ashburton, Alpine Energy and Network Waitaki
- Iwi
- 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 our partners:

- **DETA** – process heat demand-side assessment
- **PF Olsen** – biomass cost analysis
- **Ahikā and Margules Groome** – biomass availability analysis
- **Ergo Consultants** – electricity network analysis
- **EnergyLink** – electricity price forecast
- **Tonkin and Taylor** – organic waste analysis
- **Wayne Manor Advisory** – report collation, publication and modelling assistance

The Mid-South Canterbury region is the focus for New Zealand's second Regional Energy Transition Accelerator (RETA).

3 Table of Contents

4 Regional Overview

The Mid-South Canterbury region is the focus for New Zealand's second Regional Energy Transition Accelerator (RETA).

The Mid-South Canterbury RETA brings together information about process heat decarbonisation plans from EECA's 'Energy Transitional Accelerators' (ETAs) with individual organisations as well as 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 (for example, 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 33 sites covered by the Mid-South Canterbury RETA either have process heat equipment larger than 500kW (that is, process heat equipment details have been captured in the RHDD) or are sites for which EECA has detailed information about their decarbonisation pathway[1]. Together, these sites collectively consume 5,731TJ of process heat energy, primarily in the form of coal, and currently produce 542kt pa of greenhouse gas emissions.

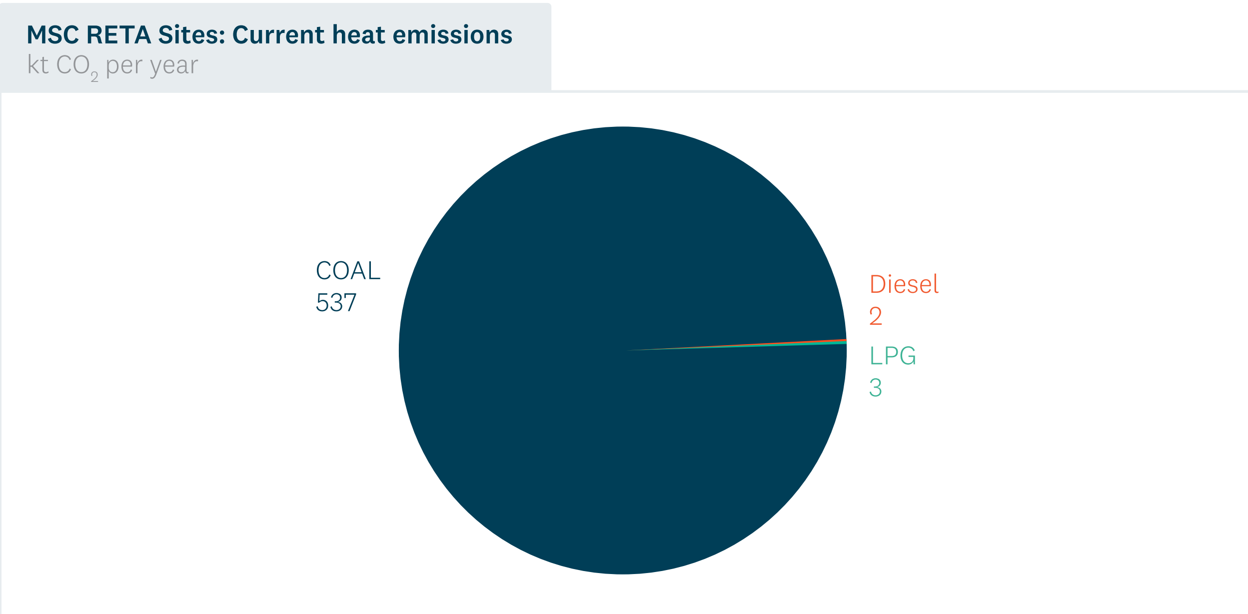
[1] That is, process heat equipment details have been captured in an ETA opportunities assessment report

Table 1 – Summary of Mid-South Canterbury RETA sites fossil fuel process heat demands

Sector	Sites	Thermal Capacity (MW)[2]	Process Heat Demand Today (TJ pa)	Process Heat Annual Emissions (ktCO₂e pa)
Dairy	4	207	3,450	352
Meat	7	72	970	82
Other Industrial	12	75	1,225	101
Commercial[3]	10	13	86	7
Total	**33**	**367**	**5,731**	**542**

The majority of Mid-South Canterbury RETA process heat emissions come from coal (Figure 1).

Figure 1 - 2020 Annual emissions by process heat fuel in Mid-South Canterbury RETA. Source: EECA



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

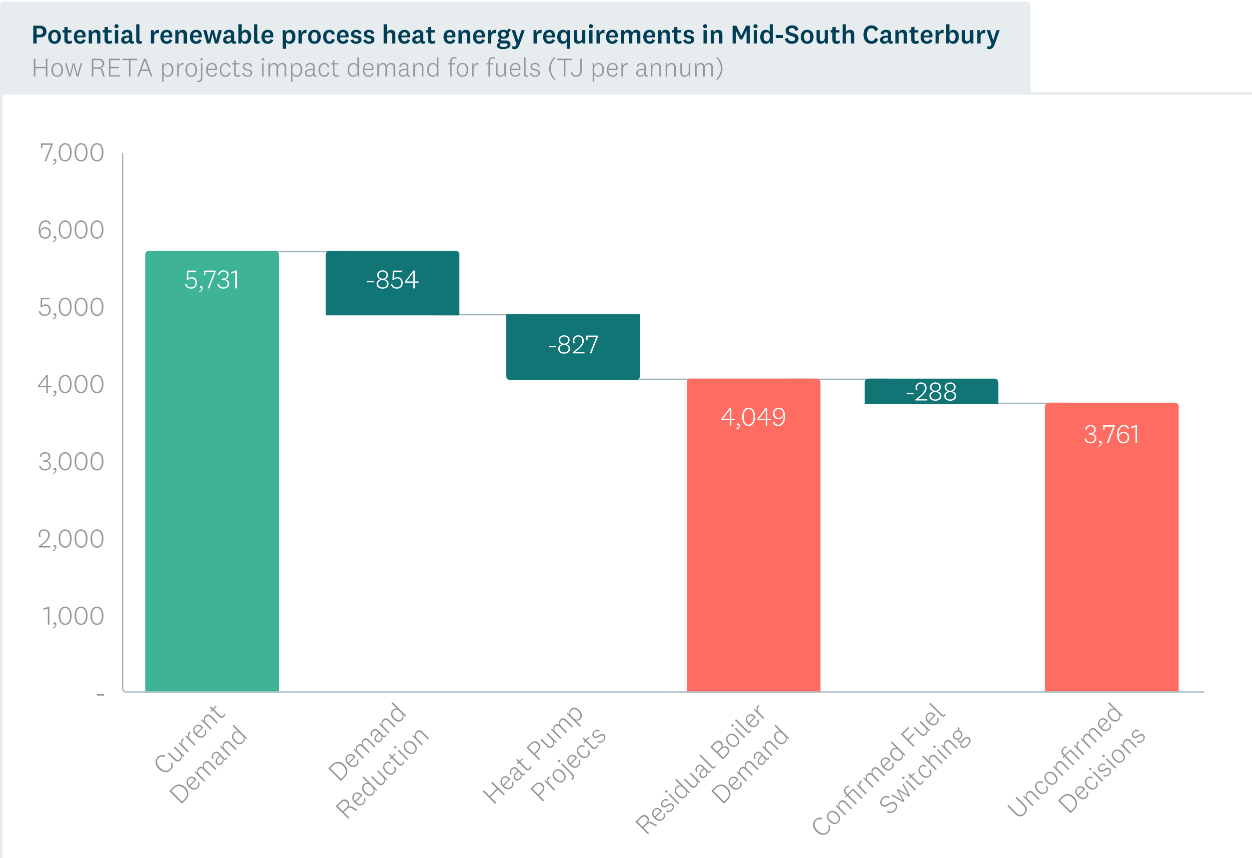
- Demand reduction (for example, reducing heat demand through process optimisation).
- Thermal efficiency (for example, installation of highly efficient heat pumps).
- Switching away from fossil-based fuels, to a low-emissions source such as biomass and/or electricity.

[2] Includes any existing electrical thermal capacity

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

Figure 2 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 2 - Potential impact of fuel switching on fossil fuel usage, 2022-2037. Source: EECA



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. 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. 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 33 sites considered in this study. Across these sites, there are numerous individual projects, including:

- 40 potential demand reduction projects
- 26 potential heat pump projects
- 73 potential fuel switching projects[4]

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

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

[4] For the majority of the 33 sites, there is only one fuel switching decision to be made, usually between two fuels (biomass and electricity). These would be counted as two projects in the calculation above. However, there are a number of more complex sites with multiple fuel switching decisions, and some sites where only one fuel is being considered.

Table 4 – summary of RETA sites included in this study

Site Name	Industry	Project Status	Bioenergy Required in TJ ('000t)	Electricity Peak Demand (MW)
McCain Foods (NZ) Ltd, Timaru	**Manufacturing**	**Confirmed**	**175 (24.3)**	**N/A**
Makikihi Fries	**Manufacturing**	**Confirmed**	**13 (1.8)**	**N/A**
Ashburton College	**Education**	**Confirmed**	**2 (0.3)**	**N/A**
Waitaki Boys	**Education**	**Confirmed**	**2 (0.2)**	**N/A**
Oamaru Intermediate	**Education**	**Confirmed**	**1 (0.1)**	**N/A**
Timaru Girls High School	**Education**	**Confirmed**	**1 (0.1)**	**N/A**
Woolworks NZ, Washdyke	**Manufacturing**	**Confirmed**	**N/A**	**9**
Canterbury Spinners Ltd, Oamaru	**Manufacturing**	**Confirmed**	**N/A**	**3**
Fonterra, Clandeboye - Boiler 1	Dairy	Unconfirmed	674 (93.8)	**40**
Fonterra, Clandeboye - Boiler 2	Dairy	Unconfirmed	556 (77.4)	**33**
Oceania Dairy Ltd, Oamaru[5]	Dairy	Unconfirmed	**342 (47.5)**	**26**
Fonterra, Clandeboye - Boiler 3	Dairy	Unconfirmed	337 (46.9)	**20**
Fonterra, Clandeboye - Boiler 4	Dairy	Unconfirmed	337 (46.9)	**20**
Talleys, Ashburton	Manufacturing	Unconfirmed	**221 (30.7)**	14
Fonterra, Studholme	Dairy	Unconfirmed	194 (27.1)	**16**
South Canterbury By Products, Washdyke	Manufacturing	Unconfirmed	**141 (19.6)**	7
ANZCO Canterbury	Meat	Unconfirmed	**133 (18.5)**	10
Silver Fern Farms, Pareora	Meat	Unconfirmed	**74 (10.3)**	8
Alliance Group Ltd, Pukeuri[7]	Meat	Unconfirmed	**71 (N/A[8])**	**8.8**
Adrian James Harmer	Manufacturing	Unconfirmed	53 (7.4)	**1.7**
Canterbury Dried Foods	Manufacturing	Unconfirmed	46 (6.4)	**2.2**
Alliance, Smithfield	Meat	Unconfirmed	**34 (4.7)**	5.9
South Island Brewery Limited, Washdyke	Manufacturing	Unconfirmed	**18 (2.5)**	
Barkers Fruit Processing, Geraldine	Manufacturing	Unconfirmed	**13 (1.9)**	1.3

[5] Oceania Dairy was modelled as three projects – two chose biomass and one electrified.

[7] Alliance Pukeuri had both biomass and electric fuel switching projects in our pathways.

[8] Biogas is the optimal fuel for this project, and the underlying fuel for biogas was not woody biomass

Site Name	Industry	Project Status	Bioenergy Required in TJ ('000t)	Electricity Peak Demand (MW)
Oamaru Meats Ltd, Oamaru	Meat	Unconfirmed	**11 (1.5)**	1.1
Synlait, Talbot Forest Cheese	Manufacturing	Unconfirmed	**10 (1.4)**	1.3
Heartland Chips, Timaru	Manufacturing	Unconfirmed	**10 (1.4)**	
NZ Juice Products, Washdyke	Manufacturing	Unconfirmed	**9 (1.3)**	
Ravensdown Lime, Geraldine Quarry	Manufacturing	Unconfirmed	**6 (0.9)**	1.3
Ashburton Meat Processors	Meat	Unconfirmed	**4 (0.5)**	1
Mount Hutt College	Education	Unconfirmed	**1 (0.1)**	
Craighead Diocesan School	Education	Unconfirmed	**1 (0.1)**	
Geraldine High School	Education	Unconfirmed	**1 (0.1)**	
Roncalli College	Education	Unconfirmed	**1 (0.1)**	

Eight sites have already confirmed their fuel of choice, representing a demand for 192TJ (27,000t) of biomass and 96TJ (28GWh) of electricity.

The potential decisions associated with the remaining 23 sites[8] are the primary focus of this report. We highlight in green the preferred fuel based on the MAC Optimal calculations as outlined in Section 8.

5 Biomass

The use of woody biomass for bioenergy requires careful consideration of emissions and sustainability.

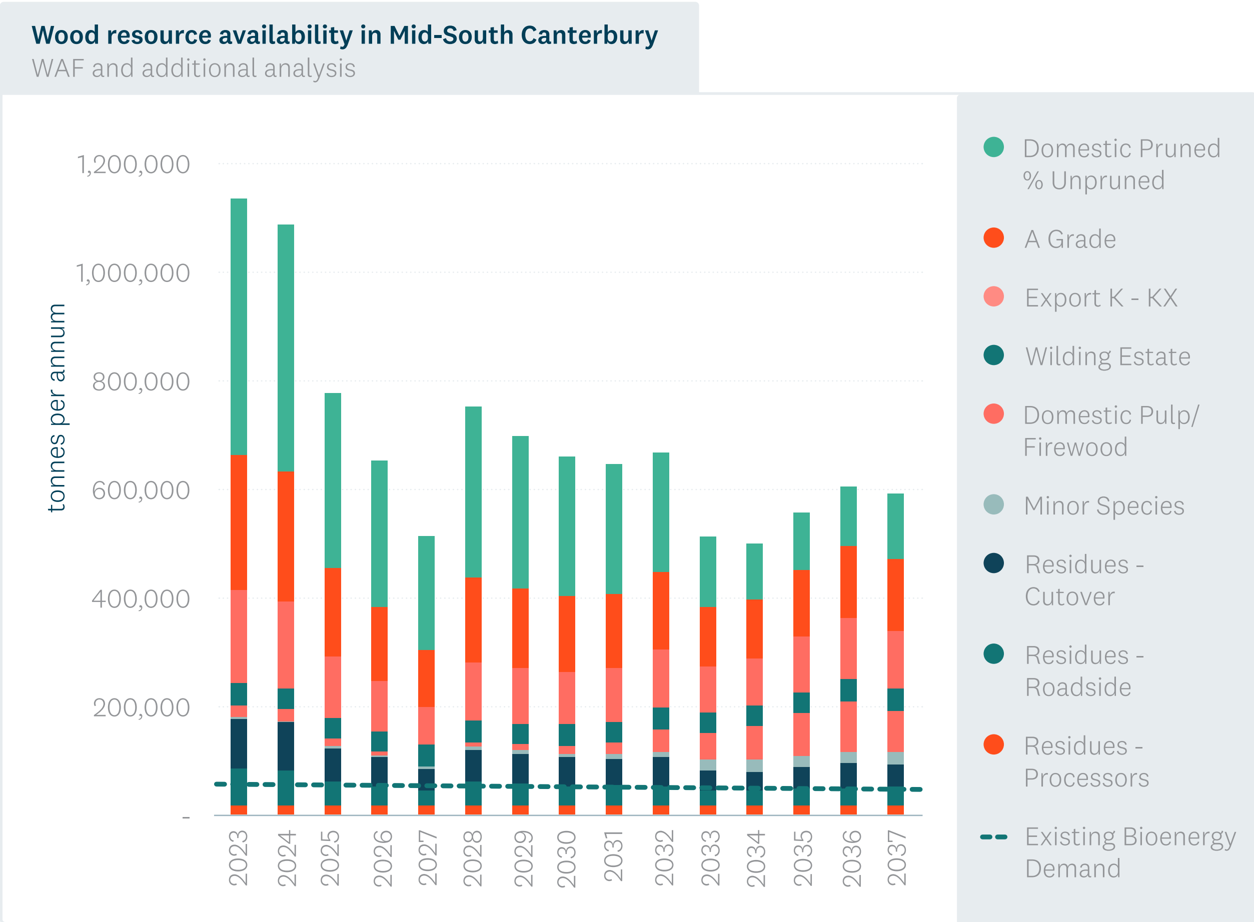
For example, depending on the source, the diversion of wood to bioenergy may change the timing of the release of emissions by a significant period (compared to the natural decomposition of biomass). Suppliers and consumers of biomass for bioenergy need to be confident they understand any wider implications 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 Mid-South Canterbury 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.

A top-down analysis suggests that an average of around **615,000t pa (4,425TJ) of wood will be harvested in Mid-South Canterbury over the next 15 years**[9], although volumes are significantly higher than this over the period 2023-2025 (Figure 1). The majority of this will be radiata pine. Slightly less than half will be harvested into Export A, K, KI and KIS grades.

[9] All RETA decarbonisation projects are assumed to be executed by 2037 in line with the Government's aspiration to phase out coal boilers by 2037. See https://www.beehive.govt.nz/release/government-delivers-next-phase-climate-action

Figure 3 - Wood resource availability in Mid-South Canterbury, 2023-2037



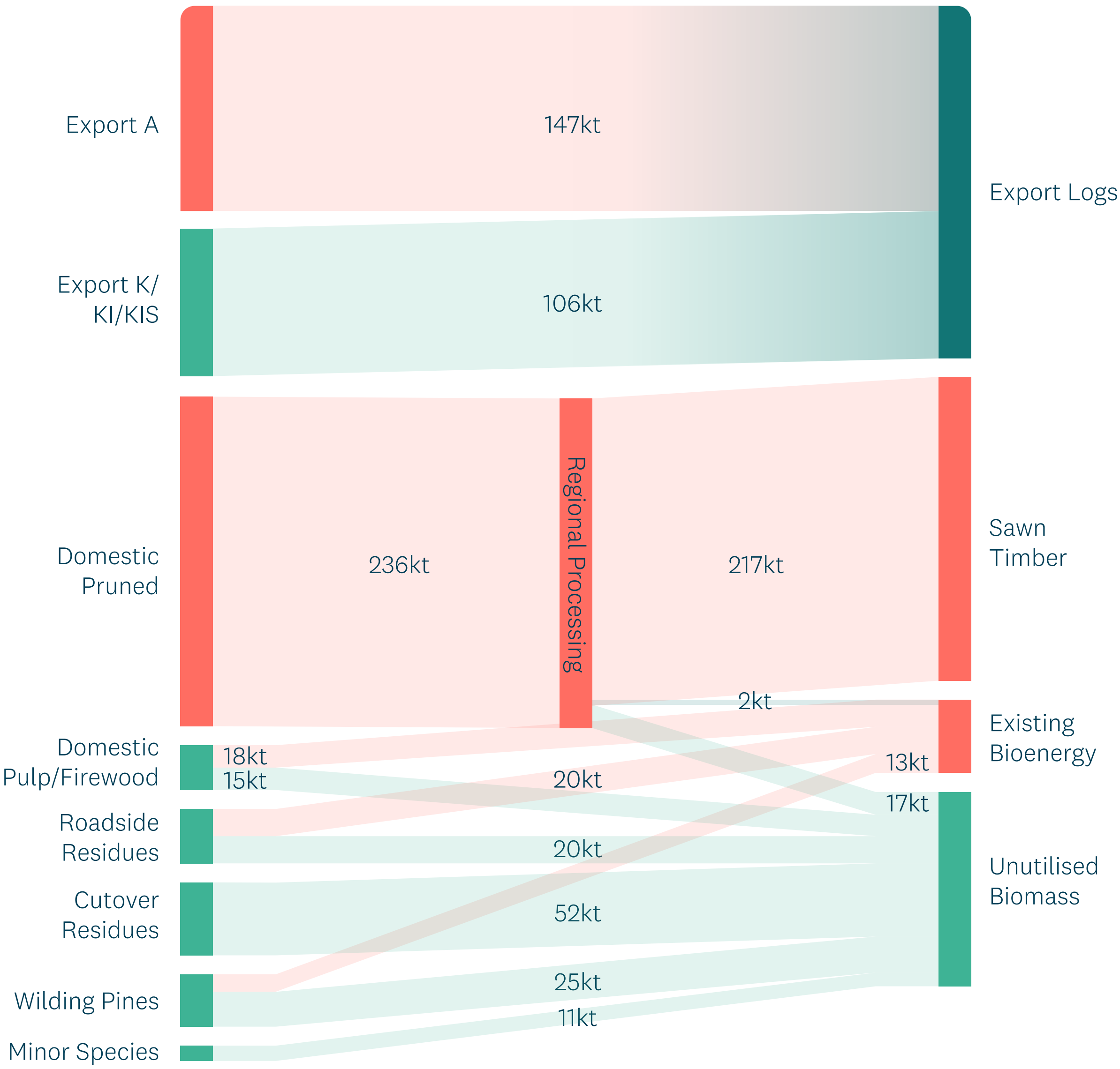
A more comprehensive view of resource availability, that combines the top-down and bottom-up analyses reveals:

- On average, **92,000t pa (664TJ) of harvest residues could be available for bioenergy**. Around 20,000t pa (144TJ) is currently being recovered and is destined for bioenergy markets (e.g. firewood), while the rest – dominated by cutover residues, which will be more expensive to extract – is not currently utilised.
- Interviews with sawmills suggested that around **19,000t pa (141TJ) of processing residues** are produced (mostly post peelings) of which 2,000t (15TJ) is currently being used for bioenergy (wood pellets or boiler fuel). The unutilised portion is primarily post-peelings (14,500t), which currently has no destination market and is stockpiled.

- EECA estimates that up to **38,000t pa (276 TJ) of additional wilding pines in the Mackenzie Country could be recovered for bioenergy** over the next 15 years, of which 12,800 (92TJ) are currently being recovered for bioenergy. After this resource has been fully extracted, wood growth elsewhere in the Mid-South Canterbury estate, which the WAF reports will increase after 2037, can replace this volume.
- On average over 15 years, **11,000t (80TJ) of minor species, and 33,000t (240TJ) of domestic pulp/ firewood is available (of which 18,000t, or 129PJ is currently used for firewood)**, although the volumes are minimal in the short term, and increase towards the end of the period. Domestic firewood demand may increase over the period and absorb some of this increase.

The outcome of this analysis is summarised in Figure 4. Wood flows that could – in part or in full – be diverted to new bioenergy demand from process heat are shown in green[10].

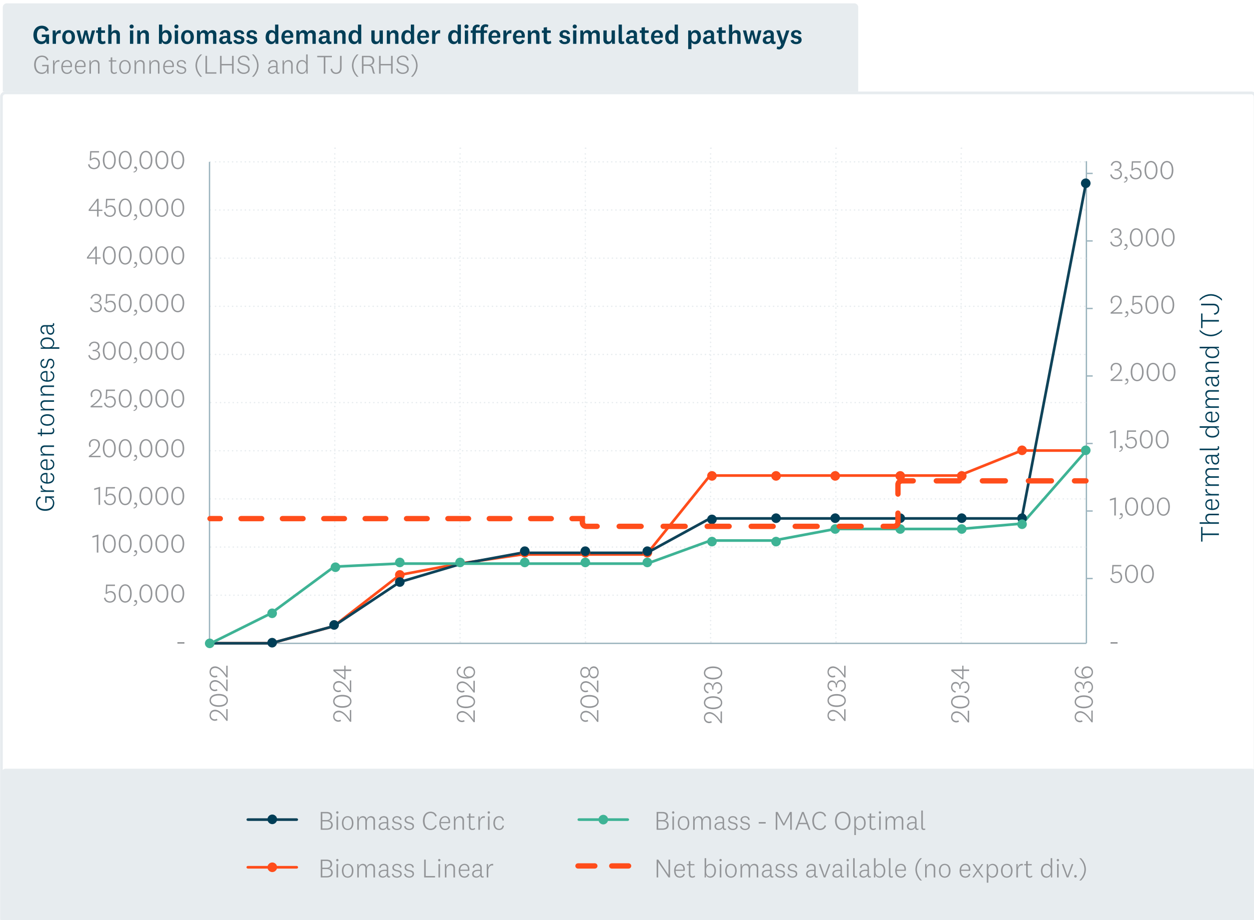
Figure 4 – Average wood flows over 15 years in Mid-South Canterbury region. Source: Ahikā, Margules Groome



[10] Note that a large proportion of the 236kt domestic pruned wood is processed outside of the region, which is why the local availability of processing residues is a very small portion. There is unlikely to be 217kt of Mid-South Canterbury wood going to sawn timber markets; rather it would go to another region for processing and a smaller amount would finally reach the timber market. However, since we do not have data for the quantity of wood going to other regions, or the residues generated, we have not been able to depict this in the chart.

Overall, EECA estimates that, on average over the next 15 years, **approximately 142,000t pa (1,021TJ) of Mid-South Canterbury woody biomass could be recovered for new boiler demands without disrupting low or high grade export markets or existing bioenergy consumers.** Our pathway analysis suggests this will be sufficient to cover 80% of new process heat demands under the MAC Optimal and Linear Pathways, and 40% of the BAU - Biomass Centric Pathway[11].

Figure 5 – Growth in biomass demand from pathways. Source: EECA



Therefore, to meet our simulated pathways, additional woody biomass will be required. There is also some uncertainty about the extent to which wilding pines and cutover residues may be able to be recovered economically. To meet this demand, **an additional 106,000t pa (763TJ) of Export K, KI and KIS could be diverted in the near term to supplement the realised residues, wilding pines, and minor species.** This includes an assumption that these lower grade export logs could be diverted with little change to the timing of the release of greenhouse gas emissions from this wood. Diversion of some export volumes would allow all demand from the MAC Optimal pathway to be met but would still be insufficient for our Biomass Centric pathway. The Biomass Centric pathway would require diversion of high-grade logs, or the import of biomass from other regions (which could also substitute for low-grade export diversion).

[11] Note that by the end of the 15 year period, it is assumed that surplus domestic firewood will be available relative to current demand. This is what drives the increase in net available residues over the period 2033-2037. We expect that some of this surplus will be taken up by growth in domestic firewood demand.

The forestry and food processing sector have partnered with Government to develop a Forestry and Wood Processing Industry Transformation Plan[12] which is focused on increasing the total area of forestry and getting greater value from wood. This includes significantly increasing the areas of trees on farms and domestic processing. Additional domestic processing within New Zealand may result in greater quantities of processing residues being available as an energy fuel.

Allowing for estimated costs of procurement, chipping, storage and delivery, the potential cost per GJ of the various resources identified may range between:

- $9/GJ - $13/GJ for all harvesting residues and processing residues
- $15/GJ for wilding pines
- $21/GJ for Export K-KIS grade logs
- $23/GJ for Export A-grade unpruned logs
- $29/GJ for domestic pruned logs

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. For example, it is probably preferable to import biomass from neighboring regions than to divert pruned logs. 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.

[12] https://www.mpi.govt.nz/forestry/forest-industry-and-workforce/forestry-and-wood-processing-industry-transformation-plan/

Port Blakely - Waimate, Canterbury, New Zealand

6 Electricity

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 GXPs).

The price paid for electricity by a process heat user is made up of two main components[13]

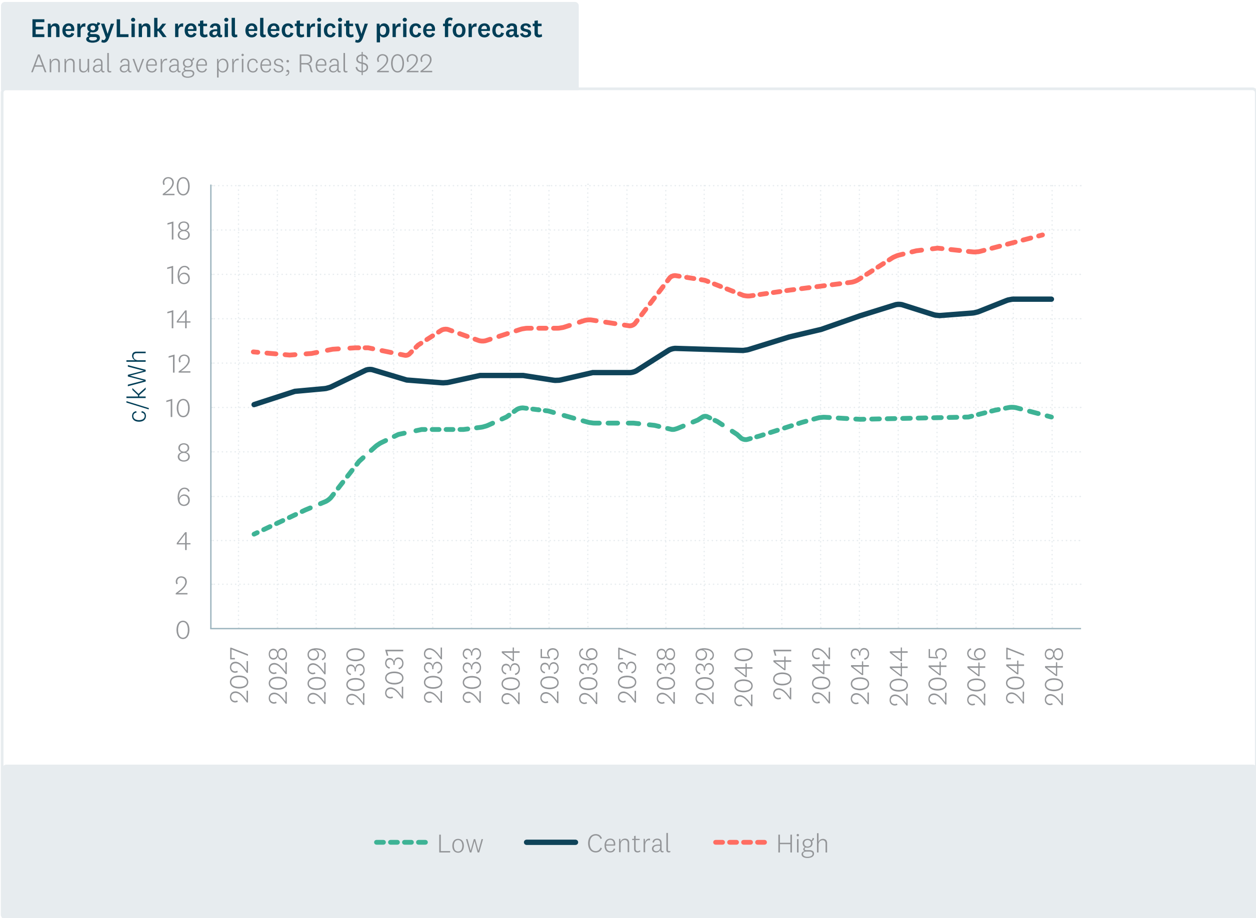
- A price for 'retail electricity' – the wholesale cost of electricity generation plus costs associated with electricity retailing.
- A price for access to the transmission and distribution networks.

As shown in the figure below[14], the forecast price of **retail electricity** is expected to rise (in real terms) around 10% between 2027 and 2037 (to ~11c/kWh) under a 'central scenario'. However, different scenarios could see real retail prices higher or lower than that level by 2037.

[13] Other smaller components include metering and regulatory levies

[14] Figure 29 from the main report

Figure 6 - Forecast of real annual average electricity price for large commercial and industrial demand in Mid-South Canterbury. 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 Mid-South Canterbury region are EA Networks, Alpine Energy and Network Waitaki. EDBs charge electricity consumers for the use of the existing distribution network. An approximation of the potential charges faced by process heat users who electrify is presented below. These are based on each of the EDB's announced prices for the year 2023/24.

Table 2 – Estimated and normalised network charges for large industrial process heat consumers by EDB

EDB	Fixed (pa)	Per MW/MVA (pa)
Alpine Energy	$1,047	$171,700
Network Waitaki	$960	$80,000
EA Networks	$1,708	$91,500
Average[15]	**$1,238**	**$114,710**

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 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**, although it will be eight years before the full allocation of transmission charges will be made[16]. 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. A new Transmission Pricing Methodology (TPM), developed by the Electricity Authority, will apply to transmission charges in the 2023/24 year. It is difficult to provide a simple summary of how each EDB will pass through these charges, however, we estimate these charges will be between $50,000/MW and $80,000/MW per year (in addition to the distribution network charges above). The level of charge faced depends on each network's pricing methodology, the nature of its customers and network, and its allocation of transmission charges it receives under the TPM.

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 and process heat. While this RETA analysis only examines demand from process heat electrification, and public electric vehicle (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 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

[15] Note that the average is just a simple average and does not take account of the volumes of peak electricity demand that each network faces at these charges.

[16] This refers to the delay in calculation of Residual Charges until 4 years of operation, and then a further four-year transition to full residual charges.

- 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 (for example 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 (for example, 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 the capital cost associated with accommodating the new potential peak electricity demand from the majority of RETA process heat sites is relatively minor in complexity. The estimated costs of the equipment required to connect them is <$3M per site, and these would take between 6-18 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 $3M and $5M. These upgrades are expected to take between 12 and 18 months.

There is only one process heat user that would require upgrades to both distribution and transmission networks. The estimated cost ranges between $21M to $52M, depending on how much of the site is electrified. These upgrades are expected to require three to four years.

The timeframes above assume these investments are paid for by each process heat customer (that is, are customer-initiated investments), and do not require Transpower or EDBs to obtain regulatory approval. We note that if connections also rely on wider upgrades to the network or grid (which is the case for some connections), Transpower or 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.

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.

7 Organic Waste

The recovery of organic materials presents opportunities to eliminate waste and pollution, as well as better circulate products and materials.

A number of opportunities exist to divert organic waste from landfill, including:

- Use as stock feed
- Composting
- Food re-distribution
- Energy recovery – for example through combustion or anaerobic digestion

In many cases, increasing the utilisation of organic waste for energy recovery – via combustion or anaerobic digestion – means diverting it from its current destination.

A number of wider national influences could change the way the organic waste is handled and the appeal of existing end markets. This includes existing reform to the Resource Management Act, National Environmental Standards, and the use of the waste disposal levy.

Based on a set of assumptions, as well as local Mid-South Canterbury data, it is estimated that around 180TJs of thermal energy could be produced using existing organic waste, either via combustion or anaerobic digestion. This is 3% of the Mid-South Canterbury process heat energy requirement.

Table 3 - Summary table of estimated energy potentials from organic waste streams

Sector	Estimated quantity of organic waste (tonnes/year) unless stated	Energy potential via combustion (GJ/Year)	Energy potential via AD (GJ/Year)	Existing indicative costs ($ per year)	Current use
Dairy	19,150	>100,000 GJ	35,300 GJ	$200,000-$400,000	Stock feed
Meat processing	4,300	45,500 GJ	17,400 GJ	Nominal	Composting
Seafood processing	26,000	Not applicable	9,900 GJ	$18,000	Trade waste
Other food & beverage processing	55,600	32,000 GJ	120,000 GJ	Nominal	Stock feed
Wool processing	1,000	6,500 GJ	4,500 GJ	Nominal	Fertiliser
Estimated total	**80,050**	**>184,000GJ**	**187,100GJ**	**Approx. $400,000**	**-**

Due to the relatively small site volumes, realising this potential will depend on the locations of the sources and the ability for aggregators to combine organic waste streams in a single, or small number of locations. Generally, for waste not already being utilised onsite, we expect economies of scale would favour a centralised location, but transport logistics and costs need to be considered.

8 Decarbonisation Pathways

EECA has developed various decarbonisation pathways (or scenarios) by simulating the decisions of the Mid-South Canterbury RETA sites based on a range of information and assumptions about the factors that drive each of these decisions (including decisions already committed to). Different decision-making frameworks give rise to the following three 'pathways':

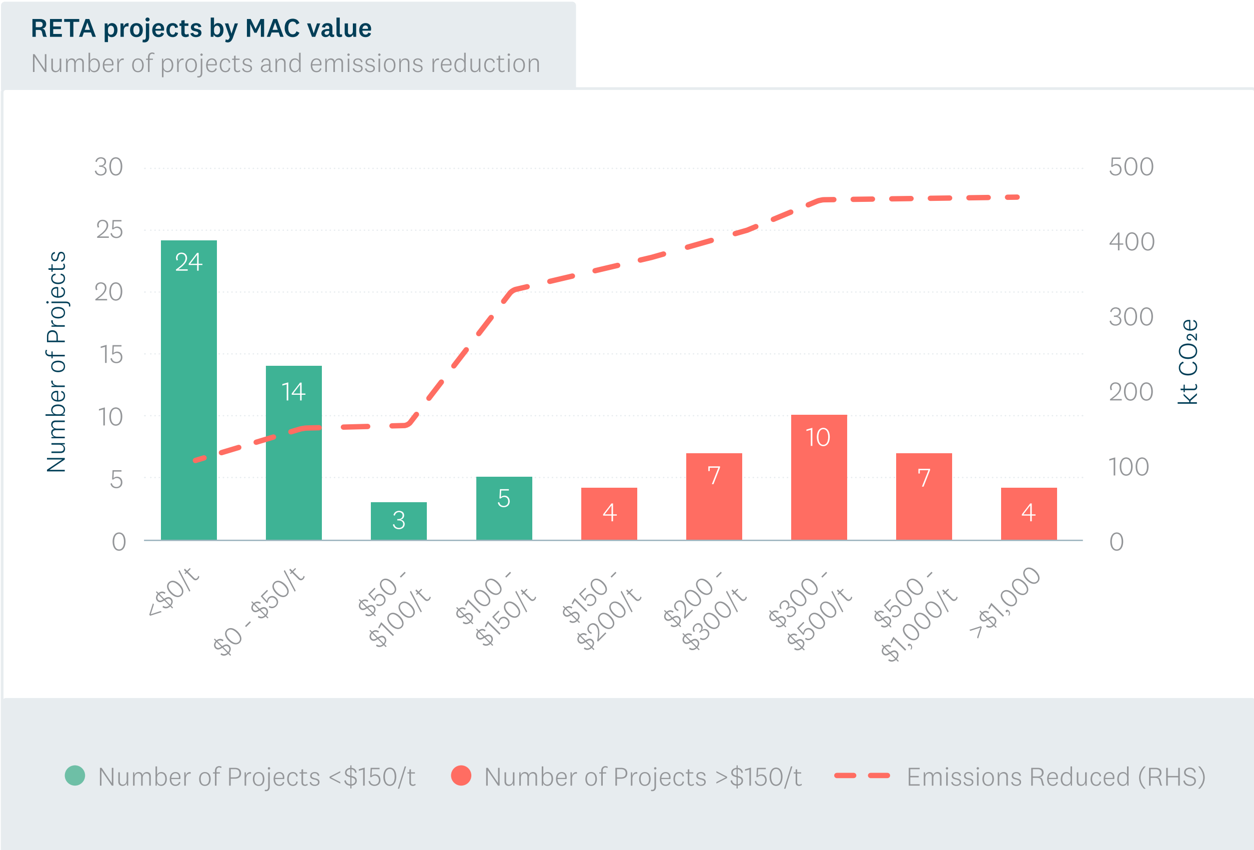
- Biomass Centric and BAU - Electricity Centric – where each fuel (biomass or electricity) is the fuel chosen for every (unconfirmed) fuel switching decision, and is timed as per each site's ETA, where available, or 2036[17] if not
- MAC Optimal – where the decision with the lowest marginal abatement cost (MAC) is made by each unconfirmed site at a time triggered by 10-year moving average of the Climate Change Commission's carbon price pathway; and
- A 'linear' approach, which chooses the optimal fuel using the MAC approach, but the growth in overall demand for each fuel is smoothed through time to avoid lumpy, sudden increases in demand.

8.1. By 2025, 75% of emissions reductions are economic

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 model many of these. In this report we use a simple economic criteria: at an assumed future trajectory of carbon prices (which will affect the cost of fossil fuels), at what point does a decarbonisation decision save the organisation money over the lifetime of the investment? We represent this first point in time that the MAC of the project is exceeded by the expected future carbon price.

[17] The target of 2037 relates to the Government's preferred option to phase out the use of coal at existing sites for low and medium temperature process heat requirements through national environmental standards. See https://consult.environment.govt.nz/climate/phasing-out-fossil-fuels-in-process-heat/supporting_documents/phasingoutfossilfuelsinprocessheat.pdf

Figure 7 - Number of projects by range of MAC value. Source: EECA

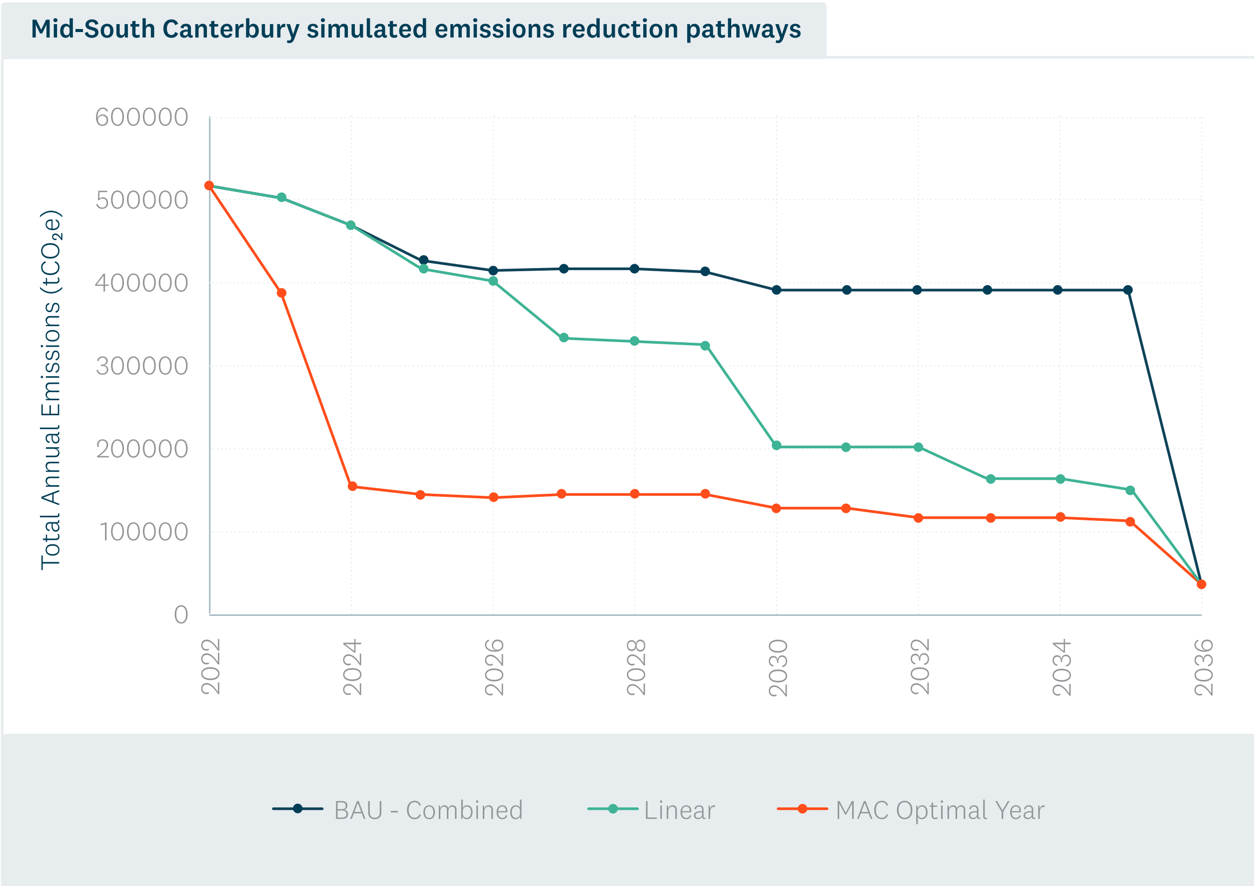


Out of 540kT of process heat emissions covered in the Mid-South Canterbury RETA, 333kT – 75% - have MACs less than $116/t CO_2e. Based on an expectation the carbon prices will follow the Climate Change Commission's Demonstration Pathway, these emissions reduction projects - would be economic[18] prior to 2025.

Further, as shown in the figure below, by 2036, all pathways eliminate over 90% of process heat emissions in the region (a reduction of 504kt out of a total 542kt) but at significantly different paces. The remaining emissions are largely Scope 2 emissions from electricity consumption.

[18] 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).

Figure 8 - Emissions reduction trajectories for different simulated pathways. Source: EECA



The 'BAU' pathway, which uses the project timings in the individual ETAs (or 2036 where unavailable), is the slowest decarbonisation path. Over 70% of the emissions reductions are assumed to occur in 2036.

The MAC Optimal pathway proceeds much faster, with the majority of emissions reductions achieved by 2025. This is a result of the scenario including a number of unconfirmed large boiler projects switching to electricity early in the period. 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; and/or
- the ability of forest owners and bioenergy aggregators to make sufficient resource available.

The linear pathway, by design, achieves the same degree of decarbonisation in 2036, but at a smoother pace.

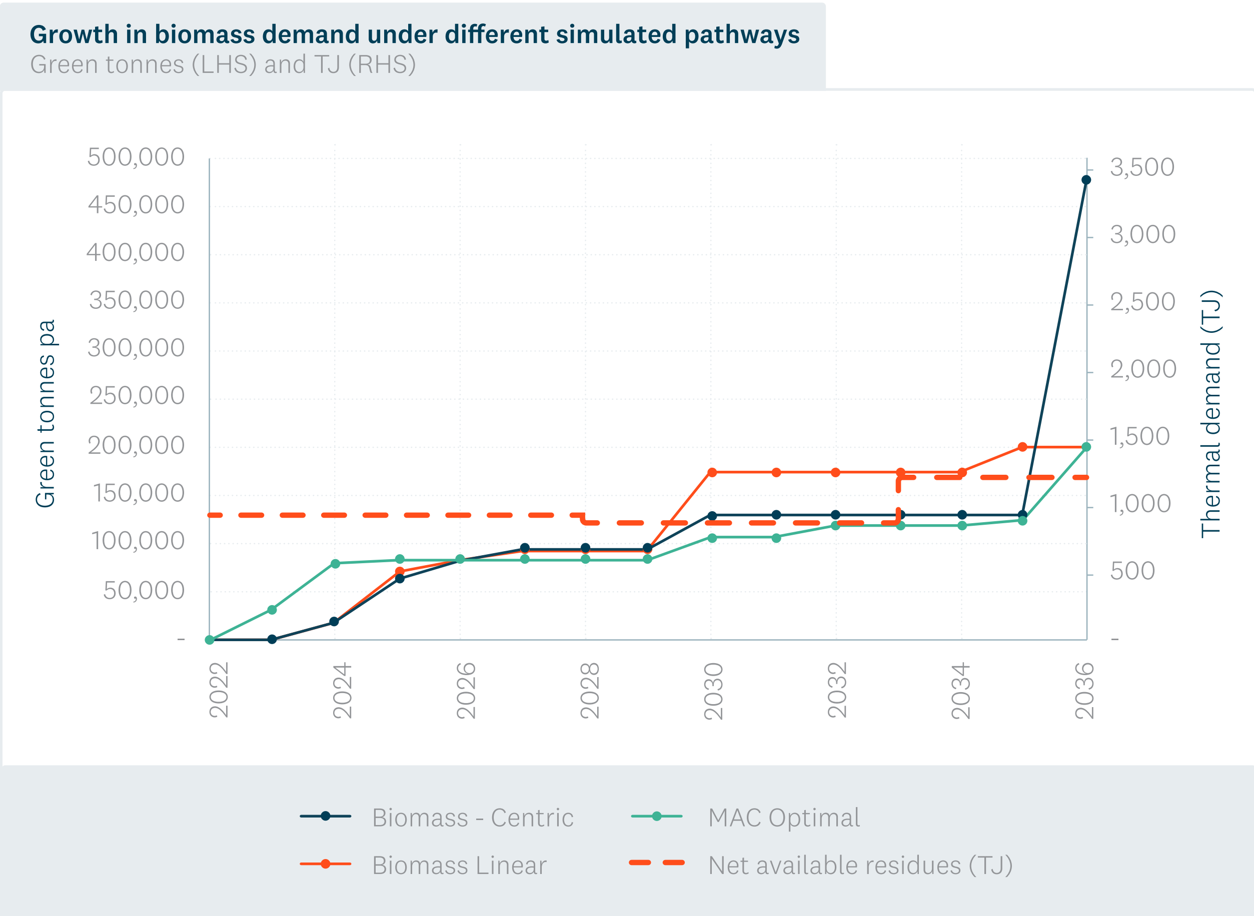
8.2. Fuel use under different pathways

The MAC Optimal pathway sees fuel decisions that result in 40% of the energy needs supplied by biomass in 2036 (with a consumption of 402GWh of delivered energy), and 60% of energy needs supplied by electricity in 2036 (with 575GWh of delivered energy).

Before outlining the fuel switching decision, it is important to recognise the significant impact that demand reduction and heat pump efficiency projects have on the overall picture of Mid-South Canterbury process heat decarbonisation. As shown in Figure 2, investment in demand reduction and heat pumps meets nearly 30% of today's Mid-South Canterbury energy demands[19] from process heat, which in turn reduces the necessary fuel switching infrastructure required. This reduced the thermal capacity required from new biomass and electric boilers by 100MW. We estimate that demand reduction and heat pumps has thus avoided investment in $150M of electricity and biomass infrastructure.

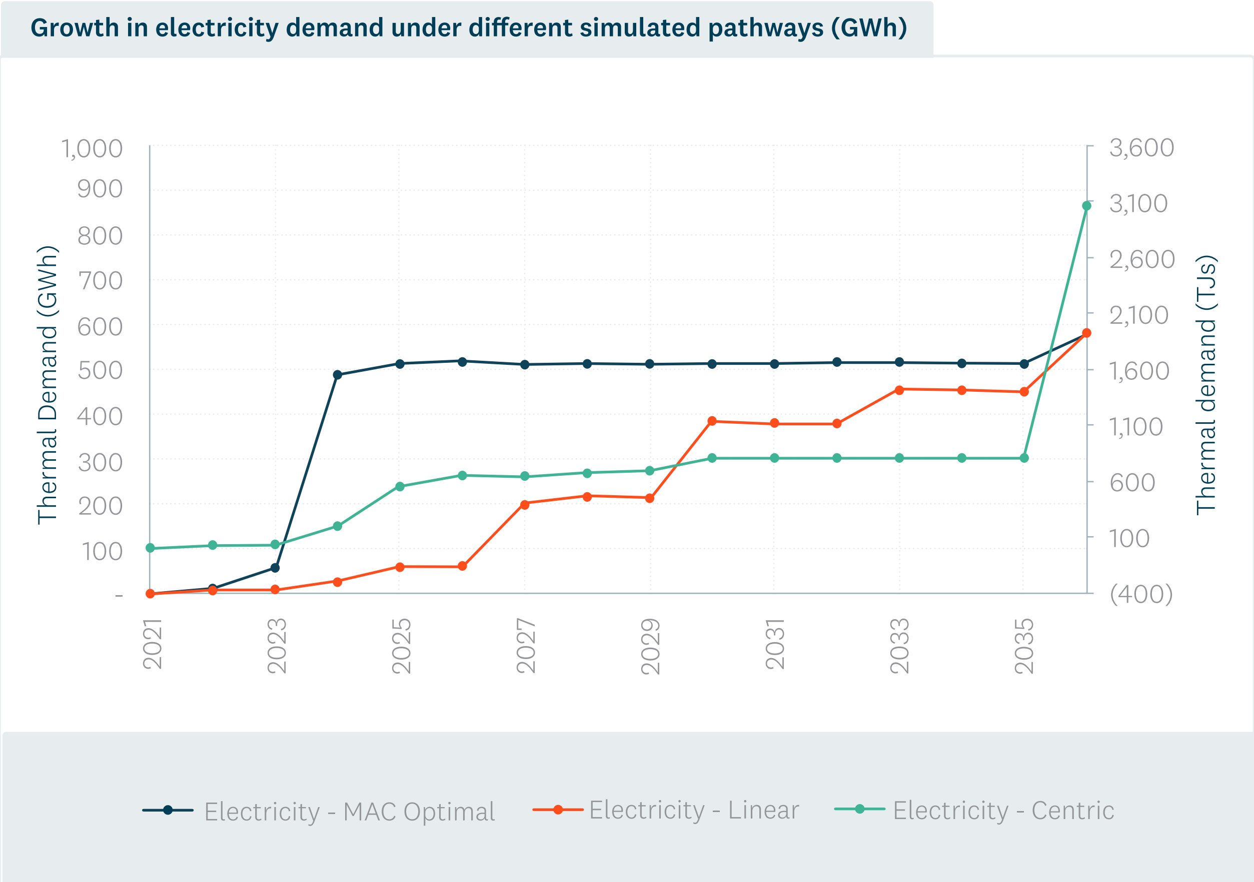
The figures below show the pace of demand growth under the different pathways, for both electricity and biomass.

Figure 9 – Growth in biomass demand from pathways. Source: EECA



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

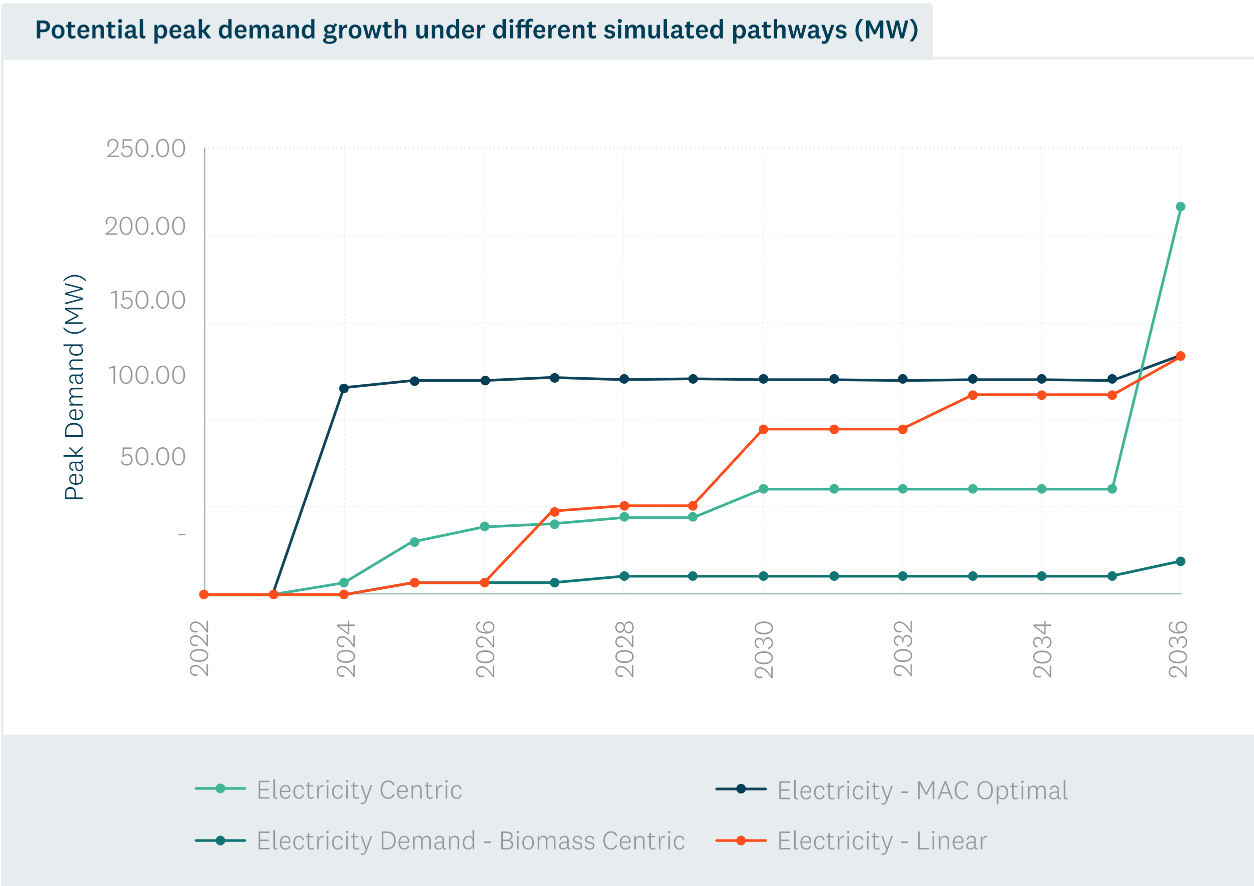
Figure 10 - Growth in electricity demand from fuel switching pathways (unconfirmed RETA sites). Source: EECA



Our analysis suggests that, over the next 15 years, the MAC Optimal process heat market demand for processing and harvesting residues exceeds $75M on a cost basis, not including chipping, storage, and transport.

Network planning by EDBs and Transpower will be driven more by the potential increase in peak demand at different locations in the network; each of the pathways draw quite a different pace of peak demand growth.

Figure 11 - Potential peak demand growth under different pathways



There can be material differences between adjacent networks in terms of unused capacity; these differences exist for a range of historical reasons. This can lead to quite different relative connection costs for projects connection in each region. Table 13 shows how the connections potentially affect each EDB's network.

Table 4 - 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)
EA	29	$5.38	15	$3.77
Alpine	76	$16.48	38	$6.54
Network Waitaki	13	$4.85	12	$4.85
Transpower	91[20]	$51.90	91	$51
Total	**209**	**$78.61**	**154**	**$65.75**

Table 4 shows that Alpine Energy will experience the largest relative increase in process heat-related electricity demand, irrespective of whether the electricity-centric or MAC Optimal pathway results. The connection cost estimates suggest that between $66 - $79M will be spent by process heat organisations connecting their new plant to either Transpower's or the EDB's networks, depending on the pathway.

The pathways above assume relatively unlimited access to each type of fuel (albeit at an increasing cost). However, more realistic assumptions about available volumes of woody biomass, coupled with changes in fuel decisions by large boiler owners, could lead to bioenergy costs increasing to the point where they are more comparable with electricity.

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. Our analysis illustrates that accelerated co-funding and lower electricity prices should have a modest effect on project timing, given assumptions about their economics. 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. Co-funding can perform an important role in neutralising these barriers to undertaking good investments.

[20] Fonterra converting all four boilers at Clandeboye to electric. Ergo's analysis showed that the only practical way to do this was to divert the load from Alpine's network and connect directly to Transpower's grid at Orari. Technically, this would result in a small reduction in Alpine's peak demand (resulting from the disconnection of Fonterra's current electricity demand), but we do not have data on what that is.

Wairakei Geothermal Power Station - Taupo, New Zealand

9 Recommendations

In summary, our recommendations are:

- **More analysis, and potentially pilots, are 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.**
- **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.**
- **Development of a national guidance or standard, based 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.**
- **More in-depth analysis of competing uses of biomass for energy at a national and regional level could help future RETA studies understand the significance of these competitive pressures.**
- **Each RETA analysis should be updated in a brief, standardised format every two-to-three years, to ensure all organisations who support or participate in the decarbonisation of process heat have access to good, evidence based insights.**
- **Mechanisms should be investigated and established to help suppliers and consumers to see 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.**

- **Wood processors are encouraged to explore the production of pellets locally, based on the likely demand provided in this report.**

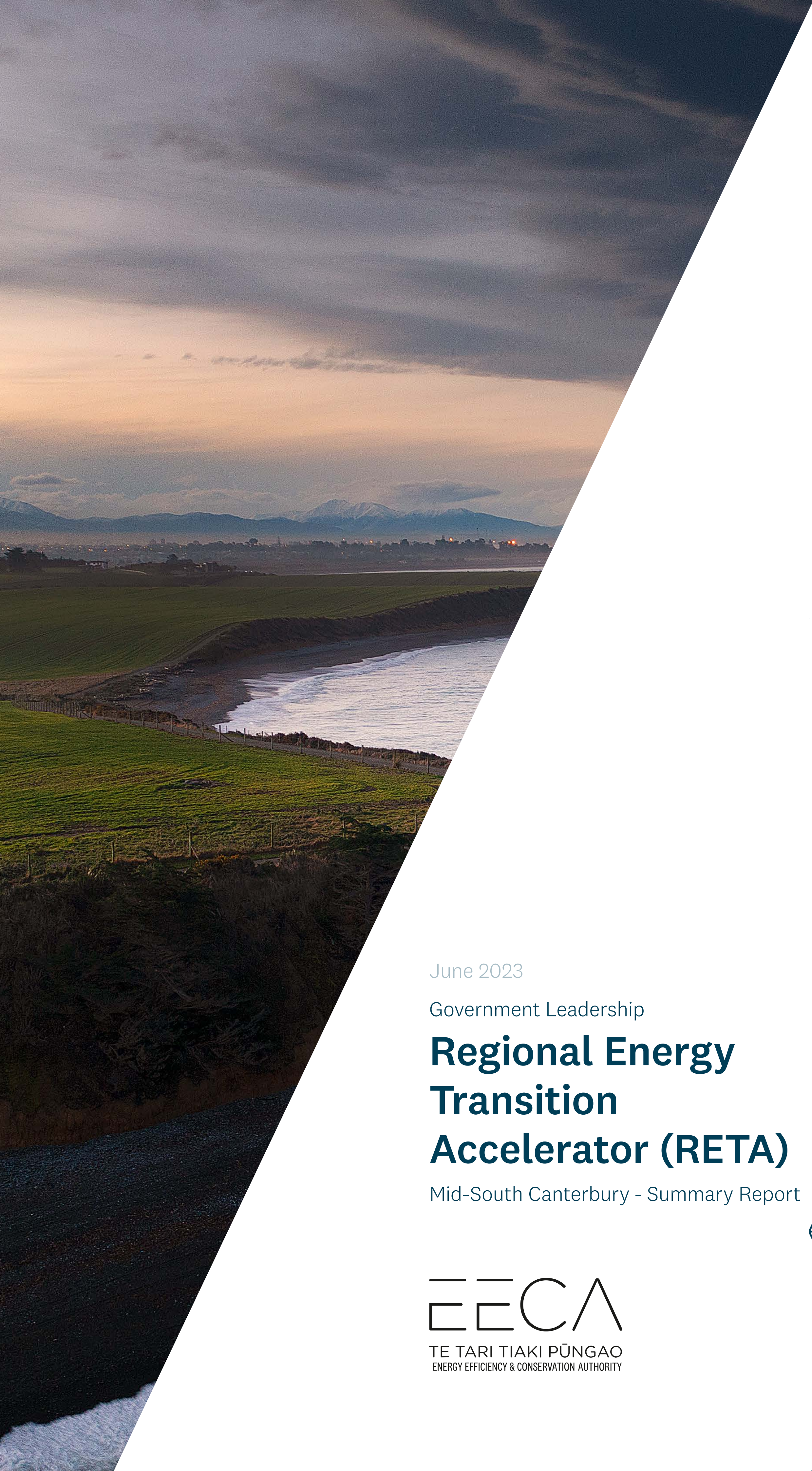
- **EDBs to proactively engage with process heat users to understand their intentions, and help process heat users obtain a greater understanding of required network upgrades, cost, security levels, possibilities for acceleration, use of system charges and network loss factors.**

By 2025, 75% of emissions reductions are economic

- **EDBs 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 share sufficient information about network demand to help process heat users determine whether they can limit the extent to which they increase peak demand on the network, and the nature of network security standards.**

- **EDBs to investigate how they could equitably pass on, to electrifying process heat users, the benefit of the eight-year delay in experiencing the full residual cost component of the TPM associated with an increased demand.**

- **Transpower expands their renewable energy hub concept beyond the supply-side to the demand-side.**
- **Retailers, EDBs and the Electricity Authority should assist by sharing information that helps process heat consumers model the benefits of providing flexibility.**
- **EDBs and retailers should ensure that the tariffs they offer process heat users are incentivising the right behaviour.**
- **EECA expands future iterations of regional analyses to include transport as a decarbonising decision that will compete for electrical network capacity and biomass 100%.**
- **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.**
- **Process heat users enquire about government co-funding where the economics of decarbonisation are challenging; where they are economic, EECA encourages organisations to explore the potential for self-funded acceleration.**



June 2023

Government Leadership

Regional Energy Transition Accelerator (RETA)

Mid-South Canterbury - Summary Report

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