



Creating a Murihiku Southland Electrification Development Plan

Tactical Options Paper

September 2023

Overview

Murihiku Southland has abundant renewable energy resources and substantial energy demand from fossil-fuelled heating in industrial processes. We know there is a great deal of interest in developing these renewable generation options and in shifting away from high emissions fuels. These initiatives will increase Aotearoa New Zealand's electricity generation capacity and enable businesses and people to replace fossil fuels with low-emission, renewable electricity. This decarbonisation activity is already happening and is accelerating.

Transpower and PowerNet are working to ensure the electricity infrastructure in your region can enable and support your needs, so people and businesses can continue to grow and flourish.

Together, we are creating an integrated Regional Electrification Development Plan for the electricity transmission and distribution networks in Southland.

This approach gives us a broader planning perspective and will result in a more efficient development plan than a reactive, project-by-project approach. It will also provide an optimised path for accelerated decarbonisation in Southland, while ensuring a safe and reliable supply of electricity to homes and businesses.

The purpose of this Tactical Options Paper is to provide you with an update on the information we have received since our first discussion document release in July 2023, and how we have incorporated that feedback into our thinking. Creating a Regional Electrification Development Plan relies on input from a wide range of stakeholders to ensure it is based on the latest information about future demand and decarbonisation activity, up-to-date forecasts, and potential new generation opportunities. If there is further information that you think we should consider when finalising these plans, please contact us at Southland@transpower.co.nz.

Based on your input to date and our understanding of growth in the region, we are suggesting the following tactical investment options across the transmission and distribution networks.

› More detail about these options is on pages 9-11.



- Transpower to complete a Tactical Thermal Upgrade of the Invercargill–North Makarewa circuit to increase capacity.
- Transpower to implement special protection schemes to avoid scenarios that may overload the 110 kV Gore–Roxburgh circuit and the 110 kV Brydone–Gore circuit as new generation and electricity load connects.
- PowerNet to increase transferable load between Invercargill and North Makarewa via the 66 kV network.
- PowerNet to undertake a 66 kV network development to the Awarua Region.



- Duplex the North Makarewa to Three Mile Hill line.
- Upgrade or develop grid exit points, for example at Edendale.

We expect these investments will ensure the electricity network in Southland is ready to connect new generation and supply electricity to new and growing users as development progresses.



Who we are



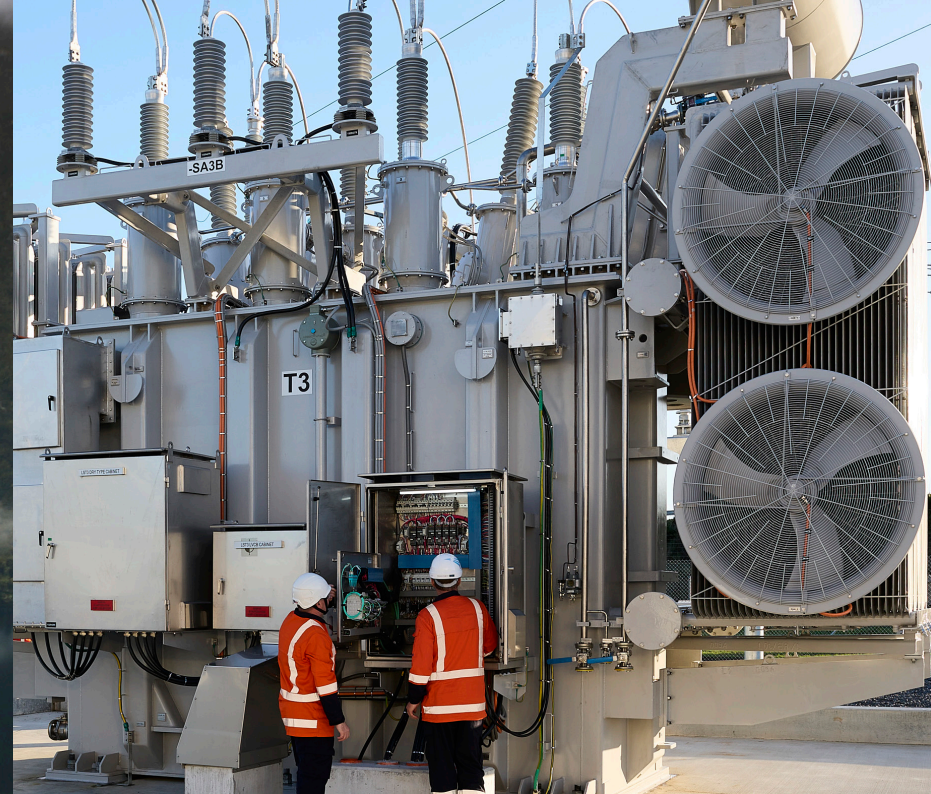
Transpower

As the owner and operator of New Zealand's national grid, Transpower needs to understand how the transmission network might need to change to accommodate and enable new large-scale renewable generation and load growth in the Southland region and support electrification at pace.



PowerNet

As the distribution network operator for the region, PowerNet delivers a safe, efficient and reliable supply of electricity to the homes and businesses of Southland. PowerNet needs to understand how its distribution network might need to change to support local communities and businesses as they decarbonise and enable new smaller-scale renewable generation and load growth in the Southland region.



Background

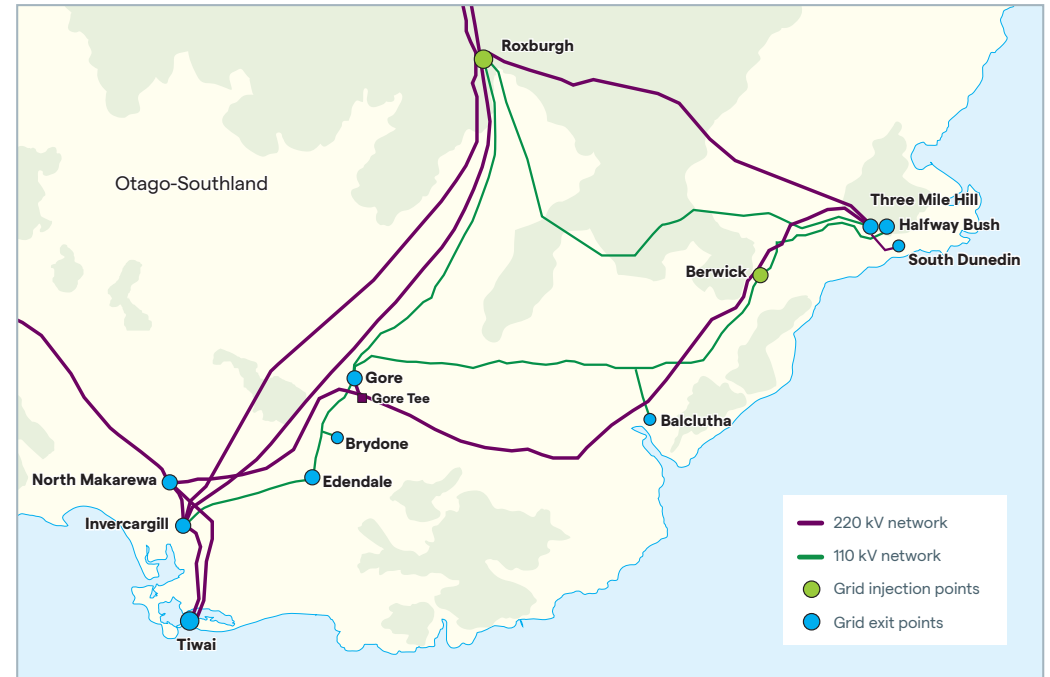
The Southland region is primed for decarbonisation and growth. Various businesses, community groups, iwi, local and central government are looking to capitalise on the region's abundant renewable energy resources, both to increase renewable generation and support the decarbonisation of existing industries, alongside supporting potential new growth.

Given the amount of change and the ongoing negotiations by the New Zealand Aluminium Smelter (NZAS) on its longer-term electricity needs, Transpower and PowerNet are scoping a Regional Electrification Development Plan for Southland.

A Regional Electrification Development Plan provides the opportunity for integrated planning and will result in an efficient approach to upgrade investments on the national grid and the distribution network, rather than a reactive or project-by-project approach to network investments.

We will seek to encapsulate the latest demand drivers, forecasts, and potential new generation opportunities in the area, and will therefore need input from a broad range of Southland stakeholders.

Following our initial discussion document, we have already engaged with several stakeholders regarding their plans in the Southland region, including new renewable generation and load developments.



The transmission network in Southland and Southern Otago.

What we understand about electrification in Southland

Our July 2023 discussion document highlighted the activity already underway such as work with the Energy Efficiency and Conservation Authority (EECA) on its Regional Accelerator and Government Investment in Decarbonising Industry Fund, and the Southland Just Transition and Southland Murihiku Regional Energy Strategy.

It also highlighted that Transpower and PowerNet are receiving connection requests and supporting development activities. Since 2019 Transpower has received 23 enquiries for new generation projects in the Southland and Southern Otago regions, totalling over 4,400 MW. Almost 1,200 MW has progressed beyond the enquiry stage.¹ We have also received 18 enquiries for potential non-generation connections, such as load connections for new electrified process heat. Ten of these are seeking to connect to PowerNet's network.

Our conversations with stakeholders have indicated that there is a large appetite and opportunity for process heat decarbonisation through electrification, increasing residential and commercial loads, and step loads regarding data centres and other emerging technologies. They have also indicated that the information that we already hold in our systems is largely accurate in terms of sizing and timing. This has provided clarity on the timings of our tactical investment options and potential future growth and development plans for the region.

The Southern Green Hydrogen project potentially represents a significant step load increase and has the potential to become one of New Zealand's largest load connections to the national grid. However, at this stage, there is insufficient certainty about this project's size, location or timings to inform any current network decisions. The investment in tactical upgrades noted in the Regional Electrification Development Plan are required in any event, and Transpower and PowerNet will continue to monitor this project as it develops.



¹ [Connection enquiry information | Transpower.](#)

Process heat electrification

Process heat electrification has been identified as the region's primary driver for network load growth. To further understand the opportunities and needs of our customers and potential electrification projects in the pipeline, PowerNet, in partnership with Transpower and EECA, conducted a process heat stocktake of large customers in 2021/2022. Objectives of the process heat stocktake were to:

- Understand the number of process heat boilers in our region, their capacity, and the fuel used.
- Understand transition intentions, timelines and future capacity requirements to aid in our long-term planning.
- Understand customers' drivers for decarbonisation.
- Understand the support required to enable decarbonisation.

The 44 customers who participated in the stocktake represent around 96% of PowerNet's large commercial and industrial customers who currently use fossil fuels for process heating. It was found that 300 MW of electrical capacity equivalent (70 percent of total capacity required) worth of coal was still being used in our region, which will need to be shifted to either electricity or biomass.

While preliminary results in July 2021 showed that biomass was the dominant renewable fuel of choice for decarbonisation, follow-up discussions in March 2022 found many had moved to favour electricity due to cost, operational

efficiency and other factors, and that the future electricity capacity required would be 188 MW by 2035, an 85 percent increase compared to the 2021 stocktake. The results indicate that there will likely be significant electricity demand growth in the Southland region, and the move towards electrification is happening more rapidly than anticipated.

A greater electrification scenario

PowerNet believes that there is also potential for a greater electrification scenario in the next ten years. In this scenario, advancements in electrode boiler and high temperature heat pump technology, and better understanding of the benefits of these from early adopters, would see some customers that have indicated a transition to biomass consider electricity instead, as part of their decarbonisation solution. In this greater electrification scenario, which considers a

50:50 conversion to electricity and biomass, the electricity capacity required will more than double in the next 10-15 years, as depicted in Figure 1.

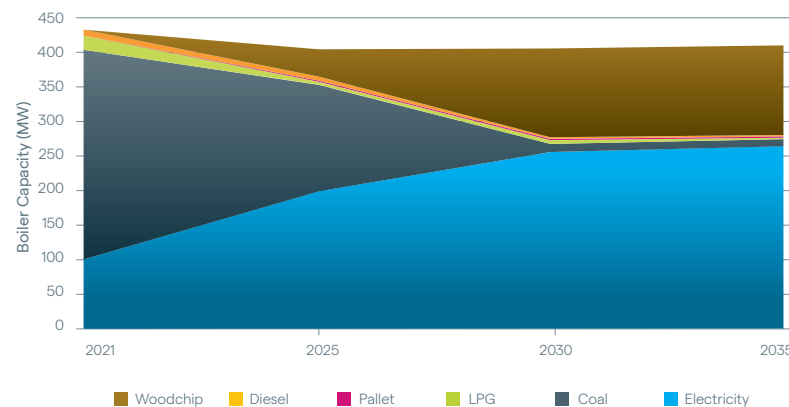
New grid-scale generation

Several parties are also at advanced stages of planning new grid-scale generation within the Southland region.

Developing local grid-scale generation in line with the region's electricity demand growth will help to ensure the electricity supply is affordable and reliable

As a result of bringing the above information together, we have scoped a draft regional development plan that identifies a range of low-cost, short-term upgrades that can be undertaken to support additional capacity on the distribution and transmission networks and support active new generation and connection requests.

Figure 1: Transition plan to renewable fuel source - Greater Electrification Scenario



Technical work and Tactical options

Based on the feedback received to date, we have done some initial technical work to model the capacity of the grid with different project combinations. We have then identified common or no regrets projects that are sensible to construct in a range of future scenarios.

Through power flow analysis, we identified which transmission assets will constrain new generation and load projects. These could include everything from the conductors on the lines, to parts of the circuit such as substation assets and protection systems that monitor the circuits and activate in the case of faults.

The most effective tactical upgrades to remove constraints often include Tactical Thermal Upgrades (TTU). This allows existing line conductors to operate at higher temperatures and therefore carry more power. This is achieved through increasing the distance between the conductor and the ground or nearby structures using methods such as reconductoring, earthworks, or raising towers. Equipment within our substations may also need to be upgraded if they become the next constraint following a TTU.

Larger upgrade investments of more than \$20 million must be approved by the Commerce Commission before Transpower can proceed with these projects. Therefore, it is important that we have confidence in the forecast load increases and the likelihood of new renewable generation developments.

Our analysis shows that demand growth in the short term can be supplied from the existing grid exit points in the region with some tactical investments. PowerNet also has the capability to upgrade its distribution network to support more demand growth out of both North Makarewa and Invercargill in the medium term. Opportunities for electrification of large industrial processes within the region remains, for example Fonterra's Edendale plant, which could trigger the need for major transmission upgrades or establishment of a new substation to supply these new loads. We

see opportunities for Transpower, PowerNet, Fonterra and other related stakeholders to work together on developing plans to electrify these large industrial processes.

On the generation front, we have analysed what we need to do now to be ready to connect new generation as projects are completed. Our generation connection pipeline identifies three windfarms (totalling over 800 MW) looking to connect in future to the 220 kV North Makarewa–Three Mile Hill line.

Based on this demand and generation information, we have identified the following projects that can unlock network capacity to support the development of the Southland region.



Potential Tactical Projects



Transpower to complete a Tactical Thermal Upgrade of the Invercargill–North Makarewa circuit to increase capacity.

A Tactical Thermal Upgrade increases capacity of a line by increasing the distance between the line and the ground or other obstacles. This allows the line to sag further, which happens as it carries more electricity, without breaching minimum clearance distances. A Tactical Thermal Upgrade is achieved through earthworks, tower raising or decreasing the existing sag in the conductor.

Demand growth in Southland and new generation connected to the 220 kV North Makarewa–Three Mile Hill circuits may overload the 220 kV Invercargill–North Makarewa circuit, rated at 404/457 MVA (summer/winter).

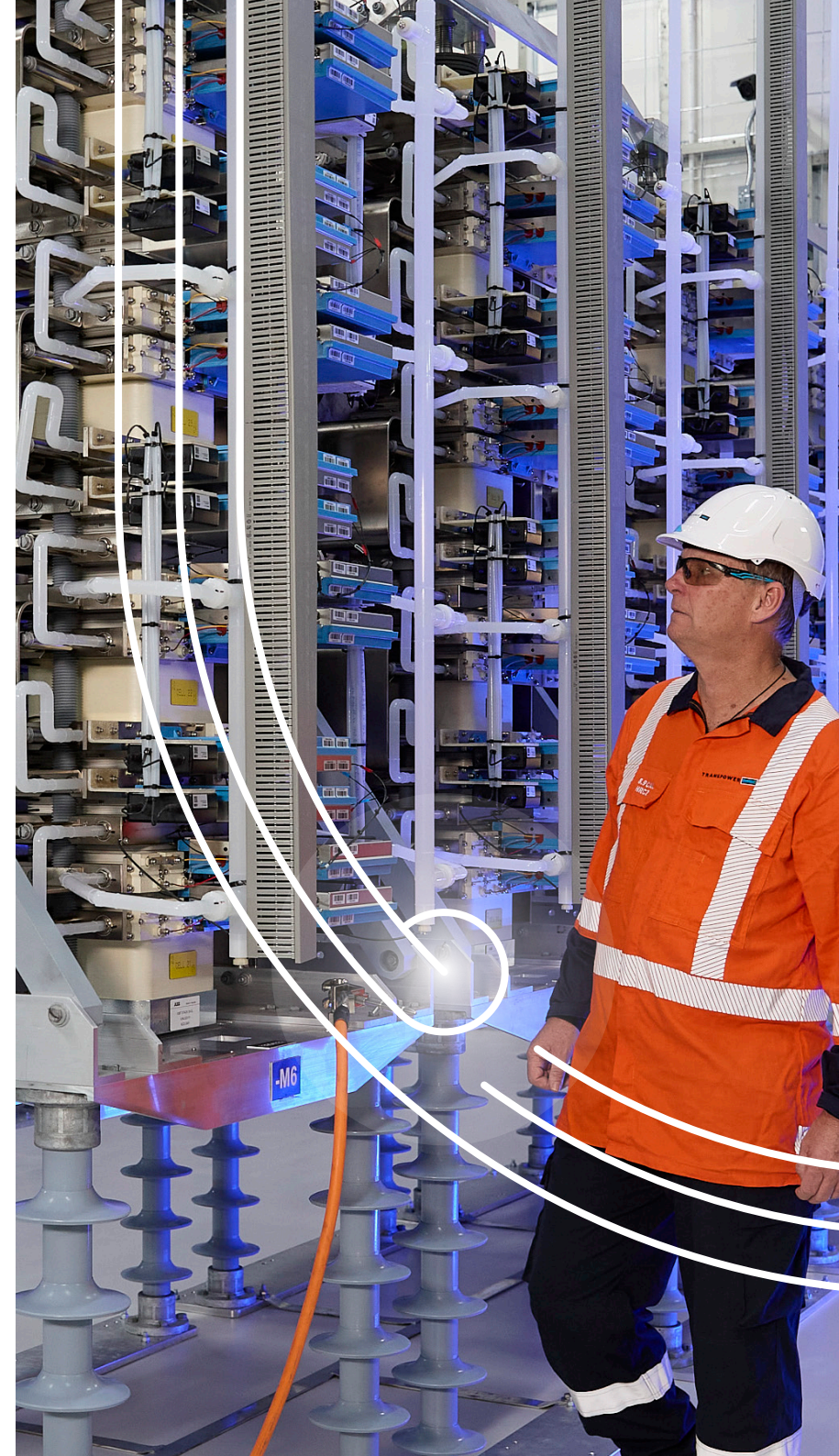
Transpower can see an opportunity to undertake a Tactical Thermal Upgrade of the Invercargill–North Makarewa circuit to increase capacity to 666/717 MVA (summer/winter). Transpower has undertaken preliminary investigations and concluded that the cost for this project (and the associated substations components) would be unlikely to exceed our \$20 million major capex threshold. Transpower will continue to investigate the practicalities of this upgrade.



Transpower to implement special protection schemes to avoid scenarios that may overload the 110 kV Gore–Roxburgh circuit and the 110 kV Brydone–Gore circuit as new generation and electricity load connects

A Special Protection Scheme is an automated system that monitors electricity flows through a circuit, and takes action to switch circuits, remove load or remove generation in abnormal or overload conditions.

Demand growth in Southland and new generation connected along the 220 kV North Makarewa–Three Mile Hill circuits may overload the 110 kV Gore–Roxburgh circuit during low generation at Manapouri, and the 110 kV Brydone–Gore circuit during high wind generation scenarios. These 110 kV constraints can be resolved in the short term by Transpower implementing low-cost special protection schemes (SPS) which will automatically reconfigure the 110 kV network to remove overloading. The SPS will push power to flow through the higher capacity 220 kV network, and will be sufficient for the short term, but does not cater for any long-term load growth on the 110 kV network. Should customers need to add additional load to the 110 kV network, further investigation will be required to assess how these circuits could be upgraded further. The specifics of this work will be proportionate with the level of increased demand but could require the installation of a larger conductor on the existing line, or a line rebuild (see Major Project 2).





66 kV network development to the Awarua Region

Open Country Dairy received significant funding² from the Government Investment in Decarbonising Industry Fund (GIDI) to enable an estimated annual carbon reduction of 41,110 tons. This site electrification and decarbonisation project would involve the installation of a high-pressure electrode boiler and high-temperature heat pumps, which will significantly reduce coal use by the site. Enabling the decarbonisation activity would require establishing a 66 kV line to the Awarua region with a target completion date of mid-2025. This work would enable future development in the region.

An understanding of future load and generation is needed to plan any additional developments to relieve the foreseeable constraints on the existing 33 kV network between the Invercargill GXP and the Colyer Road Substation.

² <https://www.eeca.govt.nz/assets/EECA-Resources/Co-funding/GIDI-Files/Round-5/Round-5-Projects-Map-and-Summaries.pdf>



Increase transferable load between Invercargill and North Makarewa via 66 kV network

In the past two years, there have been many large enquiries and applications to the North Makarewa network, particularly in the Makarewa region, which would trigger significant network upgrades at both the Transpower GXP level and on PowerNet's sub-transmission network. PowerNet is considering transferring some of the load from the Makarewa region from North Makarewa GXP to the Invercargill GXP via the new 66 kV connection, triggered by the development in the Awarua region. This work would relieve the capacity constraint on the North Makarewa region, improve resilience to western Southland and defer major investments such as the GXP upgrade.



Potential Major Projects

These projects are likely to be larger, longer-term upgrade investments of more than \$20 million and require approval by the Commerce Commission.



Duplex the North Makarewa to Three Mile Hill line

Duplexing of electricity lines replaces a single conductor (wire) on a transmission circuit with twin conductors. This is what occurred on Transpower's recent Clutha Upper Waitaki Lines project between Roxburgh and Livingstone.

Given our understanding of the three potential wind generation projects between Transpower's North Makarewa/Gore and Three Mile Hill substations, Transpower has looked at the capacity of the 220kV line that services this region and concluded that the two North Makarewa–Three Mile Hill circuits could host two wind farms (one on each circuit) with only minor or no generation constraints. Additional wind farms are expected to impose generation constraints to prevent overloading of the circuits. This project will require a major capital proposal approved by the Commerce Commission.

Contingent on Transpower's 'Grid Investment Test', three or more generation connections may justify duplexing of the North Makarewa to Three Mile Hill line.



Upgrade or develop grid exit points, for example at Edendale

Edendale supplies the largest dairy processing plant in the Southland region that has the potential to electrify. The Edendale grid exit point and the 110 kV lines that connects it to the wider grid can supply some additional loads to allow electrification in the short term. However, to fully electrify a site like the Edendale dairy factory, major upgrades to the grid exit point and 110 kV lines that connect to it are necessary. Alternative options include establishing new grid exit points supplied from nearby high capacity 220 kV lines.

In addition, PowerNet has fielded other enquiries for new load and generation connections at Edendale. However, we don't have sufficient certainty of loads in the area to justify major investments now. Transpower sees an opportunity to do more work with PowerNet, Fonterra and other stakeholders to develop the long-term plans for the Edendale area to ensure there is sufficient transmission and distribution infrastructure in place to support it.



Next Steps

PowerNet and Transpower will seek to engage with stakeholders in the region to talk through what these tactical options mean, and how that might support your electrification plans in the region.

If you have not been in contact with us yet, we encourage you to reach out to us at Southland@Transpower.co.nz to register your interest in being part of these discussions. Stakeholders can expect to hear from Transpower and PowerNet during October and November on engagement options. Please also share this document with others you know who may have an interest.



We are broadly seeking:

- a. your views on the tactical options that we have identified and what that might mean for your decision-making on electrification investment, and
- b. information about increased electricity demand and generation projects that we are not aware of in the region, so we can ensure that these are considered as part of our development planning.



Engaging further on options and feedback

Based on your input, we will further assess the need for transmission and distribution investment in the region, including the tactical upgrades to support load and generation projects that are ready to progress. This will set the foundation to confirm the approach to develop the longer-term solutions to support projects still currently in a scoping phase or not yet committed.



Publishing our Murihiku Southland Electrification Development Plan

In December, we aim to deliver our Murihiku Southland Electrification Development Plan. This will include low-cost, tactical upgrades required to unlock capacity in the short term, and a timeline for next steps. Should your input show that major transmission upgrades are required, we will communicate further on the process and timings for this level of investment, which will require the approval of the Commerce Commission.



Timeframe	Activity
September 2023	Publish short-term tactical options and invite further input into a Murihiku Southland Electrification Development Plan.
October/ November 2023	Engage further on options, assess feedback, and consider electricity network implications. Publish a draft Murihiku Southland Electrification Development Plan, including high level costings for transmission and distribution projects.
December 2023	Publish a finalised Murihiku Southland Electrification Development Plan and provide an update on next steps.

Contact us

We value your continued input as our work on a Murihiku Southland Electrification Development Plan progresses.

To submit feedback or request a meeting, email Southland@transpower.co.nz. If you have something else to talk about, or just want more information, you can also reach out to Tania or Kavi.

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