TRANSPOWER

Transmission Planning Report

2025

Table of Contents

Chapter 1 Introduction **1**
Chapter 2 Existing National Grid **8**
Chapter 3 Forecast Demand and Generation **17**
Chapter 4 Enhancement and Development Portfolio **25**
Chapter 5 Major Industry Trends **35**
Chapter 6 Grid Backbone **42**
Chapter 7 Northland Regional Plan **93**
Chapter 8 Auckland Regional Plan **109**
Chapter 9 Waikato Regional Plan **135**
Chapter 10 Bay of Plenty Regional Plan **167**
Chapter 11 Central North Island Regional Plan **195**
Chapter 12 Taranaki Regional Plan **222**
Chapter 13 Hawke's Bay Regional Plan **242**
Chapter 14 Wellington Regional Plan **258**
Chapter 15 Nelson-Marlborough Regional Plan **280**
Chapter 16 West Coast Regional Plan **293**
Chapter 17 Canterbury Regional Plan **309**
Chapter 18 South Canterbury Regional Plan **330**
Chapter 19 Otago-Southland Regional Plan **357**
Appendix A: Enhancement and Development Process **384**
Appendix B: Indicative Forecast Fault Levels **389**
Appendix C: Glossary **405**
Appendix D: Grid Exit and Injection Points **410**

1 Introduction

1.1	Purpose of the Transmission Planning Report
1.2	Investment process and classification
1.3	Document overview

Transpower owns, maintains, operates and develops New Zealand's high voltage electricity transmission network (the National Grid).

This Transmission Planning Report (TPR):

- describes how we assess the adequacy of the transmission network to meet future needs of users, and identifies potential investments to address future demand or alleviate expected constraints
- identifies investment opportunities in the interconnected grid that will improve grid operations, reduce losses, improve reliability at least cost or enhance market operation
- builds on previous versions, reflecting new information or changes in assumptions, and reflects our continuously evolving planning processes.

A Decision Framework is a core element of our transmission planning process. This supports making effective, consistent, repeatable asset planning decisions that balance risk, service levels and investment, taking into account the uncertainty inherent in assumptions about the future. This is an area of increased focus, as we continuously improve our understanding of uncertainties and potential impacts on our investment planning and regulatory processes.

This TPR is about the New Zealand transmission network as at 31 March 2025 unless otherwise stated.

1.1 Purpose of the Transmission Planning Report

This TPR sets out:

- the existing and required future capability of the National Grid
- our transmission planning processes
- the Enhancement and Development[1] (E&D) transmission investments that may be required within a 15-year planning period (2025 to 2040) to address gaps in capability.

Quality information supports efficient industry investment decision-making. We aim to be transparent regarding our transmission planning processes, and the potential grid development needs and options we have identified.

1.1.1 Transpower context

Transpower's view of the future, as outlined in *Whakamana i Te Mauri Hiko – Empowering the energy future for New Zealand*[2] and shaped by both the global and local environment, provides the context for our purpose and guides our strategy. It describes how our context is evolving and explores a range of potential energy futures out to 2050 and the role of the electricity sector. Our base case scenario is Accelerated Electrification which presents a realistic yet aspirational scenario for the New Zealand economy and electricity industry. It anticipates a large-scale transformation that will require integrated, coordinated planning and action from across the economy and government. This scenario expects that by 2050, electricity demand will increase 68% and installed generation capacity will increase 137%. We estimated this will be largely driven by electrification of process heat and transport. Since publication, there has been growing consensus on the key role that electricity will play in the future energy system, and the potential for new emerging demand from data centres and possibly e-fuels which would have the potential to shift the future of energy in New Zealand.

1 The E&D portfolio encompasses all investments that change the capability of the transmission grid to provide desired levels of service to our customers. Changing the capability of the grid may be by either an increase or decrease in capability.

2 https://www.transpower.co.nz/about-us/our-strategy/whakamana-i-te-mauri-hiko-empowering-our-energy-future

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

We continue to closely monitor the global and domestic environment we operate in to understand the implications of the possible changes and challenges we face, particularly in relation to investment uncertainty (discussed further in Chapter 3) and the impact on our transmission system.

Transmission Tomorrow[3] – our strategy – outlines our choices and strategic priorities for how we plan to deliver across these energy futures and supply sustainable, affordable, and reliable power to electricity consumers across Aotearoa New Zealand. Transpower's strategic priorities are reflected in our recent work – Net Zero Grid Pathways, our HVDC upgrade and Te Kanapu, and builds on the energy futures outlined in *Whakamana i Te Mauri Hiko*.

We develop the electricity grid and operate the electricity market to enable the electrification of Aotearoa, and deliver on our five strategic priorities:

- Enhance our social licence to operate
- Deliver services that meet our customers' needs
- Facilitate delivery of an optimised transmission path for the New Zealand energy system
- Accelerate electrification through our asset investments
- Advance our organisational effectiveness.

While our earlier work in *Whakamana i Te Mauri Hiko* highlighted the opportunity for electrification, our Te Kanapu initiative will build on this and identify what work Transpower must do on our national grid to bring that opportunity to life. Our Te Kanapu initiative will develop a future grid blueprint for Aotearoa[4]. This blueprint will guide Transpower's investments in the national electricity grid out to 2050, the way we manage the electricity system, and support industry and those in the energy sector with their long-term planning.

To support our objective of providing quality transmission services and investing appropriately in long-life assets in a changing environment, we developed a set of grid strategic goals which lie at the core of our planning strategies and processes. The TPR sets out how we plan for grid E&D, how we will engage with stakeholders, and how we will progress towards the following grid strategic goals:

- Service Performance: The investments proposed in the TPR consider the needs of the interconnected grid and the service performance required by customers, enabling effective cost-service trade-offs to be made. The flexibility in the process for investigating transmission problems or opportunities supports consideration of a broad range of options to meet transmission development needs.
- Cost Performance: The changing environment for transmission services requires us to match our investments to grid needs, value the future flexibility some options may provide, and select 'least-regrets' investments[5]. Our assessment of potential transmission investments gives significant weight to whole-of-life asset costs and the extent to which they enable us to achieve desired service levels.
- Customers and Stakeholders: Customers' development plans, preferred service levels and technology choices are central to our transmission investment decisions. The TPR describes how customer choices impact transmission investment choices and timing. Sharing investment planning information and processes, and working closely with customers and stakeholders, ensures best outcomes are achieved, nationally and regionally.
- Asset Management Capability: A key challenge for investment planning is managing uncertainty. The need for and timing of investments is inevitably affected by external factors such as changes in the wider economy and uptake of new technologies. We put considerable effort into understanding the main uncertainties affecting grid development and are cognisant of their potential impacts.

[3] Transpower Transmission Tomorrow 2023

[4] Te Kanapu | Transpower

[5] A 'least regrets' approach to planning is a prudent approach for the stewardship of an essential service based on long-lived assets.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

1.1.2 Integrated Transmission Plan

We usually publish an updated Integrated Transmission Plan (ITP) each year. The ITP also satisfies requirements under the Capital Expenditure Input Methodology[6] (Capex IM).

The ITP describes Transpower's business objectives, strategies and our approach to decision-making. It provides a high-level view of forecast expenditure and service outputs across network development, replacement, refurbishment and maintenance expenditure. As a supporting document to the ITP, the TPR provides information on current and potential future E&D investment, including both base capex projects (expenditure less than $30 million) and Major Capex Projects (expenditure greater than $30 million).

1.1.3 Regulatory context

Investment funding

Investments which increase or decrease grid capability are categorised as E&D projects.

The grid development plans set out in this TPR (Chapters 6 - 19) are a bottom-up view of possible E&D projects for the next 15 years. We also consider how wider uncertainties in our operating environment (e.g. uptake of new technologies, changes in economic conditions and decisions by our customers) may impact overall investment needs. Our approach is described in Chapter 3.

Our view of E&D investment needs is a component of our five-yearly regulatory reset proposals, alongside our assessment of reinvestment and operating costs. The Commerce Commission (Commission) evaluates our proposal as a whole and approves an overall expenditure envelope along with baselines, output targets and incentives. Once the overall expenditure is approved, we have flexibility to reprioritise our plans and increase or decrease overall investment within the regulatory period in response to new information. This five-yearly process excludes development investments expected to exceed $30 million; these Major Capex Projects are assessed individually by the Commission.[7]

In our planning processes we classify our transmission network development projects by funding arrangement (summarised in Table 1-4).

Reporting requirements

Part 12 of the Electricity Industry Participation Code requires that every two years we publish:

- a Grid Reliability Report (GRR) setting out 10-year forecasts of demand at grid exit points, generation at grid injection points, and whether the National Grid can reasonably be expected to meet (n-1) security requirements, and proposals for addressing identified issues.
- a Grid Economic Investment Report (GEIR) identifying economic investments (those creating net market benefits) that could be made in respect of the interconnection assets.

The TPR fulfils the requirements of the GRR by providing for the next 10 years:

- forecasts of demand at each grid exit point (GXP) (Chapters 7 - 19)
- forecasts of supply at each grid injection point (GIP) (Chapters 7 - 19)
- whether the power system is reasonably expected to meet the n-1 criterion at all times (Grid Asset Capability and Management sections of Chapters 6 - 19).

The Grid Asset Capability and Management sections of each regional and backbone TPR chapter fulfil the requirements of the GRR and GEIR by outlining:

- proposals for addressing n-1 issues identified in our assessment of asset capability
- issues impacting economic operation of the grid, and
- proposals to address any issues impacting economic operation of the grid.

The blue 'investment boxes' throughout this TPR (similar to Table 1-1) detail proposals we consider will address identified issues.

6 comcom.govt.nz - Transpower input methodologies

7 Major Capex Projects (MCPs) are included in the proposal for information purposes, but funding is not approved as part of the Commission assessment described here. MCPs are individually submitted to the Commission as proposals are completed.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 1-1: Example of proposal to address a GRR issue[8]

Project Name	Gore–Roxburgh overload management
Project description:	Install special protection scheme on Gore–Roxburgh and Balclutha–Berwick to manage overloads
Project's state of completion	Committed
Grid need date:	2025
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

The TPR contains the information required to be published in the GRR and GEIR under Part 12 of the Electricity Industry Participation Code; we do not publish these separately. Under the Commerce Act Information Disclosure (ID) regulation[9], Transpower is obliged to disclose grid demand and injection information (Schedule G2); the demand and injection information produced for the ID is the same as that produced for the GRR.

1.2 Investment process and classification

1.2.1 Investment process

There are two main elements to our investment planning process:

- identifying grid needs and opportunities for changing grid capability, and
- investigating options to resolve these issues through our Decision Framework[10].

Identifying problems and opportunities for changing grid capability

We use three main inputs to identify grid needs and opportunities:

1. Annual Transmission Planning process: We test the capability of the grid to meet forecast demand and generation needs over the next 15 years. This considers the ability of the grid to remain in a secure state with any one asset out of service (n-1), from which we can identify potential future upgrades. This process provides the main input to the Decision Framework for E&D investments. The Grid Asset Capability and Management sections of each TPR regional or backbone chapter detail the results of these studies.
2. Customer Developments: When customers require new connections, increase demand or develop their own networks, changes in the transmission grid may be needed to ensure acceptable service performance and security. We obtain relevant information from customers and through our Concept Assessment (CA) process. Customer input is discussed in the Grid Asset Capability and Management sections of each regional or backbone chapter.
3. Asset Feedback: We obtain information about potential transmission needs, opportunities and risks associated with current asset capability while operating and maintaining the grid. Asset feedback within Transpower is through documented Asset Feedback loops, asset feedback loop review meetings and an Asset Feedback Register. Asset Feedback is discussed in the Grid Enhancement Approach and Inputs section of each regional or backbone chapter.

While the annual transmission planning process has a natural focus on identifying potential development needs, each of the processes above may identify opportunities for grid investment. These generally involve grid investments that produce net market benefits (such as where they improve operation of the grid, reduce losses or enhance market operation).

All identified development needs and opportunities are reviewed and assessed to determine if there is an investment need (a 'System Need', if confirmed).

8 The classifications used in this table are described in section 1.2.2.

9 Transpower Information Disclosure Determination 2014, paragraph 11 available at https://comcom.govt.nz - Transpower-information-disclosure-determination-2014-consolidated-3-April 2018

10 Our Decision Framework is a process allowing us to make effective, consistent, repeatable asset planning decisions that balance risk, service levels and investment. See Appendix A for more information.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

E&D system needs, covered by the TPR, exclude resilience investment needs which are also classed as E&D expenditure under our regulations. Resilience investment needs are covered by our Asset Management Plan (AMP).

Our investment decision making process is described in Appendix A.

Applying the Decision Framework

We investigate E&D investment needs and options to resolve them by applying the Decision Framework. Using the framework requires us to consider System Needs alongside refurbishment, replacement and maintenance requirements. If appropriate, we combine individual needs into collective grid needs, ensuring that investigations consider interrelated development needs and opportunities.

The Grid Asset Capability and Management sections of the TPR capture application of the Decision Framework to E&D System Needs, the outcome from which are potential investments in each region and on the grid backbone.

1.2.2 Project classification

The TPR refers to several current and potential transmission and generation projects. This section explains how we present the state of completion, regulatory status, identification references and costs of those projects.

State of completion

We classify transmission network development projects by their state of completion; doing so indicates the planning stage of each project. Table 1-2 lists the completion states we derive using the Decision Framework and Option Assessment Approach (see section below, 'Investigation detail').

Table 1-2: State of completion classifications

Status	Definition
Delivery	Projects having an approved delivery business case and in delivery.
Committed	Projects having completed the options assessment stage (i.e. gone through a delivery level options assessment) and either: • the investment has obtained approval to proceed, or • Transpower has agreed an investment contract with a customer or customers.
Proposed	Projects still in the options assessment stage, having gone through a planning level options assessment.
Possible	Projects in the needs identification stage that have not gone through an options assessment stage. The investments identified are possible options for future grid upgrades, subject to further analysis.

Investigation detail

We use an Options Assessment Approach (OAA) to guide the level of investigation detail undertaken when assessing System Needs. The OAA provides guidance for undertaking a commensurate approach to investigations and options analysis. The expected cost, complexity of analysis required, and timing of System Needs are considered when selecting the OAA assessment level.

As the TPR covers grid development needs and opportunities over a 10 to 15-year period, most assessments in the Grid asset capability and management sections are 'Planning' or 'None' level options analyses. These inform the development plans in this TPR and our financial forecasting. Preferred solutions from planning level OAA assessments are reassessed using a detailed delivery level assessment, at the appropriate time.

Table 1-3 provides a high-level description of the OAA classifications, indicating the type of System Needs fitting the criteria for each level.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 1-3: Options Assessment Approach classifications

OAA Assessment Level	Investigation parameters
None	The problem or opportunity has been identified but not yet assessed. Costing information is based on judgement and experience.
1	The preferred solution is prescribed in one of our asset class strategies, which define solutions applying across a group of assets. No options assessment is undertaken.
2 – Planning (AL 2p)	Investigations with low complexity and/or cost, required within 10 years. Preferred solution informs plan. Investigation revisited before any expenditure.
2 – Delivery (AL 2d)	Investigations with low complexity and or delivery cost. Preferred solution is delivered.
3 – Planning (AL 3p)	Investigations with: • medium complexity and / or cost, required within 10 years • high complexity and medium cost, required after 10 years. Preferred solution informs plan. Investigation revisited before any expenditure.
3 – Delivery (AL 3d)	Investigations with: • medium complexity and or cost, required for delivery • high complexity and medium cost, required for delivery. Preferred solution is delivered.
4 – Planning (AL 4p)	Investigations with high complexity and cost (<$30 million), required within 10 years. Preferred solution informs plan. Investigation revisited before any expenditure.
4 – Delivery (AL 4d)	Investigations with high complexity and cost (<$30 million), required for delivery. Preferred solution is delivered.
5 – Delivery (AL 5d)	Investigations with a preferred solution cost >$30 million, requiring full consultation with stakeholders and individual approval by the Commission.

Investment type

We classify our transmission network development projects by funding arrangement, as shown in Table 1-4.

Table 1-4: Regulatory investment type

Investment type	Definition
Base Capex	Replacement and Refurbishment projects of any value, or Enhancement and Development projects forecast to cost less than $30 million. We have flexibility to reprioritise across base capex, to increase or decrease overall base capex, and to shift between base capex and opex (e.g. procuring demand response to defer investments).
Major Capex Projects	These are individual investment proposals costing in excess of $30 million to enhance the National Grid, which are submitted to the Commission for approval on a case-by-case basis.
Customer-specific	Enhancement projects on assets specific to a customer or group of customers which are paid for under an investment contract between Transpower and the customer.

Project costing

Where investment is required to resolve an identified development need or opportunity, an indicative cost is shown. Indicative costs represent the expected capital cost (in 2025 dollars) to fully implement the indicated solution. Note that the accuracy of costs presented is commensurate with the current level of detail in the investigation. Cost estimates should be relatively accurate for projects in the Delivery or Committed stages, they will be highly uncertain for Proposed or Possible projects. Property and consenting costs are generally not included because of the uncertainties involved; for some projects, property costs significantly impact the overall cost.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Cost information generally represents a high level and provisional estimate only and should not form the basis for investment decisions. Interested parties should confirm the adequacy of these cost estimates for themselves or contact us for more detailed information.

Grid enhancement approach investment proposals

The Grid Asset Capability and Management sections in each regional and grid backbone chapter outline our proposals to address investment needs. The proposals are summarised throughout the chapters in the blue 'investment boxes' (similar to Table 1-1 above).

1.3 Document overview

In this TPR:

- Chapter 2 'Existing National Grid' describes the National Grid's existing configuration, including recently completed projects.
- Chapter 3 ''Forecasting demand and generation' discusses our process for developing demand forecasts and generation expansion plans. It discusses how investment drivers vary over time, the resultant uncertainty for investment decision making and how this impacts Transpower's view of funding required to undertake E&D transmission investments.
- Chapter 4: 'Enhancement and Development Portfolio' provides an overview of our E&D expenditure requirements in regulatory control period 4 (RCP4).
- Chapter 5: 'Major Industry Trends' links the issues raised in Chapters 6 to 19 that are directly related to possible major industry and environmental changes.
- Chapter 6 'Grid Backbone' discusses the grid backbone's ability to accommodate the forecast demand, possible generation developments and identified investment needs.
- Chapters 7 to 19 'Regional Plans' describe proposed investment needs and transmission capability over the next 15 years for the transmission network in each region.

Each regional plan has an overview of the existing regional transmission network and any anticipated security issues.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

2 Existing National Grid

2.1	National Grid
2.2	Load and generation

2.1 National Grid

This chapter provides an overview of New Zealand's existing National Grid as at 31 March 2025. The National Grid comprises:

- the HVAC transmission network
- an inter-island HVDC link.

2.1.1 The AC transmission network

New Zealand's HVAC transmission network supplies all major load centres. It consists of:

- a grid backbone of 220 kV transmission lines stretching nearly the full length of each Island
- a network of 110 kV lines running roughly parallel to the 220 kV system.

The 110 kV lines were the original grid backbone prior to development of the 220 kV grid from the 1950s. The 110 kV system supplies regions not reached by the 220 kV system and sub-transmission to substations within a region. There is also 66 kV system in the Canterbury and West Coast regions.

Figure 2-1 and Figure 2-2 show maps of the existing North and South Island transmission networks.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 2-1: New Zealand's North Island transmission network

Figure 2-2: New Zealand's South Island transmission network

2.1.2 The HVDC link

The HVDC link connects the North and South Island transmission networks.

This bi-directional link runs from Benmore in the South Island, to Haywards in the North Island. It comprises a 535 km overhead transmission line between Benmore and Fighting Bay (Marlborough), three 40 km submarine cables across Cook Strait between Fighting Bay and

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Oteranga Bay, and a further 37 km overhead transmission line to Haywards substation north of Wellington. Both Haywards and Benmore substations have AC/DC converter stations.

Table 2-1 lists the capacities of the existing HVDC Poles for converting power from AC to DC and DC to AC. Due to cable constraints, total HVDC capacity is less than the sum of converting capacity of the individual Poles.

Table 2-*1* Converter ratings and pole capacities

Pole	Commissioned	Converter type	Nominal capacity
Pole 2	1991	Thyristor valves	700 MW
Pole 3	2013	Thyristor valves	700 MW
Total possible HVDC transmission capacity			1200 MW

2.1.3 Transmission network asset profile

Table 2-2 provides a summary of our transmission network assets.

Table 2-2: Transmission network assets

Asset description	Detail
HVAC and HVDC transmission lines and cables	11,057 route km
Substations, including HVDC	174
HVAC transmission line voltages	220, 110, 66 kV
HVDC transmission line voltage	350 kV
HVDC link capacity	1200 MW
Capacitor banks and filters	65
Transformers (banks)	321
Synchronous condensers	8
Static Var Compensators/STATCOMS	12
Shunt reactors	8
Series reactors (on high voltage circuits)	3

2.1.4 Recently completed transmission upgrade projects

Table 2-3 lists the major transmission upgrade projects completed since our 2023 Transmission Planning Report.

Table 2-3: Projects completed since the 2023 TPR

Project name
Atarau substation bypass and dismantle
Bombay decommission 33 kV grid exit point
Bream Bay battery energy storage system (BESS) 33 kV connection
Brownhill–Whakamaru temporary 220 kV deviation at Ohinewai
Edendale Transformer and Circuit Overload Special Protection Scheme
Edgecumbe–Kawerau–3 thermal upgrade to 90°C
Frankton–T1 and T3 transformers replacement with two 120 MVA units
Hautapu new 220/33 kV grid exit point
Hawera 33 kV outdoor switchyard to indoor switchboard conversion
Islington SVC3 mid-life refurbishment
Karapiro Circuit Overload Protection Scheme
Kawerau–T13 transformer replacement with a 250 MVA unit
Lichfield–Tarukenga–1 circuit capacity upgrade (reconductor 2 km section)
Norwood new 220/66 kV grid exit point

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Project name
Opunake 33 kV outdoor switchyard to indoor switchboard conversion
Otahuhu new ±150 Mvar STATCOM
Pakuranga two new 100 Mvar 220 kV shunt reactors
South Dunedin–T2 transformer replacement
Tauhara - addition of 220/33 kV grid exit point at substation
Tekapo A 11 kV switchboard replacement
Temuka 33 kV switchboard replacement
Timaru–T8 transformer replacement with a 250 MVA unit
Waihou 110 kV upgrades for future connection of Tauhei solar farm
Waikato and Upper North Island Automatic Overvoltage Capacitor Switching Scheme
Waimangaroa substation bypass and dismantle
Waiotahe Lodestone solar farm 33 kV connection
Waiotahe–T1 and T2 transformer replacement
Wiri outdoor switchyard to indoor switchboard conversion

2.2 Load and generation

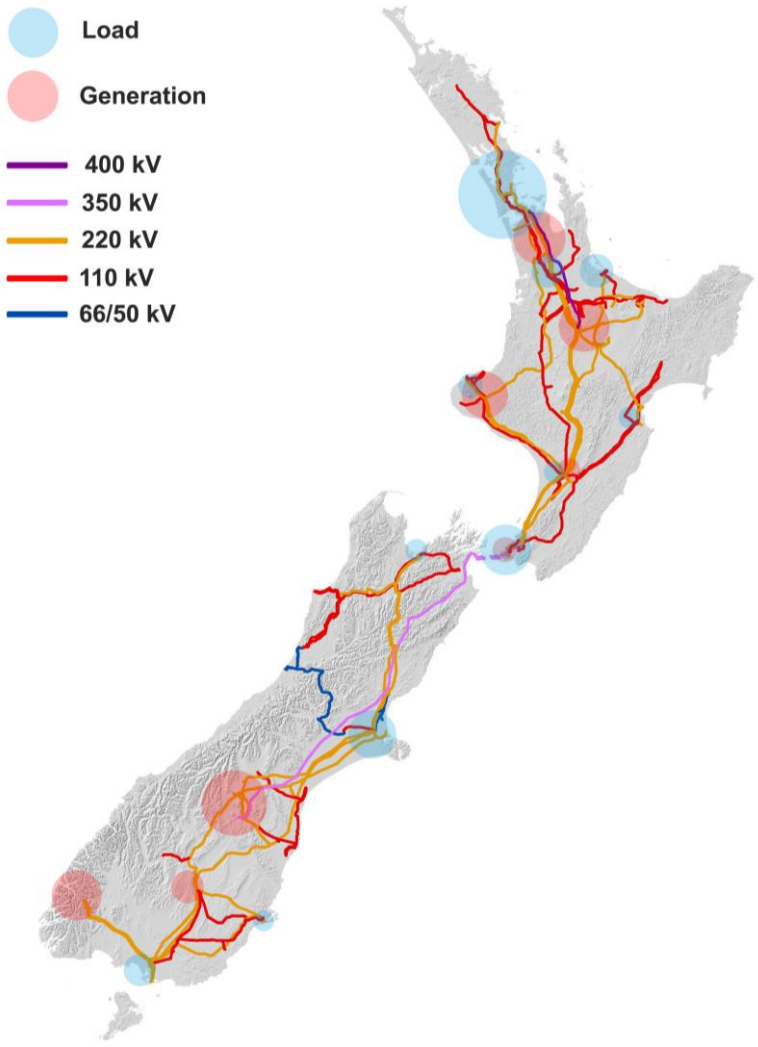
New Zealand's transmission network is narrow and longitudinal, with areas of demand (load) generally some distance from the areas of significant generation. The transmission network is

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

essential to transport electricity to where it is needed, as well as to balance demand and generation between the Islands.

Figure 2-3 shows a simplified map of load, generation, and our transmission network. Demand and generation assumptions are discussed in more detail in Chapter 3, and the transmission backbone in Chapter 6.

Figure 2-3: Load, generation and our transmission network



Many of New Zealand's larger population centres are located in the North Island, while a significant amount of hydro generation is located in the South Island.

HVDC power flow is predominantly northward during normal hydrological periods, when available generation exceeds South Island demand. During 'dry' hydrological periods in the

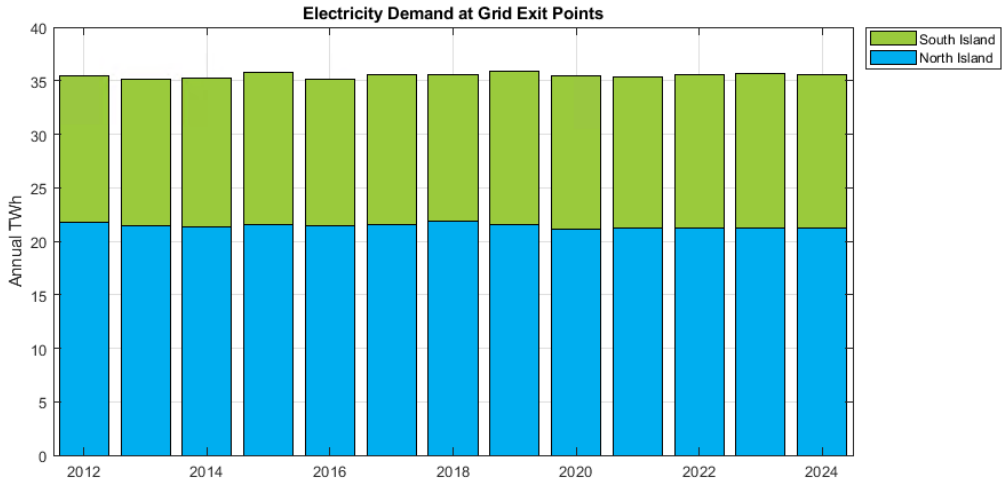
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

South Island, extended southward flow occurs as South Island generators conserve water. Long periods of southward transfers have occurred in recent years.

2.2.1 Historical electricity demand

Figure 2-4 shows New Zealand's electricity demand as measured at grid exit points over the past thirteen years[1].

Figure 2-4: New Zealand grid exit point electricity demand (TWh)



Total electricity offtake from the transmission grid has been flat over this period, particularly when compared to the strong growth in demand seen in earlier decades. Of interest is that this lack of growth occurred despite the strong national population growth of 21% since December 2011[2] and economic growth as measured by real GDP of 42%[3].

The Ministry of Business, Innovation and Employment's (MBIE) gross electricity consumption data[4] reports a 2.2% reduction in total electricity consumption in 2024 from the pre-Covid level reported for 2019 (see Figure 2-5). This fall was driven by a downturn in demand from the Wood, Pulp and Paper and Chemicals sectors only partially offset by the growth in Food Processing and Residential demand. Furthermore, the New Zealand Aluminium Smelter entered into a demand response agreement for 2024[5] resulting in an annual reduction of approximately 580 GWh over the year. NZAS is expected to be at full capacity again in April 2025. The contraction in the Wood, Pulp, Paper and Printing sector has been sharp at 58% since 2019 (before including the closure of the paper machines at the Kinleith Mill in June 2025).

1 Excludes generation embedded within the distribution networks.

2 Source: Population | Stats NZ

3 Source: Gross Domestic Product (M5) - Reserve Bank of New Zealand - Te Pūtea Matua

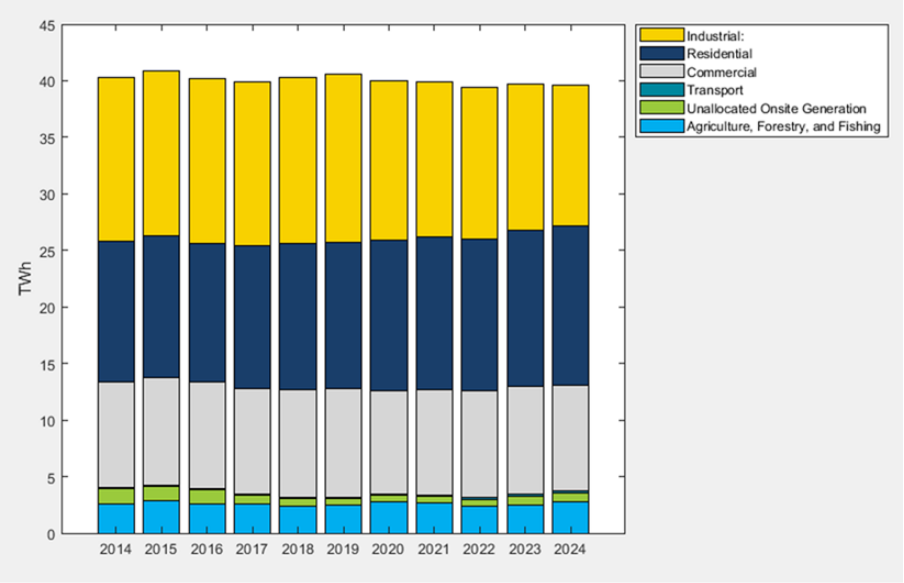
4 Source: Electricity statistics | Ministry of Business, Innovation & Employment

5 Source: The Tiwai Point smelter demand response in winter 2024 | Electricity Authority

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Residential power demand has grown with a compound annual growth rate of 1.2% over the last 10 years. Average annual consumption per residential ICP is around 7,200 kWh, lower that its 10-year high of 7,350kWh in 2021.

Figure 2-5: evolution of New Zealand gross electricity demand by sector (TWh)



2.2.2 Existing grid-connected generation

Table 2-4 lists the operating capacities of existing grid-connected generators larger than 10 MW[6].

Table 2-4: Existing grid-connected generation

Generation plant	Region	Type	Operating capacity in MW	Grid injection point
Ngawha[1]	Northland	Geothermal	35	Kaikohe
Glenbrook[1]	Auckland	Cogeneration	74	Glenbrook
Kawerau	Bay of Plenty	Geothermal	107	Kawerau
Matahina	Bay of Plenty	Hydro	80	Matahina
Aratiatia	Central North Island	Hydro	78	Aratiatia
Nga Awa Purua	Central North Island	Geothermal	140	Nga Awa Purua
Ngatamariki	Central North Island	Geothermal	82	Nga Awa Purua
Ohaaki	Central North Island	Geothermal	56	Ohaaki
Poihipi	Central North Island	Geothermal	51	Poihipi
Rangipo	Central North Island	Hydro	120	Rangipo
Tararua III	Central North Island	Wind	93	Tararua Wind Central
Te Apiti	Central North Island	Wind	90	Woodville
Te Mihi	Central North Island	Geothermal	175	Te Mihi
Te Rere Hau	Central North Island	Wind	49	Tararua Wind Central
Turitea	Central North Island	Wind	221	Linton
Tokaanu	Central North Island	Hydro	240	Tokaanu
Wairakei	Central North Island	Geothermal	132	Wairakei
Harapaki	Hawkes Bay	Wind	176	Harapaki
Kaitawa	Hawkes Bay	Hydro	36	Tuai

6 Installed capacity may differ from operating capacity in some cases.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Generation plant	Region	Type	Operating capacity in MW	Grid injection point
Piripaua	Hawkes Bay	Hydro	42	Tuai
Tuai	Hawkes Bay	Hydro	68	Tuai
Tauhara	Hawkes Bay	Geothermal	174	Tauhara
Whirinaki	Hawkes Bay	Diesel	156	Whirinaki
Junction Road	Taranaki	Gas – OCGT	98	Junction Road
McKee	Taranaki	Gas - OCGT	94	Motunui Deviation
Taranaki CC	Taranaki	Gas - CCGT	383	Stratford
Stratford Peaker	Taranaki	Gas - OCGT	220	Stratford
Waipipi	Taranaki	Wind	130	Waverly
Arapuni	Waikato	Hydro	198	Arapuni
Atiamuri	Waikato	Hydro	84	Atiamuri
Huntly Rankines	Waikato	Coal and Gas	750	Huntly
Huntly Unit 5	Waikato	Gas - CCGT	403	Huntly
Huntly Unit 6	Waikato	Gas - OCGT	51	Huntly
Karapiro	Waikato	Hydro	112	Karapiro
Maraetai	Waikato	Hydro	360	Maraetai
Ohakuri	Waikato	Hydro	112	Ohakuri
Waipapa	Waikato	Hydro	51	Maraetai
Whakamaru	Waikato	Hydro	126	Whakamaru
West Wind	Wellington	Wind	143	West Wind
Argyle/Wairau	Nelson/Marlborough	Hydro	11	Argyle
Coleridge	Canterbury	Hydro	41	Coleridge
Aviemore	South Canterbury	Hydro	232	Aviemore
Benmore	South Canterbury	Hydro	540	Benmore
Ohau A	South Canterbury	Hydro	264	Ohau A
Ohau B	South Canterbury	Hydro	212	Ohau B
Ohau C	South Canterbury	Hydro	212	Ohau C
Tekapo A	South Canterbury	Hydro	30	Tekapo A
Tekapo B	South Canterbury	Hydro	154	Tekapo B
Waitaki	South Canterbury	Hydro	90	Waitaki
Clyde	Otago/Southland	Hydro	464	Clyde
Manapouri	Otago/Southland	Hydro	820	Manapouri
Roxburgh	Otago/Southland	Hydro	320	Roxburgh

1. This includes only the grid-connected generation. This generation station is partially embedded.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

3 Forecasting demand and generation

3.1	Whakamana i Te Mauri Hiko
3.2	Historical peak demand growth
3.3	Demand forecasting methodology
3.4	National peak demand forecasts
3.5	Generation development modelling
3.6	Uncertainty and investment planning

This chapter provides as overview of how we construct demand forecasts and potential generation development paths to inform our grid planning process.

3.1 Whakamana i Te Mauri Hiko

In our 2020 publication Whakamana i Te Mauri Hiko1 we outlined a pathway to decarbonisation facilitated through the uptake of technologies, such as electric vehicles (EV), solar photovoltaic (PV) panels, battery storage, electrification of industrial processes, and development of renewable generation opportunities. Collectively, it highlighted the high potential for decarbonisation to significantly impact future demand and generation in Aotearoa New Zealand.

In *Whakamana i Te Mauri Hiko* we outlined a range of potential future energy scenarios. These were developed after considerable engagement with the electricity sector and a wide range of industry stakeholders. After considering feedback we decided to use the *Accelerated Electrification* scenario as our base case. This scenario foresees the evolution of a stronger, more reliable energy system with a much lower reliance on fossil fuel imports, electrification of much of the transport and industrial heat sectors and reduced overall energy costs. It assumes a strong role for energy efficiency and sees smart demand solutions assisting to manage peak demand. It also sees increasing levels of solar and battery installations, either grid-connected or distributed. The uptake rate of these technologies before 2025 was seen to be relatively modest but then to accelerate. In most regions the effect of these technologies will not become evident until after 2030.

We continue to believe the *Accelerated Electrification* scenario is a realistic and aspirational scenario for New Zealand and a suitable base case for our modelling. Our most recent *Whakamana i Te Mauri Hiko* monitoring reports[2] highlight that most indicators are consistent with the *Accelerated Electrification* scenario. They observe that:

- EV uptake is broadly consistent with expectations. Several monitoring reports highlighted the growth in EVs supported by the Clean Car Discount (CCD) policy. Since this was discontinued there has been a drop in monthly registrations of new EVs. Nevertheless, other indicators, such as the increase in heavy EV numbers, and narrowing of EV purchase price parity give confidence that uptake is broadly consistent with our forecasts.
- There is strong uptake of distributed solar, both for residential and commercial installations. The total number of residential solar installations has grown by an average of 35% per year and is currently above the Accelerated Electrification scenario projection for 2025. The total amount of commercial solar installations is growing at a similar rate.
- This is increasing uptake of residential batteries. Recent statistics released by the Electricity Authority suggest uptake rates of residential battery installations are increasing.
- Industrial demand has reduced but there are signs of future growth. Electricity demand from industrial sector has reduced recently, with increased prices and the discontinuation of the Government Investment in Decarbonising Industry[3] (GIDI) fund being cited as reasons for the reduction. However, several GIDI projects are under way and will be completed by 2027, several other electrification projects have been identified as economic[4] and we see

1 TP Whakamana i Te Mauri Hiko.pdf

2 Whakamana i Te Mauri Hiko - Empowering our Energy Future | Transpower

3 Approved GIDI projects | EECA

4 Regional Energy Transition Accelerator | EECA

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

signals for long-term growth in wider electricity demand. There is now some certainty that the Tiwai Point smelter will continue to operate following announcements from NZAS in May 2024 that it will "stay open in a 20-year deal"[5]. Data centre growth, which is a load in addition to the Accelerated Electrification scenario, is also now expected to support new electricity demand.

- Transpower's connection pipeline has increased significantly with a growing share of wind and solar capacity in the pipeline. Solar projects now make up the largest share of projects in advanced stages, with around two-thirds of projects being in the investigation stage.
- A Governmental focus on developing renewable energy. In August 2024, the Government announced next steps on electrifying New Zealand under its Electrify NZ[6] plan. This signals a focus on renewable generation investment and enabling transmission and distribution infrastructure with a policy to double renewable energy by 2050. To enable this, the Government is undertaking steps to remove red tape to support regulatory certainty and facilitate private investment, including a more enabling consenting pathway for renewable energy, updated regulatory settings and a stronger national direction for renewables.
- Our most recent report[7] also highlights that there is broad consensus with the future expectations of electricity demand with the Boston Consulting Group (in their *Future is Electric* report), Climate Change Commission and MBIE Electricity Demand and Generation Scenarios, all suggesting the potential for strong demand growth. The Summary conclusion states: "Our indicators confirm we are in the stages of a push towards a more renewable electricity system and a new period of electrification growth. For this reason, New Zealand could remain on the base case *Accelerated Electrification* trajectory."

For these reasons we used *Whakamana i Te Mauri Hiko's Accelerated Electrification* scenario as the basis for our planning in this publication. The updates we made to it continue to be relatively minor and driven mainly by more recent historical data becoming available.

3.2 Historical peak demand growth

Figure 3-1 shows New Zealand's peak grid demand[8] from 1997. Up to 2007 peak demand grew an average 1.5% per annum. Since then, peak demand has been relatively flat, although in recent years it has started to show signs of sustained growth. During the period from 2007 there were some years where peak demand has increased significantly from previous years. This is normally associated with an abnormally cold weather event and highlights the year-on-year volatility of peak demand. For example, the increase in 2011 was the result of an unusual polar weather event; and in 2021 we saw peak demand growth of 3.4% recorded on August 9th, one of the coldest nights of the year.

Transpower conducts annual reviews of the winter peak in the context of security of supply. Over the last two years we have observed:

- Between 2019 and 2023[9] peak demand has increased by approximately 1.5 – 2% per annum – based on analysis of the top 20 daily peaks in each year, strengthening the notion that year-on-year peak demand is growing. With the exception of 2011, the top 10 daily load peaks all occurred in the last three years. The following factors appear to be contributing to peak demand growth:
  - Underlying demand growth being masked during 2019/20 by warmer winters and Covid.
  - The residual effects of the RCPD[10] removal.
  - Household growth, with an increase of approximately 35,000 new connections per annum.
  - Electrification, shifting demand from fossil fuels to electricity.
- In 2024 the winter peak[11] reduced, not only in the peak but in all statistics of the top 20 daily load peaks. Our view is that this was largely due to reduced industrial load resulting from higher spot market prices and warmer temperatures. This included up to ~205 MW of Tiwai

5 NZAS media release – 31 May 2024

6 Next steps on Electrifying New Zealand | Beehive.govt.nz

7 Whakamana i Te Mauri Hiko Monitoring Report – October 2024

8 New Zealand Peak Grid Demand is taken as the maximum value seen of the sum of the demands across all grid exit points in any half-hour in each calendar year.

9 Winter 2023 Review – Transpower

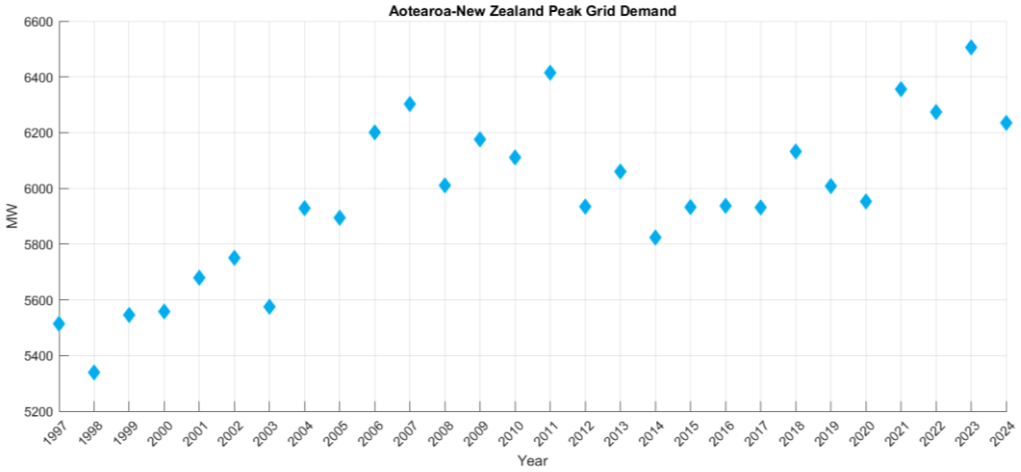
10 Regional Coincident Peak Demand (RCPD) was a transmission charge that was based on usage at peak demand periods and incentivised participants to limit peak demand usage.

11 Winter 2024 Review – Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

aluminium smelter demand reduction through its contractual arrangements with Meridian Energy. Lower peak demand periods in 2024 contributed to lower capacity risks this winter when hydrology was low.

Figure 3-1: New Zealand peak grid demand (MW)



While the figure above shows national annual peak demand, we also consider the historical demand by island and region and by season[12]. In some drier regions there has been strong demand growth because of new irrigation schemes to service dairy production expansion, leading to strong growth in summer peak demand. The South Canterbury region has seen these effects and is now summer peaking. The West Coast and Canterbury regions have also seen summer peaks in some but not all recent years.

3.3 Demand forecasting methodology

To support development of *Whakamana i Te Mauri Hiko* we enhanced our demand forecasting models to capture future complexities associated with the uptake of technologies such as electric vehicles, solar photovoltaic panels, battery storage and industrial electrification. These technologies have the potential to significantly impact peak demand. For example, the timing of electric vehicle charging is a critical consideration in forecasting their impact on peak demand. Battery storage may be used to store electricity generated at times of low demand and discharged at peak times to reduce peak demand. Our forecasting models consider how demand profiles across a day can change with the uptake of these technologies. Within our modelling the "smartness" associated with electric vehicles and battery uptake has a significant impact on moderating growth in peak demand.

To forecast demand, we developed a two-stage modelling process outlined in more detail below. Stage 1 considers how underlying, business-as-usual growth will evolve. In this stage we consider specific information from distribution companies and major electricity users about their expectations of future demand. Stage 2 considers how the uptake of electric vehicles, solar photovoltaic panels, battery storage and industrial electrification will impact demand. Our process incorporates information from a wide range of sources as is shown in Figure 3-2.

In Stage 1 we use both top-down and bottom-up approaches to forecast growth in underlying peak demand. For national, island and regional peak forecasts, we use an ensemble of models[13] (trend, econometric, etc.) to produce forecasts based on historical peak values. At a GXP level we rely on forecasts from Electricity Distribution Businesses' (EDBs) to derive base level GXP peak forecasts, known or expected step load increases, load shifts and to corroborate the effect of Stage 2 components.

Our Stage 2 process first uses the hierarchy of peak forecasts (i.e. national, island, regional, and GXP) in combination with historical half-hourly profile data to create half-hourly base profiles for all GXP's, regions, islands and the nation. These profiles represent the 'organic growth' which are independent of step loads or extra electrification. The profiles are reconciled to best agree with the peak forecasts at all levels of the hierarchy (i.e. national, island, regional

[12] Winter is 10th May to 19th October, Shoulder is 15th March to 9th May and 20th October to 30th November, Summer is 1st Dec to 14th March (of the next calendar year)

[13] Use of an ensemble approach combines forecasts from different forecasting models, such as trend and econometric models, to derive a forecast of the underlying growth. Our approach derives a distribution for future demand growth that we use to inform the construction of a prudent forecast.

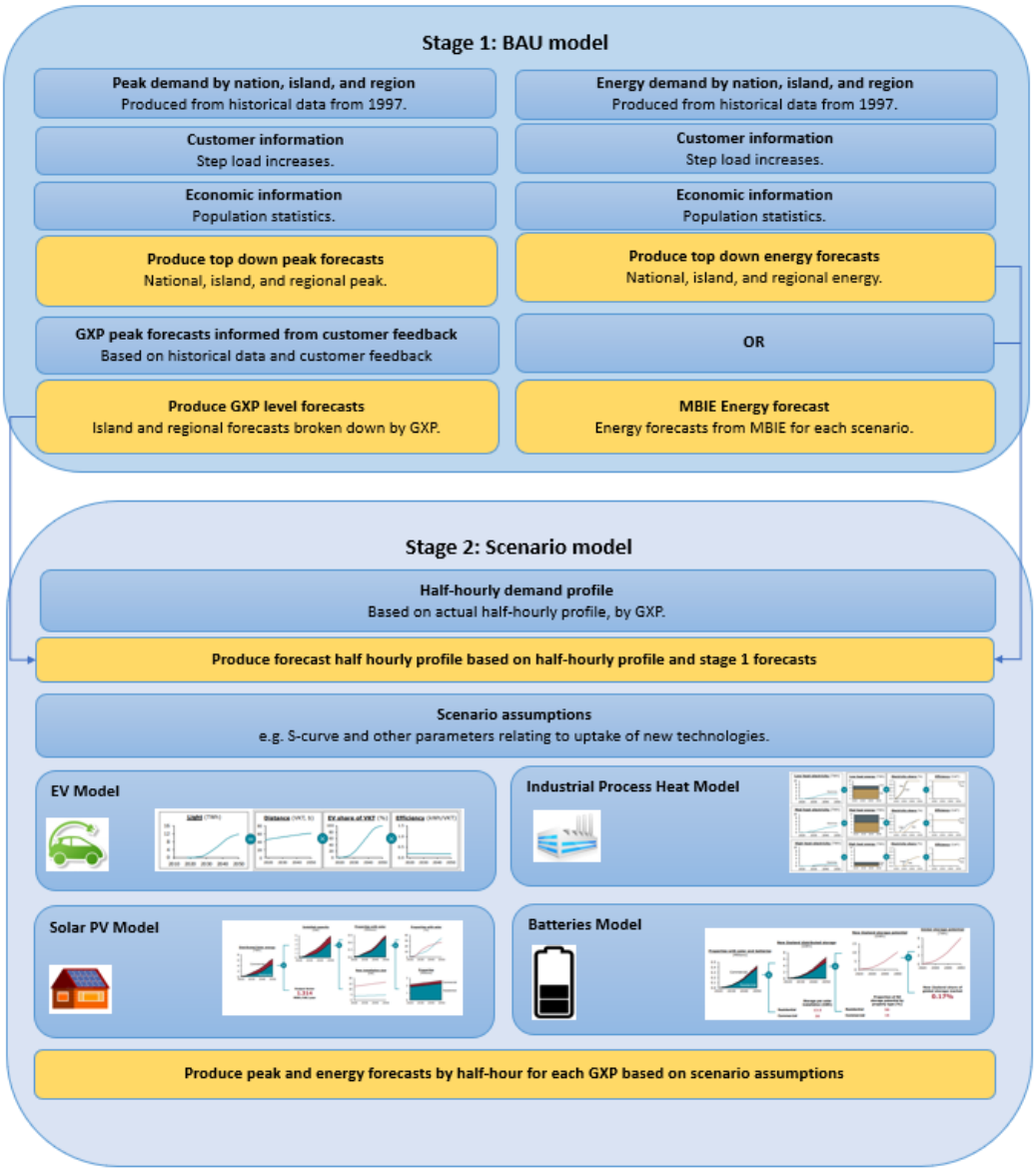
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

and GXP) using a standard approach[14]. The weighting of the reconciliation provides the ability for the forecasting model to focus strongly on the EDBs input and regional forecast for the first 7-12 years before transitioning to a weighting that favours the top-down forecast in the longer term. The profiles are then adjusted to match the national and island level energy forecast.

The Stage 2 process enables consideration of how the underlying Stage 1 forecasts (including both energy and peak demand) may be affected by an assumed uptake of decentralised solar PV, electric vehicles, residential battery storage and the electrification of industrial heat processes. As outlined in Section 3.1 we use the *Whakamana i Te Mauri Hiko Accelerated Electrification* scenario to inform these assumptions.

We continue to consider the impact of distributed generation. Metered data supplied by the NZEM Reconciliation Manager on existing distributed generation is used to forecast gross demand supplied by the grid and by distributed generation plant. From this we derive grid demand forecasts by making assumptions about the generation output we expect from existing distributed generation at times of regional and island peaks[15].

Figure 3-2: Demand modelling flow diagram



[14] 11.3 Forecast reconciliation | Forecasting: Principles and Practice (3rd ed)

[15] Future distributed generation development is discussed in our generation section.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

3.3.1 Prudent forecast

For the TPR we use a 'prudent' peak demand forecast. As highlighted in Section 3.2, historical demand can vary significantly from year to year because of unusual weather events and other factors. To account for this, we add an additional risk factor to our forecast. This is to ensure that in most situations we do not invest too late such that demand cannot be supplied at a peak time when it may be needed most (e.g. a winter night). In effect, we add an additional component to peak demand to account for the potential for unusually high levels of demand. We determine the amount to add by calculating in our Stage 1 models both the expected level of base peak demand and the 10% probability of exceedance base peak demand (P90)[16]. A prudent base forecast follows the P90 forecast for the first 7 years then grows as the same rate as the expected forecast. The ratio of the Stage 1 prudent base growth to expected base growth is then used to scale up the final peak demand from the Stage 2 output to give the final "prudent" forecast.

3.3.2 Grid Exit Point forecasts

As part of our annual survey of demand we sought the views of the EDBs who are well-placed to advise on local growth. This year we received responses from all distribution companies, including their expectations of base demand growth and information on likely step changes in demand from new or expanding consumers, industrial plant retirements and information about likely shifts of demand between different GXPs.

EDBs were asked to provide a likelihood of a step load occurring based on the criteria shown below, and an estimate of the 'Earliest Year' and the 'Expected Year' that a step might appear.

Likelihood	Notes to inform confidence
90-100%	Committed projects, projects with finance, consents, construction contracts etc.
75-90%	Projects where some aspects of the project have been completed (e.g. consents and finance) but some still have to be completed (e.g. construction contract).
50-75%	Projects that are likely to take place but aspects of the project are still to be finalised.
0-25%	More speculative projects that are still highly uncertain

The size of the steps in MW was requested both for summer and winter seasons. The steps were designated as either 'Nameplate' or 'Expected GXP Increase'. Steps designated as 'Nameplate' were given an appropriate half-hourly profile with the given step's size. Steps designated as 'Expected GXP increase' were given a profile that increased the GXP peak by the amount given.

In this forecast we based the timing of the step on the "Earliest Year" specified by the distribution companies. We varied the likelihood threshold used to decide which step is included in the forecas addross the forecast period. For the 2025 forecast year we used a threshold of 50%, for 2026 and beyond a threshold of 30% was used. If a step with an 'Earliest Year' of 2025 didn't meet the 50% threshold, but did meet the 30% threshold in its 'Expected Year', it was included in the forecast in the expected year.

3.3.3 Process Heat

Process heat assumptions are a scenario assumption made at a national level. We use the following steps to avoid double counting and to dissaggregate the top down down assumption.

1. The information we receive from EDBs frequently identify step loads as process heat, the energy associated with these steps is removed from the top down total.
2. Projects identifed by RETA[17] studies of which we are not notified by EDBs are included as steps, and the energy associated with these steps is removed from the top down total. The timing of these steps is given in the RETA studies
3. A proportion of the top down energy is assocated with the electrification of dairy factories. Such loads would be large and site specific, so if we haven't been notified of this by an EDB, and it is not identified in a RETA studies, in is not included. The

[16] This is equivalent to a P90 forecast, in which peak demand has a 90% chance of being less than the prudent forecast. Put another way, we expect actual peak demand to exceed the forecast in just one year in ten.

[17] Regional Energy Transition Accelerator | EECA

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

energy associated with unallocted dairy plant electrification is removed from the top down total.

4. A boiler survey commissioned by Transpower and the Energy Efficiency and Conservation Agency (EECA) provided site specific estimates of loads associated with potential electrification. Where these projects were not identified as customer steps, or as RETA projects, a load was added and the associated energy was removed from the top down total. The timing of these dissaggreated loads is given by the boiler survey.
5. After the top down energy assocated with the site specfic projects of 1,2 and 4 is removed and the energy associated with step 3 is removed, the remaining top down energy is dissaggregated pro rata around the non-industrial GXPs, using the timing determined by the scenario assumption.

3.3.4 Electric Vehicles

EV uptake is a scenario assumption made at a national level. Our disaggregation process uses data relating to the industrial classification of ICPs behind each GXP to identify how many residential and transport related ICPs are behind each GXP. This proportion gives one set of data with which we can pro rata EV load. We use a second data set, the existing load across non-industrial GXPs, to create a second pro rata data set. The two data sets, weighted at 25% towards transport related ICPs and 75% towards existing load are averaged to determine our initial disaggregation of EV load.

We solicited information from EDBs about Vehicle Kilometres Travelled (VKt) behind GXPs. Where this was provided we used these VKt numbers for the early period of the forecast and then transitioned to using our original disaggregation in the latter part of the forecast. The profile used for fixed, or convenience, charging is drawn from an Australian study[18].

The fraction of smart charging EV's grows during the forecast period. Smart charging EVs behind a GXP are assumed to be attempting to avoid the region peak. Smart charging EVs can occasionally contribute to the GXP peak but will not add to the region peak.

3.3.5 Distributed solar and batteries

Distributed solar and battery uptake is another scenario assumption made at national level. To disaggregate this information we start by using EMI[19] data relating to current levels of residential, commercial and industrial solar installations by Network Service Participant (NSP). The early years of our solar residential top-down forecasts are modified to agree with the current residential installation and these current values are used for the disaggregation of total future installations. Installations on commercial premises represent a smaller total capacity. For these installations we use our top-down forecast without modification. The installation capacity is disaggregated based on assumptions about the propensities of commercial enterprises to add solar, together with data relating to industrial classification of ICPs.

Regional monthly average irradiance profiles are used from the Solarview Calculator provided by NIWA[20] to estimate the generation from the installed capacity.

We solicited information from EDBs about current numbers of battery installations behind each GXP. Where these were provided, they were used for disaggregation and serve as the starting point for our top-down forecast. For other GXPs, the data from EMI is considered. The battery installation numbers published by EMI vary considerably by EDB and were only used when the numbers reported for a NSP appeared reasonable, otherwise our top down assumptions were used. The batteries were assumed to charge during GXP troughs and discharge into GXP peaks.

3.4 National peak demand forecasts

Figure 3-3 shows our latest national peak demand forecast compared to the 2023 TPR. In our 2023 TPR we assumed NZAS would close at the end of 2034. Recent announcements of a 20-year contract means that the smelter's future is more certain and we have assumed it will remain operating for the entirety of the forecast horizon.

The base peak growth (dashed line) remains very similar between 2023 and 2025, dropping slightly from 1.0% to 0.9% with a slight downwards movement of around 90 MW. The growth

[18] https://www.aer.gov.au/documents/aemo-2023-iasr-assumptions-workbook-august-2023-1

[19] Electricity Authority's Electricity Market Information

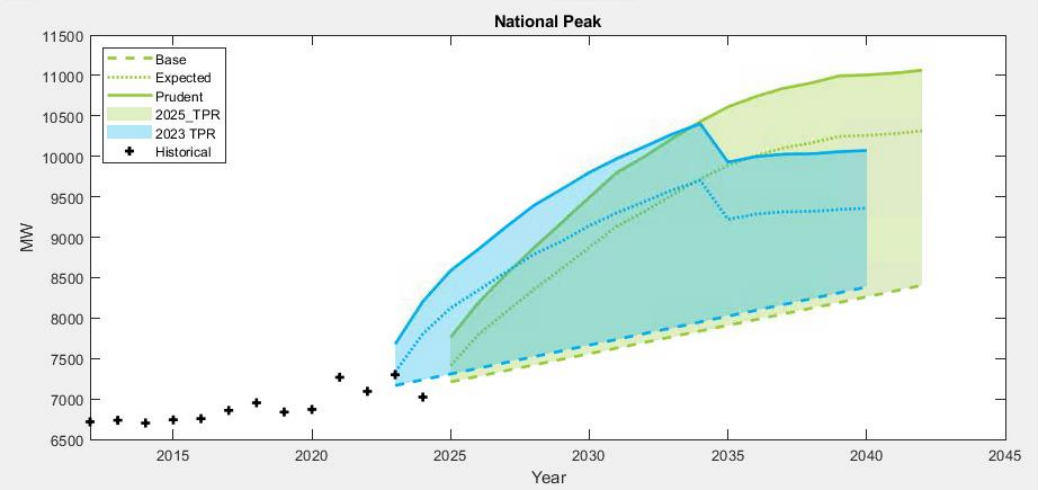
[20] Solarview - NIWA

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

initially forecast from EDBs steps for the first 2 years in 2023 (represented by the blue dotted line) hasn't materialised, but in this year's forecast EDBs are still optimistic of step load increases in the coming years. By 2033 the two forecasts (TPR 2023 and TPR 2025) reach a similar value.

The shaded region indicates the evolution of the scenario from the Stage 1 base growth (dashed line) to the expected forecast from the Stage 2 forecast (dotted line) and finally the prudent forecast (solid line).

Figure 3-3: Comparison of 2025 TPR peak demand forecast to the 2023 TPR



3.5 Generation development modelling

In addition to demand growth, generation development (expansion and retirement) materially impacts transmission requirements. This section sets out our assumptions and approach to developing a view of generation development.

3.5.1 Generation development assumptions

Our assumptions are described in detail in the Benefit Based Charges Assumptions Book, version 2.0.

3.5.2 Generation development forecasts

Our future view of generation development focuses on the cost of new generation. We use PSR Inc's 'OptGen' modelling software[21] to effectively step through time (out to 2040 in this case), building new generation as required to meet forecast demand. It chooses new generation from a generation stack with the overall objective of minimising the total cost of electricity dispatched over the period being considered. This is done in two separate stages:

- Operating costs (for new and existing generation) are estimated using PSR's SDDP generation dispatch simulation model. Operating costs account for hydro energy variability, hydro uncertainty, and renewable energy variability.
- Operating costs are fed into a separate algorithm to determine the least cost combination of generation capital and operating costs.

Optgen can be configured with several different possible generation, energy or capacity constraints. We applied a maximum wind and solar installed capacity constraint such that only 1,000 MW of wind or solar can be built within a given year.

The time frame for new generation to be commissioned is typically much shorter than for a major transmission upgrade, particularly for grid-scale solar, batteries, and onshore wind. The economic consequence of transmission being built *a few years too early* versus *a few years too late* can be highly asymmetric and generation investors need confidence the grid will be ready when connection is required. Our generation expansion modelling helps us understand the likely timing/location of new generation.

[21] More information can be found on the OptGen website.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 3-1 shows the region and technology type of new generation that may be built out to 2040. Our modelling suggests solar and wind generation will dominate future generation capacity, accounting for almost 8.7 GW by 2040. Modelled future generation is sensitive to assumptions but highlights the role wind and solar is expected to play in New Zealand's energy future. As part of process of undertaking power system studies we made minor amendments to the model outputs to align with more recent information. Table 3-1 reflects these amendments.

The generation expansion also includes a significant amount of new grid-scale batteries, about 0.4 GW by 2035 increasing to around 1 GW by 2040 with most grid batteries expected to be deployed in the North Island. In our analysis we place them strategically to help identify potential issues and opportunities that may arise for grid-scale batteries.

Table 3-1: Cumulative new generation capacity by type (does not include generation retirements)

	Northland	Auckland	Waikato	Bay of Plenty	Central North Island	Taranaki	Hawkes Bay	Wellington	Nelson-Marlborough	West Coast	Canterbury	South Canterbury	Otago-Southland
2030													
BESS	0	100	100										
Geothermal				55	82								
Peaking plant													
Hydro													
Solar	130		467	177	25		200				150		
Wind	765	80	182		878		50						605
2035													
BESS	16	180	156		77								
Geothermal				55	15								
Peaking plant													
Hydro													
Solar	130	200	767	356	25		600				150	200	
Wind	1027	80	182		1349		50				292		957
2040													
BESS	16	364	284	40	77	22	96	60				80	
Geothermal				55	15								
Peaking plant						182							
Hydro												35	17
Solar	210	920	1087	377	25		780				170	400	
Wind	1347	180	257		1360		150	65			292		1096

Most of the existing thermal generators are assumed to be retired by 2040, as detailed below:

- Taranaki Combined Cycle (383 MW) retired by end 2025
- all three Huntly Rankine units (750 MW) retired in 2030
- both Stratford Peakers (220 MW) retired in 2035
- Huntly Unit 5 (403 MW) retired in 2037
- McKee Peakers (94 MW) retired in 2038

3.6 Uncertainty and investment planning

We believe that the *Whakamana i Te Mauri Hiko Accelerated Electrification scenario* is a realistic and aspirational scenario suitable to inform our planning but we also recognise that many uncertainties remain. System planning is complicated by these uncertainties as new developments can significantly impact how the grid operates and where capacity constraints may occur. We accept that this is the case and do attempt to take these uncertainties into account when considering upgrades to the grid, both in this publication and in more detailed investigations of identified issues. Considering alternative scenarios and sensitivities are key tools we use to explore these uncertainties.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

4 Enhancement and Development Portfolio

4.1	Regulatory context
4.2	Enhancement and Development planning process
4.3	Building the RCP4 portfolio
4.4	Major capex projects

This chapter consists of three main parts:

- an overview of our regulatory context and how we build our Enhancement and Development (E&D) portfolio
- an annual snapshot of our E&D portfolio base capex funding requirements[1], how we are tracking against our RCP4 base capex allowance and, for the first two reporting years in RCP4, a view of further base capex funding requirements expected within RCP4 to inform the mid-reopener process.
- An annual snapshot of our major capital project requirements (for investments over $30 million). These projects are subject to individual approval processes and are not included in the RCP4 baseline funding for the E&D portfolio.

Customer-funded investments are funded through contracts (known as a Transpower Works Agreement) between Transpower and the customer (primarily covering connection assets). As such, these investments are not included in our regulatory submission (for the E&D portfolio or otherwise). Our views of the customer-funded investments that will be required are set out in the relevant regional chapters of this TPR. The decision to investigate and invest primarily resides with the customer. We identify and publish n-1 grid issues within the planning time frame in each of the regional chapters (Chapters 7 to 19). For further information customers are encouraged to contact us.

4.1 Regulatory context

Transpower is regulated by both the Electricity Authority and the Commerce Commission. The Electricity Authority is regulator of New Zealand's electricity industry, it makes and administers the Electricity Industry Participation Code 2010 (EIPC or the Code). The Commerce Commission on the other hand has the role to set the maximum revenue Transpower can recover from consumers to run the National Grid efficiently.

4.1.1 Electricity Authority

The Code, which the Electricity Authority is responsible for, is a set of rules that govern nearly every aspect of the New Zealand electricity industry. Transpower's function, as grid owner, is largely governed by part 12 of the Code – Transport. Our activities as grid owner are also governed by part 8 – Common Quality.

The Code, among other things, prescribes the Grid Reliability Standards (GRS). The purpose of the GRS is to provide a basis for Transpower – as Grid Owner – to appraise opportunities for transmission investments and transmission alternatives to resolve core grid and non-core grid needs.

The Grid Reliability Standards include:

- an economic (probabilistic) standard for the whole grid, and
- a "safety net" minimum reliability standard of N-1 for contingencies on the Core grid[2].

We use the GRS to guide our decisions on E&D expenditure required to resolve system needs.

1 E&D base capex expenditure covers all grid enhancement projects that are under $30 million

2 The Core grid is determined by the Electricity Authority and prescribed in the Code.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

4.1.2 Commerce Commission

Since April 2011, Transpower has been regulated by the Commerce Commission by way of individual price-quality regulation. The individual price-quality path governs Transpower's revenues for each pricing year, with the paths being reset every 4 or 5 years. We are currently on the fourth regulatory period (RCP4) which started on 1 April 2025.

Each of our E&D project or programme is categorised as a major capex project (MCP) if forecast capital expenditure is greater than $30 million or otherwise its categorised as base capex. Our base capex E&D funding is subject to the individual price-quality path described above.

MCPs are separate proposals to seek approval, from the Commerce Commission, for certain capital investment projects greater than $30 million. These proposals are separate to the allowance under the individual price-quality path. The Capital Expenditure Input Methodology (Capex IM) sets out the requirements Transpower follows when preparing MCPs and the criteria that the Commerce Commission uses to review and approve an MCP.

4.2 Enhancement and Development planning process

E&D system needs are identified, investigated, and progressed through the E&D planning process described in Appendix A of the TPR. This process connects E&D system needs to the Decision Framework and Options Assessment Approach (OAA) that is used for assessing all grid problems and opportunities including replacement, refurbishment, and maintenance expenditure.

E&D system needs, covered by the TPR, excludes resilience investment needs which are also classed as E&D expenditure under our regulations. Resilience investment needs are covered by our Asset Management Plan (AMP).

4.2.1 Drivers of E&D System Needs

Drivers of E&D system needs are varied and often complex, with a myriad of intersecting issues requiring consideration and resolution. As our external environmental changes, so too does demand and generation. This gives rise to E&D system needs as the transmission grid must change to meet agreed or mandated service, security, or reliability standards. A change may increase or decrease grid capability, depending on the driver, and may be used to elicit a range of system outcomes including:

- providing adequate capacity to generators or connected loads
- matching reliability or security of supply to the required standard or agreed service level
- maintaining or improving power quality measures
- maintaining grid stability during and following power system disturbances.

Asset health and criticality may also drive E&D system needs where, when making replacement and refurbishment decisions, our considerations identify the need for future grid capability change.

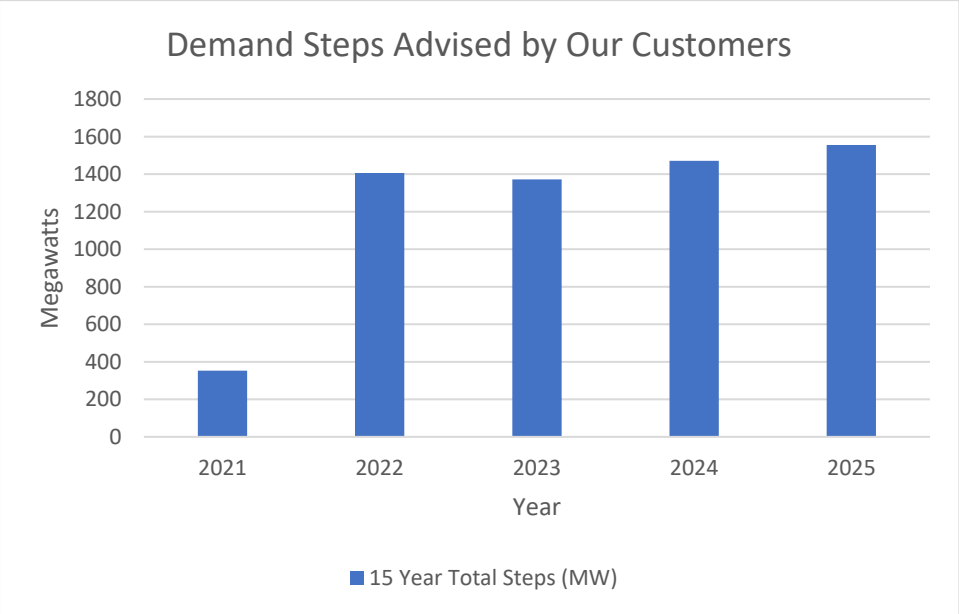
External environment

As mentioned above, most E&D system needs reflect changes to electricity demand and generation development, use and retirement. Historically, demand could be projected based on population, economic activity, and intensity of use. Changes in demand were gradual and there was a high degree of confidence in expectations about energy usage and forward-forecasting. This, in turn, heightened confidence in development or change in the generation landscape.

Our external environment is now changing very quickly, with step loads being committed over the next few years and more being forecasted by our customers. The decline in gas reserves and funding mechanisms for decarbonisation and driving electrification at pace.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 4-1: Demand step forecasts from customers (15 years)



Increasing forecast step loads are coupled with generation connections[3] at a scale not seen in recent history. Figure 4-2 shows the capacity of generation that are at various stages of Transpower's customer connection process, these are projects progressing beyond the enquiry stage[4]. As these projects get committed and built, the level of transmission grid constraints will inevitably increase, which is a driver for E&D investment to enable the economic dispatch of lower cost generation sources. Although Transpower's connection process gives us certainty of connection capacity and location at the investigation stage, we have little control of when the customer commits to building their generation plant. As an example, about 621 MW of wind and solar generation in the delivery stage (that we know of) is on hold awaiting customer commitment. This is an uncertainty we have to manage when developing E&D investment plans.

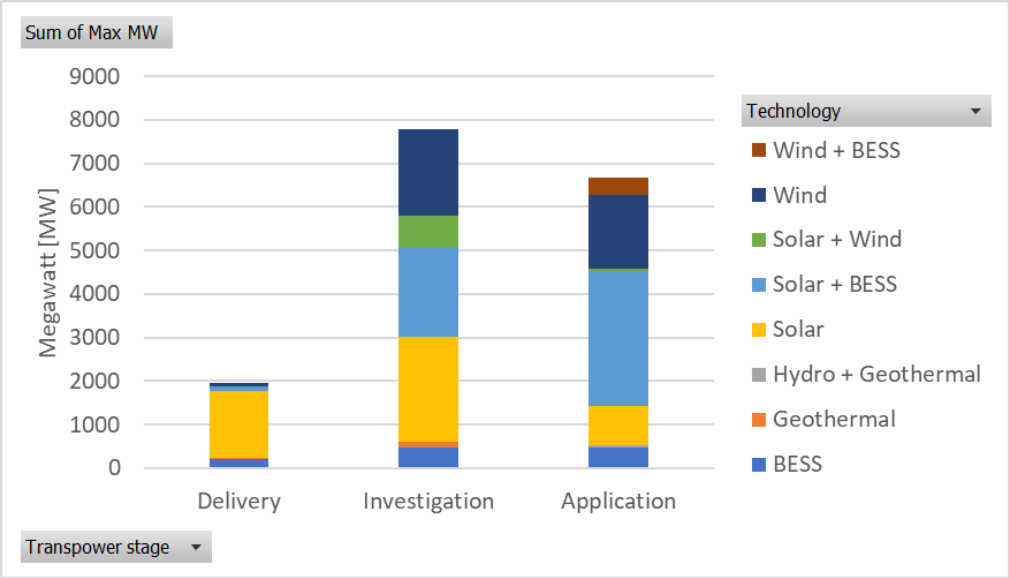
We are also aware of significant increases in the number of generation enquiries and connections within distribution networks (embedded generation). These currently don't typically trigger E&D investment needs but may do in future as more embedded generation is connected.

We are working with customers to ensure they are well informed as to the capacity of the existing transmission network and what investment may be justified if their project is committed.

3 Generation connection inquiries are predominantly wind and solar which means they can be consented, designed, and commissioned at a much faster pace than traditional thermal and hydro generation.

4 https://www.transpower.co.nz/connections/whats-latest-grid-connections

Figure 4-2: new grid connected generation capacity at different connection stages as of 7 July 2025



As such there is an acceleration in external environmental drivers of E&D system needs including:

- demand and generation changes (both increases and decreases)
- facilitating other infrastructure projects (e.g., roading, wastewater, rail, and land release for housing)
- step-load changes from industrial expansion or new industrial loads
- new technology innovation and adoption changing power flows and power quality
- climate change (e.g., irrigation requirements, resilience of the grid, hydro and wind generation patterns)
- Investments in decarbonisation, both from the government and private enterprises.

An accelerated electrification future means demand forecasting is less certain, particularly on timing of step-load changes as these are driven by individual businesses and broader factors such as alternative fuel availability and worsening global supply chains. We expect more frequent regional step-changes in load and generation, with shorter notice periods for the development and retirement of generation.

4.2.2 Planning process

E&D system needs are identified, investigated, and progressed through the E&D planning process described in Appendix A of the TPR, which connects E&D system needs to the Decision Framework and OAA. The planning process utilises power flow analysis using PowerFactory (DIgSILENT) software to identify when grid capability needs to change. The issues identified through power flow analysis become system needs in the planning process and progressed through the Decision Framework and OAA for further assessment.

As an E&D system need progresses through the process it may pass through the OAA multiple times, with more detailed optioneering each time, as the need date becomes closer and uncertainty in the environment resolves. The guiding principle to the level of detail in optioneering, costs, design and economic justification will be commensurate with the urgency and certainty of the system need.

For system needs later in the planning horizon, or less certain in terms of scope, timing or driver, the commensurate level of process detail will be high-level; relying on desktop studies, engineering judgement and high-level costings based on experience. In this situation our process drives us to focus on a ‘credible’ solution rather than identifying a ‘preferred solution’. At this point the system need will not be passed to delivery, but will be monitored for changes in drivers, credible solutions or impacts from other projects. An OAA revision date will be assigned to the project.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

As the need date of the issue advances and/or uncertainty surrounding the issue begins to resolve, we revisit the options to resolve the System Need through the OAA. We carry out a multidisciplinary investigation to develop in-depth understanding of relevant options to resolve the need; this includes consideration of transmission alternatives where appropriate[5]. The investigation presents a long list of potential investment options, reduces this to a short list of options based on predefined criteria[6], and assesses economic justification before choosing a 'preferred' solution. The preferred solution is progressed to detailed design, where cost accuracy is developed further. After detailed design is completed, final approval for investment is sought and the project is handed over to delivery groups.

The E&D system needs presented to size the E&D portfolio baseline represent a range of system needs at various stages of the E&D planning process. For some projects we have a significant amount of detail available, where the multidisciplinary investigation has commenced, or concluded. For other projects where there is an uncertainty of the driver, need date, scope, or preferred solution, we generally have only high-level information available.

These system needs and the associated uncertainty in costs is considered collectively when sizing the E&D portfolio baseline. Due to the inherent uncertainty, primarily driven by external drivers, the portfolio investments will change over time.

The fluctuations of projects into and out of the E&D portfolio is expected and welcomed, as it illustrates the robustness of the E&D planning process to volatility in the external environment and ensures the best use of funding in the interests of consumers.

4.2.3 Resulting uncertainty in E&D portfolio

The high level of uncertainty in the external environment drives the need for E&D investment decisions to deliver a 'least regrets' outcome. The decision to invest, defer expenditure or change credible solutions must be flexible for a number of credible scenarios.

As a result, the E&D portfolio is not presented as an exact list of specific investments to be made during the RCP4 period. For near term investments (extremely likely category) the projects will reflect our actual E&D investments. Projects later in the RCP4 period (highly likely and likely categories) are our best estimates to size the portfolio expenditure. We expect that some of these less certain projects may be deferred or have different credible or preferred solutions, and due to the rapidly changing demand and supply picture, there will inevitably be system needs that are not yet foreseen.

To ensure we maintain efficiency within the portfolio, we continually review investment requirements within the period as new information becomes available. New information may change our views on the certainty and or timing of investments. In deciding to progress investigations, alter preferred solutions, defer, or cancel investments we follow the relevant stages of the OAA and Decision Framework and associated approval stage-gates.

4.3 Building the RCP4 portfolio

To build our portfolio of expenditure we consider the certainty of the projects identified in the current iteration of the TPR. The demand and generation forecast and resultant system needs in the current iteration of the TPR is our latest and best available information to inform our expected investment requirements in RCP4 and beyond. We consider this the most practical way to estimate portfolio expenditure, but as noted, these are not fixed investment commitments for RCP4.

4.3.1 Methodology

We group our projects based on likelihood of expenditure using the following methodology.

[5] Transmission alternatives are considered equally alongside transmission options. To progress through an investigation from long list to short list the transmission alternative option is assessed using the same selection criteria as for transmission options including technical feasibility, future flexibility, cost, constructability/timing, environment, and property concerns.

[6] Including but limited to constructability, cost, technical feasibility, longevity of solution, least regrets outcome, benefits delivered, environmental and property concerns, operability and future flexibility.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Extremely likely projects

This category includes investment needs we are either already or imminently progressing options through the OAA to meet approval stage gates. We have confidence in projected generation or load changes, and/or that have other drivers (such as asset condition) we consider certain. Projects must meet these conditions:

- Demand driven or constraints due to committed or existing generation
- Investigation has either started or is imminent

Highly likely projects

This category reflects those investment needs we expect to progress options through the OAA to meet approval stage gates. It includes investment needs that would occur later in the regulatory control period and/or when we have more certainty on the needs (e.g. as connection investigations progress to delivery). Projects must meet these conditions:

- Demand driven or constraints due to a high volume of generation connection investigations. As a rule of thumb, where intermittent generation connection investigation(s) exceed 200 percent of n-1 capacity, or exceeds 100 percent of n capacity, or firm generation (includes intermittent plus storage) connection investigation exceeds 100 percent of n-1 capacity, or exceeds 95 percent of n capacity]
- Condition driven investments within forecast period and sufficient connection investigations and/or enquiries to trigger a need for more capacity

Likely projects

This category reflects those investment needs we may progress options through the OAA to meet approval stage gates. It includes investment needs that would occur later in the regulatory control period when we have more certainty on the needs, e.g. as connection enquiries progress to investigations or demand driven investment needs that maybe displaced by other investments (e.g. a new GXP investment nearby that may offload the constrained network or generation connection, either investigation or enquiry, which may resolve the constraint).

Projects must meet these conditions:

- Constraints due to a moderate level of generation connection investigations. As a rule of thumb, where intermittent generation connection investigation(s) between 100-200 percent of n-1 capacity], or
- high volume of generation connection enquiries. As a rule of thumb, where intermittent generation connection investigation(s) exceed 200% of n-1 capacity, or exceeds 100% of n capacity or firm generation (includes intermittent plus storage) connection investigation exceeds 100 percent of n-1 capacity or exceeds 95% of n capacity, or
- Demand driven need that may be displaced by other investments by either Transpower or Others, including new generation connections which are currently in the investigation or enquiry stage

4.3.2 Regulatory Control Period 4

This section covers our RCP4 E&D base capex allowance, current view of the E&D base capex requirements and our expected RCP4 E&D base capex top up requirements – using the mid reopener process.

4.3.3 E&D Base Capex allowance

The Commerce Commission approved $106.7 million of the proposed $111.7 million E&D expenditure. The difference consisted of $5 million for corridor management which is not related to specific projects to resolve E&D needs.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

4.3.4 E&D Base Capex allowance adjustments

RCP4 E&D portfolio downward adjustments

The Kaitimako 220/110 kV interconnection capacity and Western Bay of Plenty Voltage support projects made up the extremely likely projects list that supported our RCP4 base capex E&D portfolio funding justification. These two projects are now covered under the approved Western Bay of Plenty region MCP[7]. Therefore, we intend to request for the Commerce Commission to remove funding for these from our RCP4 Base Capex. This will reduce our approved RCP4 E&D Base Capex allowance by $30 million, E&D portfolio allowance reduces from $106.7 million to $76.7 million.

Table 4-1: Projects included in our RCP4 application that are now funded under an approved MCP

Project description	Driver for issue	2023 TPR reference	Capex investigation spend in RCP4 ($m)	Capex build spend in RCP4 ($m)
Kaitimako 220/110 kV interconnection capacity	Load growth	10.4.2	0.5	15.5
Western Bay of Plenty Voltage support	Load growth	10.4.4	0.5	13.5

RCP4 E&D portfolio top up using the mid reopener mechanism

After adjusting for E&D projects covered by an approved MCP, our remaining RCP4 E&D portfolio allowance sits at $76.7 million. Our 2025 TPR forecasts a need for $101.45 million of E&D investments within the RCP4 period. This requires a $24.75 million top up of our RCP4 Base Capex allowance.

The increase in base capex allowance is to primarily fund projects to resolve E&D needs that have come forwards due to accelerated electrification and generation connections. These new projects are indicated as not being included in the approved Base Capex column in the RCP4 project categories below. Note that the total cost of projects that are not included in the approved Base Capex allowance will not match the $24.75 million top up requirement as some projects that are included may have been pushed out of RCP4 or not needed at all.

4.3.5 Extremely likely expenditure

This category includes investments we expect to progress through the OAA and to meet approval stage gates. These include those that are already well into the design process, where we have confidence in projected generation or load changes, and/or that have other drivers (such as asset condition) we consider certain. Table 4-1 sets out the projects included as Extremely Likely investment expenditure.

Table 4-2: Extremely likely expenditure on E&D system needs

Project description	Driver for issue	Included in approved Base Capex?	2025 TPR reference	Capex investigation spend in RCP4 ($m)	Capex build spend in RCP4 ($m)
Aviemore-Benmore COPS enhancement	Load growth	Y	6.9.3	0.0	0.25
Bus Arapuni–Bombay circuit at Hamilton	Load growth and Asset health	Y	9.4.1	0.1	2.4
Edgecumbe–T5 220/110 kV transformer replacement	Load growth & generation dispatch	N	10.4.5	0.1	6

[7] https://comcom.govt.nz/regulated-industries/electricity-lines/electricity-transmission/transpower-capital-investment-proposals/transpower-major-capital-proposal/western-bay-of-plenty-region

Invercargill–North Makarewa thermal upgrade	Load growth & generation dispatch	Y	19.8.3	0.25	8.75
North Canterbury 66 kV regional COPS	Load growth	N	17.7.1	0	0.2
Ohangai substation[1]	Load growth	Y	12.4.1	0.5	15
Redclyffe 220/110 kV TOPS enhancement	Load growth	N	13.4.1	0	0.2
Studholme auto-changeover enhancement	Load growth & asset health	N	18.4.1.6	0	0.6
Implement VLR on the HAM-WKM and OHW-WKM	Load growth	N	6.5.1.2	0	3.5
Minor capacity upgrades[2]	Load growth	Y	N/A	0	0.1
			Total	**0.95**	**37**
				Overall total	**37.95**

1. This project was previously known as Stratford interconnecting transformer capacity, new demand growth has meant the preferred option to increase 220/110 kV capacity is to implement the Ohangai substation project
2. This covers resolving the branch limit on the 33 kV winding of the Haywards 110/33/11 kV transformers to increase it's n-1 capacity (see 14.5.4).

4.3.6 Highly likely expenditure

This category reflects investments we expect to progress through the OAA and to meet approval stage gates, but which have a less certain identified solution and associated cost. It also includes projects with less certain drivers, or those that would occur later in the period when we have more certainty around the costs of the project. Table 4-3 sets out the projects included as highly likely investment expenditure.

Table 4-3: Highly likely expenditure on E&D system needs

Project description	Driver for issue	Included in approved Base Capex?	2025 TPR reference	Capex investigation spend in RCP4 ($m)	Capex build spend in RCP4 ($m)
Arapuni North Runback Scheme enhancement	Load growth	N	9.4.1	0.1	0.7
Bunnythorpe–Paraparaumu thermal upgrade	Load growth & generation dispatch	N	6.5.4	0.2	9.8
Drury 220 kV circuit busing	Load growth & generation dispatch	N	8.8.3	0.1	1.9
Fernhill–Redclyffe COPS	Load growth	N	13.4.2	0.1	0.7
Fernhill–Redclyffe–A and B line reconductoring	Load growth & generation dispatch	Y	13.4.2	0.5	16.5
Hawera–Ohangai circuit capacity upgrade	Load growth	N	12.4.3	0.5	19.5
Henderson–Wellsford overload mitigation	Load growth	Y	7.7.2	0.1	0.4

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Project description	Driver for issue	Included in approved Base Capex?	2025 TPR reference	Capex investigation spend in RCP4 ($m)	Capex build spend in RCP4 ($m)
Kawerau–Ohakuri–1 COPS	Generation dispatch	Y	10.4.5	0.1	0.7
Linton 220 kV bus upgrade	Generation dispatch	N	11.7.1	0.2	9.3
Mount Maunganui COPS	Load growth	N	10.4.3	0.1	0.4
North Makarewa capacitor upgrade	Load growth & asset health	N	6.9.3	0	1
Tarukenga 220 kV bus security	Load growth	Y	10.6.3	0.5	3.5
Te Matai COPS	Load growth	N	10.4.4	0.1	0.4
Minor capacity upgrades[1]	Load growth	Y	N/A	0	0.1
			Total	**2.1**	**61.4**
				Overall total	**63.5**

1. The TPR identified demand growth at Kopu (section 9.5.10) that requires investments to remove transformer branch limits which are typically low-cost investments to remove protection or metering limits.

4.3.7 Likely expenditure

This category reflects investments we expect to require some expenditure, but the scope of the system need is less certain, solution detail is very high-level based on the OAA principles. Table 4-4 sets out the projects included as likely investment expenditure.

Table 4-4: Likely expenditure on E&D system needs

Project description	Driver for issue	Included in approved Base Capex?	2025 TPR reference	Capex investigation spend in RCP4 ($m)	Capex build spend in RCP4 ($m)
Ashburton–Timaru–Twizel outage windows	Load growth	N	17.7.2	0.1	0.7
Dannevirke–Woodville special protection scheme	Load growth	N	11.4.5	0.1	0.7
Wellington interconnecting transformer capacity	Load growth	N	14.4.2	0.5	11.5
			Total	0.7	12.9
				Overall total	**13.6**

4.4 Major capex projects

A major capex project is an E&D investment with an expected cost greater than $30 million. Table 4-5 details proposed major capex projects, both approved and unapproved. For those currently unapproved, some are under investigation. Others would only be progressed if generation development or significant load changes occurred, stretching the capability of the existing transmission system.

Investments are classified as either Economic, forming part of the Grid Economic Investment Report (GEIR), or Reliability, forming part of the Grid Reliability Report (GRR).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 4-5: Approved and unapproved major capex projects within the planning horizon

Region	Project name	Indicative commissioning	Economic or Reliability?	Status
Approved major capex projects				
Western Bay of Plenty	Western Bay of Plenty Regional	2029 - 2032	Reliability	In delivery
Major capex projects under consideration by the Commerce Commission				
Upper South Island	Upper South Island upgrade	2028 - 2031	Reliability	Awaiting approval
Hawkes Bay	Redclyffe 220 kV switchyard resilience	2027	Reliability	Awaiting approval
Grid Backbone	HVDC	2031	Economic	Awaiting approval
Unapproved major capex projects – under investigation				
NI Grid Backbone	Waikato and Upper North Island Transmission Capacity (WUNI 2)	2028-2032	Reliability	Investigation currently underway
Waikato	220/110 kV interconnection capacity	Tentatively 2029	Reliability	Investigation currently underway
Unapproved major capex projects – investigation scheduled for options analysis				
Central North Island	Tararua enabling renewables	Tentatively 2030	Economic	Investigation starting
Central North Island	Wairakei-Whakamaru capacity	Tentatively 2032	Economic	Investigation starting
Unapproved major capex projects – investigation scheduled to confirm need				
Southland	Southland transmission capacity	TBC	Economic	Needs identification
Northland	Northland 220 kV transmission capacity	TBC	Economic	Needs identification
Canterbury	Waimakariri interconnection	Tentatively 2032	Reliability	Needs identification
Taranaki	Brunswick-Stratford	TBC	Economic	Needs identification

Each major capex project is individually submitted to the Commerce Commission for approval. We endeavour to provide the Commission with indicative timings for submissions for transparency and to assist with workload planning.

Due to the volume of generation and load connection requests, we expect to be undertaking more regional studies which may identify the need for new major capex projects. Regions where we forsee future work in include:

- Central North Island and Wairarapa 110 kV regional network
- Taranaki 110 kV regional network
- North of Auckland and Northland 220 kV transmission capacity

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

5 Major Industry Trends

5.1	Accelerated demand growth
5.2	Renewable generation connections
5.3	Grid-connected battery energy storage systems (BESS)
5.4	Transmission resilience
5.5	Te Kanapu – our Grid Blueprint
5.6	Our investment planning approach in the current context
5.7	Efficiently connecting our customers and maintaining grid security

The New Zealand energy system is in a major transition phase due to many factors, including electrification of industry, decline in gas reserves and new and expanding loads such as data centre growth, transport electrification and mining expansion.

Major industrials (particularly in the North Island) are accelerating their fuel switching initiatives with electrification being a common alternative for large energy users. In addition, there is increasing certainty of new types of electricity demand, including data centres, mining sector growth and potentially green hydrogen, linked to sustainable aviation fuel production (eSAF) and other chemicals.

This transition, along with the long-term supply contract for the Tiwai smelter, is providing the electricity industry certainty to invest and we are starting to see major investments being announced recently. This includes battery energy storage systems (BESS) and large generation projects in both the North and South Islands all earmarked for commissioning in the next few years.

With increasing share of electricity as a proportion of our economy's energy mix and recent events in the local and overseas power systems, there is an increasing focus on improved resilience against major events. This includes known risks such as environmental events (earthquakes, flooding or volcanic activity), major equipment failures (substation fires or fires under transmission lines) and space weather risk (geomagnetically induced currents – GIC risks).

The above all combine to present a once-in-a-generation challenge for Transpower to ensure the transmission system is the right size and right place to enable New Zealand to meet its objectives. In this chapter we identify trends as the economy transitions to electricity at pace, discuss our approach to these trends and make linkages to sections of the TPR that discuss relevant transmission issues and opportunities.

Major electricity industry trends and issues we have identified include:

- accelerated demand growth driven by electrification of process heat, transport electrification, data centre loads and mining expansion
- rapid demand growth has resulted in the continued high level of inquiries and requests for renewable generation connections
- increasing interest in grid-scale battery energy storage systems (BESS)
- increased focus on resilience.

At the end of this chapter, we outline our approach to managing these major industry trends and issues.

5.1 Accelerated demand growth

5.1.1 Process heat electrification

We are seeing a step change in the pace of process heat electrification in the North Island due to the faster than expected decline in natural gas supply. For example, in January 2025 Fonterra announced $150 million of investments in electrification projects across its North

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Island operations over the next 18 months[1]. The investments are largely in electric boilers at the Cooperative's Whareroa, Edgecumbe and Waitoa sites and also includes some tanker fleet decarbonisation projects.

The largest of the announced Fonterra electrification projects is at their Whareroa site which will more than double its current typical offtake to around 90 MW. The transmission upgrade solution involved close collaboration between Transpower, Fonterra and Manawa Energy to achieve the timeframes required, see section 12.4.1.

Electrification at Fonterra's Edgecumbe and Waitoa sites are supplied via the local distribution network. Edgecumbe requires a minor investment (special protection scheme) at the grid exit point (section 10.5.1) and the new load at Waitoa can be accommodated within the existing Waihou GXP's capacity.

We expect further large process heat electrification projects to be announced, particularly in the North Island, in the coming years as the outlook on gas availability is for continued decline.

In the South Island, electrification is largely driven by the Government Investment in Decarbonising Industry (GIDI) funding provided by the Energy Efficiency and Conservation Authority (EECA) and end user's asset replacement needs. The bulk of the electrification in the South Island is within the Southland region, where a new 220/110 kV GXP near Edendale and a new 220/66 kV GXP at Invercargill are being built, see sections 19.5.6 and 19.5.10 respectively. Beyond the inflight electrification projects, we do not expect further large-scale electrification projects in the South Island in the short term. Fonterra, a major process heat user in the South Island, is converting two boilers at its Clandeboye site to run on wood pellets with the aim of supporting the development of a wood pellet supply chain to support future decarbonisation opportunities at their other South Island sites[2].

In addition to the large electrification projects discussed above, lot of smaller scale electrification is also occurring such as at schools and other commercial properties. We would see the effects of these smaller scale electrification through the grid exit point (GXP) demand forecasts provided annually by the electricity distribution businesses (EDBs).

5.1.2 Transport electrification

Decarbonising transport is a significant opportunity as it contributes approximately half of the emissions in the energy sector.

The most visible form of transport electrification is electric vehicles, both light vehicles and buses, and to some extent heavy vehicles such as trucks. We model the effect of electric vehicle uptake in stage 2 of our peak demand forecasting process (see section 3.1.2). With current electric vehicle technologies, any issues and challenges are likely to first appear in distribution networks and be captured in forecasts from lines companies. The impact of the emerging higher capacity EV batteries and rapid "supercharging" may have more immediate implications for the transmission network. However, we have not been approached by charging station developers for transmission-connected rapid charging stations.

We are involved in supporting increased rail electrification – particularly in the expansion of Auckland's electrified rail network.

We have also had very preliminary enquiries on future electricity demand to de-carbonise the aviation industry, either through electric planes or Sustainable Aviation Fuel (eSAF). At present, the impact this may have on the Grid in future is unknown and largely speculative. There is no major load steps included in our load forecasts.

5.1.3 Data centres

Data centres to support increased cloud-based computer storage and processing (cloud computing) are growing rapidly due to the increasing requirement to onshore our data for security and sovereignty reasons. Data centres that support cloud computing (we are currently aware of) are within distribution networks supplied from existing grid exit points, which may bring forward upgrades of the grid exit points. Data centres within distribution networks that we are aware of are included in our load forecasts, but this is a fast-growing industry and developers' plans evolve rapidly so there will be a higher degree of uncertainty in their load

1 https://www.fonterra.com/nz/en/our-stories/media/fonterra-announces-electrification-plans-to-future-proof-operations.html

2 https://www.fonterra.com/nz/en/our-stories/media/fonterra-announces-its-largest-decarbonisation-project-to-date.html?trk=organization_guest_main-feed-card_reshare-text

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

forecast. We expect these types of data centres to ultimately have installed capacity (individually) of tens of megawatts.

Data centres to support the development and adoption of artificial intelligence (AI) is increasing rapidly around the world. In New Zealand, there is an increasing amount of AI data centre connection enquiries particularly within the Auckland region which is already New Zealand's largest demand centre with little local generation. In economies where AI datacentre penetration is high, e.g. in the United States, the additional demand from AI data centres is starting to introduce new challenges for their electricity industry. Some of these challenges include energy adequacy and the equitable recovery of transmission upgrade costs the added demand triggers. Our load forecasts do not include any large-scale grid connected AI data centres. We understand that these types of data centres can have an installed capacity in the hundreds of megawatts so it is likely that these will typically be grid connected and have a much larger impact on the electricity industry than data centres that support cloud computing.

5.1.4 Mining sector growth

The current Government's focus in promoting the mining sector and its fast track consenting process may enable some mining projects to develop at pace, with the notable ones being the expansion of the Waihi gold mine and development of the Bendigo-Ophir gold mine near Cromwell[3]. These mines have a relatively large electricity demand and are typically supplied via the local distribution network. The two projects are included in our demand forecast for Waikino and Cromwell GXPs respectively and both projects will trigger the need for short- and long-term investments at their respective GXPs (section 9.5.16 and section 19.5.5 respectively).

We have had enquiries for connecting other types of mining load such as iron sands and high purity silica over the years. However, there are no active investigations at the moment; we have not included any of these less certain mining and processing demand in our load forecasts.

5.1.5 Green Hydrogen

The development of a hydrogen supply chain has largely been happening at a slow pace globally. This is due largely to the technical challenges and poor economics of hydrogen as a fuel vector and the low adoption rates of the technology by original equipment manufacturers (OEMs). Battery electric vehicles (BEVs) is the predominant technology being adopted to decarbonise our road transport fleet, making it more challenging to justify a hydrogen supply chain and associated infrastructure. Reflecting the global slowdown in hydrogen uptake, we currently do not have any active enquiries for grid connections to facilitate hydrogen production projects.

Examples of large potential hydrogen industries that have been proposed over the last few years are Southern Green Hydrogen being investigated in Southland and the proposal to produce Sustainable Aviation Fuel (eSAF) at Marsden (green hydrogen is a feedstock to SAF). Large scale hydrogen production is not included in our load forecasts.

Smaller scale hydrogen fuelling stations are being explored to decarbonise long distance heavy transport (long haul trucking). These projects will be supplied via their local distribution networks and we would see the effects of it through the GXP demand forecasts provided annually by the relevant EDBs.

5.2 Renewable generation connections

Solar resources are reasonably well distributed through the country and the generation technology can be rapidly deployed to almost anywhere in the country where it makes economic sense for developers. As such, it is difficult to predict where and when enquiries will come up. We have several initiatives to address the issues we face with managing such a flexible-to-deploy form of generation technology, including:

- our Envision Opportunities tool[4]
- providing more in-depth information via our regional chapters (chapter 7-19)

[3] Bendigo–Ophir Gold Project | Fast-track website

[4] https://www.transpower.co.nz/keeping-you-connected/getting-you-connected/envision-geospatial-tools

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The Envision Opportunities tool is a geospatial tool to enable developers to explore available capacity at our grid exit points to connect generation under a range of system conditions. It also provides developers an indicative view of technical details such as system strength, which could help gauge the ease of connecting to the grid exit point. The Envision Opportunities tool complements our TPR Envision tool that helps users to explore the Transmission Planning Report.

Regional chapters (7-19) each include a section dedicated to discussing generation opportunities specific to the region. Where we are aware of significant interest for generation connections in an area, we endeavour to provide information on the ability to connect generation in these areas. Where relevant, we provide information such as available headroom, constraints that may bind and linkages to our enhancement approach. This includes potential investments we have identified for the area. See also section 5.6.2.

5.3 Grid-connected battery energy storage systems (BESS)

There are now several examples of BESS installed in the New Zealand electricity system. Meridian Energy's 100 MW/200 MWh Ruakaka BESS was commissioned in May 2025 and two more 100 MW/200 MWh BESS at Glenbrook and Huntly will be commissioned in 2026. Some BESS developers have future stages planned into their projects which could increase both the charging/discharging and energy storage capacities. The more certain developments are currently concentrated in the Waikato and Upper North Island (WUNI) region.

As grid-scale BESS are a new technology being rapidly adopted, we are still to determine how it could impact our grid investment plans such as our WUNI stage 2 major capital project (see Section 6.5.1). Our general understanding is that grid scale BESS will charge at some fraction of its inverter rated capacity during off peak periods and discharge at up to its inverter's rated capacity during peak periods. Based on this understanding, we do not expect grid scale BESS to contribute to regional or national peak demand but consider it likely to reduce average peak demand. However, due to the limited storage capacity of BESS (typically 2 hours) it may not significantly defer transmission investments. As part of our MCP programme we remain committed to engage with providers to elicit and evaluate proposals for viable Non-Transmission Alternatives (NTA) that can defer transmission investment (or provide bridging until new transmission investments are built).

Battery systems come with advanced power electronics and control systems that continue to evolve. They offer the potential to improve voltage quality and stability, and improve resilience and reliability of supply to customers. A sufficiently large battery in a remote part of the grid with local sources of renewable intermittent wind or solar generation has the potential to provide continuity of supply if regular transmission service to that part of the grid is interrupted. We are exploring what would be our technical requirements (and the economics) for a battery system to provide such a service.

Small scale BESS such as residential systems are captured via demand forecasts provided by EDBs and our assumptions in our demand forecasting process (see Chapter 3).

5.4 Transmission resilience

With rapid electrification driven by the need to decarbonise our economy, along with increasing risk from climate change, resilience is becoming an ever-more important consideration for the electricity industry. As the transmission system owner and operator we must fulfil the obligations of a Lifeline Utility under the Civil Defence Emergency Management Act 2002. That means we must be able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency. At the same time, the National Adaptation Plan released in 2022 has a specific action for Transpower to develop and implement a Transpower Adaptation Plan.

Transpower is continuously improving the management of major hazards and potential mitigations that may impact on grid resilience, in alignment with the global industry. We developed a grid resilience strategy, identifying threats and major hazards, and our approaches to managing a resilient transmission service. Refer to our Asset Management Plan (AMP) for more information on our approach.

Our next tranche of Major Capex Proposals such as Wairakei Ring and Waikato Interconnection will include options for new transmission assets (both lines and substations). New assets not only provide added transmission capacity but can also add resilience through

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

diversity of transmission line routes and substations. We will include the benefits of resilience when selecting a preferred transmission upgrade option for Major Capex Proposals.

5.5 Te Kanapu – our Grid Blueprint

Te Kanapu is Transpower's strategic initiative to develop a blueprint for the transmission grid of the future. Te Kanapu will define what Transpower needs to do to enable an energy transition that is affordable, and one that delivers the reliable and resilient transmission grid that communities and businesses expect. Our earlier Whakamana i Te Mauri Hiko highlighted the opportunity for electrification. Te Kanapu will consider a future where New Zealand realises larger ambitions, plays to its strengths and grows an electrified economy.

The first grid blueprint will be published in late 2026 and set the direction to 2050. We will develop a set of refreshed scenarios for New Zealand's energy future to explore plausible futures with a thriving economy and net zero emissions. How our economy grows and achieves net zero will differ across each scenario, but the goal of a thriving sustainable future will remain the same. Te Kanapu will draw from growth trends, planned MCPs, stakeholder feedback and insights. Our Regional Development Plans will also feed into Te Kanapu's planning process, particularly where there is the potential for major regional disruptions like hyperscale data centre developments, hydrogen manufacturing or other large-scale generation that could trigger the need for strategic investments in the long-term.

We expect more transmission infrastructure will be needed in the longer term. It is likely new transmission lines and substations will be part of the pathway to lower the overall energy costs for consumers of the future, especially when we consider the transmission grid's role in coordination and optimisation across the power system as a whole.

The grid blueprint will map out the possible strategic investments for our transmission network, including low-regrets major projects to the mid 2030's, and make the case for the investments to meet future demand and unlock growth across a much longer timeframe. We will analyse impacts and opportunities for broader changes in the power system, consider an economy that is more dependent on electricity as the end source of energy, explore technology changes, and the role of consumer energy resources in our work – we see this becoming increasingly common and affordable, playing a critical role in enabling smarter and more efficient use of the grid.

Our work will be underpinned by a clear and transparent evidence base and a programme of stakeholder engagement and consultations. The investments outlined in the grid blueprint will be backed by carefully considered analysis drawing on a wide range of information to identify optimal investments that put New Zealand's interests first. More work is needed to develop these into detailed investment proposals which will proceed through the existing regulatory processes. Ultimately the goal of the grid blueprint is to guide the delivery of low-regrets investments to unlock a thriving, electrified New Zealand.

We expect to reevaluate the grid blueprint every 2-3 years as our context and power system continues to evolve and adjust our direction accordingly. We see the future grid blueprint as our strategic guide for the years ahead.

For more information on Te Kanapu see: https://www.transpower.co.nz/our-work/te-kanapu

5.6 Our investment planning approach in the current context

Our planning approach will include an increased focus on customer and stakeholder engagement, valuing resilience and access to renewables.

By way of example, we recently worked closely with Powerco to look at the needs of the Western Bay or Plenty. We developed a co-ordinated plan that optimised the total investment required for the transmission and distribution networks in that region.

Our strategy will be embodied in future MCPs, which will include longer-term backbone and regional development plans. We will ensure that our backbone and regional planning is aligned and coordinated.

We are taking a broader approach to consultation including wider and earlier engagement, so that all stakeholders can have input to shape the transmission system of tomorrow. We are also continuously working to improve the general information we provide on existing capacity and constraints, for example through our Envision Opportunities tool (as noted in section 5.2).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

We are doing more work to develop our understanding of resilience, and how it can be valued in the context of the Grid Reliability Standards that underpin our investments. We will work with regional and national authorities to ensure our transmission system provides adequate levels of resilience to the communities it connects.

Our backbone and regional development planning will also consider access to sources of the renewable energy that will be essential to support electrification. We will work with our customers and stakeholders to ensure our investment planning covers a sufficiently broad range of renewable generation development scenarios within regions that have a high potential.

5.6.1 Larger scale investments

Due to the costs, consenting issues and difficulty of taking lines out of service for extended periods, it may not always be practical or cost effective to upgrade existing assets. This, in conjunction with more emphasis on resilience and access to renewable energy resources, may see new line options preferred over upgrading of existing lines. This was reflected in our NZGP1 MCP, where long-term development plans included new line options for both the central North Island and Wairakei ring.

We will investigate these new line options in more detail and work with stakeholders to realise the maximum benefits of such assets, if they are justified. These investigations will also consider diversifying our substations, and incremental investments to help resolve constraints in neighbouring regions.

5.6.2 Investing to enable renewable generation

Through our connection process[5], we are able to identify regions with significantly more renewable generation projects than available grid capacity. We have started a major capital proposal (MCP) investigation to look at investments that might be justified to enable more renewable generation connections in the Tararua and Wairarapa regions. The two regions are currently served by a low capacity 110 kV network spanning between our Bunnythorpe and Haywards substations.

The MCP investigation will explore the extent of investments justifiable under the Commerce Commission's capital expenditure input methodology (Capex IM) which sets out the rules for Transpower proposing, and the Commerce Commission assessing Transpower's capital expenditure proposals. We plan to engage early with customers and stakeholders within the two regions to test the level of interest for renewable project developments and gather project level information to help inform later stages of our investigations.

We are also undertaking an MCP investigation looking at increasing capacity in the Wairakei Ring area, to enable more renewable generation. There are several other regions where an MCP investigation may be warranted. We will share information on these once we have done sufficient work to inform a constructive conversation with our stakeholders and customers in those regions.

5.6.3 Regional strategy

With increasing interest from new generation proponents and high load growth (driven in part by electrification and new loads such as data centres), we are seeing a need for new or updated transmission development plans and strategies for many, if not all, regional networks over the next decade. These plans will integrate enhancement needs with replacement and refurbishment works, to deal with growth and condition-related needs in an integrated, efficient manner.

Each region is unique and each will require a different approach to match the region's needs. Outcomes will range from strategic approaches and long-term goals, to specific near- and long-term development plans.

We will develop this work in close collaboration with the local electricity distribution companies, and wide-ranging engagement with stakeholders in each region.

Current examples of this work include the upcoming Auckland Roadmap work with Vector, work recently completed with Powerco on the transmission and distribution needs for the Western

5 What's the latest with grid connections? | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Bay of Plenty region (see Chapter 10) and ongoing work with Aurora and PowerNet on the transmission and distribution needs for the Queenstown region[6] (see Chapter 19).

We will adapt our approach to regional strategies depending on the issues and, as our capability matures, we expect to eventually cover every region in the country in a prioritised order.

5.7 Efficiently connecting our customers and maintaining grid security

5.7.1 Guidelines for new connections to the grid

Our customers' key driver when designing connections to the grid has often been bespoke and the lowest capital cost solution. This approach was generally acceptable in a low electricity demand growth environment where we experienced a small number of new customer connection requests. However, new connection requests both for generation (especially wind and solar) and new demand have increased and are predicted to increase further.

We are also finding that solutions designed and built within the last few years are running out of capacity much sooner than expected. Therefore, future expansion capability and flexibility is becoming increasingly important as the economy electrifies at a rapid pace. While the initial capital cost is still an important element, our historical approach of exploring bespoke connection solutions needs to adapt and be standardised to meet the needs not just of the customer, but also the needs of the transmission network, i.e. cost-effective, maintainable, constructable, reliable, and available, with flexibility to expand if needed.

The grid is expected to change rapidly for the foreseeable future as new connections are added, and the grid is enhanced to meet grid reliability standards. In response, we have developed principle-based guidelines for new connections to the grid[7]. Guidelines for New Connections to the Grid was issued in June 2025, and provides clarity on Transpower's design principles for new connections and discusses our standard designs with the aim of enabling the efficient connection of our customers and future flexibility.

5.7.2 Maintaining grid stability and power quality

There is a significant increase in inverter-based resources (IBR) connecting to the grid, whether this its solar farms, windfarms, data centres, static frequency converters or electric arc furnaces. The applications and the distributed nature of IBRs introduces new opportunities and risks for the grid to manage. While static frequency converters in traction supplies can help improve voltage imbalance issues, IBRs increase the harmonics in the power system, and distributed solar generation is increasing the need for coordination of power system controls – for example, between our automatic voltage regulators on our GXP transformers and the solar farm's voltage controller.

Transpower as Grid Owner is obliged to consider and manage these opportunities and risks. We achieve this by assessing each connection to ensure the customer can meet its obligations under the default Transmission Agreement and the grid remains compliant with our grid planning guidelines. We have published an overview of the various studies and models required across a new connection's project life cycle[8]. These studies are critical to ensure we identify power system risks early in the project life cycle and resolve them before the customer connects to the grid. Due to the increasing penetration of IBRs, the access to accurate models is becoming increasingly important as it enables Transpower to simulate how the grid behaves under different system conditions to identify operational and/or investment needs to ensure the grid remains secure and power quality remains within statutory limits.

6 http://www.energisingqueenstown.co.nz/

7 https://static.transpower.co.nz/public/2025-07/Guidelines%20for%20new%20connections%20to%20the%20grid.pdf?VersionId=X7_n07lnQwNkdPSqmCk7W6mgrhA78SFL

8 https://static.transpower.co.nz/public/2025-05/Transpower%20connection%20study%20process.pdf?VersionId=TVDufrGKMB2._hRliBHUIV5SCgSuf9RW

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

6 Grid Backbone

6.1	Introduction
6.2	North Island grid backbone
6.3	North Island grid enhancement approach and inputs
6.4	North Island grid backbone capability and constraints
6.5	North Island grid backbone possible capacity upgrades
6.6	South Island grid backbone
6.7	South Island grid enhancement approach and inputs
6.8	South Island asset capability and constraints
6.9	South Island grid backbone possible capacity upgrades
6.10	HVDC link
6.11	HVDC enhancement approach and inputs
6.12	HVDC link asset capability and constraints
6.13	HVDC link possible capacity upgrades

6.1 Introduction

This chapter describes the adequacy of the grid backbone to transfer energy from generators to loads now and in the future, while maintaining a secure grid.

The grid backbone describes the bulk interconnected transmission system, primarily the 220 kV network, which connects the regions described in Chapters 7 to 19.

The grid backbone is divided into:

- North Island (sections 6.2 to 6.5)
- South Island (sections 6.6 to 6.9)
- HVDC (sections 6.10 to 6.13)

We identify potential grid backbone issues by studying the system's capability to meet the forecast growth in demand (see Chapter 3) under a range of system conditions[1]. A generation expansion plan (see Chapter 3) is also used to balance generation with load growth. Grid upgrades to resolve issues must meet the requirements of the Grid Reliability Standards. Many grid upgrades will also require submission of a Major Capital Proposal (MCP) to the Commerce Commission for approval.

6.1.1 Our objective

We seek to maintain a grid backbone that provides an economic level of security to load and generation, and facilitates competition in the electricity market. We assessed transmission capacity and reactive support requirements over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancements to address identified issues we take into account:

- existing transmission asset capability
- forecast demand and committed new generation and retirements
- possible longer-term new generation developments
- possible technological changes, including non-transmission alternatives
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

[1] System conditions are load and generation patterns that we use to highlight transmission issues we can reasonably expect to occur given currently available information and trends.

Where an issue or opportunity exists that we believe may be economically justified to address, we have examined initial options and actions that may be taken to address it.

6.1.2 Methodology

System conditions

A small number of realistically challenging system conditions are used to assess the capability of the existing North Island and South Island grid backbone (including the committed projects discussed in sections 6.3.1 and 6.7.1 and a possible generation expansion discussed in Chapter 3). Transmission constraints are identified by designing realistically challenging system conditions for different generation dispatch and load scenarios. The system conditions provide snapshots to identify transmission constraints that may require investments to ensure security of supply and voltage stability are maintained.

Limits in the electricity market

Transmission constraints identified by the system conditions do not always cause generation limits in the wholesale electricity market. The System Operator's management of a transmission constraint depends on what equipment outage causes the constraint:

- Circuit outages are managed as contingent events requiring pre-contingent management (for example, by using market security constraints to apply a maximum generation limit or pre-contingent load management).
- Other outages (for example, bus-sections) may be managed using pre-contingent or post-contingent actions, depending on the extent and magnitude of the system impact resulting from the outage.

Additionally, we do not consider short term ratings (15 minute off-load ratings) in our planning studies for the grid backbone.

6.1.3 Demand forecasts and generation expansion

Demand forecast

The demand forecast is based on our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*.

The grid backbone results reported in the TPR use a grid exit point (GXP) prudent demand forecast at the time of the island peak, unless otherwise noted. This is typically less than the anytime prudent peak demand at a GXP, and also usually less than the regional peak demand. As such, some grid backbone constraints may be marginally better or worse than reported in the TPR.

See Chapter 3 for a discussion on load forecasting.

Generation expansion

To identify possible grid backbone constraints within the forecast period and beyond, generation expansion is required in order that there is sufficient generation to meet the forecast prudent demand forecast. For the grid backbone studies, we include committed generation that is not yet commissioned. We also include possible but uncommitted generation from the Generation Stack. See Chapter 3 for a list of these generators and discussion on generation expansion modelling.

For some generation dispatch scenarios there is still a shortfall of generation to meet the peak prudent demand. Where this occurs, we use a 'slack generator' or 'expansion plan generation' (see Chapter 3) to balance load and generation.

6.1.4 Assessing grid enhancement options

Appendix A describes our Options Assessment Approach (OAA) to identify a range of investment options to address issues and ensure our assets remain fit for purpose into the future. The level of options assessment is commensurate with the level of expenditure likely to be required to address the issue.

6.2 North Island grid backbone

6.2.1 Existing grid backbone

The North Island grid backbone comprises the following 220 kV circuits:

- four from Wellington to Bunnythorpe
- three from Bunnythorpe to Wairakei and Whakamaru
- three connecting Wairakei and Whakamaru
- two from Bunnythorpe to Brunswick, then three from Brunswick to Stratford
- two from Stratford to Huntly
- eight into Auckland from Huntly, Ohinewai and Whakamaru.

Power flows on the inter-island HVDC link vary. The net annual power flow is northwards, and north flow occurs especially at times of North Island peak demand. However, during light load periods, power may flow southward to conserve South Island hydro storage, especially during periods of low hydro inflows in the South Island.

The existing North Island grid backbone is set out geographically in Figure 6-1 and schematically in Figure 6-2.

To help describe transmission system problems and opportunities on the grid backbone, we split the North Island transmission system into five main transmission corridors or areas:

- Lower North Island transmission corridor, which encompasses everything south of Bunnythorpe
- Central North Island transmission corridor, which connects the Wellington transmission corridor with Whakamaru and Wairakei
- Wairakei Ring transmission corridor, which encompasses the 220 kV circuits between Wairakei and Whakamaru connecting the major hydro and geothermal generation in the Central North Island, Bay of Plenty and Hawke's Bay regions to the transmission network
- Taranaki transmission corridor, which encompasses the grid backbone that connects generation in the Taranaki region to the Waikato and Upper North Island (WUNI) and Central North Island areas
- WUNI transmission corridor, which encompasses everything north of Whakamaru, including the Auckland and Northland regions and most of the Waikato region[2].

[2] This is the same area that is the focus of the Waikato and Upper North Island Voltage Management project, which is discussed in section 6.5.1.

Figure 6-1: North Island grid backbone map

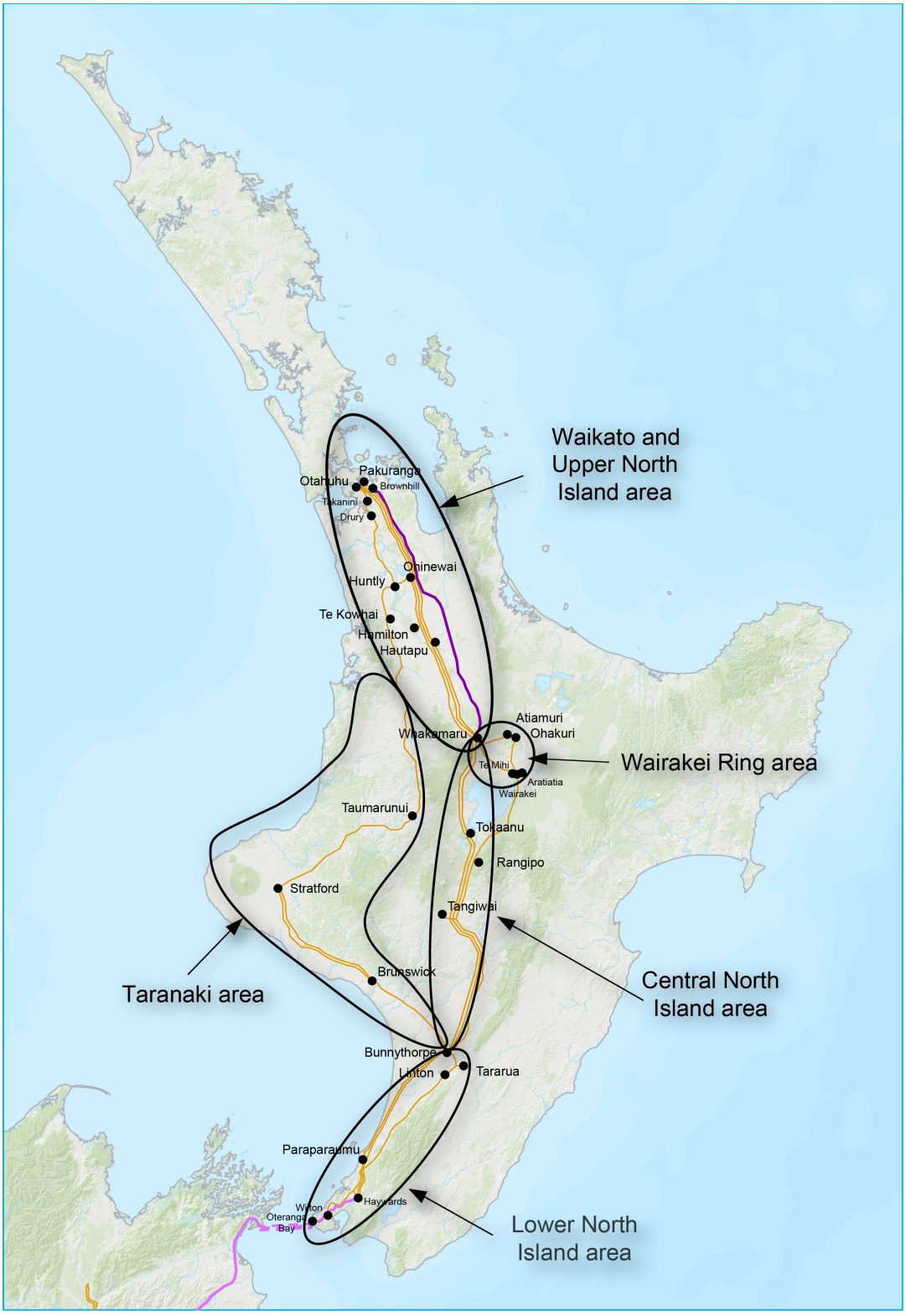
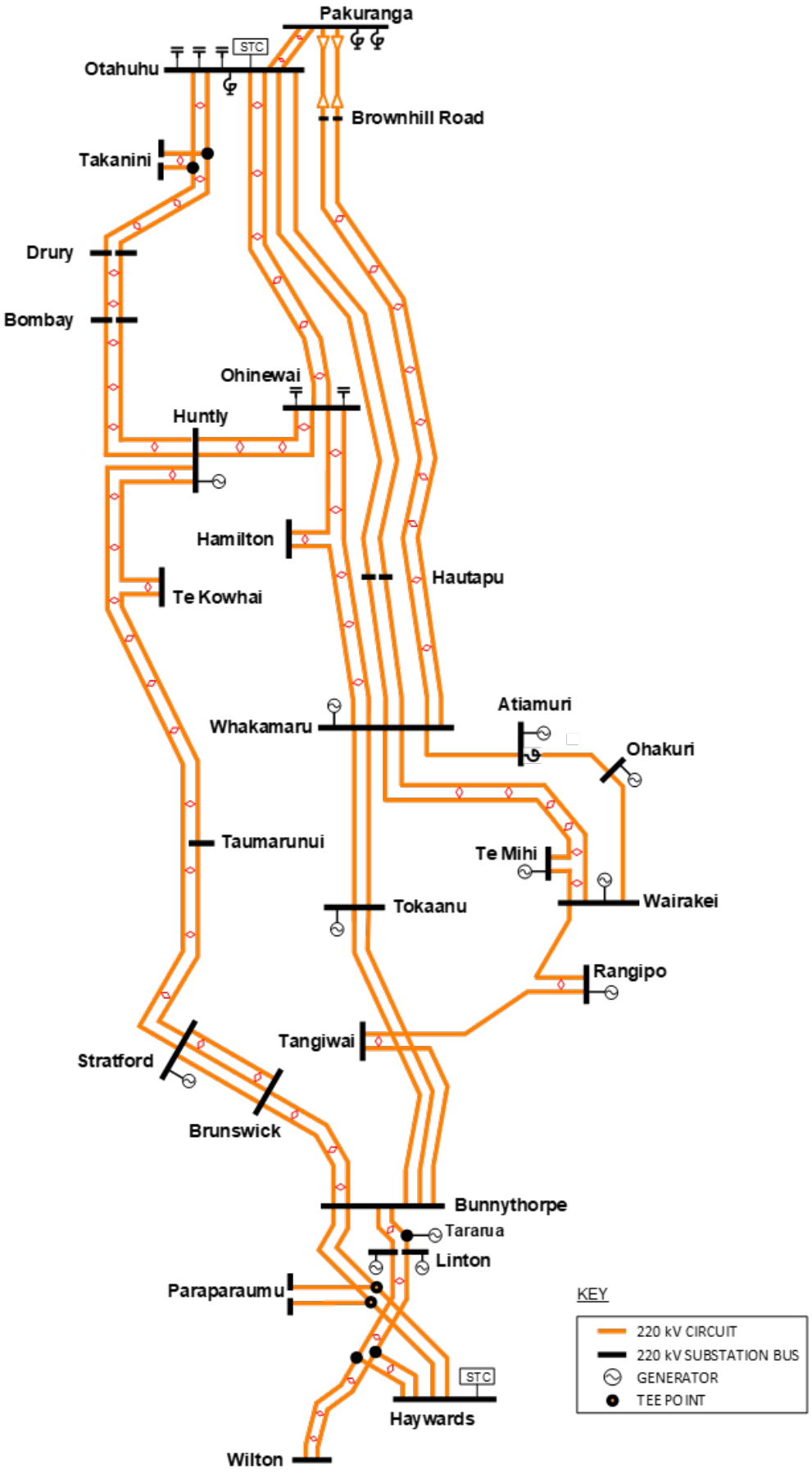


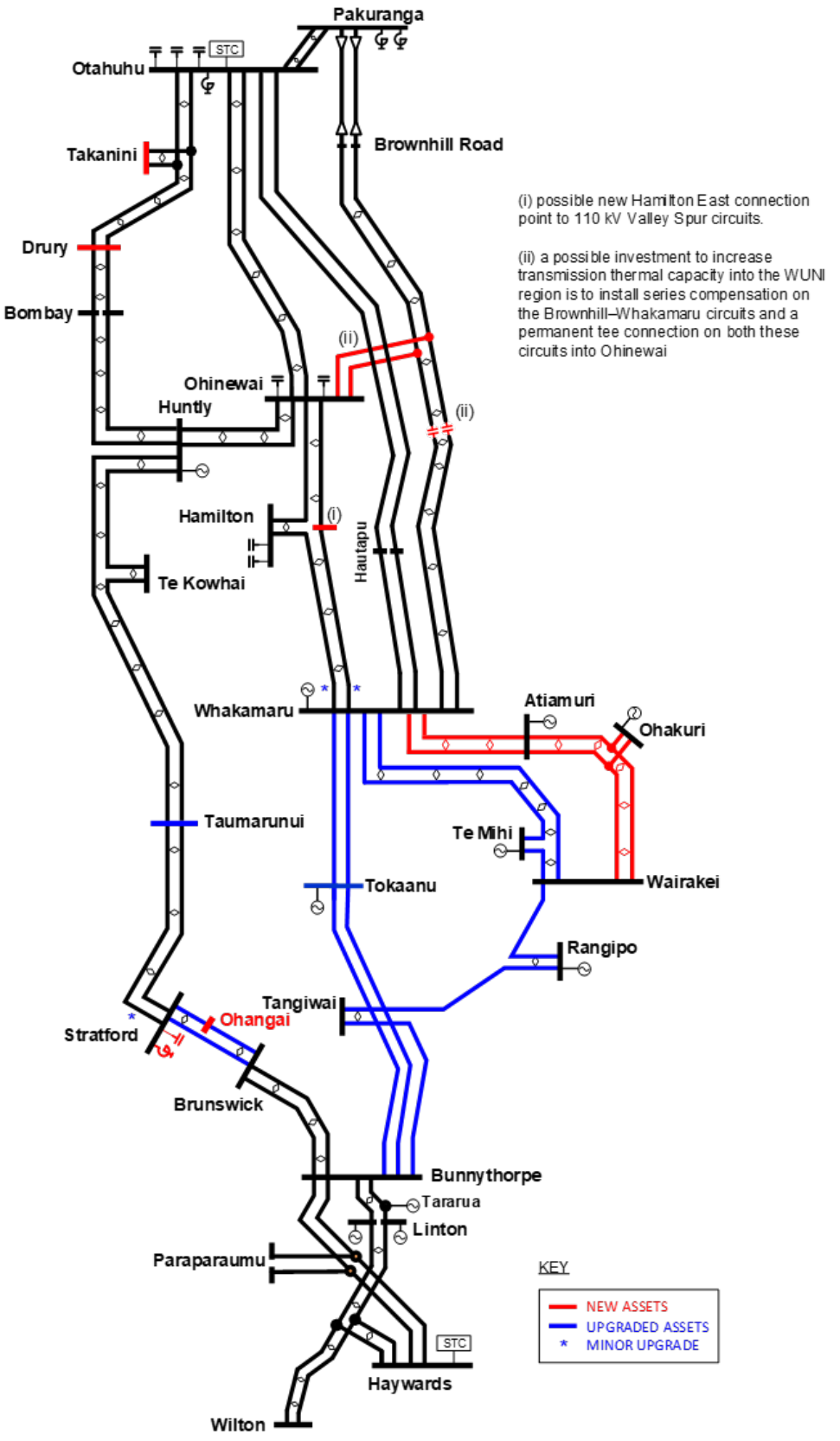
Figure 6-2: Simplified North Island grid backbone schematic



6.2.2 Possible North Island grid backbone to 2040

Figure 6-3 provides an indication of possible North Island grid backbone development in the medium-term (the next 15 years). Assets that are new or upgraded within the forecast period (based on potential enhancement approaches set out in the following sections) are shown.

Figure 6-3: Indicative North Island grid backbone schematic to 2040



6.2.3 North Island grid backbone beyond the planning horizon (2040)

Figure 6-4 provides an indication of the possible North Island transmission backbone development in the longer term (beyond 2040). Transpower's Te Kanapu strategic initiative under development (see Chapter 5) will provide a blueprint for grid development and regional needs to 2050 to accommodate renewables and electrification.

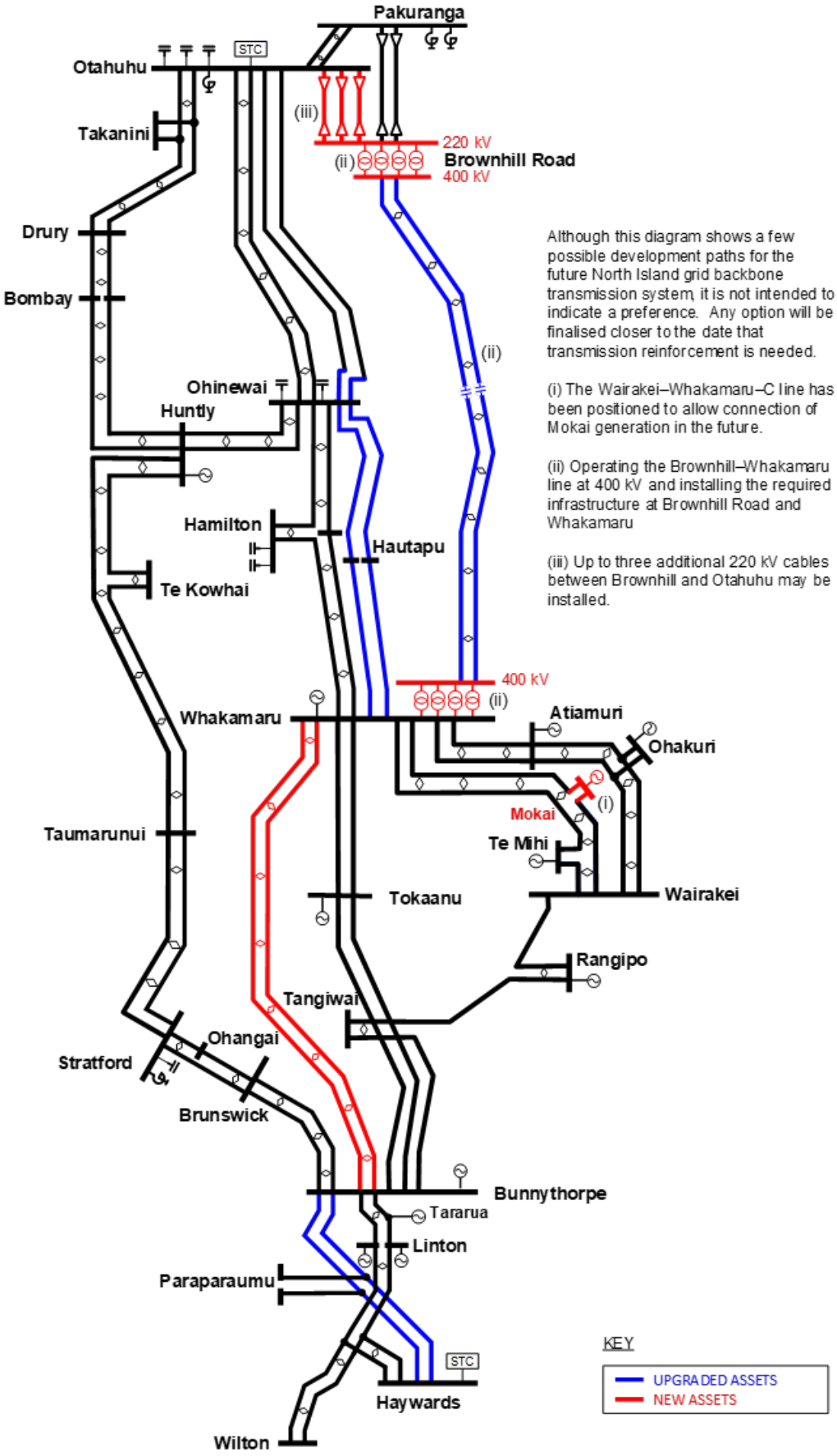
Increased operating voltages from Whakamaru to Brownhill Road

The operating voltage on the overhead transmission line from Whakamaru to Brownhill Road may be increased to 400 kV. This will also require additional 220 kV cables from Brownhill Road north into Auckland and a 220 kV bus at Brownhill Road. This upgrade is highly dependent on future load and generation growth, and the viability of alternatives.

Transmission capacity north of Bunnythorpe

Transmission capacity north of Bunnythorpe may be increased through the Central North Island to Wairakei and Whakamaru, beyond reconductoring of existing assets. Ultimately, we may also require an increase in transmission capacity from Wellington to Bunnythorpe. These upgrades are highly dependent on significant new generation being developed south of Taupō.

Figure 6-4: Longer-term indicative North Island grid backbone schematic (beyond 2040)



6.3 North Island grid enhancement approach and inputs

When analysing the North Island grid backbone to determine capacity constraints and investigate upgrade options, we are guided by our objective (section 6.1.1), a study methodology (section 6.1.2), and the forecasts for demand and generation (section 6.1.3).

Additional inputs specific to the North Island grid backbone analysis are discussed below.

6.3.1 Committed and modelled projects

Projects that are not complete at the time of publication, but included in the analysis, are:

- variable line ratings on Hamilton–Whakamaru and Ohinewai–Whakamaru circuits by 2027
- staged thermal upgrade, variable line ratings, and reconductoring of the Tokaanu–Whakamaru circuits, to be implemented from 2025 to 2027. The Tokaanu special protection scheme will also undergo staged upgrades as these primary upgrades are implemented
- removal of the protection limit on the Huntly–Stratford circuit to unlock the full transmission capacity of the conductors, to be completed in 2026
- thermal upgrade of the Bunnythorpe–Tokaanu circuits, to be completed in 2029
- a 110 kV system split at Ongarue and auto-changeover scheme to maintain switched n-1 security to affected grid exit points, to be implemented in 2026
- thermal upgrade of the Wairakei–Whakamaru–C line (Te Mihi–Wairakei, Te Mihi–Whakamaru and Wairakei–Whakamaru circuits), implemented by end 2025
- new Ohangai substation connected into the Brunswick–Stratford–1 circuit, with one 220/110 kV transformer to support the Taranaki 110 kV network. This is expected to be implemented in 2026
- 150 MVAr STATCOM at Henderson, assumed to be commissioned in 2029 (modelled project)
- 100 MVAr shunt capacitor at Pakuranga, assumed to be commissioned in 2028 (modelled project).

Generation and grid-scale battery developments that are not completed at the time of publication, but which meet the definition of committed are shown in Table 6-1..

Table 6-1: Committed generation and grid-scale battery developments in the North Island

Generator	Connection Point	Approximate Capacity (MW)
Glenbrook BESS	Glenbrook	100
Huntly BESS	Huntly	100
Kaiwaikawe Wind Farm	Maungatapere	77
Nga Tamariki unit 5	Nga Tamariki	46
Omeheu Solar Farm	Edgecumbe	29
Pāmu Rā ki Whitianga	Kopu	24
Papareireia Solar Farm	Maungaturoto	18
Ruakākā Solar Farm	Bream Bay	130
Taiohi Solar Farm	Huntly	22
Tauhei Solar Farm	Waihou	150
Te Mihi Stage 2	Te Mihi	101
Te Rahui Solar Farm	New grid injection point on Wairakei–Whirinaki–A line	200
TOPP2 Geothermal	Kawerau	55
Twin Rivers Solar Farm	Kaikohe	24

6.3.2 Line conductor reviews and replacements

Table 6-1 lists the major grid backbone line conductor review and replacement projects expected to be undertaken between 2025 and 2040.

Table 6-2: North Island grid backbone line conductor reviews and replacements 2025 to 2040

Line	Affected circuits	Tentative year	Further information
Bunnythorpe–Wilton–A (Judgeford–Wilton section)	Bunnythorpe–Linton–Wilton–1 Bunnythorpe–Tararua C–Haywards–1 Haywards–Linton–1	2025-2026	Note 1 6.3.2.1
Bunnythorpe–Wilton–A (Bunnythorpe–Judgeford section)	Bunnythorpe–Linton–Wilton–1 Haywards–Wilton–1	2025-2030	Note 2 Note 3 6.3.2.1
Brunswick–Stratford–A and B	Brunswick–Stratford–1 Brunswick–Stratford–2 Brunswick–Stratford–3	2025-2030	Note 2 Note 4 6.3.2.2
Otahuhu–Whakamaru–A Otahuhu–Whakamaru–B	Otahuhu–Whakamaru–1 Otahuhu–Whakamaru–2	2026-2028	Note 2 Note 5 6.3.2.3
Huntly–Otahuhu–A	Drury–Bombay–Huntly1 Drury–Bombay–Huntly2	2033-2035	6.3.2.4
Huntly–Dev–A	Huntly–Ohinewai–1 Huntly–Ohinewai–2	2027-2029	6.3.2.5

1. Reconductoring the Judgeford–Wilton section is an approved project.
2. Condition-based intervention is being investigated on these lines.
3. The Bunnythorpe–Wilton–A (Bunnythorpe–Judgeford section) will be reconductored in sections, with phase one expected before 2026, and phase two expected 2025-2030.
4. We will potentially submit an MCP proposal to the Commerce Commission for this work.
5. The northern-most 5 km section of the Otahuhu–Whakamaru A and B lines has been reconductored and the next 23 km is scheduled to be reconductored in 2026-2028.

These line conductors are all approaching risk-based condition replacement criteria, which provides the opportunity to review the circuit capacities and whether they will continue to be required in future. Options providing the greatest net benefit will be implemented, optimising the conductor types and operating temperatures, circuit capacities, losses, the cost of replacing conductors and strengthening towers, market benefits, and future maintenance costs.

6.3.2.1 Bunnythorpe–Wilton–A line conductor replacement

The project involves reconductoring the Judgeford–Wilton section of the Bunnythorpe–Wilton A line, replacing the existing duplex zebra conductor with predominantly simplex pheasant. The conductor replacement will be done in stages and completed in 2026.

6.3.2.2 Brunswick–Stratford–A and B line conductor replacement

Replacement options for the Brunswick–Stratford B line are being investigated and, if required, an MCP proposal will be submitted to the Commerce Commission. The two options considered are:

- upgrading the Brunswick–Stratford–A line and dismantling the B line
- reconductoring both Brunswick–Stratford lines.

The analysis referred to in this TPR uses the existing line conductor.

6.3.2.3 Otahuhu–Whakamaru–A and B line conductor replacement

The northern section (approximately 5 km) of the Otahuhu–Whakamaru A and B lines has been reconductored. The next stage of this project involves reconductoring the next 23 km due to meeting replacement criteria based on risk-based condition assessment.

The conductor on the rest of the line will also reach replacement criteria in stages post-2030. We will assess the options for each section as the need arises. Options include reconductoring with a modern equivalent conductor or a larger conductor, or building a new line section and dismantling an existing line section. This will be either part of a future RCP submission, Listed Project or a Major Capex Proposal.

This work is closely linked to the Waikato and Upper North Island (WUNI) Project. For more details, refer to section 6.5.1.

6.3.2.4 Huntly–Otahuhu–A line conductor replacement

Replacement works on the section of Huntly–Otahuhu–A line between Bombay and Drury are expected post 2030. Conductor type will be determined during the investigation stage in future.

6.3.2.5 Huntly–Dev–A line conductor replacement

Replacement works on the complete Huntly–Dev–A line, from Huntly to Ohinewai, are scheduled in 2027-2029. The project is expected to be a like for like conductor replacement on the lines.

6.3.3 North Island grid backbone asset feedback register

The Asset Feedback Register does not contain any E&D related entries specific to the North Island grid backbone.

6.4 North Island grid backbone capability and constraints

Grid backbone asset changes since the 2023 TPR

Changes since the 2023 TPR include:

- the new Hautapu grid exit point is commissioned, with variable line ratings implemented on both Otahuhu–Hautapu–Whakamaru circuits
- a 220/33 kV transformer at Tauhara to connect the new Te Huka 3 geothermal plant and a new grid exit point for Unison Networks
- the thermal upgrade of the 220 kV Edgecumbe–Kawerau–3 circuit
- a temporary line to divert Pakuranga–Whakamaru–2 into Ohinewai during the cable joint replacement on the Brownhill–Pakuranga–2 cable
- two 100 Mvar shunt reactors at Pakuranga to assist with high voltage management
- new ±165 MVAr STATCOM at Otahuhu.

System conditions

We assessed the transmission capacity and performed high level analysis of reactive support requirements on the North Island grid backbone for a range of system conditions over the next 15 years. The system conditions that provide snapshots of the capability of the North Island grid backbone to transfer energy from generators to the loads while maintaining a secure grid are shown below.

Section number	System conditions
6.4.1	System condition 1: North Island winter peak with high WUNI variable renewable generation
6.4.2	System condition 2: North Island winter peak with low WUNI variable renewable generation and high south-WUNI variable renewable generation
6.4.3	System condition 3: HVDC south transfer
6.4.4	System condition 4: high Bay of Plenty generation
6.4.5	System condition 5: light load
6.4.6	System condition 6: high solar

System conditions 1 and 2 were adjusted this year compared to 2023 TPR. The generation expansion plan forecasts a large proportion of wind and solar generation, and as a result a ‘low wind’ scenario cannot feasibly meet the peak demand in later years.

Instead of scenarios with low and high variable renewable generation, scenarios were developed by adjusting wind generation grouped within the WUNI area and grouped within the south-WUNI area. For the purposes of system condition 1 and 2 in this chapter, the

south-WUNII wind group includes Taranaki, Hawke's Bay, Bay of Plenty, Central North Island, and Wellington regions.

System condition 1 considers high WUNI variable renewable generation and low south-WUNI variable renewable generation while system condition 2 has low WUNI variable renewable generation and high south-WUNI variable renewable generation. The scenarios test the same transmission interfaces under different conditions, both meeting the load with the proposed expansion plan generation. System condition 2 stresses the north flow capabilities of the system much more than system condition 1.

In the 2023 TPR, system condition 3 looked at supplying WUNI during peak regional load, with an emphasis on the effect of the temporary Ohinewai tee connection. Since this temporary line deviation will be removed in 2026 at the completion of the cable joint replacement programme on the Brownhill–Pakuranga–2 cable, we removed this system condition and included a commentary on the short-term impact of the Ohinewai tee in system conditions 1 and 2.

When a problem or opportunity is identified that we expect will be economic to address, we examined initial options and actions that may be taken to address it, as set out in section 6.5.

Key results for 2025 TPR

Key findings for the North Island grid backbone system conditions include:

- The development of new renewable generation to supply growing demand and replace some ageing thermal plants will cause transmission constraints in the Wairakei Ring, Central North Island and Taranaki transmission corridors. The upgrade projects within the Central North Island and Wairakei Ring areas (see section 6.3.1) alleviate transmission constraints to enable higher through-transmission.
- The 110 kV Bunnythorpe–Mataroa circuit may limit transmission in the Central North Island area. This issue will be resolved from mid-2026 by the Ongarue 110 kV system split (see section 6.3.1)
- A reduction in thermal generation in the WUNI area requires investment in both dynamic and static reactive support. Reduced generation will also worsen, or bring forward, the transmission thermal constraints into the WUNI area which may trigger investments.

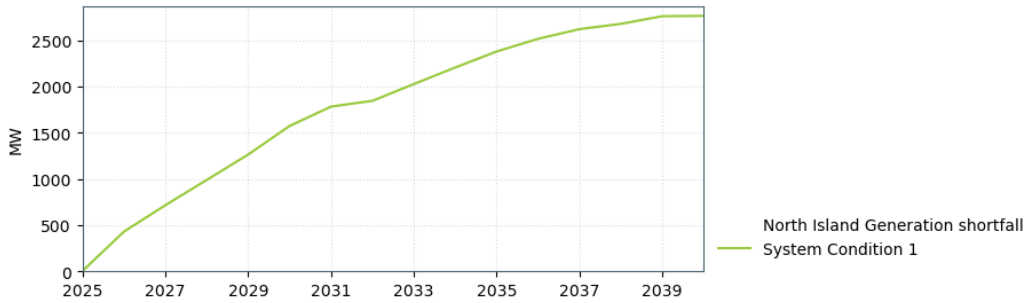
Expansion plan generation

Expansion plan generation, contributing real power but not reactive power, is used to balance the load in system condition 1 and 2 (see Chapter 3 for details).

If expansion plan generation was not dispatched a slack generator would be required to balance the load increase. Figure 6-5 shows additional slack generation[3] that would be required if we did not use expansion plan generation, for System Condition 1, for the forecast period.

[3] The slack generation is calculated assuming no contribution from the Huntly Rankine and Taranaki Combined Cycle units.

Figure 6-5: Additional slack generation if expansion plan generation is not dispatched in system condition 1



6.4.1 System condition 1: North Island winter peak with high WUNI variable renewable generation and low south-WUNI variable renewable generation

This system condition (SC1) tests the case with high WUNI variable renewable generation and low south-WUNI variable renewable generation[4] and high load (winter peak). The specific assumptions for this system condition are:

- North Island prudent winter peak load.
- Huntly Rankine units are out of service.
- Huntly combined cycle gas turbine generator (Unit 5) contributes 90-100 percent of installed capacity until removed from service by end 2037.
- Whirinaki diesel units contributing 90 percent in 2025, removed from service in 2029.
- Gas peakers at Huntly, Stratford, McKee, and Junction Road contribute 75-100 percent of installed capacity. These peaking units, except for Junction Road, are assumed to be retired by 2040 (see Chapter 3).
- North Island hydro generation contributes 95-100 percent of installed capacity.
- Grid-scale batteries (BESS) contribute 100 percent of installed capacity. This includes the existing Ruakaka BESS and future potential BESS as assumed in the generation expansion plan (see Chapter 3), of which 280 MW is dispatched in 2030, increasing to 900 MW in 2040.
- Geothermal generation contributes 90-100 percent of installed capacity. The new geothermal generation in the expansion plan (see Chapter 3) is a net 137 MW dispatch in 2030, decreasing to a net 70 MW dispatch in 2040 due to the decommissioning of the remaining Wairakei geothermal generation in 2031.
- WUNI wind generation contributes 100 percent in all years. This includes new expansion plan generation (see Chapter 3), which is 840 MW dispatched in 2030, increasing to 1,620 MW dispatched in 2040.
- LNI wind generation contributes 30-35 percent of installed capacity in all years. This includes new expansion plan generation (see Chapter 3), which is 229 MW in 2030, increasing to 400 MW in 2040.
- New expansion plan thermal generation: 140 MW in 2040.
- Solar generation does not contribute any real or reactive power.
- HVDC north transfer at 1,060 MW (received at the Haywards 220 kV bus).

Under this system condition, peak demand is met by North Island non-dispatchable generation (wind) in the WUNI region, high levels of HVDC import (HVDC north flow), high level of hydro and geothermal generation, and thermal generation until their assumed retirement.

SC1: Central North Island transmission corridor constraints

- The committed upgrades of the Tokaanu–Whakamaru and Bunnythorpe–Tokaanu circuits (see section 6.5.3.1) means these circuits do not overload under this system condition for the forecast period.

[4] For the purposes of the TPR, variable renewable generation encompasses wind and solar generation.

SC1: Taranaki transmission corridor constraints

- The committed removal of the protection limit on the Huntly–Stratford circuit (see section 6.5.3.1) means the circuit does not overload under this system condition for the forecast period.

SC1: WUNI transmission corridor constraints

- The Hautapu–Whakamaru section of the Otahuhu–Hautapu–Whakamaru circuits does not overload under this system condition for the forecast period. However, it is loaded to about 95% for an outage of the other Otahuhu–Hautapu–Whakamaru circuit, or an outage of a Ohinewai–Whakamaru, Pakuranga–Whakamaru or Hamilton–Whakamaru circuit.

SC1: Wairakei Ring transmission corridor constraints

- By 2035, the Atiamuri–Ohakuri circuit may overload following an outage of the Edgecumbe–Kawerau 220 kV circuit.

What next?

This system condition shows that if a large amount of generation supplies the WUNI area locally during periods of high load, the transmission network with committed upgrades will not be over-burdened.

Refer to the following sections for more information on our committed upgrades on the various transmission corridors:

- transmission capacity between Bunnythorpe and Whakamaru, section 6.5.3
- transmission capacity between Stratford and Huntly, section 6.5.3
- transmission capacity in the Wairakei Ring, section 6.5.2
- transmission capacity into the WUNI area, section 6.5.1.

6.4.2 System condition 2: North Island winter peak with low WUNI variable renewable generation and high south-WUNI variable renewable generation

This system condition (SC2) tests the case with low WUNI variable generation and high south-WUNI variable generation, high load (winter peak) and high HVDC north transfer. The specific assumptions for this system condition are:

- North Island prudent winter peak load.
- Huntly Rankine units are out of service.
- Huntly Unit 5 contributes 90-100 percent of installed capacity until removed from service in 2037.
- Whirinaki diesel units contributing 0% in 2025, removed from service in 2029.
- Gas peakers at Huntly, Stratford, McKee, and Junction Road contribute 30-100 percent of installed capacity. All these peaking units, except for Junction Road, are assumed to be retired by 2040 (see Chapter 3).
- North Island hydro generation contributes 95-100 percent of installed capacity.
- Grid-scale batteries (BESS) contribute 100 percent of installed capacity. This includes the existing Ruakaka BESS and future potential BESS as assumed in the generation expansion plan (see Chapter 3), of which 280 MW is dispatched in 2030, increasing to 900 MW in 2040.
- Geothermal generation contributes 90-100 percent of installed capacity. The new geothermal generation in the expansion plan (see Chapter 3) is a net 137 MW dispatch in 2030, decreasing to a net 70 MW in 2040 due to the decommissioning of the remaining Wairakei geothermal generation in 2031.
- WUNI wind generation contributes 30% of installed capacity in all years. This includes new expansion plan generation (see Chapter 3), which is 250 MW dispatched in 2030, increasing to 480 MW dispatched in 2040.
- LNI wind generation contributes 70-80 percent of installed capacity as needed in order to balance the island load. This includes new expansion plan generation (see Chapter 3), which is 550 MW dispatched in 2030, increasing to 1,040 MW dispatched in 2040.
- New expansion plan thermal generation: 140 MW in 2040
- Solar generation does not contribute any real or reactive power

- HVDC north transfer at 1,200 MW (received at the Haywards 220 kV bus).

Under this system condition, peak demand is met by North Island non-dispatchable generation (wind) in the LNI region, high levels of HVDC import (HVDC north flow), high level of hydro and geothermal generation, and thermal generation until their assumed retirement..

SC2: Central North Island transmission corridor constraints

- Following the permanent 110 kV system split at Ongarue in 2026 (see section 6.5.3.1), issues with pre-contingency overloading of the 110 kV Bunnythorpe–Mataroa circuit constraining power flow through the Central North Island transmission corridor are avoided.
- Following the committed reconductoring of the Tokaanu–Whakamaru circuits, overloads are not seen until after 2035 for a Whakamaru 220 kV bus section outage.
- Following the committed thermal upgrades of the Bunnythorpe–Tokaanu circuits, overloads are not seen until after 2030. Circuits may overload following an outage of Bunnythorpe–Tokaanu, Bunnythorpe–Tangiwai, Rangipo–Tangiwai, or Brunswick–Stratford. The circuits may also overload following a 220 kV bus section outage at Ohangai or Tangiwai.
- By 2035, the Bunnythorpe–Tangiwai–Rangipo–Wairakei circuit may overload following an outage of a Bunnythorpe–Tokaanu circuit. The circuit may also overload following a 220 kV bus section outage at Bunnythorpe.
- By 2035, additional voltage support may be required in the Central North Island region to support high levels of power transfer.

SC2: Taranaki transmission corridor constraints

- The committed removal of the Huntly–Stratford protection limit (see section 6.5.3.1) means this circuit does not overload under this system condition for the forecast period.
- Due to high load growth at Te Kowhai, a Huntly–Te Kowhai outage causes low voltage and voltage stability issues at Te Kowhai (see section 9.5.14).
- By 2035, the Stratford 220 kV bus voltage may drop below 0.9 pu following an outage of Bunnythorpe–Brunswick, Bunnythorpe–Tokaanu, Brunswick–Ohangai, Brunswick–Stratford, Huntly–Stratford, Rangipo–Tangiwai, Rangipo–Wairakei, or Tokaanu–Whakamaru. The Taumarunui 220 kV bus voltage may also drop below 0.9 pu pre-contingency, with voltage further affected the same outages. This issue is exacerbated by the assumed retirement of the Stratford peaker units in 2035 in the generation expansion plan (see Chapter 3).

SC2: WUNI transmission corridor constraints

- In 2025, the Otahuhu–Hautapu–Whakamaru circuits may overload for a 220 kV bus section outage at Whakamaru. By 2030, the Otahuhu–Hautapu–Whakamaru circuits may overload following an outage of the other Otahuhu–Hautapu–Whakamaru circuit, or Hamilton–Whakamaru, Pakuranga–Whakamaru, or Ohinewai–Whakamaru. The circuits may also overload for a 220 kV bus section outage at Whakamaru or Hamilton. By 2035, these circuits can overload pre-contingency. The overloads are heavily influenced by the high load growth forecast at the new Hautapu grid exit point.
- By 2035, voltage stability issues limit power transfer through the WUNI transmission corridor for Pakuranga–Whakamaru, Hamilton–Whakamaru, Ohinewai–Whakamaru outages, and various other 220 kV circuit contingencies in the WUNI transmission corridor.

SC2: Wairakei Ring transmission corridor constraints

- By 2030, Atiamuri–Ohakuri may overload following an Edgecumbe–Kawerau 220 kV circuit outage. The circuit may also overload following a 220 kV bus section outage at Whakamaru or Kawerau.

What next?

SC1 and SC2 test the same grid backbone interfaces under the same load conditions, but different generation scenarios. With low generation in the WUNI region, we are heavily reliant on the transmission system to supply power to the region.

This system condition highlights capacity issues on same transmission interfaces identified as highly loaded in SC1. However, the severity of transmission constraints is much higher because peak demand is met mostly by generation located outside the WUNI region flowing north into the region.

At present the transmission constraints can be managed operationally through generation dispatch. At times, this may require generation to be constrained on within the WUNI region.

With the generation expansion plan assumed in this TPR, an increasingly large amount of wind is needed to balance winter peak load throughout the forecast period. Without appropriate firming, future variable renewable generation installed in the WUNI region would not avoid the need for further transmission capacity upgrades into the WUNI region.

We are studying options to alleviate or remove the transmission constraints to supply capacity into the WUNI area. For more specific information on our enhancement approach for the:

- transmission capacity between Bunnythorpe and Whakamaru, see section 6.5.3
- transmission capacity between Stratford and Huntly, see section 6.5.3
- transmission capacity in the Wairakei Ring, see section 6.5.2
- transmission capacity into the WUNI area, see section 6.5.1.

6.4.3 System condition 3: HVDC south transfer

This system condition (SC3) tests the existing power system with extremely low generation in the South Island requiring high HVDC south transfer from generators in the Taranaki and Central North Island regions close to the time of winter peak load. It represents a dry period in the South Island where either North Island thermal or wind generation provides the balance of energy. The specific assumptions for this system condition are:

- 80 percent of North Island 2025 prudent winter island peak load.
- North Island wind generation at 80 percent of installed capacity. A sensitivity test which replaced North Island wind generation with increased North Island thermal generation was also studied.
- The Taranaki combined cycle gas generator is dispatched[5]. Huntly power station provides the balance of energy in the North Island
- North Island geothermal and hydro generation is dispatched at 95 percent of installed capacity.

The HVDC control system prevents voltage stability issues[6] by automatically reducing HVDC transfer, if required, following a power system fault. The reduction in HVDC transfer depends on how many circuits, transformers, synchronous condensers and filters are available in the Lower North Island. The largest reduction will occur for 220 kV bus faults at Bunnythorpe or Haywards. The reduction in HVDC transfer also limits thermal issues within the North Island grid backbone.

SC3: 110 kV regional network

For high HVDC south flow coupled with high wind generation:

- The Mangamaire–Woodville circuit can overload following a 220 kV bus section outage at Bunnythorpe. Generation from the Te Apiti wind farm blocks through-transmission on the Bunnythorpe–Woodville circuits but increases loading on the Mangamaire–Woodville circuit, which transports the Te Apiti generation southward. However, the voltage stability limits are expected to bind before the Mangamaire–Woodville constraint.

For high HVDC south flow coupled with low wind generation:

- A Bunnythorpe–Woodville circuit may overload for an outage of the parallel circuit. This transmission constraint is managed by the existing special protection scheme at Woodville[7].

[5] Taranaki combined cycle is expected to be retired by end of 2025 but is still generating in this system condition for the purposes of studying high south transfer. There are many new generation proposals in the Taranaki region, and for this system condition generation from the Taranaki combined cycle generator also represents the possible new generation developments.

[6] Two main voltage stability issues could occur if HVDC south transfer is too high:

- An HVDC bipole trip could cause transient over-voltages in the Wellington region. The required HVDC south flow reduction to prevent this issue will be larger in case of low net load in the Wellington region.
- A 220 kV circuit outage between Bunnythorpe and Wellington or a 220 kV bus outage at Bunnythorpe could cause voltage collapse in the Wellington region during periods of high Wellington load. The required HVDC south flow reduction to prevent this issue will be larger in case of high net load in the Wellington region.

[7] The special protection scheme at Woodville detects an outage of a Bunnythorpe–Woodville circuit and if the other circuit is overloaded, it reconfigures the grid by opening the Mangamaire–Woodville circuit at Woodville. This prevents power from flowing to the Wellington area through the lower capacity 110 kV network.

- Both Bunnythorpe–Woodville circuits may also overload for outages of: Haywards–Wilton–Linton, Bunnythorpe–Tararua Wind Central–Linton, Bunnythorpe–Linton, or Bunnythorpe–Paraparaumu–Haywards. The circuits may also overload following a 220 kV bus section outage at Bunnythorpe, Haywards, Linton or Tararua Wind Central. This transmission constraint is not managed by the special protection scheme at Woodville.

SC3: Central North Island transmission corridor 220 kV constraints

For high HVDC south flow coupled with high wind generation:

- Voltage stability limits and Lower North Island 220 kV constraints precede the Central North Island 220 kV constraints.

For high HVDC south flow coupled with low wind generation, the order in which Central North Island transmission corridor constraints bind for circuit outages are:

- The Bunnythorpe–Tangiwai–Rangipo circuits may overload for an outage of Bunnythorpe–Tokaanu, Tokaanu–Whakamaru, Te Mihi–Whakamaru, Wairakei–Whakamaru, or Bunnythorpe–Brunswick. The circuits may also overload for 220 kV bus outages at Tokaanu, Bunnythorpe or Wairakei.
- The Bunnythorpe–Tokaanu circuits may also overload for a parallel Bunnythorpe–Tokaanu circuit outage or a 220 kV bus outage at Bunnythorpe. The Bunnythorpe–Tangiwai–Rangipo constraints precede this constraint.

SC3: Brunswick–Stratford 220 kV constraints

For high HVDC south flow coupled with high wind generation:

- Voltage stability limits, Central North Island and Lower North Island constraints precede the Brunswick–Stratford constraint by a significant margin.

For a high HVDC south flow coupled with low wind generation:

- The Brunswick–Stratford circuits may overload following an outage on a parallel Brunswick–Stratford circuit. However, the Bunnythorpe–Tangiwai–Rangipo and Bunnythorpe–Tokaanu circuit constraints precede this constraint.

SC3: Lower North Island constraints

For high HVDC south flow coupled with high wind generation:

- The Bunnythorpe–Paraparaumu–Haywards circuits may overload first following a 220 kV bus section outage at Bunnythorpe. This limit can precede the voltage stability limits.
- The Bunnythorpe–Paraparaumu–Haywards circuits may overload for a Haywards–Wilton–Linton circuit outage. However, the voltage stability limit will precede the circuit constraints.

For a high HVDC south flow coupled with low wind generation:

- Both Bunnythorpe–Paraparaumu–Haywards circuits may overload following an outage of a 220 kV bus section outage at Bunnythorpe.
- The Bunnythorpe–Paraparaumu–Haywards circuits may overload following an outage of Haywards–Wilton–Linton, Bunnythorpe–Linton, Bunnythorpe–Tararua–Linton, or Bunnythorpe–Paraparaumu–Haywards. However, voltage stability and the Rangipo–Tangiwai, Bunnythorpe–Tangiwai, Bunnythorpe–Tokaanu, Brunswick–Stratford and Bunnythorpe–Woodville constraints precede this constraint.

What next?

The constraints that limit south flow on the HVDC are heavily dependent on the level of wind generation within the Wellington region. For low levels of wind generation (replaced by North Island thermal generation), the order in which constraints bind for circuit outages are:

- Rangipo–Tangiwai overloading for a Bunnythorpe–Tokaanu outage
- Bunnythorpe–Tangiwai overloading for a Bunnythorpe–Tokaanu outage
- Bunnythorpe–Tokaanu overloading for a parallel circuit outage
- Both Bunnythorpe–Woodville 110 kV circuits overloading for a Haywards–Wilton–Linton or Bunnythorpe–Linton circuit outage
- Brunswick–Stratford overloading for a parallel circuit outage.
- Bunnythorpe–Paraparaumu Tee sections overloading for a Haywards–Wilton–Linton circuit outage

For 220 kV bus section outages at Bunnythorpe, Haywards, Tokaanu, Whakamaru, Wairakei and Linton, thermal limits precede the HVDC voltage stability limits.

For high levels of wind generation in the Wellington region, both Bunnythorpe–Paraparaumu Tee circuit sections may overload for a Haywards–Wilton–Linton circuit outage. Also, Rangipo–Tangiwai may overload for a Bunnythorpe–Tokaanu outage. The HVDC voltage stability limits precede thermal issues caused by 220 kV circuit outages and 220 kV bus section outages at Haywards or Bunnythorpe.

In the short term, these transmission constraints can be managed with generation dispatch changes in the Lower North Island or South Island.

We will upgrade the existing Bunnythorpe–Woodville special protection scheme when it is due for risk-based condition replacement in 2028-2029 to ensure that it removes overloads when both Bunnythorpe–Woodville circuits are overloaded at the same time (see section 11.4.3).

In the longer term, we will consider transmission upgrades to alleviate or remove the transmission constraints. Note that some investments to resolve north flow constraints also relieve some of the south flow constraints. For more specific information on our enhancement approach for:

- the transmission capacity between Whakamaru and Bunnythorpe, see section 6.5.3
- the transmission capacity between Bunnythorpe and Haywards, see section 6.5.4
- limiting the impact of a Bunnythorpe 220 kV bus section outage, see section 11.6.1.

6.4.4 System condition 4: high Bay of Plenty generation

This system condition (SC4) tests the effect on the North Island grid backbone of high generation export from the eastern Bay of Plenty. It represents a winter peak period with low thermal generation in the WUNI and Taranaki areas and high generation in the eastern Bay of Plenty.

This system condition focuses on identifying potential transmission capacity constraints on the Wairakei Ring transmission corridor.

The specific assumptions for this system condition are:

- Winter 2025 and 2030 island prudent peak load and generation expansion plan scenarios used
- Thermal generation in the WUNI area limited to one combined cycle unit generating at Huntly
- Geothermal generation at 100 percent of installed capacity
- North Island hydro at 100 percent of installed capacity
- Lower North Island wind generation at 30-67 percent of installed capacity
- WUNI wind generation between 0-20 percent of installed capacity
- The series reactor on the Atiamuri–Ohakuri circuit[8] is on the 17 ohm tap position.
- A permanent 110 kV Edgecumbe–Kawerau system split (see section 10.4.5).

SC4: Wairakei Ring transmission corridor

The first Wairakei Ring circuits that overload in this system condition are:

- Atiamuri–Ohakuri for an outage of the 220 kV Edgecumbe–Kawerau circuit. This occurs with high through flow from Wairakei to Whakamaru, and high Bay of Plenty load. The issue is aggravated when generation in the eastern Bay of Plenty is also high.
- Atiamuri–Whakamaru for an outage of Te Mihi–Whakamaru. This overload may occur with high through flow from Wairakei to Whakamaru, when the total Bay of Plenty generation exceeds regional load.

When the Bay of Plenty total net load roughly offsets the hydro generation at Atiamuri and Ohakuri, the first circuit to overload can be Te Mihi–Whakamaru for a Wairakei –Whakamaru outage, even after the circuit is thermally upgraded. However, this constraint leads to a higher northwards transfer through the Wairakei Ring compared with what can be achieved during high levels of power flow into or out of the Bay of Plenty.

[8] The Atiamuri series reactor is tapped to allow different levels of impedance. The tap position is currently set to 17 Ohms. The reactor tap may be changed to 19.5 Ohms after the thermal upgrade is completed on the Wairakei–Whakamaru C line.

With low load and high generation in the Bay of Plenty, an Atiamuri–Whakamaru outage may overload Ohakuri–Wairakei, and vice versa. This scenario has an increasing risk of causing regional constraints as more generation connects in the Bay of Plenty. This is a Bay of Plenty regional export issue, and has no significant impact on the transmission capacity of the Wairakei Ring corridor.

What next?

The committed capacity upgrades on the Whakamaru–Wairakei, Te Mihi–Whakamaru and Te Mihi–Wairakei and Edgecumbe–Kawerau 220 kV circuits will increase capacity for the Wairakei ring to export generation under high north flow conditions. After the upgrades, power transfer from Wairakei to Whakamaru may be constrained mostly by Atiamuri–Whakamaru or Atiamuri–Ohakuri, depending on the load and generation levels in the Bay of Plenty.

For the longer term, we are investigating further 220 kV transmission upgrades to alleviate or remove the transmission constraints. For more specific information on our proposed approach for increasing the capacity in the Wairakei Ring, see section 6.5.2.

6.4.5 System condition 5: light load

This system condition (SC5) summarises the effect of low load on the North Island grid backbone. It represents a realistic summer night light load period and highlights high voltage issues. The specific assumptions for this system condition are:

- North Island trough summer night load
- No thermal generation dispatched (except for cogeneration)
- North Island geothermal generation provides most of the generation to supply the load
- Low hydro generation (about 200 MW), with many stations having only one unit in service
- HVDC north transfer of about 250 MW.

The main concern during light load periods is high post-contingency voltages. These are dependent on load, power factor and voltage profile across the North Island.

SC5: Upper North Island area high voltages

The recent installation of two 100 Mvar shunt reactors at Pakuranga and a ±165 Mvar STATCOM at Otahuhu (in addition to the 50 Mvar shunt reactor at Otahuhu) has significantly improved the high voltage management of the WUNI area during light load periods. The 250 Mvar of shunt reactors at Otahuhu and Pakuranga compensate for the effect of light load line charging[9] that can cause high voltages. The situation is also temporarily improved by the Pakuranga–Whakamaru–2 extended outage for cable repairs and deviating the circuit into Ohinewai.

In the past, Pakuranga–Whakamaru–1 and/or 2 were removed from service if required to manage high voltage. However, switching Pakuranga–Whakamaru is now restricted due to the cable joint failures.

See section 6.5.1.3 for additional information on our approach to managing the Upper North Island high voltage.

SC5: Te Kowhai and Taumarunui high voltage

If a Huntly–Te Kowhai circuit outage occurs during a light load period, the Te Kowhai and Taumarunui 220 kV bus voltages may exceed 1.10 pu. This is more likely to occur when generation is unavailable in the Taranaki region as there is no means to absorb the excess reactive power. The extent of the high voltages at Te Kowhai and Taumarunui also depends on the response of the Te Uku Wind Farm embedded at Te Kowhai.

SC5: Lower North Island high voltages

Keeping the Lower North Island area voltages within acceptable limits with all circuits in service requires high levels of reactive power absorption from the Haywards synchronous condensers and STATCOM at light load times. HVDC transfer may also be limited for harmonic performance if the number of filters must be reduced to prevent high voltages. Operating the

[9] During light load conditions, transmission lines and cables generate reactive power, raising the voltage.

HVDC in reduced voltage mode is sometimes used to improve high voltage issues during light load periods.

What next?

Suppressing overnight high voltages requires generation and North Island dynamic reactive plant to absorb a high level of reactive power pre-contingency, limiting the available response to a post-contingency event.

We also switch circuits out of service if the risk of high voltage cannot be managed using only shunt reactors and dynamic reactive plant, particularly in the WUNI area. Switching circuits out of service is an effective way to control voltages, but its application is limited to ensure security of supply to load in the area. Also, circuits with cable sections cannot be readily switched to avoid accelerated aging of the cables.

High voltages are also managed in more severe cases by ensuring generators in the region are available to absorb reactive power.

In the short-term, we consider the operational measures are sufficient to manage the high voltage issue in Taumarunui, Te Kowhai, and the Lower North Island area. Recent upgrades in the WUNI region have significantly improved our ability to manage high voltages in the region.

In the medium-term, we will investigate the need for additional voltage control equipment in the Taranaki region and around Bunnythorpe, as discussed in section 6.5.3.3.

In the longer-term, we expect the high voltage issue to worsen. A variety of factors exacerbate the high voltage issue including the use of long transmission cables (particularly in the Auckland region), an increasing amount of distribution network being converted to underground cables, and load characteristics becoming generally more capacitive. We will continue to monitor the high voltage issue, including any new or ongoing operational challenges and practices following the recent installation of shunt reactors at Pakuranga, and investigate further options as the need arises.

6.4.6 System condition 6: high solar

This system condition (SC6) tests the case with high grid connected solar in the North Island during a summer afternoon trough period with low wind generation. It has low thermal and low hydro generation in the North Island, the specific assumptions for this system condition are:

- Summer peak 2040 scenario used with load scaled to 55 percent
- Existing, committed and potential future (as assumed by the generation expansion plan, see Chapter 3) solar generation contribute 75 percent of installed capacity[10]
- Geothermal generation contributes 80 percent of installed capacity
- North Island hydro is switched off[11]
- Lower North Island wind contributes 20 percent of installed capacity – this was dispatched to avoid pre-contingency overloads on Central North Island circuits due to high south flow
- WUNI wind farms are not generating
- No thermal generation dispatched (except for cogeneration)
- HVDC at Haywards is used to provide the balance of generation for the North Island[12], contributing about 550 MW south.

SC6: transmission constraints

The constraints in this system condition are heavily dependent on the location of the dispatched solar generation. For this study the Central North Island corridor begins to constrain transfer south. In order, the constraints are:

[10] This system condition assumes uniform dispatch of solar generation across the North Island with a high capacity factor. For this system condition, we used the solar installed capacity assumed by the generation expansion plan in 2040.

[11] No North Island hydro generation is chosen as it emphasises how the capacity of the transmission system may constrain solar generation during light load periods. It is acknowledged there is must-run hydro generation to meet resource consent requirements, and some hydro generation may also be required for lake level management following the morning peak or to meet the evening peak. Transmission upgrades to manage high load will reduce the constraints identified for this system condition.

[12] The North Island summer afternoon trough load used in this study is about 3,200 MW. For this system condition approximately 2,500 MW of solar generation is dispatched. Therefore, HVDC flow is southward.

- Rangipo–Tangiwai overloading for an outage of Bunnythorpe–Tokaanu, Tokaanu–Whakamaru, Te Mihi–Whakamaru, or Huntly–Stratford
- Bunnythorpe–Tangiwai overloading for an outage of Bunnythorpe–Tokaanu, Tokaanu–Whakamaru, Te Mihi–Whakamaru, or Huntly–Stratford.

Outside of the Central North Island region:

- Atiamuri–Whakamaru can overload for a Wairakei bus section outage due to a combination of high solar and geothermal generation in the region.

If the solar generation is located further south, in the Lower North Island, constraints may develop on circuits between Bunnythorpe and Haywards. Section 6.4.3 provides more detail on other constraints that may occur during high HVDC south flow.

What next?

The transmission constraints can be managed operationally through generation dispatch.

We will continue to facilitate the investigation and construction of new solar farm projects. As more solar farms become committed, we will assess the impact of these connections on the grid backbone in future publications. Each regional chapter (7-19) includes a 'Generation Proposals and Opportunities' section outlining the regional impacts of the current considerable interest in renewable generation connections, including solar.

6.5 North Island grid backbone possible capacity upgrades

This section provides information about the transmission constraints on the North Island grid backbone identified in section 6.4 that we expect will justify further investigation or mitigation over the next few years.

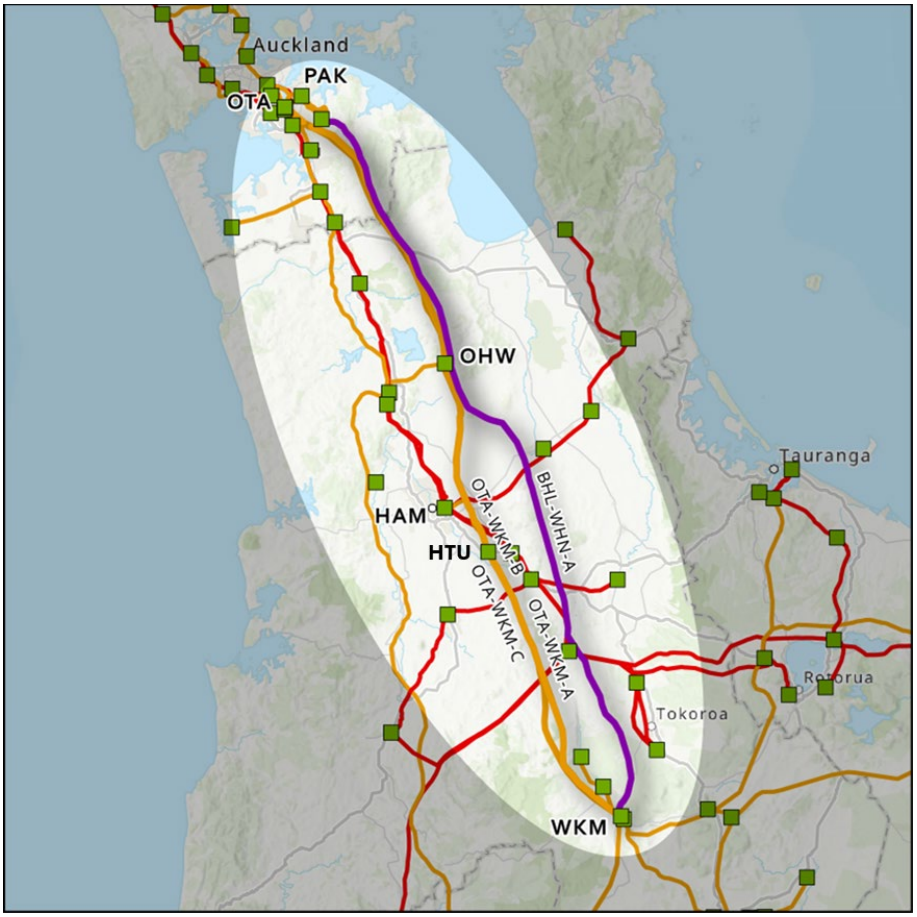
Transmission issues likely requiring E&D base capex or MCP funded investment in the North Island grid backbone over the next 10-15 years are discussed below.

Section number	Issue
6.5.1	Transmission constraints north of Whakamaru
6.5.2	Wairakei Ring transmission capacity
6.5.3	Central North Island and Taranaki transmission capacity

6.5.1 Transmission constraints north of Whakamaru

Transmission north of Whakamaru (WUNI transmission corridor) connects the WUNI area to generation-rich regions of the Central North Island, Bay of Plenty and Hawke's Bay. The WUNI transmission corridor consists of four 220 kV lines (two single-circuit 220 kV lines, a double-circuit 220 kV line and a double-circuit 400 kV-capable line that is currently operated at 220 kV). A fifth 220 kV line (double-circuit) connects Huntly to Auckland.

Figure 6-6: WUNI transmission corridor



6.5.1.1 Waikato and Upper North Island voltage management

Since 2015, nearly 800 MW of generation capacity has been decommissioned in the WUNI area. We assume closure of the remaining Huntly Rankine units in 2030[13]. The remaining generation capacity at Huntly would then be only Unit 5 and Unit 6 (total of 454 MW). However, there is no assurance Huntly will be on-line and dispatched in the electricity market during peak load periods in the WUNI area, so reliance on Huntly needs to be carefully assessed in grid upgrade plans. This, coupled with demand growth in the WUNI area, raises significant voltage stability risks.

Recent major upgrades in the WUNI area support the ongoing voltage stability issue. Most recently, a ±165 MVAr STATCOM was installed at Otahuhu substation in 2025, following the installation of a ±165 MVAr STATCOM at Hamilton substation in 2023. As demand continues to grow, further investment in reactive power support will be required.

As part of our WUNI stage 2 MCP, we expect to propose installation of reactive support as follows:

- ±165 MVAr STATCOM at Henderson
- 100 MVAr shunt capacitor at Pakuranga.

We also expect to propose series compensation of the Brownhill–Whakamaru circuits in the WUNI stage 2 MCP. Series compensation may be required by 2030 to address thermal transmission constraints (see next section), and they also increase the voltage stability limit.

2025 saw the commissioning of a 100 MW/200 MWh BESS connecting into Bream Bay. Two other 100 MW BESS are currently under construction at Huntly and Glenbrook, expected to be operational in 2026. We will assess how these BESS support the WUNI region during peak load and continue to evaluate the ongoing needs of the system.

[13] The timing of retirement of the Huntly Rankine units is uncertain. Our assumption on closure date is prudent to ensure we can plan for the worst case.

Major capex investments

Project name:	Waikato and Upper North Island Stage 2
Project description:	Install dynamic reactive plant and shunt capacitor
Project's state of completion:	Possible
Grid need date:	2028-2029
Indicative cost [$ million]:	80
Reliability or Economic investment?	Reliability (Grid Reliability Report)

6.5.1.2 Waikato and Upper North Island thermal transmission capacity

Potential closure of the remaining Huntly Rankine units and strong load growth in the WUNI region will also cause thermal constraints into the WUNI area under n-G-1 or n-1 conditions (in addition to the voltage stability risks discussed above). The limiting circuits are Hamilton–Whakamaru, Ohinewai–Whakamaru and Otahuhu–Hautapu–Whakamaru.

We will implement variable line ratings on the Hamilton–Whakamaru and Ohinewai–Whakamaru circuits by 2027.

Beyond this committed minor project, we are investigating options to further increase thermal transmission capacity into the WUNI area, including a combination of:

- installing series compensation on the Brownhill–Whakamaru circuits. This defers thermal transmission capacity issues on the four other 220 kV circuits supplying the WUNI area from Whakamaru, but it also creates a new n-1 capacity issue on the 220 kV Brownhill–Pakuranga cable sections. Two options to avoid this issue are: a 220 kV bus at Brownhill and a new 220 kV Brownhill–Otahuhu cable, or a short double circuit 220 kV line deviation to tee connect both Brownhill–Whakamaru circuits into Ohinewai substation.
- bussing both Otahuhu–Hautapu–Whakamaru 220 kV circuits at Ohinewai, and reconductoring the Ohinewai–Hautapu–Whakamaru section with duplex conductor.

The cost to resolve the thermal transmission capacity is expected to exceed the $30 million MCP threshold.

Base E&D capex investments

Project name:	Hamilton–Whakamaru and Ohinewai–Whakamaru variable line ratings
Project description:	Implement variable line ratings on the Hamilton–Whakamaru and Ohinewai–Whakamaru circuits
Project's state of completion:	Committed
Grid need date:	2027
Indicative cost [$ million]:	3.5
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Major capex investments

Project name:	Brownhill–Whakamaru series compensation
Project description:	Install series compensation on the Brownhill–Whakamaru circuit
Project's state of completion:	Possible
Grid need date:	2030
Indicative cost [$ million]:	145
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Pakuranga – Whakamaru deviation into Ohinewai
Project description:	Tee Pakuranga–Whakamaru circuits into Ohinewai substation
Project's state of completion:	Possible
Grid need date:	2033
Indicative cost [$ million]:	30
Reliability or Economic investment?	Reliability (Grid Reliability Report)

6.5.1.3 Waikato and Upper North Island high voltage management

Following the recent installation of two 100 Mvar shunt reactors at the Pakuranga substation and a 50 Mvar shunt reactor at Otahuhu, the management of high voltage issues on the grid has significantly improved. The new dynamic reactive plants at Hamilton (section 6.5.1.1) and Otahuhu also contribute towards managing the high voltage levels in the WUNI area.

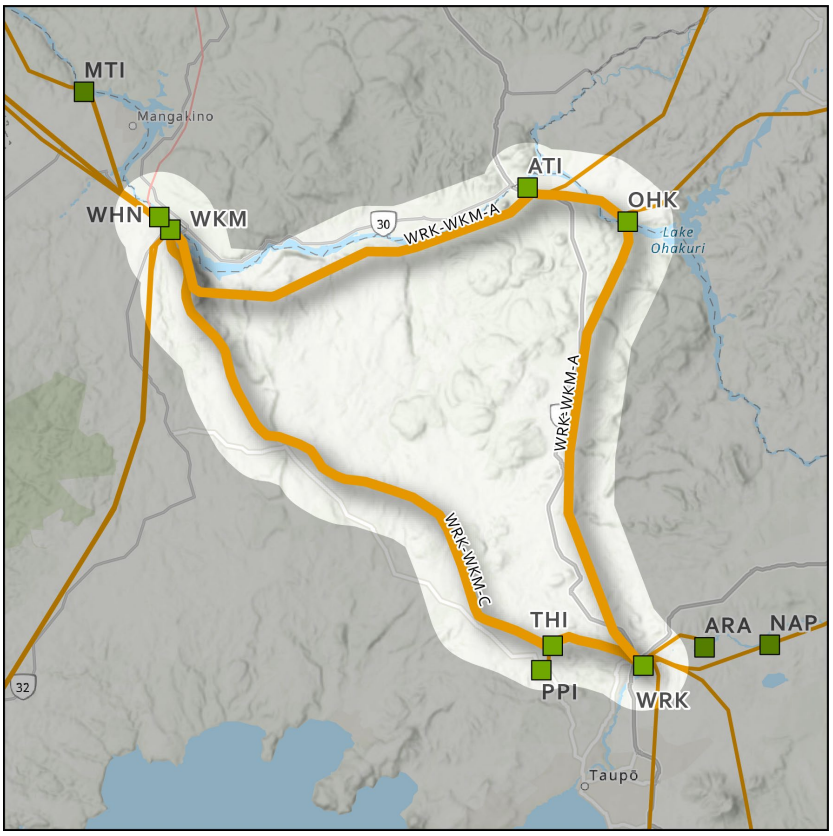
Future dynamic reactive plant included in our WUNI stage 2 MCP proposal will further increase the capability of the grid to absorb reactive power during light loads.

We will continue to assess the needs of the system and develop our strategy to mitigate issues before they occur on the grid.

6.5.2 Wairakei Ring transmission capacity

The Wairakei Ring connects the generation rich regions of the Central North Island with the high load centres of the Upper North Island, Waikato and Bay of Plenty via two 220 kV transmission lines (a single and a double circuit line).

Figure 6-7: Wairakei Ring transmission corridor



For the short term we have identified investments that will enable us to better utilise the existing Wairakei Ring assets. The following upgrades are committed as part of the NZGP1, Stage 1 MCP[14]:

- thermally upgrade the 220 kV Wairakei–Whakamaru, Te Mihi–Wairakei and Te Mihi–Whakamaru circuits. This will be completed by end 2025. The Atiamuri reactor may also be tapped to the 19 ohm position to reduce potential overload on the Atiamuri–Whakamaru and Atiamuri–Ohakuri circuits.
- thermally upgrade the 220 kV Edgecumbe–Kawerau circuit, completed in early 2025.

Options to resolve longer term capacity needs include building a new Wairakei–Ohakuri–Atiamuri–Whakamaru 220 kV line or a new 220 kV line between Wairakei and Whakamaru. The cost of these investments will exceed the $30 million MCP threshold.

[14] NZGP is Net Zero Grid Pathways. For more detail on our NZGP work programme, see https://www.transpower.co.nz/nzgp

Major capex investments

Project name:	NZGP1 – Wairakei Ring transmission capacity
Project description:	Thermally upgrade the Wairakei–Whakamaru C line (Te Mihi–Wairakei, Te Mihi–Whakamaru and Wairakei–Whakamaru circuits)
Project's state of completion:	Delivery
Grid need date:	2026, generation development dependent
Indicative cost [$ million]:	10.6
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

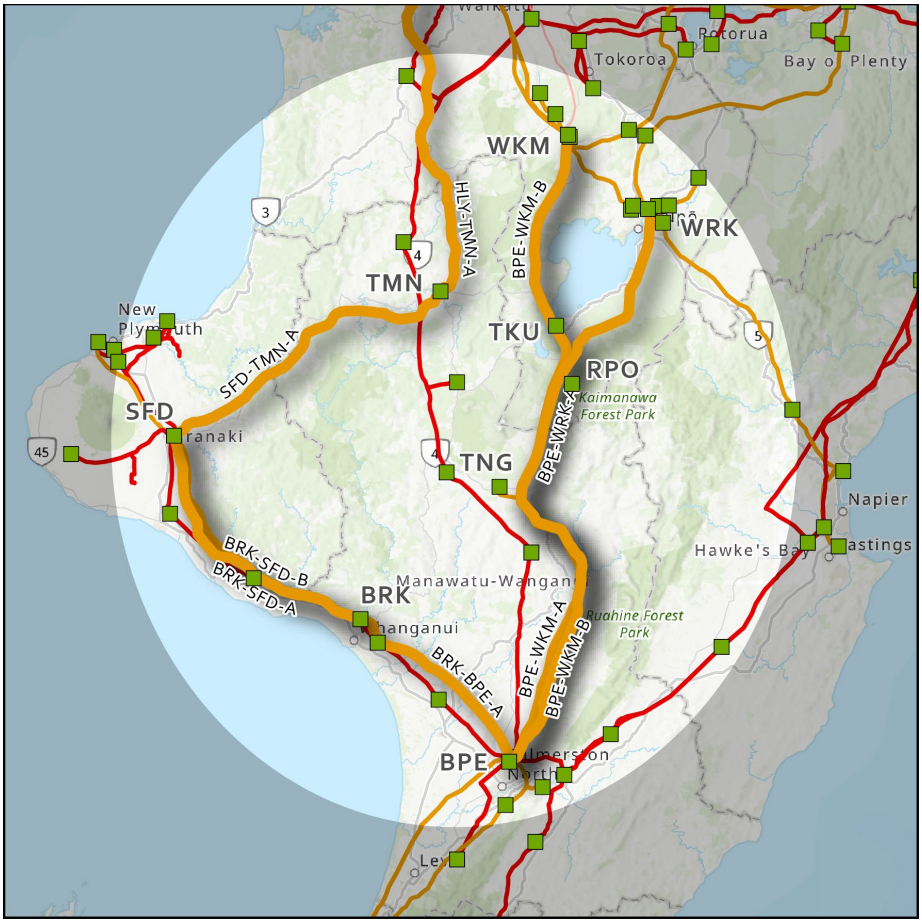
Project name:	Wairakei Ring transmission capacity
Project description:	New Wairakei–Ohakuri–Atiamuri–Whakamaru or Wairakei–Whakamaru line
Project's state of completion:	Possible
Grid need date:	2030-2035 (or earlier), generation development dependent
Indicative cost [$ million]:	90-135 (costs range depending on new line route)
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

6.5.3 Central North Island and Taranaki transmission capacity

6.5.3.1 Central North Island and Taranaki thermal capacity

The Central North Island and Taranaki transmission corridors connect the generation rich regions of the Central North Island, Taranaki and Wellington (including the HVDC) with the high load centres of the Upper North Island and Waikato regions via seven 220 kV transmission lines (four single and three double circuit lines). A low capacity 110 kV line runs in parallel connecting the Lower North Island 110 kV network to the Waikato 110 kV network.

Figure 6-8: Central North Island and Taranaki transmission corridors



For the short term, we identified investments that will enable better utilise the existing assets between Bunnythorpe and the WUNI area. The following upgrades are committed as part of the NZGP1, Stage 1 MCP:

- thermally upgrade and apply variable line ratings to Tokaanu–Whakamaru–1, then reconductor both Tokaanu–Whakamaru circuits
- thermally upgrade and apply variable line ratings on the Bunnythorpe–Tokaanu circuits.
- remove the line protection static limit on the Huntly–Stratford circuit
- implement a 110 kV system split at Ongarue[15], between Bunnythorpe and Arapuni/Hangatiki with load restoration special protection scheme to provide switched n-1 security to the grid exit points affected by this system split
- upgrade the existing Tokaanu Intertrip special protection scheme[16].

Longer-term upgrade options include reconductoring the Bunnythorpe–Tokaanu circuits, building new transmission lines, and thermally upgrading the Bunnythorpe–Tangiwai–Rangipo–Wairakei circuit. The cost of these investments will exceed the $30 million MCP threshold.

[15] The goal of this split is to avoid pre-contingency loading issues on Bunnythorpe–Mataroa 110 kV circuit. The system split will be on the north side of Ongarue.

[16] The Tokaanu Intertrip Scheme currently only operates for Tokaanu–Whakamaru contingencies. The scheme will be altered using a staged approach as upgrades are completed on the circuits connected at Tokaanu, to maximise northwards transfer. Functionality will be included so the scheme can split the Tokaanu 220 kV bus for Bunnythorpe–Tokaanu contingencies which will reduce the post-contingent loading on the Bunnythorpe–Tokaanu circuits.

Major capex investments

Project name:	NZGP1 – Central North Island transmission capacity
Project description:	System split the 110 kV grid between the Waikato and Central North Island regions at Ongarue Implement a load restoration special protection scheme for the GXPs impacted by the system split.
Project's state of completion:	Committed
Grid need date:	2026, generation development dependent
Indicative cost [$ million]:	1.9
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	NZGP1 – Central North Island transmission capacity
Project description:	Remove line protection static limit on the Huntly–Stratford circuit
Project's state of completion:	Delivery
Grid need date:	2026, generation development dependent
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	NZGP1 – Central North Island transmission capacity
Project description:	Upgrade the existing Tokaanu Intertrip Scheme
Project's state of completion:	Delivery
Grid need date:	2026, generation development dependent
Indicative cost [$ million]:	0.5
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	NZGP1 – Central North Island transmission capacity
Project description:	Thermally upgrade the Tokaanu–Whakamaru circuits and implement variable line ratings.
Project's state of completion:	Delivery
Grid need date:	2025, generation development dependent
Indicative cost [$ million]:	45.5
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	NZGP1 – Central North Island transmission capacity
Project description:	Thermally upgrade the Bunnythorpe–Tokaanu circuits and implement variable line ratings.
Project's state of completion:	Committed
Grid need date:	2029, generation development dependent
Indicative cost [$ million]:	68.1
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	NZGP1 – Central North Island transmission capacity
Project description:	Duplex the Tokaanu–Whakamaru circuits[17]
Project's state of completion:	Committed
Grid need date:	2027, generation development dependent
Indicative cost [$ million]:	94.4
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	Central North Island transmission capacity
Project description:	Duplex the Bunnythorpe–Tokaanu circuits
Project's state of completion:	Possible
Grid need date:	2029, generation development dependent
Indicative cost [$ million]:	202
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	Central North Island transmission capacity
Project description:	Thermally upgrade the Bunnythorpe–Tangiwai–Rangipo–Wairakei circuit
Project's state of completion:	Possible
Grid need date:	2035, generation development dependent
Indicative cost [$ million]:	37
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

6.5.3.2 Brunswick–Stratford circuit consolidation

The two Brunswick–Stratford 220 kV lines (Brunswick–Stratford–A, a double-circuit line and Brunswick–Stratford–B, a single-circuit line) are due for reconductoring as a risk-based condition replacement around 2035.

We will investigate the long-term need for this line, including the following options:

- dismantling the Brunswick–Stratford–B
- reconductoring the Brunswick–Stratford–A line (Brunswick–Stratford–1 and 2 circuits) with higher capacity conductor and dismantling the B line
- reconductoring both lines.

We will also consider the impacts on transmission capacity in the wider grid, particularly south flow capacity, as part of the investigation. Because the Central North Island transmission corridor constrains generation import into the Wellington region, the immediate benefits of upgrading the Brunswick–Stratford circuits will be small in terms of an increase in transmission capacity until the Central North Island constraints are resolved.

An outcome of this investigation will be a preferred option and a timeframe for submission of an MCP to the Commerce Commission.

[17] Currently, we plan to complete a tactical thermal upgrade on the Tokaanu–Whakamaru–1 circuit then start reconductoring the Tokaanu–Whakamaru–2 circuit. Thermally upgrading the first circuit can provide additional capacity during the first reconductoring outage.

Major capex investments

Project name:	Brunswick–Stratford A/B
Project description:	Reconductor A line with higher capacity conductor, dismantle B line
Project's state of completion:	Possible
Grid need date:	2025-2030
Indicative cost [$ million]:	100
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

6.5.3.3 Lower North Island voltage management

Depending on generation availability and development of demand, voltage control may become increasingly difficult in the Lower North Island. Unmanageable high voltage issues may arise in future.

Increased bulk power transfer and long-term potential closure of gas generation in the Taranaki region may require voltage support in the Taranaki or Bunnythorpe region.

We will investigate installing shunt reactors, capacitors, or voltage control equipment in the Taranaki and/or Bunnythorpe regions to manage voltage. We will also investigate alternative options such as seeking voltage support contracts as a non-transmission alternative.

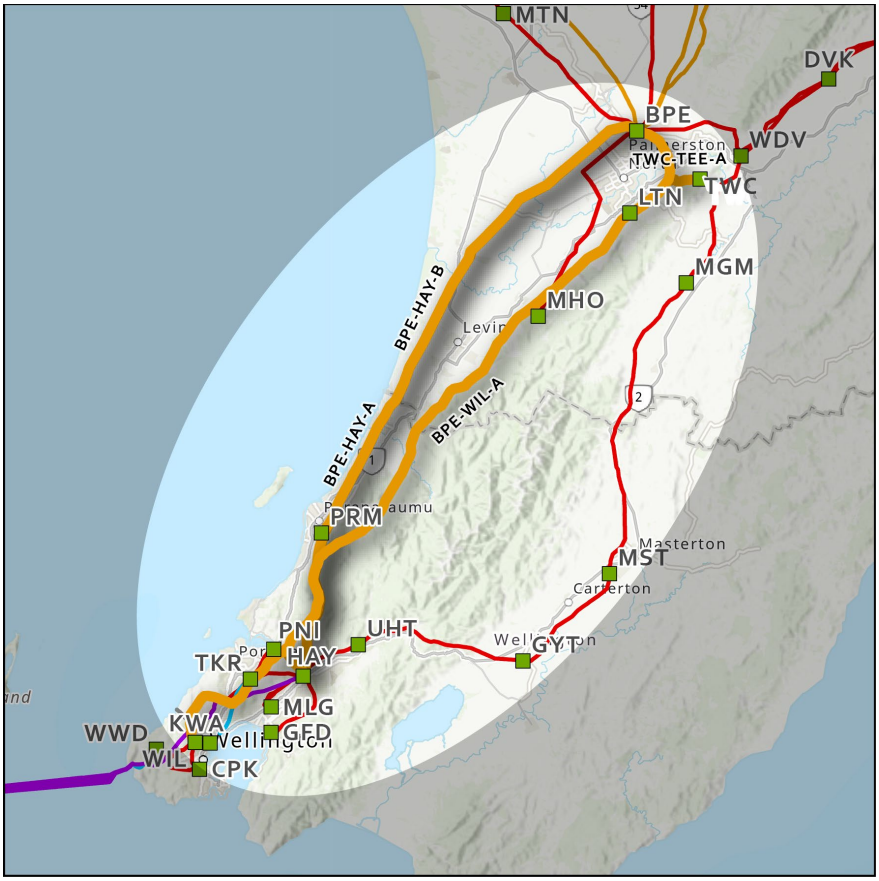
Base E&D capex investments

Project name:	Lower North Island voltage management
Project description:	Install shunt reactors and/or capacitors in Taranaki or Bunnythorpe region
Project's state of completion:	Possible
Grid need date:	to be determined
Indicative cost [$ million]:	25
Reliability or Economic investment?	Reliability (Grid Reliability Report)

6.5.4 Transmission constraints between Haywards and Bunnythorpe

The circuits from Haywards to Bunnythorpe supply Wellington load and connect the HVDC to the Central North Island. Four 220 kV transmission lines run between Haywards and Bunnythorpe with a low capacity 110 kV path, also running from Haywards to Bunnythorpe. Windfarms in the Tararua and Wellington regions connect into these circuits and contribute to the overall flow through the transmission interface.

Figure 6-9: Central North Island and Taranaki transmission corridors



In the short term, the transmission needs of circuits between Haywards and Bunnythorpe will continue to be monitored.

Potential south flow constraints on Bunnythorpe–Paraparaumu–Haywards circuits exist and may be addressed with a thermal upgrade of the circuits, depending on the system need or customer related developments which may exacerbate the issue.

Base E&D capex investments

Project name:	Bunnythorpe–Paraparaumu thermal upgrade
Project description:	Thermal upgrade of Bunnythorpe–Paraparaumu circuits from 75°C to 90°C
Project's state of completion:	Possible
Grid need date:	TBC, customer dependent
Indicative cost [$ million]:	10
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

6.6 South Island grid backbone

6.6.1 Existing grid backbone

The South Island grid backbone comprises the following 220 kV circuits:

- three from Islington to Kikiwa
- four from Twizel and Livingstone to Islington
- nine between Twizel and Livingstone, which connect six large Waitaki Valley hydro generation stations and the HVDC link
- three from Roxburgh to Twizel and Livingstone
- four from Roxburgh to Invercargill and North Makarewa (two of which run via Three Mile Hill)
- nine connecting Manapouri and Tiwai to Invercargill and North Makarewa.

The existing South Island grid backbone is set out geographically in Figure 6-1 and schematically in Figure 6-2.

The South Island grid backbone is connected to the North Island via the inter-island HVDC link. This allows power to be exchanged between the two islands. Typically, the net annual power flow is northward; north flow is particularly frequent during North Island peak demand periods. However, during light load periods, power may flow southward, conserving South Island hydro storage, especially during periods of low hydro inflows in the South Island.

To help describe transmission system issues and opportunities on the grid backbone we split the South Island transmission system into three major areas:

- Clutha Upper Waitaki area, which encompasses the transmission system between the Clutha area (Clyde and Roxburgh) and the Upper Waitaki area (Twizel to Livingstone)
- Upper South Island area, which encompasses everything north of the Clutha Upper Waitaki area
- Lower South Island area, which encompasses the Clutha area and everything south of it. Within the Lower South Island area, we refer to the area south of Roxburgh and west of Three Mile Hill as the Southland area.

Figure 6-10: South Island grid backbone map

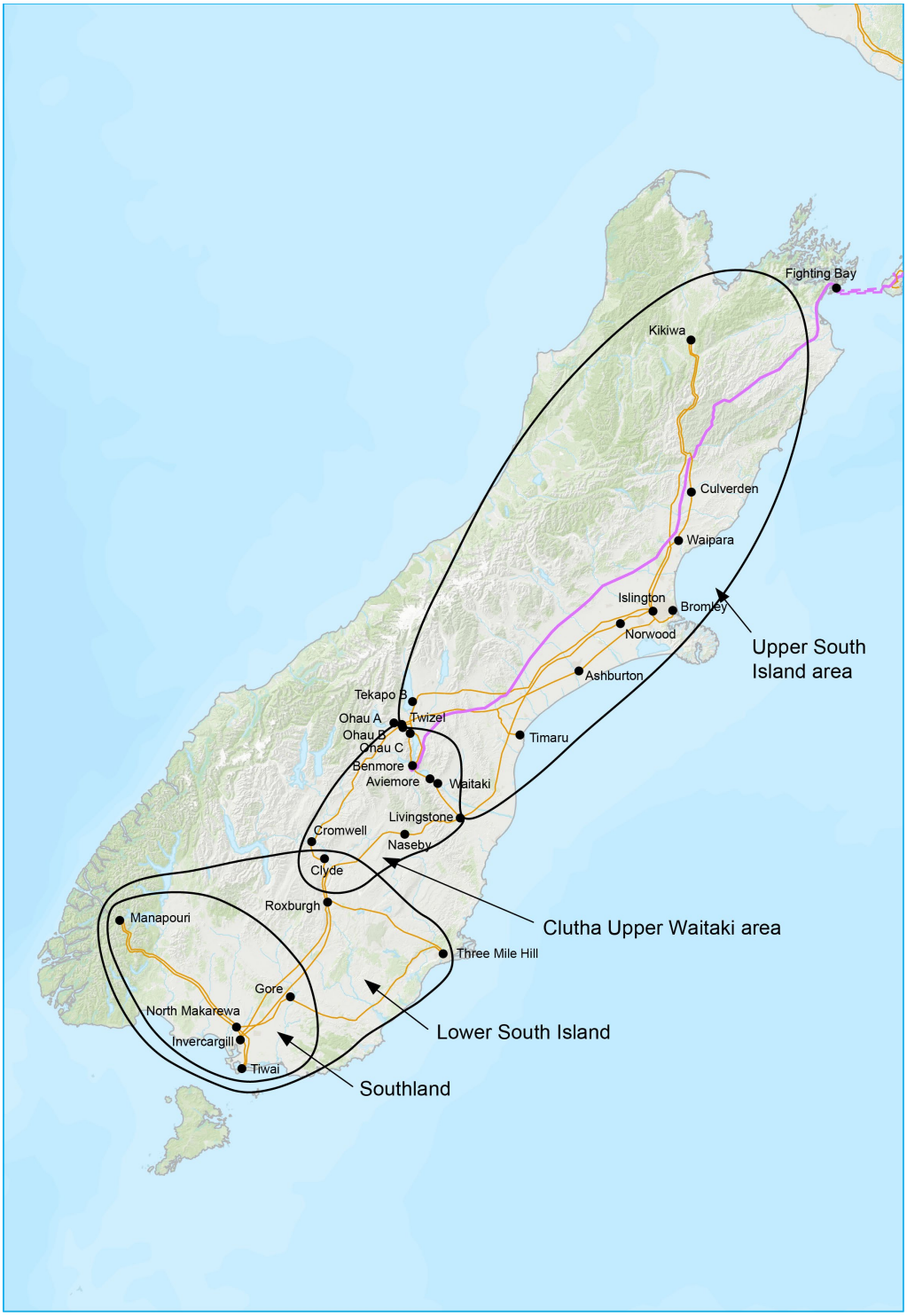
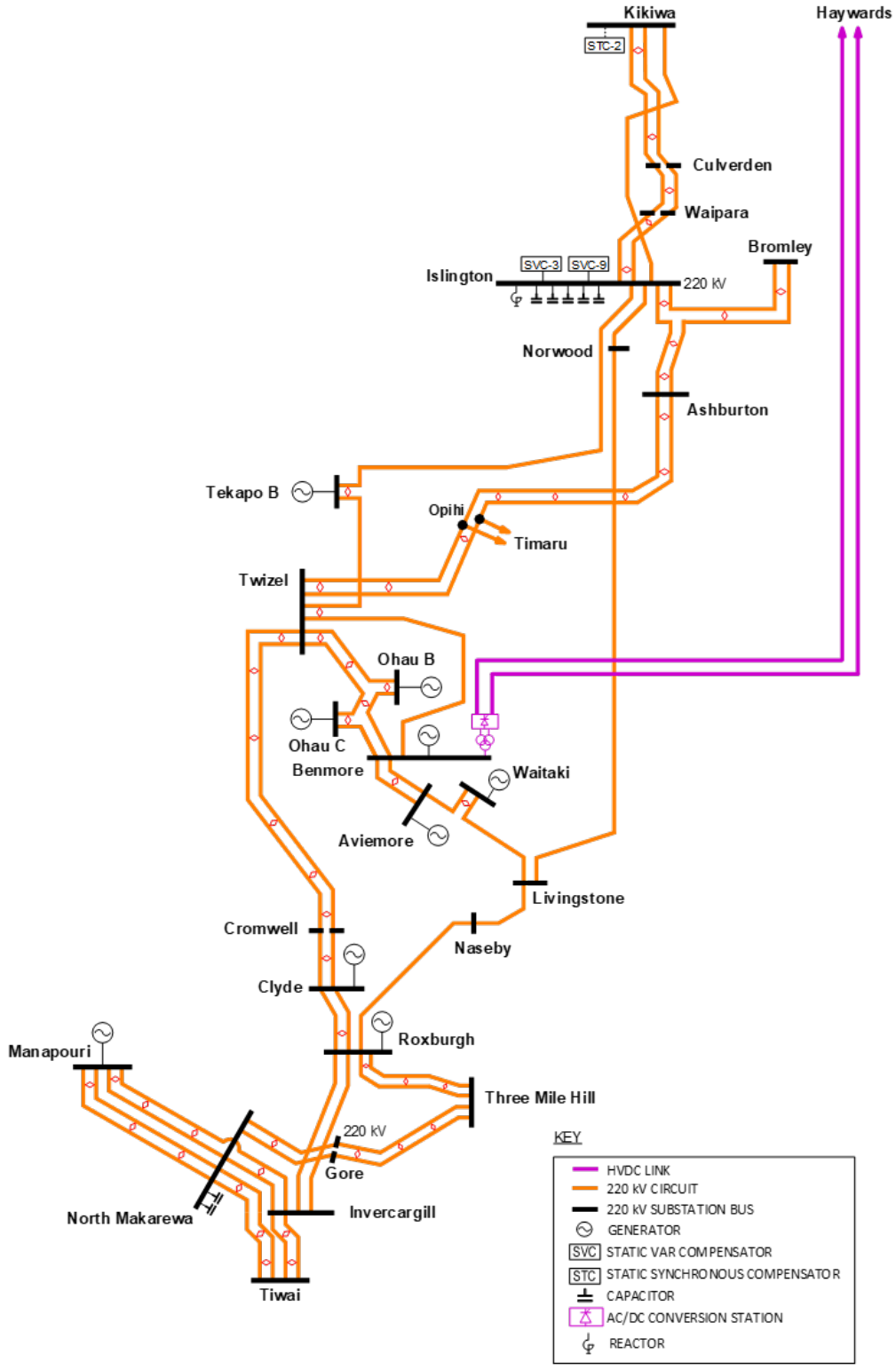


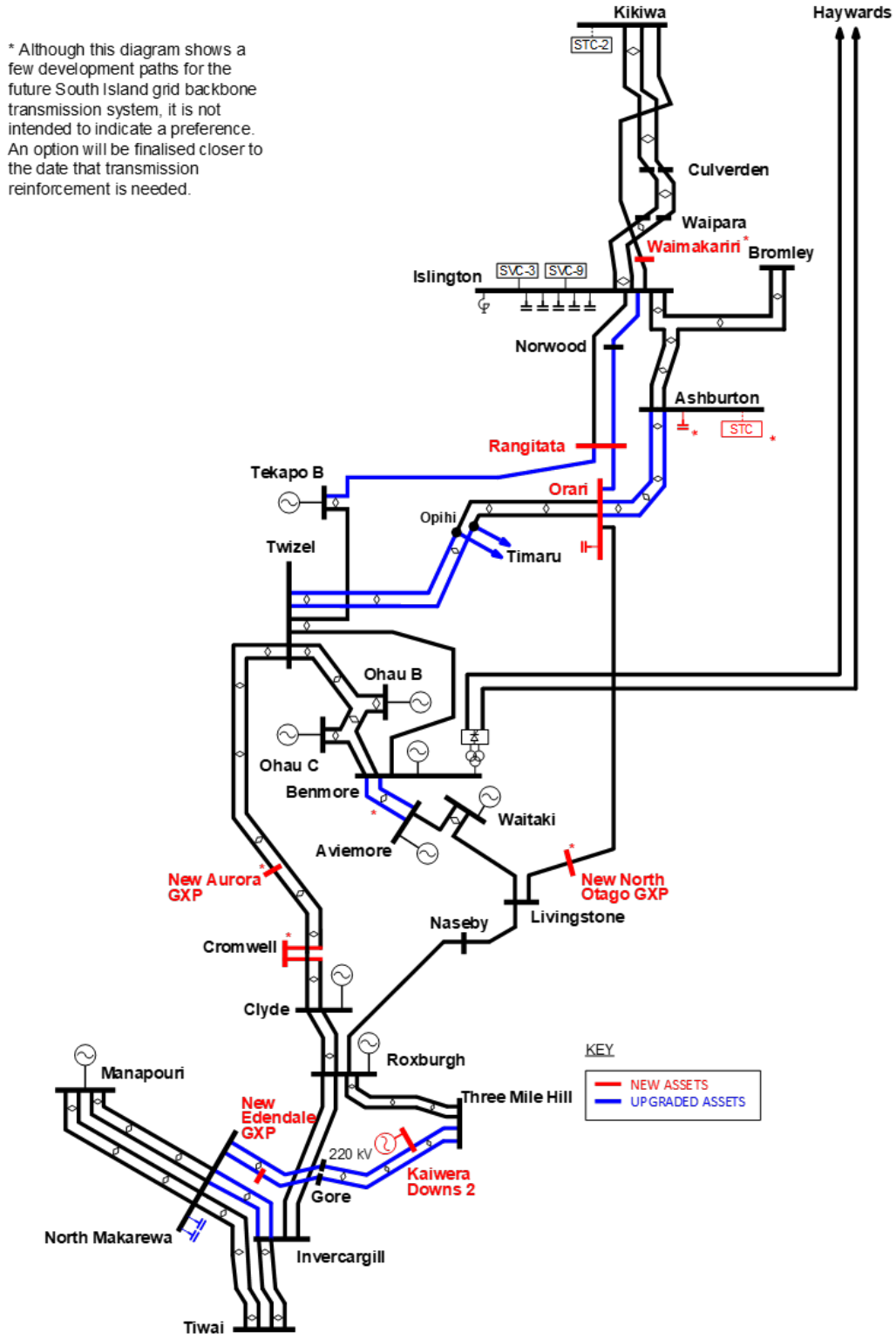
Figure 6-11: South Island grid backbone schematic



6.6.2 Possible South Island grid backbone to 2040

Figure 6-3 provides an indication of possible South Island transmission backbone development in the medium term (the next 15 years). New assets and upgraded assets (based on potential enhancement approaches set out in the following sections) are shown.

Figure 6-12: Possible South Island grid backbone schematic in 2040



6.6.3 South Island grid backbone beyond the planning horizon (2040)

Figure 6-4 provides an indication of the possible South Island transmission backbone development in the longer-term (beyond 2040).

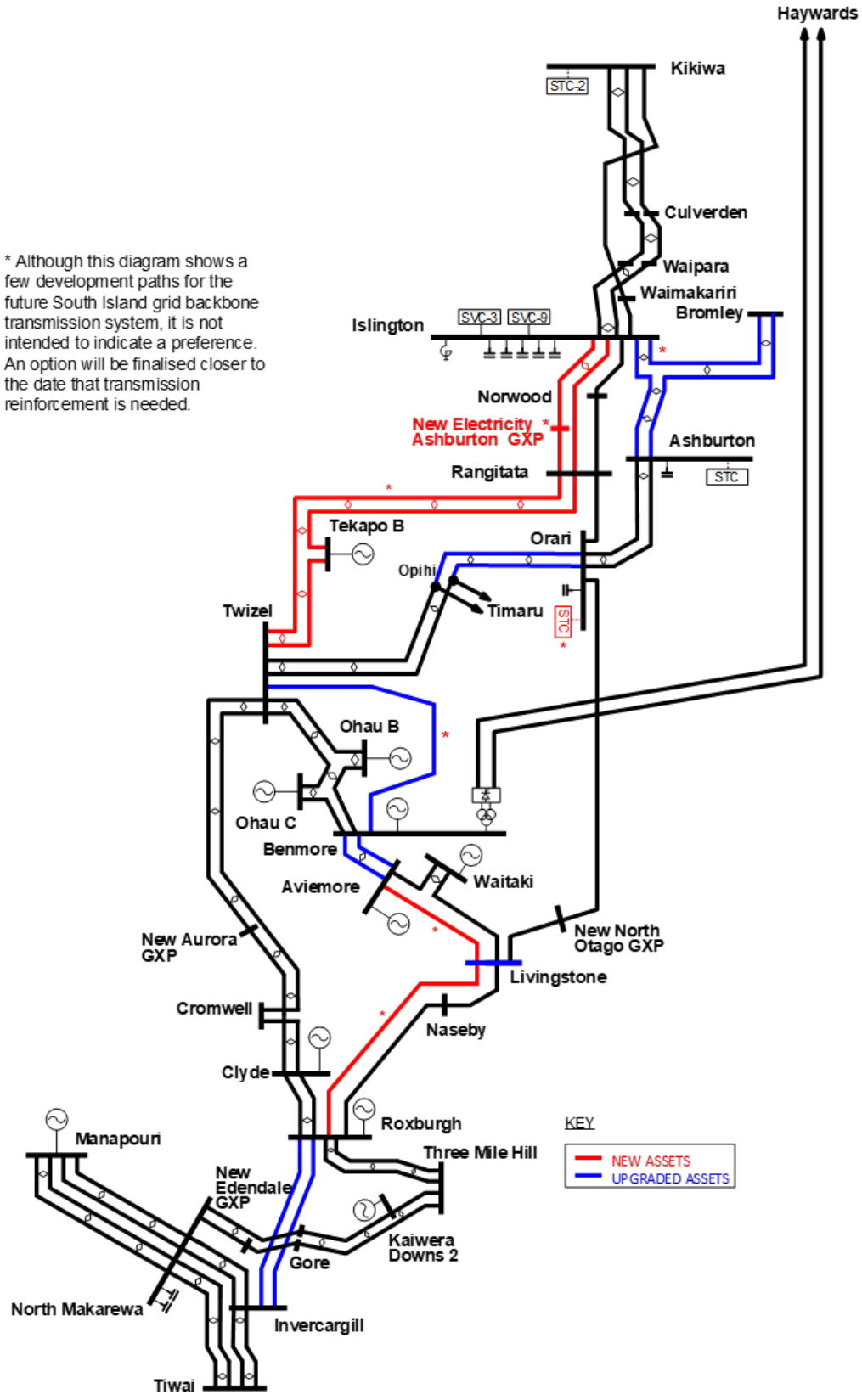
Additional transmission capacity upgrades into Christchurch will likely be required just beyond the end of the forecast period. This can be achieved by one or more of the following options:

- reconductoring existing 220 kV lines into Christchurch

- a new 220 kV transmission line between the Upper Waitaki Valley and Christchurch.

The preferred option will be determined closer to the need date.

Figure 6-13: Longer-term indicative South Island grid backbone schematic (beyond 2040)



6.7 South Island grid enhancement approach and inputs

When analysing the South Island grid backbone to determine capacity constraints and investigate upgrade options, we are guided by our objective (section 6.1.1), a study methodology (section 6.1.2), and the forecasts for demand and generation (section 6.1.3).

Additional inputs specific for the South Island grid backbone are discussed below.

6.7.1 Committed and modelled projects

Projects that are not completed at the time of beginning the TPR studies, but which are included in the analysis are:

- new Invercargill 220/66 kV grid exit point, to be completed by end of 2025
- new Edendale 220/110 kV grid exit point, to be completed by end of 2027
- new North Otago 220/110 kV grid exit point, assumed to be commissioned by end of 2027 – this is a modelled project, this grid exit point is not committed at the time of publication.

Generation and grid-scale battery developments that are not completed at the time of publication, but which meet the definition of committed are shown in Table 6-1.

Table 6-3: Committed generation and grid-scale battery developments in the South Island

Generator	Connection Point	Approximate Capacity (MW)
Clandeboye solar farm	Temuka	28
Kaiwera Downs 2 wind farm	New grid injection point on North Makarewa–Three Mile Hill–A line	155
Kowhai Park solar farm	Islington	150
Ra Nui solar farm	Blenheim	13

6.7.2 Line conductor replacements

Table 6-2 lists the major grid backbone line conductor review and replacement projects expected to be undertaken between 2025 and 2040.

Table 6-4: South Island grid backbone expected line conductor replacements 2025 to 2040

Line	Affected circuits	Tentative year	Further information
Manapouri–Tiwai–A	Manapouri–North Makarewa–1 Manapouri–North Makarewa–2 North Makarewa–Tiwai–1 North Makarewa–Tiwai–2	2025-2027	Note 1
Invercargill–Roxburgh–A	Invercargill–Roxburgh–1	2025-2027	Note 2
Invercargill–Manapouri-A	Invercargill–North Makarewa–1 Invercargill–Manapouri–2	2025-2027	Note 3

6. Only a small section of Manapouri–Tiwai–A is being reconductored. We will do like-for-like replacement for the Manapouri–North Makarewa–1 and 2 circuits. We will investigate a thermal upgrade for the replacement conductor on North Makarewa–Tiwai–1 and 2 to future proof the works for thermally upgrading both circuits in future.
7. Only a small section of Invercargill–Roxburgh–A near Invercargill is being replaced. We will investigate replacing the existing conductor with a higher rated conductor to facilitate connection of possible new wind generation.
8. Thermally upgrading the circuits between Invercargill and North Makarewa (refer to Chapter 19.8.3).

6.7.3 South Island grid backbone asset feedback register

The Asset Feedback Register records that outage windows to perform maintenance on the 220 kV Ashburton–Timaru–Twizel circuits are becoming increasingly difficult to manage. The windows are limited by summer peaks in the Upper South Island, preventing maintenance being carried out in the summer months. See section 17.7.2 for more details.

6.8 South Island asset capability and constraints

Asset changes since the 2023 TPR

Changes since the 2023 TPR:

- new Norwood 220/66 kV grid exit point
- refurbishment of Islington SVC3
- replacement of Timaru–T8 220/110 kV interconnection transformer with new 250 MVA unit
- replacement of both Frankton 110/33 kV supply transformers with new 120 MVA units[18].

System conditions

We assessed the transmission capacity and reactive support requirements on the South Island grid backbone for a range of system conditions over the next 15 years. The system conditions that provide snapshots of the capability of the South Island grid backbone to transfer energy from generators to the loads while maintaining a secure grid are shown below.

Section number	System conditions
6.8.1	System condition 1: high Upper South Island load
6.8.2	System condition 2: high Lower South Island generation
6.8.3	System condition 3: low Lower South Island generation
6.8.4	System condition 4: light load

We have not made any significant changes to the system conditions from 2023 as they remain relevant to the South Island grid backbone analysis. There is a small change in generation dispatch for system condition 1 to better illustrate the issues with high Upper South Island load and low generation.

When a problem or opportunity is identified that we expect will be economic to address, initial options and actions that may be taken to address it are examined in section 6.9.

Key results for 2025 TPR

Key findings for the South Island grid backbone system conditions include:

- Transmission capacity to the Upper South Island is first limited by a voltage stability constraint, and later by thermal constraints on the Ashburton–Timaru–Twizel (Twizel–Opihi section) and Norwood–Livingstone circuits.
- The Upper South Island voltage stability issue need date for investment is 2028. An investigation (outside the study scope of the TPR) identified a preferred solution[19]. For the TPR we assume switching stations at Orari and Rangitata, to illustrate the longevity of the proposed upgrade option for voltage stability and illustrate its interaction with other constraints.
- During periods of extreme generation export from the Lower South Island, constraints may occur (Aviemore–Benmore thermal limit, Clutha Upper Waitaki voltage stability limit and Clyde–Cromwell thermal limit). In response to a significant number of generation and load connection enquiries, as well as from a system reliability and security perspective, we are developing a Murihiku Southland Regional Development Plan for electricity infrastructure[20].
- The Southland area import limit is set by voltage stability, the thermal capacity of the Gore–Roxburgh 110 kV circuit and, later, by the thermal capacity of the Invercargill–Roxburgh 220 kV circuits.
- For very high levels of power flow into the Lower South Island from the Waitaki Valley with medium to high HVDC south flow, post-contingency overloads will occur on the Aviemore–Benmore circuit, followed by the Benmore–Twizel circuit.

[18] Frankton is supplied from Cromwell and is not part of the grid backbone. However, the rating and impedance of the Frankton supply transformers can affect the voltage stability limit in the Lower South Island for high levels of generation in the Southland region.

[19] See Transpower's Upper South Island project website: Upper South Island upgrade project | Transpower

[20] There are ongoing studies (outside of the study scope of the TPR) of issues that may occur under this scenario. Transpower will announce the findings as the studies are completed. See Murihiku Southland Regional Development Plan | Transpower.

- A minimum level of generation is required from Manapouri during high load periods in the Lower South Island, which increases with load growth (assuming Manapouri has enough hydro storage to meet system requirements).
- During light load periods, the high voltage issue in the Upper South Island area is difficult to manage. The 80 Mvar reactor installed at Islington assists in managing this issue.

Key differences in results from 2023 TPR

Key differences in results from 2023 TPR include:

- The aluminium smelter at Tiwai remains open for the whole forecast period. This removes potential constraints exporting excess generation from Southland and removes potential high voltage issues in Southland during light load periods.
- Constraints related to high levels of importing power into Southland during periods of low generation in the area are exacerbated with the aluminium smelter at Tiwai remaining open and the increased electrification of industrial processes in Southland.
- Committed and installed solar generation in the Upper South Island has altered power flows, and therefore transmission constraints, in the Waitaki Valley.

6.8.1 System condition 1: high Upper South Island load

This system condition (SC1) examines the effect of extremely low generation in the Upper South Island area during a forecast prudent Upper South Island peak load period. It is designed to highlight transmission issues into the Upper South Island from the Waitaki Valley area. Although the Upper South Island has relatively little generation compared with its load, generation still has a noticeable effect on transmission constraints. The specific assumptions for this system condition are:

- regional prudent peak load
- low generation in the Upper South Island area:
    - no generation at Tekapo A and Highbank for summer[21]
    - 20% generation at Tekapo A and Highbank for winter
    - 20% generation from all the remaining Upper South Island hydro power stations for both winter and summer
    - 33% generation from Solar Farms[22] for summer and no generation for winter
- high generation in the Waitaki Valley and Lower South Island areas
- generation and load balance is achieved using the HVDC link.

SC1: voltage stability constraints

Voltage stability within the Upper South Island area is influenced by:

- reactive power losses
- reactive power demand due to load composition (in particular, the proportion and type of motor load)
- reactive power support in the Upper South Island[23]
- generation level in the Upper South Island.

The Upper South Island MCP identified a N-1 voltage stability limit for the Upper South Island. The need date to address voltage stability limit is winter 2028. The outages that may cause a voltage stability constraint at peak load periods are:

- Livingstone–Norwood–1 circuit from winter 2028
- Ashburton–Timaru–Twizel circuit, from summer 2029[24].

Any new generation or load management within the Upper South Island will improve voltage stability. Depending on the amount, this may defer the need for transmission investment.

[21] This assumption stress tests the Upper South Island during peak loads. Tekapo A has only one generating unit that could be unavailable, and Highbank is typically offline during summer when the water is used for irrigation.

[22] The analysis considers only the existing Lauriston and future Kowhai Park (2026) solar farms.

[23] Reactive support in the Upper South Island is provided by: (i) two SVCs at Islington and a STATCOM at Kikiwa; (ii) grid backbone capacitor banks at Islington; (iii) regional grid capacitors at Islington, Southbrook, Blenheim, Stoke, Greymouth and Hokitika.

Conversely, large step changes in load in the Upper South Island not accounted for in the forecast, and shifting load from the Lower Waitaki Valley 110 kV area towards a new grid exit point connected on the Norwood–Livingstone 220 kV circuit will bring forward the need for a transmission investment.

SC1: transmission thermal constraints

The Upper South Island MCP identified an outage of an Ashburton–Timaru–Twizel circuit will cause the other Ashburton–Timaru–Twizel circuit (Twizel–Opihi section) to overload from summer 2029[24] and winter 2033.

SC1: constraints following implementation of the Upper South Island Major Capital Proposal

We are proposing the following developments in the Upper South Island MCP:

- new switching stations near Orari and Rangitata by winter 2029
- thermally upgrade the Norwood–Rangitata circuit to 90°C by 2030
- thermally upgrade the Orari–Rangitata circuit to 100°C by 2030
- two 75 Mvar shunt capacitor banks at Orari by 2030.

With these proposed developments implemented, the following circuit overload and voltage issues may occur in the 2030s. An outage of:

- an Orari–Timaru–Twizel circuit may cause the other Orari–Timaru–Twizel circuit (Twizel–Opihi section) to overload
- an Orari–Timaru–Twizel circuit may cause a voltage stability constraint
- an Orari–Timaru–Twizel circuit may cause the Rangitata–Tekapo B circuit to overload
- an Ashburton–Orari circuit may cause the other Ashburton-Orari circuit to overload towards the end of the forecast period
- an Islington–Rangitata circuit may cause the Islington–Norwood circuit to overload
- a Rangitata–Tekapo B circuit may cause the Orari–Rangitata circuit to overload.

What next?

The Upper South Island voltage stability issue was extensively studied and we submitted a Major Capital Proposal to the Commerce Commission in August 2025. Refer to section 6.9.1 for our enhancement approach.

Developments to address voltage issues in the South Canterbury region will also help address the Upper South Island voltage stability issues. See Chapter 18 (particularly section 18.4.2) for details.

6.8.2 System condition 2: high Lower South Island generation

This system condition (SC2) is designed to highlight transmission issues with very high generation export from the Lower South Island north to the Waitaki Valley. The excess power not consumed within the South Island is exported to the North Island via the HVDC link. The specific assumptions for this system condition are:

- HVDC north transfer close to maximum value (1,200 MW)
- maximum generation from Manapouri and Clutha hydro schemes
- high generation from Waitaki Valley power stations
- high output from generation connected within the distribution networks (Mahinerangi, Waipori and White Hill Wind Farms)
- low output from solar generation in the upper South Island (Lauriston and Kowhai Park)
- forecast 2025 island prudent peak summer and winter load, for summer and winter transmission constraints respectively (base case).

Lower South Island export is defined as the power exported through the Clyde–Cromwell–Twizel and Naseby–Roxburgh circuits.

[24] An Ashburton–Timaru–Twizel 220 kV circuit outage may cause low voltage followed by voltage stability issues at Timaru, discussed further in section 18.4.2.

SC2: Aviemore–Benmore transmission thermal constraint

Maximum Lower South Island generation export with high Aviemore and Waitaki generation may overload the Aviemore–Benmore circuits for an outage of the Livingstone–Norwood circuit[25]. To prevent this overload, either the Lower South Island generation or the Aviemore and Waitaki generation must be constrained down. Reducing the Aviemore and Waitaki generation is about twice as effective at addressing the overload than reducing the Lower South Island generation.

SC2: Clutha Upper Waitaki area reactive power shortage and static voltage stability limit

With high Lower South Island generation export, there is a risk of reaching the regional static voltage stability limit for a Naseby–Roxburgh circuit outage. The resulting power flow on both Clyde–Cromwell–Twizel circuits cause high reactive power losses. The reactive power required to maintain voltages at an acceptable level may exceed what can be supplied by generators in the Clutha Upper Waitaki area.

Depending on the HVDC transfer and availability of generators to provide reactive power support, voltage stability can become an issue when the Lower South Island export approaches 1,100 MW. This may limit transfer before the Clyde–Cromwell thermal capacity limit.

SC2: Clyde–Cromwell transmission thermal constraint

The Clyde–Cromwell section of the Clyde–Cromwell–Twizel circuits may overload for an outage of either the other Clyde–Cromwell–Twizel circuit or the Naseby–Roxburgh circuit.

In summer, the Clyde–Cromwell circuits may overload for an outage of the Naseby–Roxburgh or parallel Clyde–Cromwell–Twizel circuit when the Lower South Island export approaches 1,100 MW.

In winter, the thermal overload binds at about 1,150 MW of transfer, but the voltage stability limit (discussed above) will likely limit transfer before thermal limits.

Sensitivity to Lower South Island load and generation scenarios

The likelihood of generation constraints binding described above is heavily influenced by the future load and the generation in the Lower South Island. Three load cases are assessed:

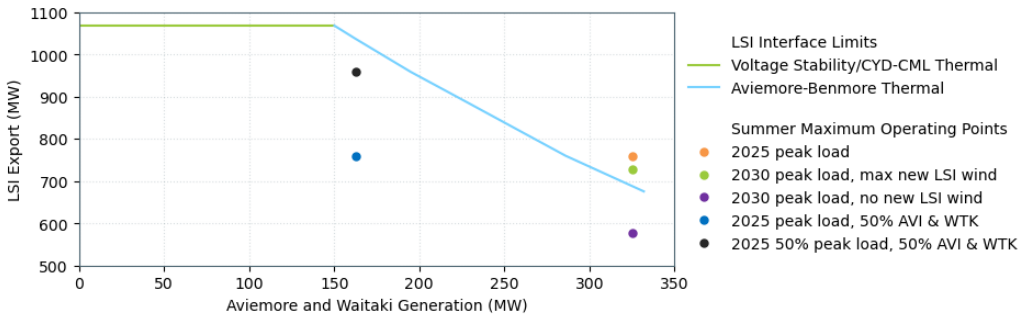
- Year 2025 island prudent peak load – base case
- Year 2030 island prudent peak load – to show impact of load growth
- Year 2025 50%[26] island prudent peak load – (to show impact of light load periods).

In addition, three generation cases are assessed:

- maximum Aviemore and Waitaki generation
- 50% of Aviemore and Waitaki generation
- including committed new generation in the Lower South Island area[27].

Figure 6-5 summarises the study results.

Figure 6-14: Lower South Island summer export limits



[25] The Aviemore–Benmore overload for a Livingstone–Norwood circuit outage is not managed by the Aviemore–Benmore circuit overload protection scheme, as its operation would cause static voltage stability issues in the Clutha Upper Waitaki area.

[26] For this light load case, loads other than Tiwai in the Otago-Southland region were scaled to 50% of 2025 island prudent peak load.

[27] The generation included in this case is the 155 MW Kaiwera Downs 2 windfarm connecting to the North Makarewa–Gore–Three Mile Hill line north of Gore.

Constraint lines from the graph are:

- The green line is the Clutha Upper Waitaki area voltage or Clyde–Cromwell thermal constraint, which occurs when Otago-Southland load is low and Lower South Island generation high.
- The blue line is the Aviemore–Benmore thermal constraint, which occurs when Aviemore and Waitaki generation is high.

Sensitivity studies using 2025 load from the graph are:

- The orange dot operating point represents the 2025 summer Island peak with high Lower South Island, Aviemore and Waitaki generation. This operating point is clearly above the Aviemore–Benmore thermal constraint. To prevent the overload, the Aviemore and Waitaki generation must be constrained down to move the operating point below the blue constraint line.
- The blue dot operating point represents the 2025 summer Island peak with high Lower South Island generation and Aviemore and Waitaki generation at half maximum output. The operating point is well below the blue constraint line.
- The black dot operating point represents 50% of 2025 summer Island peak Otago-Southland load with Aviemore and Waitaki generation at half maximum output. Although Aviemore and Waitaki generation is low, the operating point is just below both constraint lines due to high Southland export.

Sensitivity studies for long-term increase in Otago-Southland load and generation are:

- The purple dot operating point shows the effect of Otago-Southland load growth, using the 2030 summer Island peak with high Lower South Island, Aviemore and Waitaki generation. It is below the Aviemore–Benmore circuits thermal constraint. Comparing the load in 2025 (orange dot) with the increased load in 2030 (purple dot), the operating point moves from the constraint region above the Aviemore–Benmore circuits constraint to the unconstrained area as less power is available in Otago-Southland for export.
- The green dot operating point shows the effect of Otago-Southland load growth and new committed generation in the Lower South Island (making less power available for export as load growth over the five-year period slightly exceeds committed new generation in the area), using the 2030 summer Island peak load and high Lower South Island, Aviemore and Waitaki generation. This operating point is above the Aviemore–Benmore constraint. To prevent the overload, the Aviemore and Waitaki generation must be constrained down to move the operating point below the blue constraint line.
- There is considerable interest in developing generation projects in the Lower South Island area. Figure 6-5 illustrates that the Aviemore–Benmore constraint may limit the generation in the region, particularly during the summer ratings period.

SC2: Invercargill–North Makarewa 220 kV transmission capacity

The 220 kV Invercargill–North Makarewa–1 circuit is rated at 404/493 MVA (summer/winter) and operates in parallel with the 220 kV Manapouri–Invercargill–2 circuit which are a part of the grid backbone.

With high generation in the Southland region, a 220 kV Invercargill–Manapouri circuit outage may overload the 220 kV Invercargill–North Makarewa circuit (after the new Kaiwera Downs 2 wind farm is commissioned).

After another wind farm is commissioned, tentatively in 2028, the 220 kV Invercargill–North Makarewa circuit may overload pre-contingency.

What next?

We undertook a consultation for a Southland regional plan[28], which included development options for the grid backbone in Southland.

Refer to section 6.9.3 for our enhancement approach. We will continue to monitor the need to address these issues on the network.

[28] Murihiku Southland Regional Development Plan | Transpower

6.8.3 System condition 3: low Lower South Island generation

This system condition (SC3) tests the impact of low generation in the Lower South Island. This analysis focuses on summer, as worst case constraints occur during this time. It represents South Island peak load with low Lower South Island generation to highlight transmission issues during high import from the Waitaki Valley into the Lower South Island and Southland areas. It also highlights issues within the Waitaki Valley with high HVDC south flow. The specific assumptions for this system condition are:

- South Island 2028 island peak load.
- Low Lower South Island generation (Manapouri, Waipori, Clyde, Roxburgh, White Hill, Kaiwera Downs 1 and 2, and Mahinerangi).
- Upper South Island typical summer peak generation dispatch, including two new solar farms (Lauriston and Kowhai Park).
- Power required to balance load and generation is from generation in the Waitaki Valley and HVDC south flow. HVDC south flow will be moderate or high, depending on the level of generation in the Waitaki Valley.

There are two distinct groups of constraints for this system condition:

- Southland import constraints during periods of low Southland generation (south of Roxburgh).
- Thermal constraints within the Waitaki Valley area with high Lower South Island import concurrent with high HVDC south flow (low Waitaki Valley generation).

SC3: low generation south of Roxburgh – high Southland import

With low generation south of Roxburgh (Manapouri, Waipori, and the White Hill, Mahinerangi and Kaiwera Downs 1 wind farms):

- A 220 kV Invercargill–Roxburgh outage overloads the regional 110 kV Gore–Roxburgh circuit when the total southward flow from Roxburgh[29] exceeds about 500-640 MW. Reducing the Roxburgh 110 kV generation slightly increases the Southland import thermal limit. Future generation in the Southland region and future load transfer from the 110 kV network to the 220 kV network will also change these limits slightly.
- Voltage stability in the Southland region may be at risk for a 220 kV Invercargill–Roxburgh outage. This stability limit is influenced by the number of generator units available for reactive power support at Manapouri and, to a lesser extent, the amount of reactive support provided by Clyde and Roxburgh power stations.
- With high generation at Roxburgh and Clyde, static voltage stability may limit transfer when total southward flow from Roxburgh exceeds about 850-1000 MW, depending on the number of Manapouri units online.

A scenario with new generation connecting to the 220 kV North Makarewa–Gore–Three Mile Hill circuits will change the thermal issues under high Lower South Island import conditions from the Invercargill–Roxburgh circuits to the 220 kV North Makarewa–Gore–Three Mile Hill circuits.

SC3: high Lower South Island import and medium to high HVDC southward flow

With high Lower South Island import, supply to the South Island is from Waitaki generation and HVDC. The following constraints may appear within the Waitaki Valley:

- Aviemore–Benmore may overload for an outage of the other Aviemore–Benmore circuit, which is managed by an overload special protection scheme[30].
- Benmore–Twizel may overload for an Ohau B–Twizel outage, and at a later stage also for an Ohau C–Twizel outage.
- The occurrence of these overloads depends on the level of Lower South Island generation import, the Waitaki generation, and the HVDC south flow.

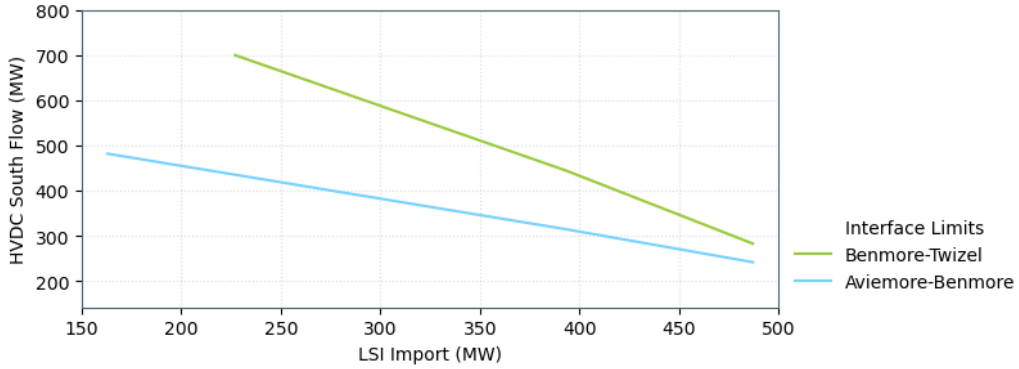
Figure 6-6 demonstrates how these limits vary with Lower South Island import levels in the Summer 2028 scenario. In this study Waitaki generation is adjusted to vary the HVDC flow.

[29] The south flow from Roxburgh is the pre-contingency power flow measured across the four 220 kV circuits (Invercargill–Roxburgh–1 and 2, Roxburgh–Three Mile Hill–1&2) and the three 110 kV circuits (Halfway Bush–Roxburgh–1 and 2, Gore–Roxburgh–1).

[30] The Aviemore–Benmore circuit overload protection scheme was originally designed to protect against overloads for power flow from Aviemore to Benmore. Last year, this special protection scheme was modified to also protect against overloads for power flow from Benmore to Aviemore.

Manapouri generation is varied to change the power import into the Lower South Island and other generation is low: Clyde is 200 MW, Roxburgh 220 kV is 68 MW, and Roxburgh 110 kV is 32 MW.

Figure 6-15: Waitaki Valley limits under high LSI import conditions



These scenarios show changes in Lower South Island import levels change the power flow through the Aviemore to Benmore and Benmore to Twizel interfaces. The Aviemore–Benmore circuits cause the first transmission constraint, followed by the Benmore–Twizel circuit. However, new generation in Waitaki area and Upper South Island may adversely influence the above Lower South Island import constraints.

Figure 6-6 also shows that high generation output is required from the Waitaki generation during periods of high Lower South Island import to prevent transmission capacity constraints in the Waitaki Valley.

What next?

The transmission constraints with high levels of power import into the Lower South Island can be managed operationally at present by requiring minimum levels of generation in the region and/or Waitaki Valley, depending on the constraint. Under very low hydro inflow scenarios, load may need to be managed; we will monitor the risk of this and investigate the options as needed.

Given the expected load and generation developments in Southland, we are investigating options to ease transmission constraints caused by the Southland 110 kV circuits (see section 19.4.3).

To address the Aviemore–Benmore thermal issues, we are investigating a small thermal upgrade (50°C to 60°C) of the circuits. In addition, we will modify the Aviemore–Benmore circuit overload protection scheme (see section 6.9.3).

6.8.4 System condition 4: light load

This system condition (SC4) tests the effect of low load on the grid backbone. It represents a realistic summer night light load period and is designed to highlight possible high voltage issues, particularly in the Upper South Island.

The specific assumptions for this system condition are:

- minimum South Island summer night load
- very low HVDC transfers.

SC4: Upper South Island high voltage

Load north of the Waitaki Valley is not dominated by heavy industrial loads, making it highly variable throughout the day with very low loads overnight, especially in summer. There are long transmission lines into the Upper South Island that produce significant amounts of reactive power during light load periods (increasing the voltage) and there is little generation to absorb reactive power (to reduce the voltage).

Three dynamic voltage control plants north of the Waitaki Valley are used to control voltages by absorbing reactive power during light load periods (combined reactive power absorption capacity 185 Mvar):

- two SVCs at Islington

- one STATCOM at Kikiwa.

In addition, a 50 Mvar shunt reactor at Kikiwa and a recently installed 80 Mvar shunt reactor at Islington help absorb reactive power during light load periods.

Available generation units in the Waitaki Valley can also be used to absorb some reactive power; this reduces loading on the SVCs at Islington but has very little effect further north.

Over the years, the high voltage issue has continued to worsen, and prior to the installation of the shunt reactors in the upper South Island we had increasingly needed to switch out transmission circuits overnight to manage the issue. A variety of factors have exacerbated the high voltage issue such as an increasing proportion of distribution networks being undergrounded[31] and the load characteristics generally becoming more capacitive. Switching circuits out during light load periods may still be required at times.

6.9 South Island grid backbone possible capacity upgrades

This section provides information about the transmission constraints on the South Island grid backbone identified in section 6.8 and that we expect will justify further investigation or mitigation over the next few years.

Transmission issues likely requiring E&D base capex or MCP funded investment in the South Island grid backbone over the next 10-15 years are listed below.

Section number	Issue
6.9.1	Upper South Island transmission capacity
6.9.2	South Island high voltage management
6.9.3	Lower South Island–Waitaki Valley transmission capacity

6.9.1 Upper South Island transmission capacity

The following investments and investigations are proposed to address the Upper South Island transmission capacity issues discussed in section 6.8.1.

6.9.1.1 Upper South Island voltage support and line thermal issues

Our Upper South Island MCP submission proposes the following investments to manage voltage stability and circuit thermal issues:

- switching stations at Orari and Rangitata to sectionalise the 220 kV circuits from the Waitaki Valley to Islington
- thermally upgrade the 220 kV Norwood–Rangitata and Orari–Rangitata circuits
- two 75 Mvar shunt capacitor banks at Orari
- an automatic over-voltage capacitor switching scheme.

The Upper South Island MCP is with the Commerce Commission for evaluation (as at the time of writing).

We have already procured the designations, easements and property for the Orari and Rangitata switching stations.

[31] Cables are naturally more capacitive than overhead lines. Therefore, they produce more reactive power during light loads.

Major Capex investment

Project name:	Upper South Island upgrade project
Project description:	Build Orari and Rangitata switching stations to bus the 220 kV circuits from the Waitaki Valley. Thermally uprate the Norwood–Rangitata and Orari–Rangitata circuits. Install two 75 Mvar shunt capacitor banks at Orari. Install an Automatic over-voltage capacitor switching scheme (AOVCS)
Project's state of completion:	Possible
Grid need date:	2027
Indicative cost [$ million]:	$164 million
Reliability or Economic investment?	Reliability (Grid Reliability Report)

6.9.1.2 Issues beyond the Upper South Island MCP (Stage 2)

Subsequent to implementing the proposals identified in section 6.9.1.1, the line thermal and voltage stability issues will occur again.

The transmission capacity is limited by an outage of an Orari–Timaru–Twizel circuit which will cause both voltage stability constraints and overload the other Orari–Timaru–Twizel circuit (Twizel–Opihi section). In subsequent years the Rangitata–Tekapo B, Orari–Rangitata and Ashburton–Orari circuits will also limit the thermal capacity into the upper South Island.

We will investigate issues and potential upgrade options for the Upper South Island region based on forecast load growth and potential generation developments. Possible upgrades include:

- thermally upgrade both Opihi–Twizel circuit sections.
- Install reactive power support at Ashburton and/or additional reactive power support at Orari
- thermally upgrade the Rangitata–Tekapo B circuit
- reconductor the Orari–Rangitata circuit
- thermally upgrade both Ashburton–Orari circuits.

Major Capex investment

Project name:	Upper South Island upgrade project (Stage 2)
Project description:	Thermally upgrade both Opihi–Twizel circuit sections Thermally upgrade Rangitata–Tekapo B circuit Reconductor Orari–Rangitata Install 150 Mvar of reactive power support at Ashburton or Orari Thermally upgrade both Ashburton–Orari circuits
Project's state of completion:	Possible
Grid need date:	2032
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

6.9.2 South Island high voltage management

We will monitor the South Island high voltage issues discussed in section 6.8.4. No investments are planned at this stage.

6.9.3 Lower South Island–Waitaki Valley transmission capacity

The following investments and investigations are proposed to address the transmission capacity issues discussed in section 6.8.2 (for power flow from the Lower South Island to the Waitaki Valley) and section 6.8.3 (for power flow from the Waitaki Valley to the Lower south Island).

In the short-term, proposed and possible upgrades are:

- A small thermal upgrade of both Aviemore–Benmore circuits.

- Modify the existing Aviemore–Benmore circuit overload protection scheme to provide separate enable/disable functionality for the “north” and “south” control actions.
- Apply a special protection scheme to the regional 110 kV Gore–Roxburgh and Balclutha–Berwick circuits to prevent them from limiting Lower South Island import (see section 19.4.3).
- Thermally upgrade the Invercargill–North Makarewa 220 kV circuit, and at a later stage bus the Invercargill–Manapouri circuit at North Makarewa (see sections 19.8.3 and 19.8.4)
- Duplex the North Makarewa–Gore–Three Mile Hill circuits (see section 19.8.5).
- Upgrade the North Makarewa capacitor banks from 50 Mvar to 70 Mvar[32].

Potential thermal and voltage stability issues within the Waitaki Valley and from the Waitaki Valley to Southland are very sensitive to changes to load and generation in the area. This includes likely new generation proposals and step increases in load, as well as prolonged dry spells for existing hydro generators, particularly Manapouri and to a slightly lesser extent Roxburgh and Clyde. We are monitoring the issue and are undertaking an investigation to understand any issues and identify upgrade options. Possible upgrade options include:

- Reconductor the Aviemore–Benmore circuits.
- Thermally upgrade the Benmore–Twizel circuit.
- Increased reactive support in the Lower South Island (capacitors and/or STATCOM).
- Phase shifting device on the North Makarewa–Three Mile Hill circuit(s).
- Generation runup special protection scheme.

Cost estimates and indicative need dates will be done as part of the investigation.

Base E&D capex investments

Project name:	Aviemore–Benmore thermal upgrade
Project description:	Thermal upgrade the 220 kV Aviemore-Benmore line (60°C)
Project’s state of completion:	Committed
Grid need date:	2026
Indicative cost [$ million]:	0 (part of general maintenance)
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Aviemore–Benmore circuit overload protection scheme
Project description:	Modify the existing circuit overload protection scheme to provide separate enable/disable functionality for the “north” and “south” control actions
Project’s state of completion:	Proposed
Grid need date:	2026
Indicative cost [$ million]:	0.25
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	North Makarewa capacitor upgrade
Project description:	Upgrade the North Makarewa capacitors to 70 Mvar each (from 50 Mvar)
Project’s state of completion:	Possible
Grid need date:	2027
Indicative cost [$ million]:	1.0
Reliability or Economic investment?	Reliability (Grid Reliability Report)

[32] The tuning reactors on the two North Makarewa capacitor banks are due for replacement in 2027, which presents a cost-effective opportunity to increase their rating.

6.10 HVDC link

The High Voltage Direct Current (HVDC) link connecting the North and South Islands provides:

- the North Island with access to the South Island's significant hydro generation capacity, which can be important for supplying the North Island during peak load periods
- the South Island with access to the North Island's thermal generation, which is important for supplying the South Island during dry hydrological periods
- frequency and reserve sharing between the North and South Islands, even if this changes the direction of power flow at low levels of power transfer.

The HVDC link reduces the need for extra generation investment in each island, facilitates price competition between all generation sources, plays an important part in managing renewable energy sources, and facilitates price competition for provision of frequency and reserve services.

The HVDC also has controls to allow the HVDC link to operate above its thermal n-1 capacity pre-contingency and minimise reserve requirements by:

- applying HVDC power limits or runbacks following equipment outages in the North and South Island AC transmission systems
- applying HVDC power limits or runbacks if reactive power margins have been eroded or AC system voltages are below the required levels
- at high transfer levels, using HVDC self-cover to reduce the AC system reserves required to cover a trip of Pole 2 or Pole 3. If a pole trips, the power transfer on the other pole is increased to match the loss of transfer, up to the capacity of the in-service pole.

The HVDC link also has short-term overload capability to assist with managing the Grid post-contingency.

6.10.1 HVDC link existing configuration

Figure 6-7 shows a simplified schematic of the existing HVDC link (including possible enhancements by 2038).

The existing HVDC link comprises:

- two ± 350 kV thyristor bipole converters (Pole 2 and Pole 3), with nominal ratings of 560 MW and 700 MW respectively. Converter stations, protection and control systems are located at Benmore in the South Island and Haywards in the North Island
- two 350 kV bipolar transmission lines. These comprise a 535 km length from Benmore to Fighting Bay (on the shore of Cook Strait in the South Island) and a 37 km length from Haywards to Oteranga Bay (on the shore of Cook Strait in the North Island)
- three 350 kV, 500 MW, 40 km long undersea cables, with cable termination stations at Fighting Bay and Oteranga Bay
- a land electrode at Bog Roy near Benmore in the South Island and a shore electrode at Te Hikowhenua near Haywards in the North Island
- AC filters to reduce harmonic distortion and provide static reactive support at both Benmore and Haywards
- eight synchronous condensers and a STATCOM at Haywards to supplement the dynamic reactive support available from the AC transmission system.

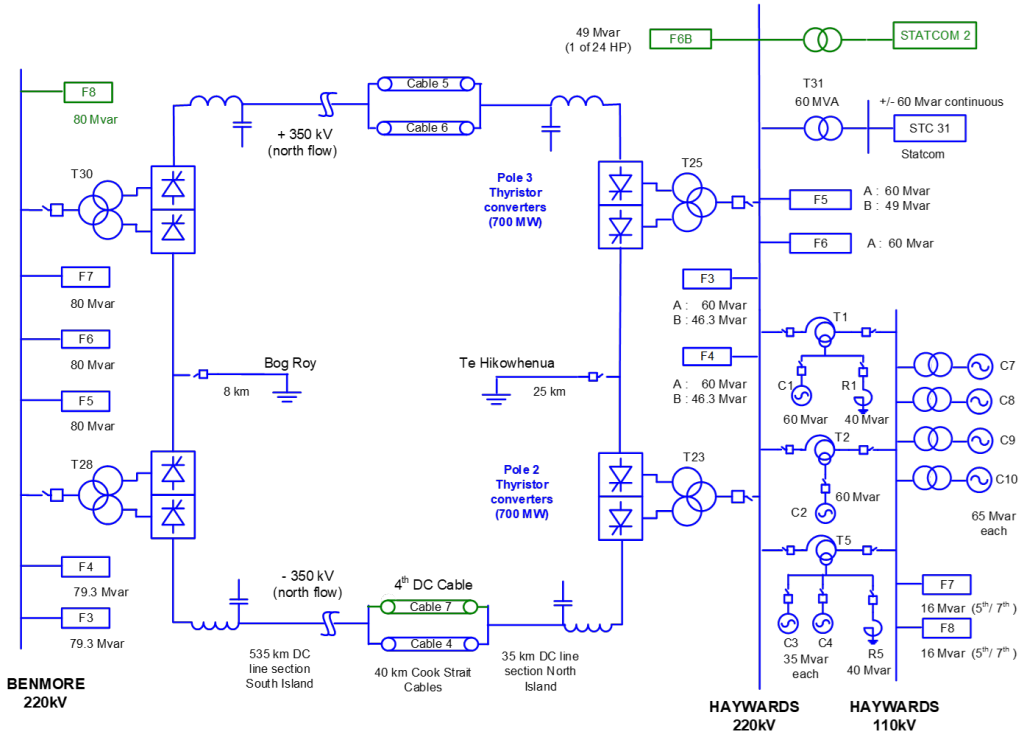
6.10.2 Possible HVDC link configuration by 2038

Figure 6-7 includes a simplified diagram for a possible expansion of the HVDC link (stage 3) to 1,400 MW north capacity.

The possible expansion includes:

- an additional submarine cable
- an additional filter at Benmore
- an additional filter and STATCOM at Haywards.

Figure 6-16: Simplified schematic of the existing HVDC link and possible configuration by 2038



6.11 HVDC enhancement approach and inputs

We look for opportunities to integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Significant upcoming work[33] proposed for the HVDC link during the next 15 years that may significantly impact related system issues or connected parties is discussed below.

6.11.1 HVDC undersea cable condition-based risk assessment

Issue

The existing undersea cables are expected to reach replacement criteria in the early 2030s. Cable failures will reduce HVDC capacity and take an extended time to repair or replace.

What next?

See section 6.13 for our approach.

6.11.2 HVDC controls replacement

Issue

The HVDC control systems have a shorter life span (around 15-20 years) than the main HVDC converter equipment because of obsolescence. At least one full replacement of the control systems is required during the life of the converter equipment. The HVDC controls and protection for Pole 2 – excluding the valve-based electronics for thyristor control – were replaced in 2013. The Pole 3 controls and the bipole control systems were installed in 2013.

What next?

We have investigated the need and timing for the replacement of the control systems; we will bundle this work with the cable replacement - see section 6.13.

[33] This may include replacement of the asset due to its risk-based condition assessment.

6.11.3 HVDC asset feedback register

The Asset Feedback Register does not include any E&D related entries specific to the HVDC.

6.12 HVDC link asset capability and constraints

This section provides details of the existing capability and sets out significant upcoming work on the HVDC link.

Asset changes since the 2023 TPR

There is no change to report since the 2023 TPR.

6.12.1 HVDC capacity

The nominal rating of the Pole 2 converter is 560 MW, with a continuous overload of 700 MW. However, the nominal end-to-end capacity of Pole 2 is limited to 500 MW by the rating of the single HVDC cable connected to the pole.

The nominal rating of the Pole 3 converter is 700 MW, with a continuous overload of at least 770 MW within the design ambient temperature range with all cooling systems available. Two 500 MW HVDC cables are connected to Pole 3, so the nominal end-to-end capacity is 700 MW.

The HVDC overhead transmission line has a nominal rating of 700 MW per pole.

The HVDC link as a whole has a capacity of up to 1,000 MW in balanced 500/500 MW bipole operation and up to 1,200 MW in unbalanced 500/700 MW bipole operation.

Issue

The 1,200 MW capacity of the HVDC cannot always be fully used because of limitations within the AC transmission systems, particularly in the Lower North Island. One cause is insufficient reactive power support for some combinations of HVDC transfer and Wellington regional load, particularly for HVDC south flow. The HVDC can be further constrained during outages of reactive plant at Haywards or 220 kV circuit outages between Haywards and the circuits going north from Bunnythorpe.[34]

The thermal capacity of the AC systems in the North and South Islands to deliver power to and from the HVDC link has increased since the last HVDC upgrade (Pole 3 in 2013) as grid upgrades are completed. In the South Island, examples include completion of the Clutha Upper Waitaki Lines Upgrade Project and the Aviemore–Benmore special protection scheme. In the North Island, examples include reconfiguring the Grid to form two Haywards–Wilton–Linton three-terminal circuits and committed upgrades of Central North Island transmission corridor as part of the NZGP1 MCP proposal (see section 6.5.3).

In addition, the full 1,400 MW capacity of the HVDC convertor stations at Benmore and Haywards cannot be used because of the capacity of the cables across Cook Strait[35].

See section 6.13 for our approach to addressing these issues.

6.12.2 HVDC controls

The HVDC controls are flexible, and additional control functions can be implemented in future if required. However, extensive testing will be required before any new control features are implemented. To assist with this, we have a Real Time Digital Simulator (RTDS) to represent the AC transmission system, interfaced to a complete spare HVDC control hardware suite.

6.13 HVDC link possible capacity upgrades

There is an ongoing investigation program considering upgrades to the HVDC link. This has resulted in an approved MCP (as part of the NZGP program) and an MCP submitted in late 2025 (HVDC Link Upgrade).

[34] Another common reason why the full capacity of the HVDC link cannot be used is lack of offered instantaneous reserves.

[35] Pole 2 is nominally rated at 700 MW but is connected to only one Cook Strait cable rated at 500 MW (see Figure 6-13).

What next?

The investigation has identified a staged upgrade and equipment replacement plan.

The first stage is to increase the reactive power support equipment at Haywards, with the addition of a second STATCOM and an additional filter bank. This was part of our NZGP1 MCP that was approved by the Commerce Commission in 2024. It will increase the real-time HVDC transfer capability for a wider range of generation dispatch and demand system conditions, and mitigate the reduction in HVDC transfer during maintenance outages of reactive power support equipment at Haywards and 220 kV circuits in the Lower North Island.

The existing three submarine cables are expected to require replacement due to their risk-based condition in early 2030s. Our HVDC Link Upgrade Programme MCP identified that a fourth cable is likely to be economic from 2031 due to possible future generation developments and forecast load growth.

Procuring and laying submarine cables is very high cost and has a long lead time due to international demand for manufacturing capacity and the availability of cable laying ships. Therefore, we concluded that we should be bundling the replacement of the three existing cables with an additional (fourth) cable.

The replacement of the existing cables and addition of a fourth cable is the main part of the HVDC Upgrade Programme MCP that we are submitting to the Commerce Commission in September 2025[36]. The short-list consultation for this MCP was completed in June 2025. The preferred option includes:

- the installation of four new submarine cables
- the recovery of the decommissioned cables
- an additional filter bank at Benmore, also required to increase the HVDC transfer capacity to 1400 MW.
- the replacement of the HVDC control and protection systems. Installed in 2013, the existing systems need to be replaced by 2033 due to obsolescence and increasing reliability risks.
- the replacement of both cable termination stations. The existing stations do not meed the current seismic requirements. Building new termination stations will also reduce the need for extended HVDC outage, improve safety during the project and enhance long-term resilience against earthquakes, tsunamis and climate change related risks.
- the construction of a new cable storage facility to accommodate spare cable lengths that will be included in the HVDC cable replacement order.
- a Temporary Overload Scheme for Pole 2. The goal is to allow Pole 2 to run at a higher capacity for up to 15 minutes in the event of a Pole 3 trip. This enhancement would improve overall network stability and reduce costs by allowing the HVDC to cover a larger portion of its own reserve requirement.

If approved, the above work is expected to be completed between 2030 and 2033.

At the end of 2024 we entered into a capacity and reservation agreement with global cable solutions supplier Prysmian for submarine cable manufacture and installation, which provides us with a procurement pathway for the submarine cables in a very high-demand market.

Major capex investments

Project name:	NZGP1 – HVDC capacity Stage 1
Project description:	New reactive support at Haywards to increase HVDC utilisation
Project's state of completion:	Committed
Grid need date:	2026
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

[36] For more detail on the HVDC Upgrade Programme MCP, please visit https://www.transpower.co.nz/hvdc-upgrade

Project name:	HVDC Link Upgrade Programme
Project description:	See main text above
Project's state of completion:	Possible
Grid need date:	2031
Indicative cost [$ million]:	1380
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

7 Northland Regional Plan

7.1	Regional overview and transmission system
7.2	Northland load and generation forecasts
7.3	Grid enhancement approach and inputs
7.4	Grid asset capability and management within the wider region
7.5	Grid asset capability and management by grid exit point
7.6	Northland bus security
7.7	Other items of interest
7.8	Northland generation opportunities and proposals

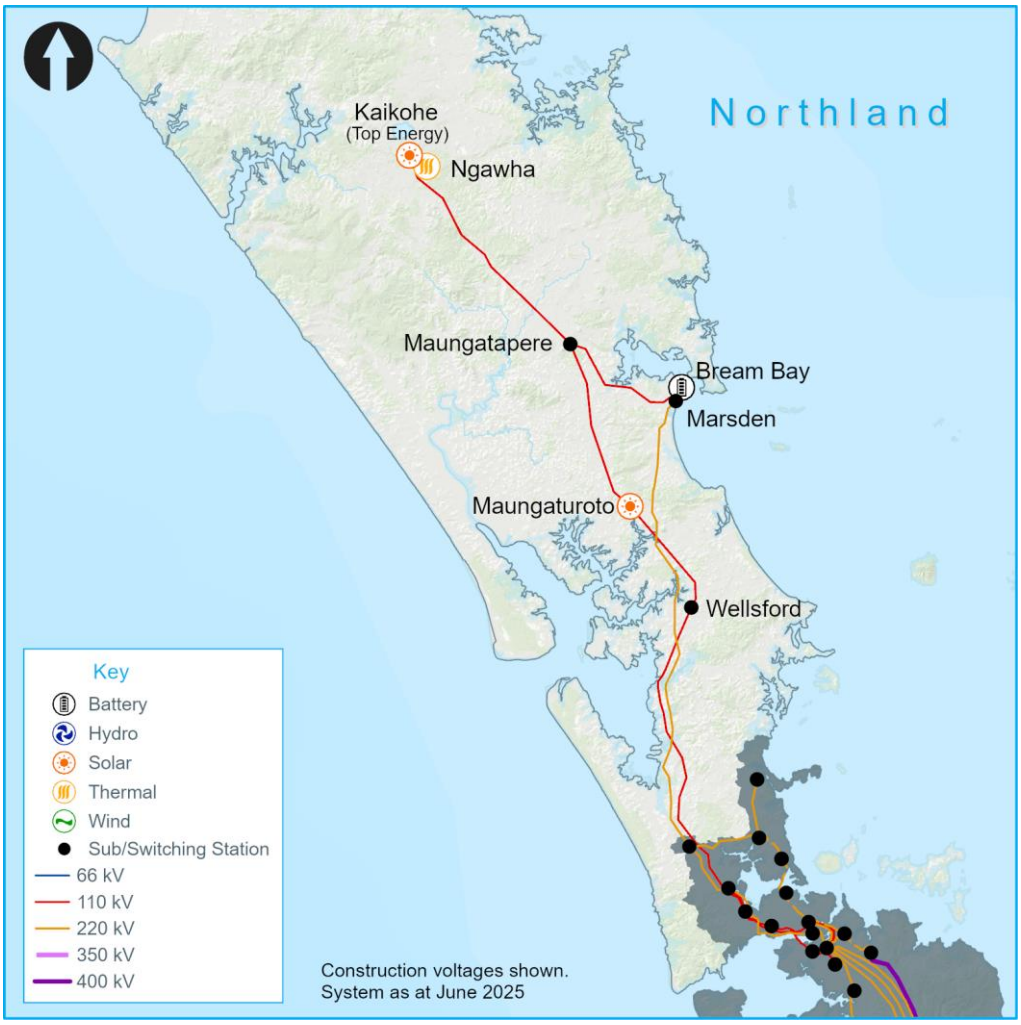
7.1 Regional overview and transmission system

The Northland region supplies a mix of industrial, commercial and other loads. Geothermal and solar generation are connected to both distribution networks and directly to the grid. Solar generation is growing rapidly in the region. A 100 MW grid-scale battery is also in operation at Bream Bay.

The existing transmission network for the Northland region is set out geographically in Figure 7-1 and schematically in Figure 7-2.

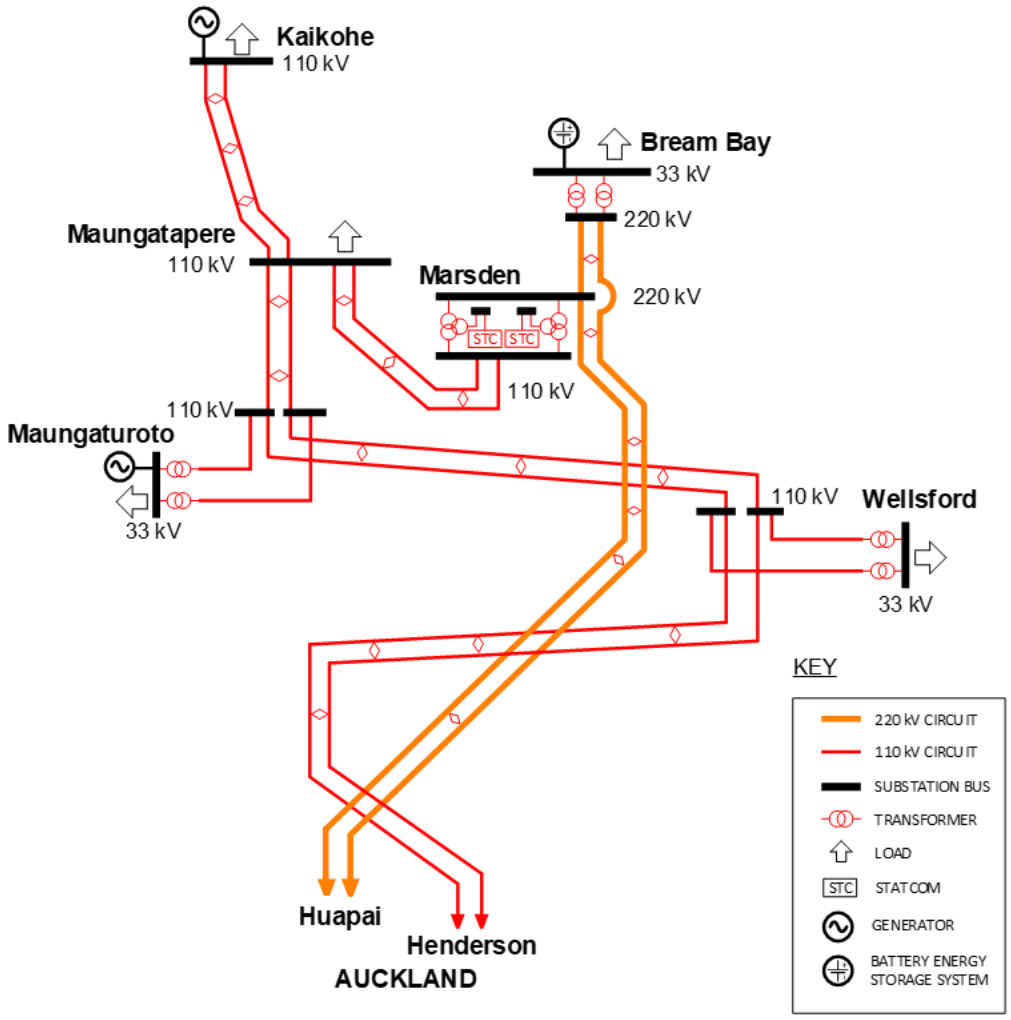
2025 Annual Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 7-1: Northland region transmission network map



2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 7-2: Northland region transmission schematic



7.1.1 Transmission into the region

The Northland region is supplied by a 220 kV double-circuit "main" line from Huapai and a 110 kV double-circuit "backup" line from Henderson. These circuits are effectively in parallel.

The installed generation in Northland already exceeds the minimum load in the region. However, due to the nature of solar generation and operation of the grid-scale battery, power is still imported from the central North Island through the Auckland region almost all the time to supply Northland load. The amount imported can drop significantly in the middle of the day when solar farms are generating.

7.1.2 Transmission within the region

Within Northland, the transmission system can be further broken down to two sub-regions:

- The high capacity 220 kV double-circuit line from Huapai to Marsden and Bream Bay defines one of the sub-regions. Voltage support is provided by two static synchronous compensators (STATCOMs) at Marsden, connected on the tertiaries of the two 220/110/11 kV interconnecting transformers.
- The second sub-region is around Maungatapere, supplied mainly through the 110 kV double-circuit Marsden–Maungatapere line. There is also a low-capacity double-circuit Henderson–Maungatapere line, with substations at Wellsford and Maungaturoto. From Maungatapere there is a 110 kV double-circuit line to Kaikohe. Voltage support for this sub-region is provided by capacitors within the distribution network[1].

[1] The capacitors within the distribution network are at Kaikohe and Kaitaia (about 55 km from Kaikohe).

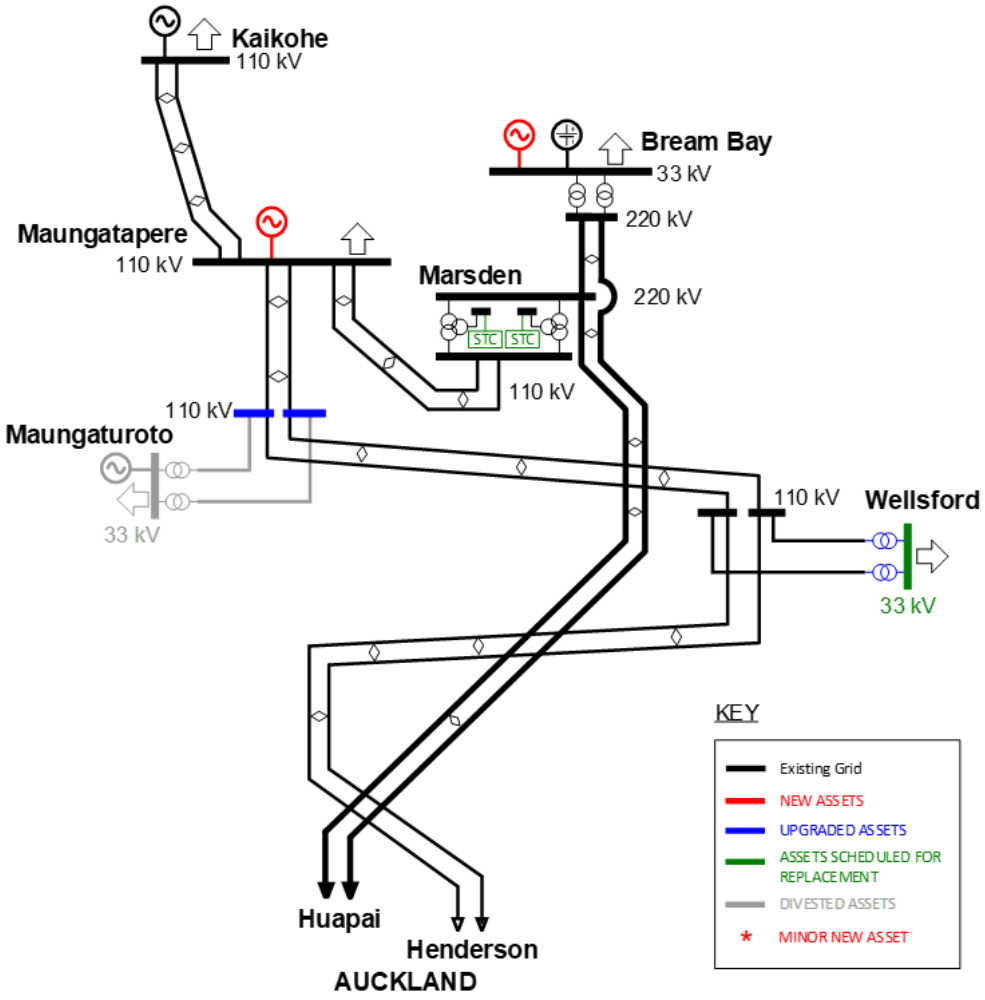
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The 220 kV and 110 kV networks in the Northland region are interconnected by two 220/110/11 kV interconnecting transformers at Marsden.

7.1.3 Possible Northland transmission configuration

Figure 7-3 shows a possible configuration of Northland transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments and divestments are shown.

Figure 7-3: Possible Northland transmission configuration in 2040.



7.2 Northland load and generation forecasts

7.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[2].

The Northland regional peak demand is forecast to grow by an average 2.6 per cent per annum over the next 15 years, from 224 MW in 2025 to 328 MW by 2040. This is equal to the national average growth rate.

Table 7-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

[2] Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 7-1: Forecast prudent annual peak demand (MW) at Northland grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Bream Bay[1]	1.00	22	25	25	31	31	75	77	77	78	79	80	82
Kaikohe[3]	1.00	74	78	80	81	83	84	85	87	88	89	90	90
Maungatapere	1.00	125	126	127	128	129	130	131	131	132	132	132	128
Maungaturoto	1.00	22	24	25	25	26	26	27	27	28	28	29	29
Wellsford[2]	0.99	45	45	47	48	49	51	53	55	58	59	61	66

1. Northpower has advised a 38 MW step load in 2030 due to Channel Infrastructure's plan for an 'Energy Precinct' at Marsden Point.
2. This is a leading Power Factor.
3. Kaikohe load is a gross demand value. It excludes generation from Ngawha. There is no output from solar generation at the time of the winter peak load.

7.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing fossil fuel users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the Northland region that are not included in the prudent demand forecast.

7.2.3 Existing and committed generation

The Northland region's generation capacity is currently 180 MW. This excludes any distributed generation, which was approximately 43 MW in the Northland region at the time of publication[3]. The regional generation is not sufficient to meet local demand, so the deficit is imported through the National Grid.

Table 7-2 lists the generation forecast for each grid injection point in the Northland region for the forecast period. This includes all existing and committed generation stations including those embedded within local lines company networks (Vector, Northpower or Top Energy)[4].

Further generation may be developed during the period. Refer to Table 7-8 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 7-2: Existing and committed generation capacity at Northland grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Bream Bay (Marsden Diesel)	9	9	9	9	9	9	9	9	9	9	9	9
Bream Bay – Ruakākā Solar Farm	0	0	130	130	130	130	130	130	130	130	130	130
Kaikohe – Ngawha B	35	35	35	35	35	35	35	35	35	35	35	35
Kaikohe												
(Ngawha A)	25	25	25	25	25	25	25	25	25	25	25	25
(Kohira Solar Farm)	23	23	23	23	23	23	23	23	23	23	23	23
(Pukenui Solar Farm)	17	17	17	17	17	17	17	17	17	17	17	17
(Twin Rivers Solar Farm)[1]	24	24	24	24	24	24	24	24	24	24	24	24

3 The capacity of existing embedded solar farms mentioned in Table 7-2 has been subtracted off the total embedded solar generation reported on the Electricity Market Information (EMI) website: Installed distributed generation trends

4 Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Maungatapere												
(Wairua Falls)	5	5	5	5	5	5	5	5	5	5	5	5
(Kaiwaikawe Wind Farm)	0	77	77	77	77	77	77	77	77	77	77	77
Maungaturoto												
(Papareireiā Solar Farm)[2]	18	18	18	18	18	18	18	18	18	18	18	18
(Te Puna Mauri ō Omaru)	17	17	17	17	17	17	17	17	17	17	17	17

1. Twin Rivers Solar Farm is expected to be commissioned in November 2025.
2. Papareireiā Solar Farm is expected to be commissioned by late 2025.

7.2.4 Batteries

Table 7-3 lists the forecast for grid-scale batteries for each grid injection point in the Northland region for the forecast period. This includes all known and committed batteries including those embedded within local lines company networks (Vector, Northpower or Top Energy)[5].

Table 7-3: Existing and committed grid-scale battery capacity at Northland grid injection points

Grid injection point (location/name if embedded)	Battery capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Wellsford												
(Snells Beach)	3	3	3	3	3	3	3	3	3	3	3	3
(Warkworth South)	2	2	2	2	2	2	2	2	2	2	2	2
Bream Bay – Ruakākā	100	100	100	100	100	100	100	100	100	100	100	100

7.3 Grid enhancement approach and inputs

7.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Northland region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancement to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 7.4 and 7.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

7.3.2 Northland significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 7-4 lists the significant upcoming risk-based replacement and refurbishment work proposed for the Northland region

5 Only batteries with a capacity greater than 1 MW are listed. Battery capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

during the next 15 years that may significantly impact related system issues or connected parties.

Table 7-4: Proposed significant upcoming replacement and refurbishment work for the Northland region

Description	Tentative year	E&D issue
Wellsford–Maungaturoto line protection replacement and 110 kV line circuit breakers installation	2025-2027	7.4.1
Maungaturoto 33 kV outdoor to indoor conversion	2026-2029	7.5.4
Wellsford 33 kV outdoor to indoor conversion	2027-2029	7.5.5
Wellsford–T1 and T2 supply transformer replacement	2027-2029	7.5.5
Marsden STC-5 and STC-6 mid-life refurbishment	2031-2034	None

7.3.3 Northland asset feedback

The Asset Feedback Register includes the following E&D-related entry specific to the Northland region.

- Henderson–Wellsford–Maungaturoto–Maungatapere double circuit line is vulnerable to both circuits tripping under a single event. This would cause a momentary or extended loss of supply at Wellsford and Maungaturoto, see section 7.7.3.

7.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Northland region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

The Northland region, together with the Auckland and Waikato regions, share the transmission network to the Central North Island. Due to the decommissioning of thermal generation in the Auckland and Waikato regions, we have installed new STATCOMs at Hamilton and Otahuhu to maintain voltage stability. There is an ongoing need to invest in voltage support to ensure voltage stability is maintained on the grid backbone (see Chapter 6).

Table 7-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 7-5: Changes within the wider region since the 2023 TPR.

Issues	Change
Marsden 220/110 kV transformer capacity	Removed. Lower load forecast on the 110 kV Northland network.

The overview of transmission capability within the wider Northland region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
7.4.1	Henderson–Wellsford transmission capacity
7.4.2	Upper North Island voltage instability for grid backbone contingencies

7.4.1 Henderson–Wellsford transmission capacity and low voltage

Background

The 110 kV double-circuit line Henderson–Wellsford–Maungaturoto–Maungatapere operates in parallel with a higher capacity 220 kV double-circuit line Huapai–Marsden–Bream Bay. These circuits supply all the Northland region's load (beyond what is supplied from local generation).

The 110 kV circuits have a:

- total nominal installed capacity of 111/136 MVA (summer/winter).
- n-1 capacity of 56/68 MVA (summer/winter).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The Henderson–Wellsford–Maungaturoto–Maungatapere circuits do not have line circuit breakers at Wellsford and Maungaturoto. A fault on any section of one of these circuits disconnects the entire circuit. As part of the line protection replacement scheduled in 2027, we will also install line circuit breakers on the Wellsford–Maungaturoto circuits at Maungaturoto.

With these new circuit breakers, a fault on:

- any section of the Henderson–Wellsford–Maungaturoto circuit will disconnect the entire Henderson–Wellsford–Maungaturoto circuit and a Wellsford 110/33 kV transformer.
- the Maungaturoto–Maungatapere circuit will disconnect the Maungaturoto–Maungatapere circuit and a Maungaturoto 110/33 kV transformer.

Issue

From winter 2036, during regional peak load periods and with all Ngawha geothermal units in service, an outage of a Henderson–Wellsford–Maungaturoto circuit will cause the Henderson–Wellsford section of the remaining circuit to exceed its winter rating. With Ngawha's largest unit out of service, this overload would start occuring in winter 2032.

- The Henderson–Wellsford–Maungaturoto circuits are also critical to Northland security during planned maintenance outages on one of the parallel 220 kV circuits, and resilience in case of double-circuit 220 kV outages. See section 7.7.2 for details.

What next?

We are considering installing a special protection scheme following the installation of line circuits breakers at Maungaturoto. This scheme will:

- defer the overloading of Henderson–Wellsford for an outage of Henderson–Wellsford–Maungaturoto to winter 2037,
- maximise the load that can be supplied in Northland during an extended outage of both main 220 kV circuits, and
- improve security during maintenance (see section 7.7.2 for details).

The Wellsford load is forecast to exceed the n-1 capacity of the Henderson–Wellsfor circuit from winter 2037, at which point the proposed special protection scheme will not be enough to remove the circuit overloads. Longer-term options will be discussed with the customer closer to the need date. A possible option could be to add a Wellsford load reduction action to the scheme.

7.4.2 Upper North Island voltage instability for grid backbone contingencies

Issue

As demand in the Waikato, Auckland and Northland regions grows, voltage stability margins will deteriorate to the point where several generator and circuit contingencies on the grid backbone can cause voltage problems within the Northland region.

What next?

We installed a STATCOM at Hamilton in 2023 and recently commissioned another at Otahuhu. These STATCOMs formed part of the approved Waikato and Upper North Island Voltage Management (WUNIVM) Stage 1 project to maintain voltage stability margins (see Chapter 6, WUNIVM project). There is an ongoing need to invest in voltage support to maintain voltage stability as load grows. Any investments made under the WUNIVM project will contribute to improving voltage stability issues in the Northland region.

7.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 level of security at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 7-6 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 7-6: Changes at each grid exit point since the 2023 TPR

Issues	Change
Maungaturoto supply capacity	Removed. Reduced load forecast.

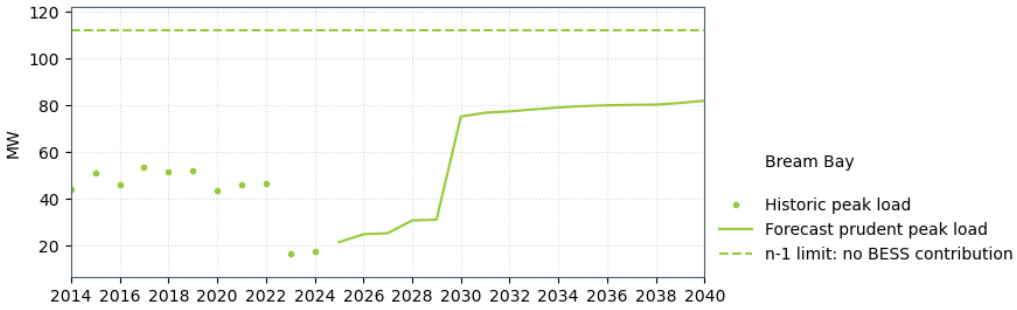
The overview of transmission capability for each grid exit point within the Northland region is listed below. Where an issue is identified we list options to address it.

Section number	Description
7.5.1	Bream Bay supply capacity
7.5.2	Kaikohe supply capacity
7.5.3	Maungatapere supply capacity
7.5.4	Maungaturoto supply capacity
7.5.5	Wellsford supply capacity

7.5.1 Bream Bay supply capacity

Two 220/33 kV transformers supply Bream Bay's load, providing a total nominal installed capacity of 200 MVA. Peak load at Bream Bay is within the n-1 capacity of the supply transformers for the forecast period, assuming the Ruakākā battery does not charge during peaks (see Figure 7-4).

Figure 7-4: Bream Bay supply capacity



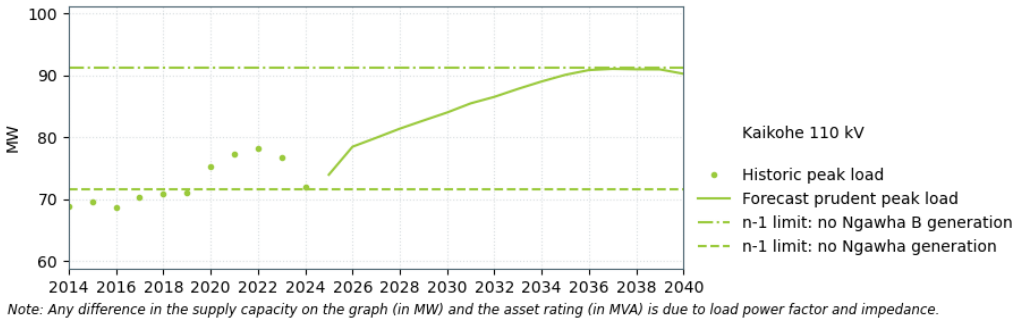
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

7.5.2 Kaikohe supply capacity

The 110 kV substation equipment at Kaikohe is owned by Top Energy. The 110 kV circuits have a total nominal installed capacity of 126/154 MVA (summer/winter).

Without Ngawha generation, the peak load at Kaikohe already exceeds the n-1 capacity of the Kaikohe–Maungatapere circuits (see Figure 7-5).

Figure 7-5: Kaikohe supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

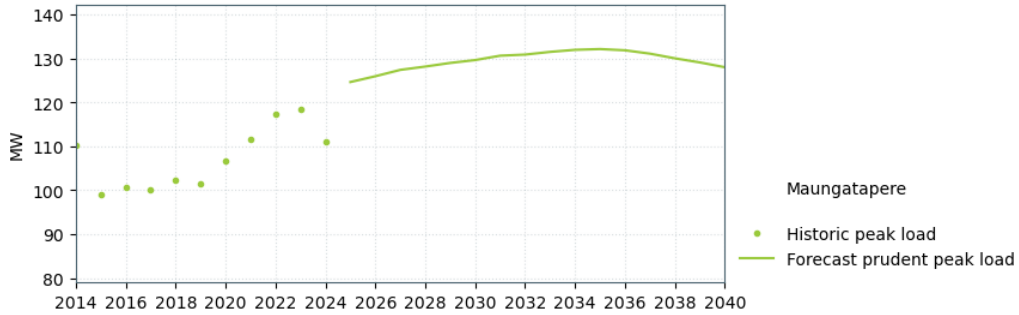
Ngawha generation will be used to provide n-1 security for the load. Ngawha has multiple generating units and without the largest of these (Ngawha B), forecast peak load at Kaikohe remains within the n-1 capacity of the circuits for the forecast period (see Figure 7-5).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

7.5.3 Maungatapere supply capacity

The supply transformers and 110 kV feeders at Maungatapere are owned by Northpower and are not reported in the TPR. See Figure 7-6 for the peak load forecast.

Figure 7-6: Maungatapere load forecast



7.5.4 Maungaturoto supply capacity

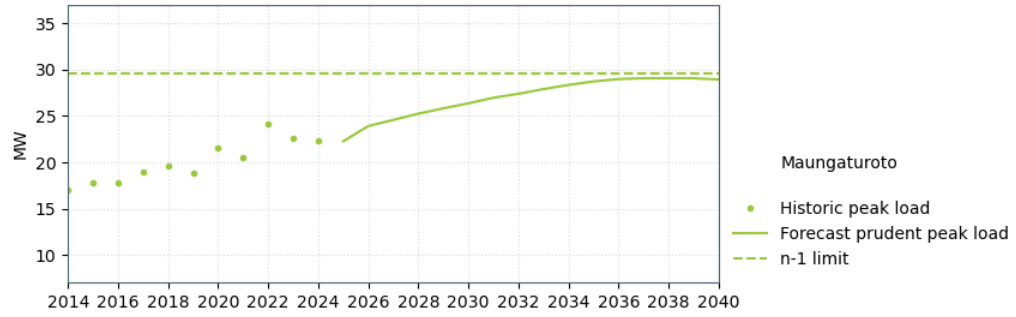
Two 110/33 kV transformers supply Maungaturoto's load, providing a total nominal installed capacity of 50 MVA. The capacity of the transformers is limited by protection equipment.

There are currently no line circuit breakers at Maungaturoto, so a Henderson–Wellsford–Maungaturoto–Maungatapere circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[6], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Maungaturoto is within the n-1 capacity of the supply transformers for the forecast period (see Figure 7-7).

Transpower is in discussion with Northpower about a potential asset transfer of the 33 kV bus and the supply transformers. If this transfer proceeds, Transpower will not undertake the outdoor to indoor conversion work listed in Table 7-4.

Figure 7-7: Maungaturoto supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

7.5.5 Wellsford supply capacity

Issue

Two 110/33 kV transformers supply Wellsford's load, providing a total nominal installed capacity of 60 MVA.

There are no line circuit breakers at Wellsford, so a Henderson–Wellsford–Maungaturoto–Maungatapere circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[6], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Wellsford is forecast to exceed the n-1 capacity of the supply transformers from winter 2025 (see Figure 7-8). A short-term post-contingent rating was recently applied to these

[6] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

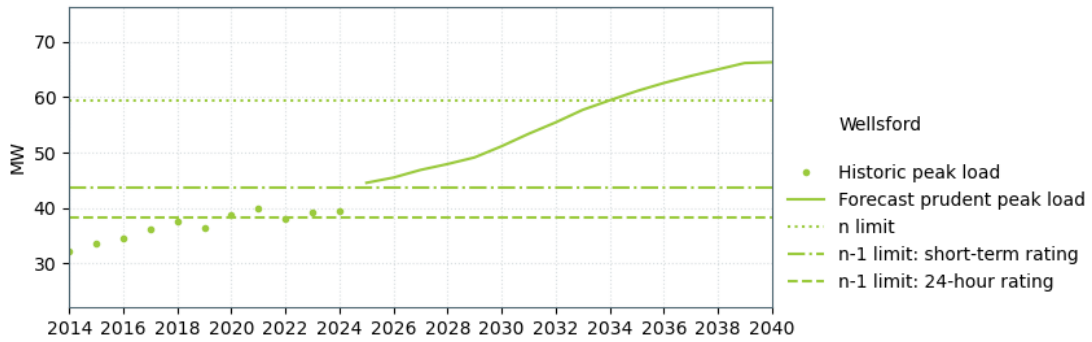
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

supply transformers to increase the maximum acceptable pre-contingency load by about 5 MW. Following a transformer outage, the transformer loading must be quickly reduced to its 24-hour post-contingency rating.

Both existing transformers comprise three single-phase units with no on-load tap changer capability. There is no spare unit on site.

In addition, a Henderson–Wellsford–Maungaturoto circuit outage during high load periods may result in the Wellsford 33 kV bus voltage falling below 0.95 p.u. from 2038.

Figure 7-8: Wellsford supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The existing transformers are scheduled for risk-based replacement by 2029. We are discussing investment options with Vector. At this stage, the preferred option is to install higher capacity transformers. The 33 kV outdoor to indoor conversion project is scheduled around the same time.

Customer investments

Project name:	Wellsford supply capacity upgrade
Project description:	Replace the existing transformers with two larger units
Project's state of completion:	Possible
Grid need date:	2025 (Customer initiated)
Indicative cost [$ million]:	TBA
Reliability or Economic investment?	Reliability (Grid Reliability Report)

7.6 Northland bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 7-7 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 7-7: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Marsden 220 kV	-	-	Henderson–Wellsford circuit sections overload Marsden 110 kV bus voltage drop	Note 1 and 7.7.2 Note 2
Maungaturoto 110 kV	-	-	Henderson–Wellsford circuit section overload and Wellsford low voltage Wellsford supply transformer overload	7.4.1 7.5.5
Maungatapere 110 kV	-	-	Kaikohe–Maungatapere circuit overload	7.5.2
Wellsford 110 kV	-	-	Henderson–Wellsford circuit section overload and Wellsford low voltage Wellsford supply transformer overload	7.4.1 7.5.5

1. An outage of a Marsden 220 kV bus section can cause the Henderson–Wellsford sections of both 110 kV Henderson–Wellsford–Maungaturoto–Maungatapere circuits to overload from winter 2035. The worst contingency is an outage of the bus section that disconnects an interconnecting transformer and the 220 kV circuit to Huapai. The issue worsens when Ngawha generation is low. The issue could be resolved by splitting the 110 kV network at Maungaturoto.
2. An outage of the Marsden 220 kV bus section that disconnects an interconnecting transformer and the 220 kV circuit to Huapai may cause the Marsden 110 kV voltage to drop more than 5%, from winter 2030.

The customers at these grid exit and injection points (Vector, Northpower, Top Energy and Meridian) have not requested higher bus security levels. Unless otherwise noted, we do not propose increasing bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

7.7 Other items of interest

7.7.1 North of Huapai transmission security

Issue

The Huapai switching station comprises three circuit breakers:

- one on each of the 220 kV circuits connecting Marsden and Bream Bay, and
- a shared circuit breaker for the two incoming 220 kV circuits from Albany and Henderson.

If the shared circuit breaker fails to trip following an incoming 220 kV circuit fault, both the outgoing circuits will trip, leaving the entire load north of Huapai supplied by the low capacity 110 kV Henderson–Maungatapere circuits. This may result in a loss of supply to the Northland region, depending on the region's load at the time.

What next?

We investigated this issue and found that investments to increase the security level are not economically justified. We will continue to monitor this issue and will consider enhancing the Huapai bus security if there are synergies with other developments.

7.7.2 Regional transmission security during maintenance of major Northland circuits or interconnecting transformers

Issue

During maintenance of a Northland 220 kV circuit, Marsden–Maungatapere 110 kV circuits or Marsden interconnecting transformers supplying the Northland region, we reconfigure (split) the grid by by opening the 110 kV Henderson–Maungatapere circuits at Maungatapere. This is done to cover a possible contingency on another circuit or transformer, which could cause voltage collapse in the Northland region. Depending on the outage, the 110 kV split puts part or all of the region on n security.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

What next?

We will investigate not splitting the 110 kV grid at Maungatapere during planned outages so that, following a fault, Northland remains connected to the grid long enough for an attempt at auto-reclosing the faulted circuit. If there is a permanent fault, the auto-reclose will not succeed in returning the circuit to service, which will usually overload both Henderson–Maungatapere circuit sections and/or cause low regional voltges.

To manage the possible circuit overloads and/or low voltages, we will investigate a two-part special protection scheme on the Henderson–Wellsford–Maungaturoto–Maungatapere circuits (following installation of line circuit breakers at Maungaturoto[7]). The special protection scheme will operate as follows:

- If a 220 kV Northland circuit trips during a planned outage of the other 220 kV circuit, the 110 kV "backup" circuits remain in service for two seconds to allow an auto-reclose of the tripped 220 kV circuit. During the two second auto-reclose period, Northland remains connected to the rest of the grid through the 110 kV circuits.
  - If the 220 kV circuit had a transient fault, the auto reclose will return the tripped circuit to service, maintaining supply to Northland.
  - If the 220 kV circuit remains out of service after the auto-reclose attempt, and low voltage is still detected at Maungatapere after two seconds, the scheme will open the 110 kV line circuit breakers at Maungatapere. This action will disconnect Maungatapere, Bream Bay and Kaikohe from the National Grid, causing loss of supply to them. If the Henderson–Wellsford circuit sections are still overloaded after having split Maungatapere, the scheme will open the 110 kV line circuit breakers at Maungaturoto. This will disconnect and cause a loss of supply at Maungaturoto.
- If a Henderson–Wellsford–Maungaturoto 110 kV circuit trips during a planned outage of a main 220 kV Northland circuit, the Henderson–Wellsford section of the remaining 110 kV circuit may overload. The special protection scheme will open the 110 kV line circuit breaker at Maungaturoto, splitting the 110 kV system. This automatic system split reconfiguration will remove the overload up to winter 2037 (set by the Wellsford peak load, see section 7.4.1).

However, before a special protection scheme can be used to manage an outage of a main 220 kV Northland circuit, system dynamic studies are required to ensure safe system operation – particularly looking at the impact on the Ngawha geothermal generators and the risk of regional voltage collapse.

An added benefit of this special protection scheme is that, for an extended outage of both main 220 kV Northland circuits, it will allow the 110 kV "backup" circuits to be operated above their n-1 capacity, maximising the load that can be restored in Northland. The restored load at Northland will be on n security.

Base E&D capex investments/

Project name:	Henderson-Wellsford overload mitigation
Project description:	Install special protection scheme to manage Henderson–Wellsford loading and low voltage issues
Project's state of completion:	Possible
Grid need date:	2027
Indicative cost [$ million]:	0.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

7.7.3 Supply capacity and security during maintenance of a 110 kV Henderson–Maungatapere circuit

Issue

The Henderson–Maungatapere double-circuit line supplies Wellsford and Maungaturoto. There are no line breakers at either of these two substations so if one circuit is out for maintenance and the other trips, there will be loss of supply at these two sites.

[7] Maungaturoto does not have line circuit breakers at present, but line circuit breakers will be installed on both Maungaturoto–Wellsford circuit sections as part of policy work to replace line protection (see Table 7-4).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

As the line is relatively long, maintenance outages are required quite frequently, which results in the load being on n security for long periods of time.

What next?

We are committed to replacing the line protections on the Henderson–Wellsford–Maungaturoto–Maungatapere circuits in 2027 (see Table 7-4). As part of that project, we will also install line circuit breakers on the Wellsford–Maungaturoto circuits at Maungaturoto. The circuit breakers will improve security of supply at Wellsford and Maungaturoto.

7.8 Northland generation opportunities and proposals

This section provides a high-level description of the Northland region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The Northland region has a high potential for new generation, particularly geothermal, wind and solar.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Section number	Description
7.8.1	Generation opportunities by substation
7.8.2	Generation investigations and proposals
7.8.3	Regional generation investigation

7.8.1 Generation opportunities by substation

Envision Opportunities[8] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[9]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy
- winter evening peak – wet/windy
- winter midday high – wet/calm.

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

[8] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

[9] "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

7.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[10]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 7-8 shows generation and grid-scale battery projects in the Northland region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 7-2 (generation) or Table 7-3 (batteries) instead.

Table 7-8: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Huapai–Marsden	Solar	Investigation	200
Huapai–Marsden	Solar	Investigation	120
Wellsford	Solar + BESS	Application	88
Marsden–Maungatapere	Wind	Application	120
Kaikohe	Various	Application	50

We have received additional requests for assessment of generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of select parts of the Northland region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

7.8.3 Regional generation investigation

Transpower, Northpower and Top Energy undertook a joint study of the Northland region looking at capacity to host new generation, and to identify upgrades required to host additional generation.

The generation scenarios used as inputs to the study were developed with input from generation developers. Three generation development scenarios were studied: highly likely (100 MW), likely (additional 300 MW) and possible (a further 400 MW). As the capacity of the transmission and distribution networks to host generation depends on where the generation is connected, generation connections were at locations appropriate to each generation development proposal.

The summary conclusions relating to the transmission system from the study are:

- the highly likely generation can be hosted on the existing network
- the likely generation has some risk of requiring generation constraints during peak export conditions, which can be addressed with upgrades to the existing network
- the possible generation will require generation constraints, even with the upgrades to the existing grid described below.

The transmission system upgrades/assets considered in the report are:

- For the Kaikohe–Maungatapere 110 kV circuits, installing a special protection scheme to automatically reduce generation post-contingency allows an additional 90 MW of generation to be hosted at or north of Kaitaia which serves the highly likely and likely scenarios. Higher levels of additional generation require the circuits be upgraded – either a thermal upgrade or reconductoring.
- For the Marsden 220/110 kV transformers, the existing system can host an additional 270 MW of generation connected to the 110 kV system. This serves the highly likely and likely scenarios. Higher levels of additional generation require the Maungaturoto–Wellsford 110 kV circuits to be split, connecting the Northland 110 kV network to the rest of the Grid through the Marsden 220/110 kV transformers. The maximum generation export is then set by the capacity of the Marsden transformers. Installing a third Marsden 220/110 kV transformer raises the transformer n-1 capacity to 360 MVA.

[10] Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- The Bream Bay–Huapai 220 kV circuit allows approximately 350 MW of generation to be hosted at Bream Bay and Marsden (including the generation contribution through the Marsden 220/110 kV transformers). This serves the highly likely and likely scenarios. Higher levels of additional generation will require the Bream Bay–Huapai circuit to be reconductored from simplex to duplex conductor.

As generation in the Northland region increases, circuits with high power levels absorb reactive power, requiring voltage support from the Marsden STATCOMs. This applies especially for power flow from Kaitaia to Maungatapere. This may require additional reactive support. Other new generators in the region may be able to provide the voltage support, depending on where they are located. Otherwise, grid connected reactive support such as capacitors and/or additional STATCOMs may be required.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

8 Auckland Regional Plan

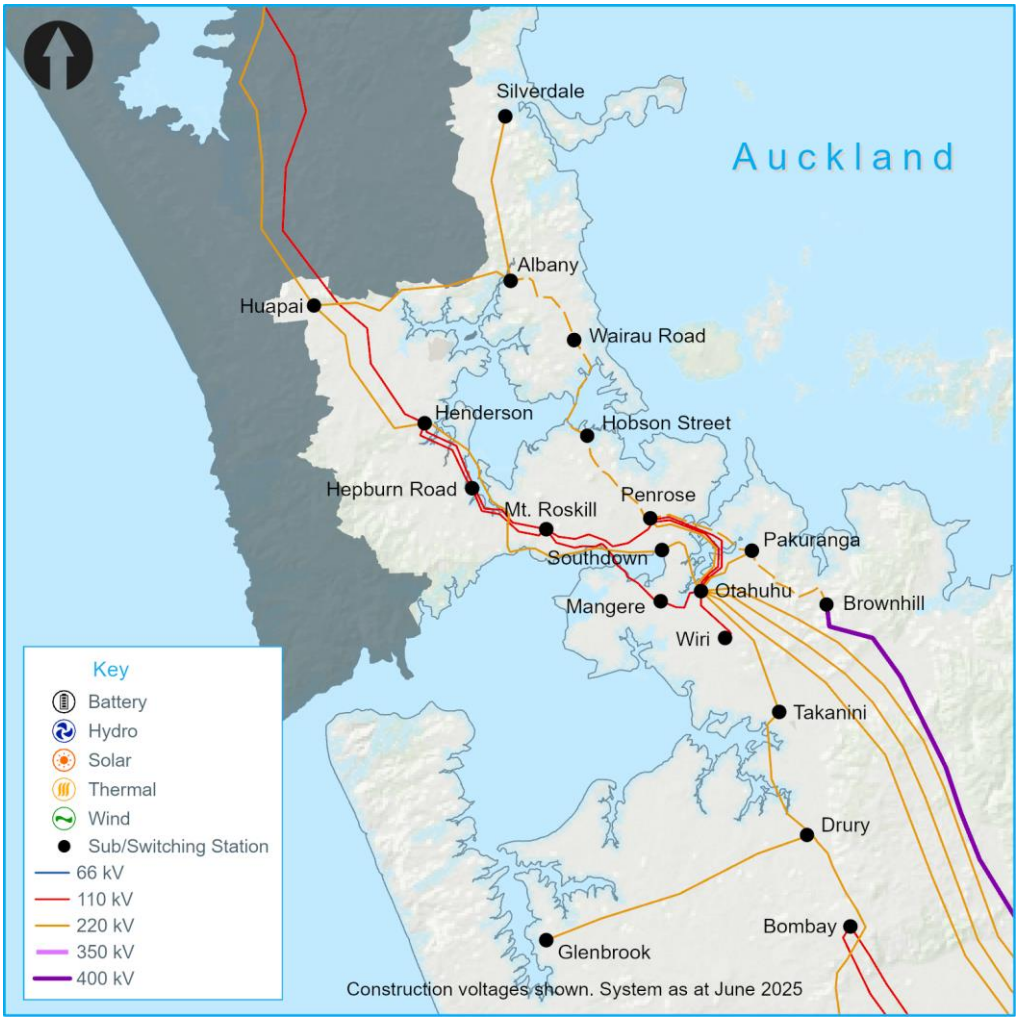
8.1	Regional overview and transmission system
8.2	Auckland load and generation forecasts
8.3	Grid enhancement approach and inputs
8.4	Grid asset capability and management within the wider region
8.5	Grid asset capability and management by grid exit point
8.6	Auckland bus security
8.7	Other items of interest
8.8	Auckland generation opportunities and proposals

8.1 Regional overview and transmission system

The Auckland region has some of the highest load densities in New Zealand, coupled with relatively low levels of local generation.

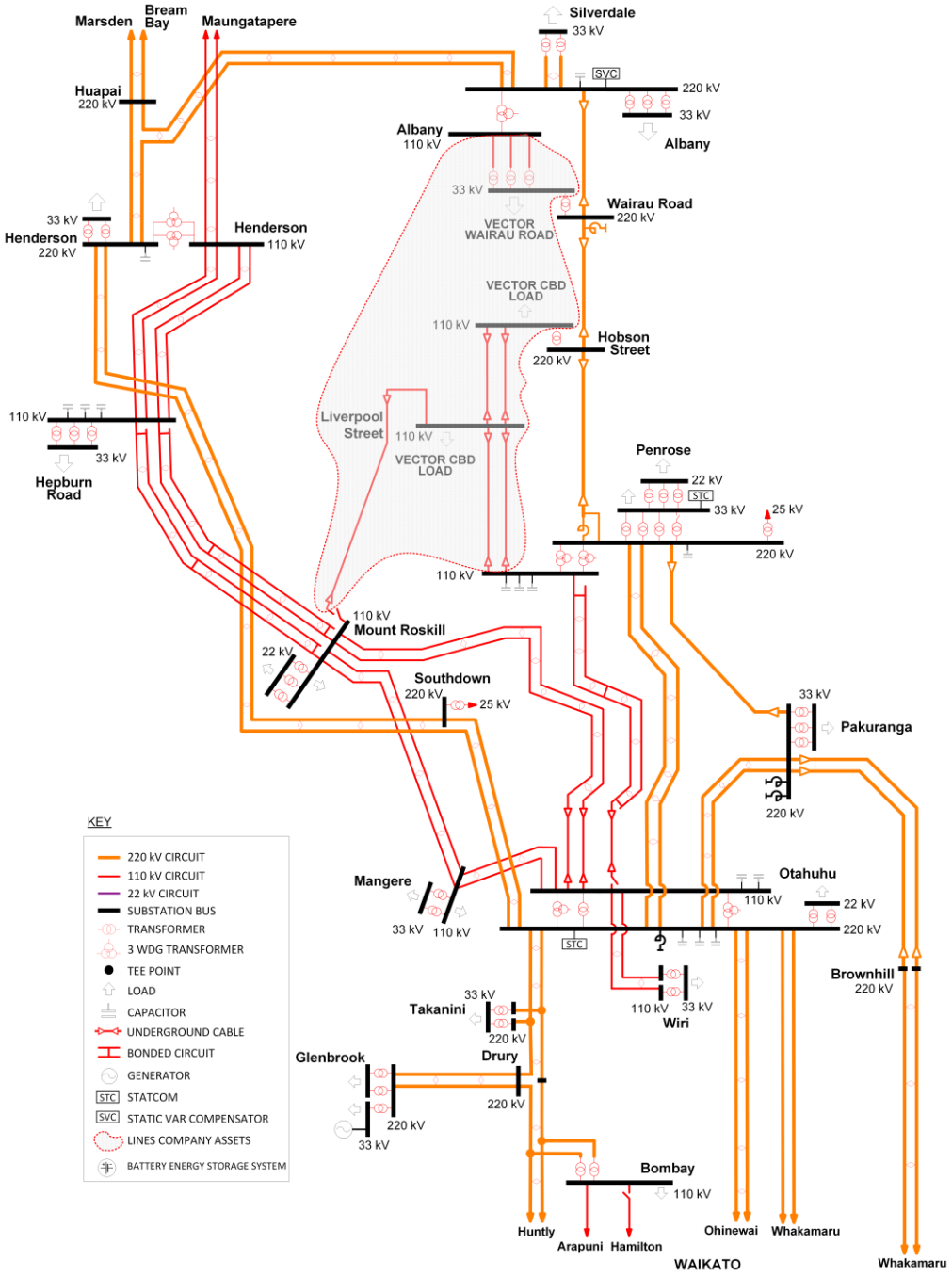
The existing transmission network for the Auckland region is set out geographically in Figure 8-1 and schematically in Figure 8-2.

Figure 8-1: Auckland region transmission network map



2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-2: Auckland region transmission schematic



8.1.1 Transmission into the region

Approximately 95 per cent of peak electricity demand in the Auckland and Northland regions is supplied by generation located south of Bombay. Transmission enables supply of this electricity into and through the Auckland region.

We have eight high capacity 220 kV circuits into Auckland from Whakamaru (the generation-rich centre of the North Island), Huntly and Taranaki. Voltage support is needed to ensure stability, and this is provided by static capacitors at the Henderson, Hepburn Road, Albany, Otahuhu, and Penrose substations, and shunt reactors at Wairau Road, Pakuranga and Otahuhu substations. The dynamic reactive support at Albany, Otahuhu, Penrose and Marsden helps to maintain voltage stability for outages of circuits supplying Auckland or outages of a major generation unit near the Auckland region.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

8.1.2 Transmission and distribution networks within the region

The Auckland transmission network distributes electricity within the region and provides through-transmission to the Northland region. It consists of three layers: the 220 kV transmission network, the 110 kV transmission network, and the 110 kV distribution system owned by Vector.

220 kV transmission network

There are two high capacity 220 kV "rings" in the Auckland region.

The first ring connects Otahuhu, Pakuranga and Penrose. It provides security and capacity into the region from the grid backbone connections at Otahuhu (six circuits) and Pakuranga (two circuits). It also provides high security to Penrose and two strong infeeds to the second ring from Otahuhu and Penrose.

The second ring connects Otahuhu and Penrose through the Henderson, Albany, Wairau Road and Hobson Street substations. It provides security and resilience to central Auckland, the North Shore and the Northland region by establishing diverse transmission routes to the substations supplying these areas.

110 kV transmission network

The 110 kV transmission network has two distinct sections.

One section has 220/110 kV interconnecting transformers at Otahuhu, Penrose and Hobson Street. The Otahuhu and Penrose transformers may be connected through the 110 kV Otahuhu–Penrose–2 circuit, which operates in parallel with the 220 kV Otahuhu–Penrose double circuit line (although Otahuhu–Penrose–2 is normally open[1]).

The other section of the 110 kV network has 220/110 kV interconnecting transformers at Otahuhu and Henderson. Two double-circuit 110 kV lines connect Otahuhu, Mangere, Mount Roskill, Hepburn Road and Henderson. These 110 kV lines operate in parallel with the 220 kV Otahuhu–Henderson double-circuit line. Power flow is generally into Mount Roskill from both south (Otahuhu) and north (Henderson).

The 110 kV network also connects to the Northland region via the Henderson–Wellsford–Maungaturoto–Maungatapere double-circuit line.

Following the commissioning of two 220/110 kV transformers at Bombay and the 110 kV Otahuhu–Wiri double-circuit line upgrade, we have reconfigured the 110 kV network from Bombay, removing the 110 kV Bombay–Wiri line. We have a project underway to disconnect the 110 kV circuits south of Bombay to the Waikato region. See section **Error! Reference source not found.** for more detail.

110 kV distribution network

Vector's 110 kV distribution network operates in parallel with the 220 kV transmission network between Penrose and Hobson Street.

Vector supplies the Auckland Central Business District (CBD) load from its Liverpool Street, Hobson Street and Quay Street substations. Vector can also supply the CBD from the Mount Roskill substation via a 110 kV underground circuit to its Liverpool Street substation. However, this is normally split and is only used to enable maintenance outages.

Vector also has a 110 kV network in parallel with Transpower's 220 kV Albany–Wairau Road circuit. The Wairau Road 33 kV load is supplied by a combination of Transpower's Wairau Road 220/33 kV transformer and Vector's 110 kV Albany–Wairau Road circuits and 110/33 kV transformers at Wairau Road.

8.1.3 Possible Auckland transmission configuration

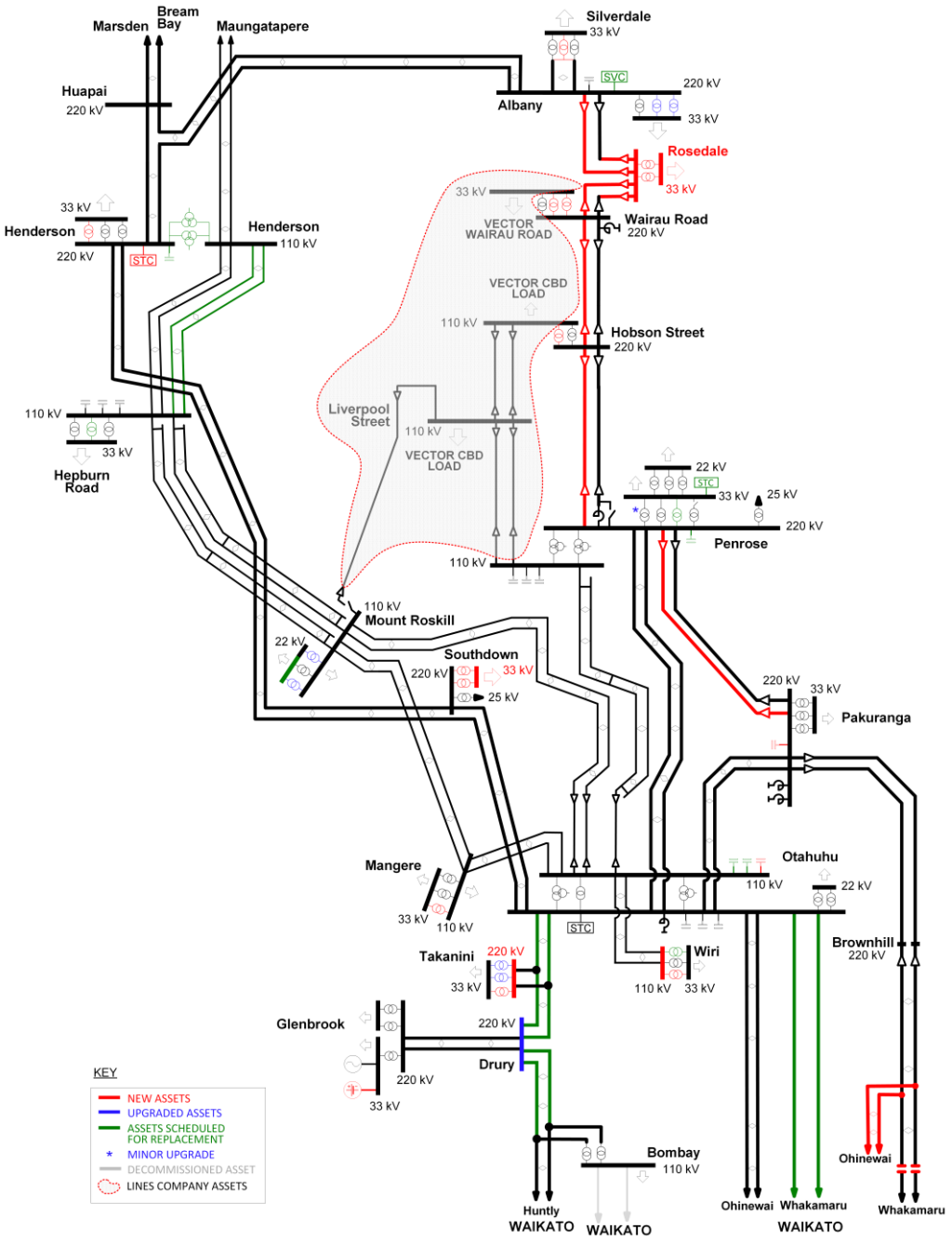
Figure 8-3 shows the possible configuration of Auckland transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

1 The 110 kV Otahuhu–Penrose circuit is usually open to improve the balance of power flow into the Auckland CBD between Penrose and Hobson Street.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

While we include sections of Vector's network for clarity, we are making no statement about Vector's future development plans.

Figure 8-3: Possible Auckland transmission configuration in 2040



8.2 Auckland load and generation forecasts

8.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years an expected (or mean) rate of underlying growth[2].

[2] Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The Auckland regional peak demand is forecast to grow by an average 3.2 per cent per annum over the next 15 years, from 2,087 MW in 2025 to 3,342 MW by 2040. This is higher than the national average growth rate of 2.6 per cent per annum. Table 8-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

Table 8-1: Forecast prudent annual peak demand (MW) at Auckland grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Albany 33 kV[1,2]	1.00	144	171	175	186	192	200	209	215	222	228	234	253
Bombay 110 kV[2]	1.00	113	119	124	130	135	140	146	150	155	160	165	176
Glenbrook 33 kV[3] (clean bus)	0.98	71	74	70	71	73	74	75	76	77	79	80	83
Glenbrook - NZ Steel (dirty bus)[4]	0.98	112	129	86	86	86	86	86	86	86	86	86	86
Henderson[1,2]	1.00	145	138	150	171	195	209	223	236	249	264	275	310
Hepburn Road	1.00	169	171	175	177	179	185	189	192	196	199	202	210
Hobson Street[1,2,5]	1.00	101	111	120	131	143	156	165	169	174	180	190	210
Mangere 33 kV	1.00	130	136	141	146	151	156	161	166	169	172	176	189
Mangere 110 kV	0.99	18	18	18	18	18	18	18	18	18	18	18	18
Mt Roskill 22 kV	1.00	121	123	127	128	131	135	140	144	148	152	155	166
Mt Roskill 110 kV[2,6]	0.98	65	67	69	72	74	77	81	84	87	90	92	100
Otahuhu	1.00	70	72	75	76	78	80	82	84	85	87	89	94
Pakuranga	1.00	162	167	169	171	181	185	189	192	195	198	201	209
Penrose 22 kV[7]	0.99	45	48	50	51	52	54	56	57	58	60	61	63
Penrose 25 kV	1.00	15	15	15	15	15	15	15	17	19	20	22	31
Penrose 33 kV	0.99	288	297	318	327	335	347	359	368	378	388	396	424
Penrose 110 kV - Liverpool Street[2,5]	1.00	101	111	120	131	143	156	165	169	174	180	190	210
Silverdale[1,2]	1.00	104	111	118	123	136	144	152	160	167	174	183	201
Southdown 25 kV	0.99	15	15	15	15	15	15	15	17	18	20	22	31
Takanini[1]	1.00	153	158	182	223	265	268	272	274	277	279	281	281
Wairau Road	1.00	152	156	161	164	169	179	184	188	192	196	200	210
Wiri	0.99	111	115	119	122	126	130	132	133	135	137	140	150

1. Significant new load increases are forecast from data centres across the Auckland grid exit points of Henderson, Silverdale, Albany 33 kV, Hobson Street and Takanini.
2. This is a leading power factor.
3. This is the Glenbrook 33 kV load on the clean bus with no contribution from the generation connected directly onto the 33 kV bus at Glenbrook.
4. The large load reduction from 2027 is due to the announced commissioning of the electric furnace and subsequent decommissioning of some existing plants.
5. The load split between Hobson Street and Liverpool Street–Penrose is an estimate only. The Vector and Transpower networks between these grid exit points are operated in parallel.
6. This includes the Kingsland feeders only.
7. The Penrose 22 kV load is split between three 33/22 kV transformers that are not directly connected on the 22 kV side. Only the aggregate 22 kV load is forecast, not separate load forecasts for the three 33/22 kV transformers.

8.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te* Mauri Hiko. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing coal users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

There is potential for additional data centres to be developed in the Auckland region that are not provided for in the load forecast.

8.2.3 Existing and committed generation

The Auckland region's generation capacity is currently 151 MW. This excludes any embedded solar (PV) generation, which was approximately 104 MW in the Auckland region at the time of publication[3]. As Auckland demand significantly exceeds local generation, the deficit is imported via the National Grid.

Table 8-2 lists the generation forecast for each grid injection point in the Auckland region for the forecast period. This includes all known and committed generation stations including those embedded within local lines company networks (Vector or Counties Energy)[4].

Further generation may be developed during the period. Refer to Table 8-8 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 8-2: Existing and committed generation capacity at Auckland grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Bombay (Hampton Downs Landfill) (Papakura)	75	75	75	75	75	75	75	75	75	75	75	75
Glenbrook[1,2]	112	112	112	112	112	112	112	112	112	112	112	112
Mangere (Watercare Mangere)	7	7	7	7	7	7	7	7	7	7	7	7
Otahuhu (Greenmount)	1	1	1	1	1	1	1	1	1	1	1	1
Penrose (Auckland Hospital)	4	4	4	4	4	4	4	4	4	4	4	4
Silverdale (Redvale Landfill[3])	12	12	12	12	12	12	12	12	12	12	12	12
Takanini (Whitford Landfill)	3	3	3	3	3	3	3	3	3	3	3	3

1. This value includes an embedded generating unit with a nominal rating of 38 MW, but continuous output of approximately 25 MW.
2. With the installation of the electric arc furnace and shutdown of two kilns and a melter, the generation output is expected to decrease; the magnitude of this reduction is currently unknown.
3. Installed capacity is 14x 1 MW machines but only 12 can be in service at any time.

8.2.4 Batteries

Table 8-3 lists the forecast for grid-scale batteries for each grid injection point in the Auckland region for the forecast period. This includes all known and committed batteries including those embedded within distribution networks (Vector, Counties Energy)[5]. Refer to Table 8-8 for more information on potential new batteries that are not sufficiently advanced to include in our forecasts.

3 Electricity Market Information (EMI): Installed distributed solar generation trends

4 Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

5 Only batteries with a capacity greater than 1 MW are listed. Battery capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 8-3: Existing and committed grid-scale battery capacity at Auckland grid injection points

Grid injection point (location/name if embedded)	Battery capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Glenbrook	0	100	100	100	100	100	100	100	100	100	100	100
Henderson (Hobsonville Point)	1	1	1	1	1	1	1	1	1	1	1	1
Penrose (Glen Innes)	1	1	1	1	1	1	1	1	1	1	1	1
Southdown	1	1	1	1	1	1	1	1	1	1	1	1
Takanini (Kawakawa Bay)	1	1	1	1	1	1	1	1	1	1	1	1

8.3 Grid enhancement approach and inputs

8.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Auckland region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancement to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 8.4 and 8.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

8.3.2 Auckland significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 8-4 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Auckland region for the next 15 years that may significantly impact related system issues or connected parties.

Table 8-4: Proposed significant upcoming replacement and refurbishment work for the Auckland region

Description	Tentative year	E&D issue
Albany SVC7 midlife refurbishment	2023-2026	Chapter 6
Albany–T3 and T6 bushing replacement	2023-2025	None
Bombay–Meremere–A and Hamilton–Meremere–A line conductor replacement (Arapuni–Bombay–1 circuit)	2028-2030	8.7.1
Hamilton–Meremere–B and Meremere–Takanini–A line conductor replacement (Bombay–Hamilton–1 and 2 circuits)	2028-2030	8.7.1
Glenbrook 220/33 kV transformers' bushing replacement	2025-2027	None

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Description	Tentative year	E&D issue
Henderson 220 kV shunt capacitor replacement Henderson–220/110 kV T1 and T5 transformers replacement	2026-2028 2035-2037	Chapter 6 None
Henderson–Hepburn–A line conductor replacement	2033-2035	None
Hepburn Road–T2 transformer replacement	2031-2033	8.5.6
Huntly–Otahuhu–A line conductor replacement Otahuhu–Drury section Drury–Huntly section	 2027-2029 2033-2035	 Chapter 6 Chapter 6
Mount Roskill circuit overload protection scheme replacement	2026-2028	None
Otahuhu–Whakamaru–A and B lines conductor replacement (30 km south of Auckland)	2024-2026	Chapter 6
Otahuhu 110 kV shunt capacitors (C11 & C12) replacement	2027-2030	Chapter 6
Penrose 220 kV shunt capacitor replacement Penrose STATCOM midlife refurbishment Penrose circuit overload protection scheme Penrose–T9 transformer replacement	2027-2028 2032-2035 2035-2037 2038-2040	Chapter 6 Chapter 6 8.4.1 8.5.12
Takanini 220/33 kV transformers' bushing replacement	2026-2028	8.5.15
Wiri–T2 transformer LV bushing replacement Wiri–T1 and T2 supply transformer replacement	2025-2027 2032-2034	8.5.17 8.5.17

8.3.3 Auckland asset feedback

The Asset Feedback Register does not contain any E&D-related entries specific to the Auckland region.

8.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Auckland region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

A number of intersecting issues impact the need for transmission infrastructure in Auckland. These include significant increases in load growth driven by new data centres, customer projects to facilitate development in housing and transport, the Auckland Unitary Plan[6] and forecast population growth for the Auckland region. We developed a long-term strategy[7] for Auckland that will enable us to coordinate this work, ensuring consistency and avoiding costly rework. Each development will still be subject to the required public consultation and regulatory approval closer to the need date.

With the potential for high Auckland load growth (as signaled by the higher forecast this year), increasing risk of adverse weather events and a greater reliance on electricity, we have increased our focus on resilience and reliability in the region. Vector and Transpower jointly commissioned an independent review of transmission resilience in the Auckland isthmus. We have committed to an ongoing collaboration to ensure appropriate consideration is given to resilience and reliability to meet the region's load growth.

Many of the 110 kV lines across Auckland will require conductor replacement between the 2030s and 2050s. We also expect to install a second 220 kV cross-harbour cable (in addition to the existing 'NAaN' cable[8]) by 2050. However, due to higher load growth, line refurbishment requirements and resilience concerns, this second cross-harbour cable may be required as early as the 2030s.

6 The Unitary Plan contains rules for development including what can be built and where it can be built (see http://unitaryplan.aucklandcouncil.govt.nz/).

7 The Auckland Strategy looked at the requirements for electricity transmission within and across Auckland up to and beyond 2050 (see Our Auckland Strategy | Transpower).

8 NAaN (North Auckland and Northland) cable refers to the following 220 kV circuits: Pakuranga–Penrose–3, Hobson Street–Penrose–1, Hobson Street–Wairau Road–1, and Albany–Wairau Road–4.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The Auckland, Northland and Waikato regions all rely on the same transmission network links to the Central North Island. This requires investment in voltage support to maintain the grid backbone voltage stability (see Chapters 6 and 9).

We have recently commissioned 150 Mvar shunt dynamic reactive support devices (STATCOM) at Hamilton and Otahuhu, and an over-voltage tripping scheme to manage transient voltage instability in the Waikato–Upper North Island region. Additionally, the Penrose series reactor is expected to switch into operation from the winter of 2028 onward to manage power flow through the 220 kV Otahuhu–Penrose circuits.

Other investments such as series capacitors and static and dynamic reactive support devices are required to provide voltage stability as load grows in these regions.

Table 8-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 8-5: Changes within the wider region since the 2023 TPR

Issues	Change
Henderson 220/110 kV transformer capacity	Removed. Lower load forecast at nearby GXPs.
Cross-Auckland transmission capacity	Modified section heading title from Hobson St – Wairau Road and expanded this section

The overview of transmission capability within the wider Auckland region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
8.4.1	Otahuhu–Penrose 220 kV transmission capacity
8.4.2	Cross-Auckland transmission capacity

8.4.1 Otahuhu–Penrose 220 kV transmission capacity

Issue

Penrose is supplied by two 220 kV overhead circuits from Otahuhu, and one 220 kV underground cable from Pakuranga.

An outage of the 220 kV Pakuranga–Penrose cable circuit during peak load periods is forecast to overload the 220 kV Otahuhu–Penrose circuits from winter 2028.

The issue affects Vector's sub-transmission network between Penrose, Liverpool Street and Hobson Street, which operates in parallel with the 220 kV transmission network.

What next?

Presently, the reactor that is in series with the 220 kV Penrose–Hobson Street cable is normally bypassed. The bypass can be opened when the load requires it, reducing loading on the 220 kV circuits into Penrose. Not bypassing the series reactor could defer the issue of Otahuhu–Penrose 220 kV transmission capacity until 2036.

Furthermore, the Auckland CBD load is supplied from Penrose and Hobson Street, with Penrose supplying the majority of the load due to system impedances. With the reactor switched into service, the increased impedance will result in almost the entire CBD load being supplied from Penrose. This places more load on Vector's 110 kV Liverpool Street–Penrose cables, and additional changes may be required to improve the balance between Hobson Street and Penrose to avoid issues on Vector's assets.

Possible options for Vector's 110 kV cables include:

- installing a second 220/110 kV interconnecting transformer at Hobson Street and splitting Vector's 110 kV network at Liverpool Street, or
- installing series reactors to increase the impedance of each Liverpool Street–Penrose cable.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Customer investments

Project name:	Second interconnecting transformer at Hobson Street
Project description:	Installing a second 220/110 kV interconnecting transformer at Hobson Street and splitting Vector's 110 kV network at Liverpool Street
Project's state of completion:	Possible
Grid need date:	2028 (Customer initiated)
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.4.2 Cross-Auckland transmission capacity

Issue

The outage of a 220 kV circuit between Otahuhu, Southdown and Henderson during high load periods can overload other circuits. Which circuits overload and when depends on if the Penrose reactor[9] is switched in. The series reactor bypass may be opened from 2028 as the normal configuration to prevent overloading of the Otahuhu–Penrose circuits (section 8.4.1).

With the Penrose series reactor not bypassed, the outage of a 220 kV circuit between Otahuhu and Henderson will overload the parallel 220 kV circuit, and the parallel 110 kV circuits connected at Mount Roskill, from 2037. If the reactor is bypassed for any reason, the same outage will overload the Penrose–Hobson Street cable circuit from 2034.

A special protection scheme at Penrose bypasses the Penrose series reactor when power flow through the reactor is high (presently set at 380 MW), to prevent overloading the 110 kV circuits connected at Mount Roskill. However, from 2035, at high load and with all circuits in service, the power flow through the reactor is expected to exceed 380 MW. This would trigger the special protection scheme and bypass the reactor, conflicting with the requirement for the reactor to be in service to address the Otahuhu–Penrose 220 kV transmission capacity constraint (section 8.4.1).

In addition, from 2034[10], the outage of a 220 kV circuit between Otahuhu, Southdown and Henderson would trigger the special protection scheme and bypass the reactor. This will result in overloading the Hobson Street–Penrose circuit.

What next?

We will investigate increasing the trigger level of the special protection scheme. This would defer the need for major investment by approximately two years. With this change the outage of a 220 kV circuit between Otahuhu, Southdown and Henderson will overload[11]:

- the other parallel 220 kV circuits from 2037.
- the 110 kV circuits between Otahuhu and Mount Roskill from 2038.

As mentioned previously, we have commenced an Auckland regional investigation and expect that a second cross-harbour transmission circuit will be required between Pakuranga and Albany, though the timing of the need is currently uncertain. Our strategy is to maximise use of existing assets through reconfigurations, targeted upgrades, and modifications to current infrastructure to defer this major investment for as long as reasonably and economically possible.

[9] The Penrose series reactor can be adjusted to manage power flow across the Auckland transmission system. An optimum value to defer major investment is 14 ohms.

[10] The analysis assumes a second 220/110 kV interconnecting transformer at Hobson Street and splitting Vector's 110 kV network at Liverpool Street (see section 8.4.1) which directly affects cross-Auckland transmission capacity. Without this modelled project the n-1 issues appear in 2037.

[11] The analysis assumes a second 220/110 kV interconnecting transformer at Hobson Street and splitting Vector's 110 kV network at Liverpool Street (see section 8.4.1) which directly affect cross-Auckland transmission capacity. Without this modelled project, there are no N-1 issues within the forecast period.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

8.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 8-6 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 8-6: Changes at each grid exit point since the 2023 TPR

Issues	Change
Otahuhu supply capacity	Added. Higher load forecast.
Penrose 22 kV supply capacity	Added. Change of transformer branch ratings.

The overview of transmission capability for each grid exit point within the Auckland region is listed below. Where an issue is identified we list options to address it.

Section number	Description
8.5.1	Auckland CBD supply capacity
8.5.2	Albany supply capacity
8.5.3	Bombay supply capacity
8.5.4	Glenbrook supply capacity
8.5.5	Henderson supply capacity
8.5.6	Hepburn Road supply capacity
8.5.7	Mangere supply capacity
8.5.8	Mount Roskill supply capacity
8.5.9	Otahuhu supply capacity
8.5.10	Pakuranga supply capacity
8.5.11	Penrose (KiwiRail) supply capacity and security
8.5.12	Penrose (Vector) supply capacity
8.5.13	Silverdale supply capacity
8.5.14	Southdown (KiwiRail) supply capacity and security
8.5.15	Takanini supply capacity
8.5.16	Wairau Road supply capacity
8.5.17	Wiri supply capacity

8.5.1 Auckland CBD supply capacity

Three 220/110 kV interconnecting transformers (two at Penrose and one at Hobson Street) supply the Auckland CBD load, providing a total nominal installed capacity of 750 MVA[12].

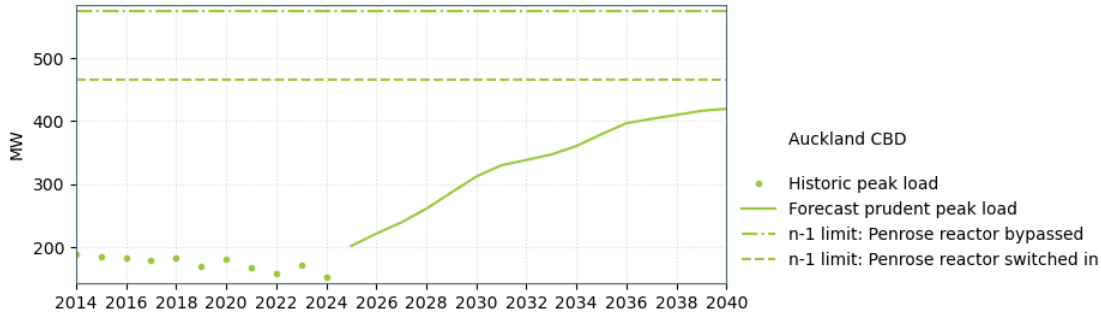
Peak load for the Auckland CBD is within the n-1 capacity of the interconnecting transformers for the forecast period (see Figure 8-4).

However, there is also a 220 kV Otahuhu–Penrose issue and one option to address this issue is to insert the 220 kV Penrose series reactor, which is currently bypassed (see section 8.4.1). This would increase loading on Vector's 110 kV Liverpool Street–Penrose cables and reduce the Auckland CBD n-1 supply capacity, reducing the headroom for unexpected future load increases or for contingencies beyond the n-1 criteria (see Figure 8.4).

[12] The Penrose interconnecting transformers supply the Auckland CBD load via two 110 kV cables owned by Vector. These cables have a lower capacity than the transformers.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-4: Auckland CBD supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

See section 8.4.1.

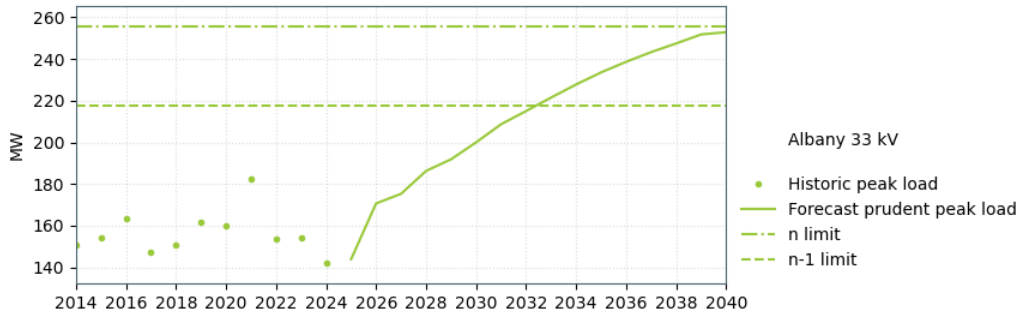
8.5.2 Albany supply capacity

Issue

Three 220/33 kV transformers supply Albany's load, providing a total nominal installed capacity of 320 MVA.

Peak load at Albany is forecast to exceed the n-1 capacity of the supply transformers from winter 2033 (see Figure 8-5).

Figure 8-5: Albany supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We are discussing investment options with Vector. Options include:

- operational measures such as transferring loads to neighbouring grid exit points
- replacing the lower capacity and older T3 and T6 transformers with higher capacity units
- building a new grid exit point between Albany and Wairau Road to allow some load to be shifted from Albany.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Customer investments

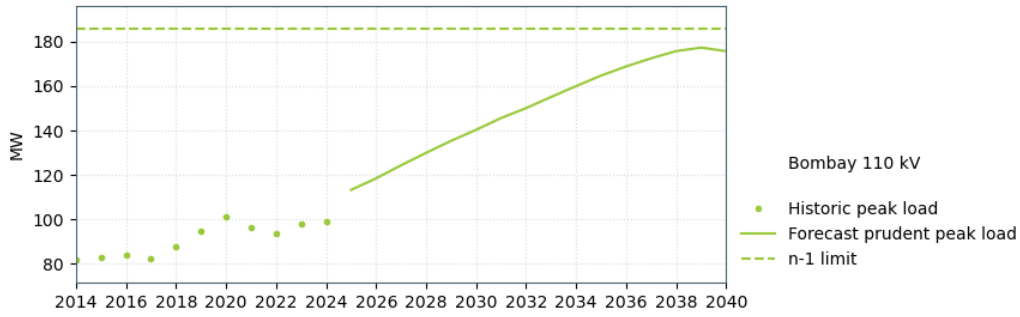
Project name:	Rosedale GXP
Project description:	Build a new GXP between Albany and Wairau Road
Project's state of completion:	Possible
Grid need date:	2033 (Customer initiated)
Indicative cost [$ million]:	60
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.5.3 Bombay supply capacity

There are two 220/110 kV transformers at Bombay to supply Bombay from the 220 kV network. The remaining two 110 kV circuits south of Bombay will be decomissioned. Once the regional 110 kV asset rationalisation work is completed, Bombay will be supplied via the two 220/110 kV transformers, providing a total nominal installed capacity of 300 MVA.

Peak load at Bombay is within the the n-1 capacity of the 220/110 kV transformers for the forecast period (see Figure 8-6).

Figure 8-6: Bombay 110 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

8.5.4 Glenbrook supply capacity

Issue

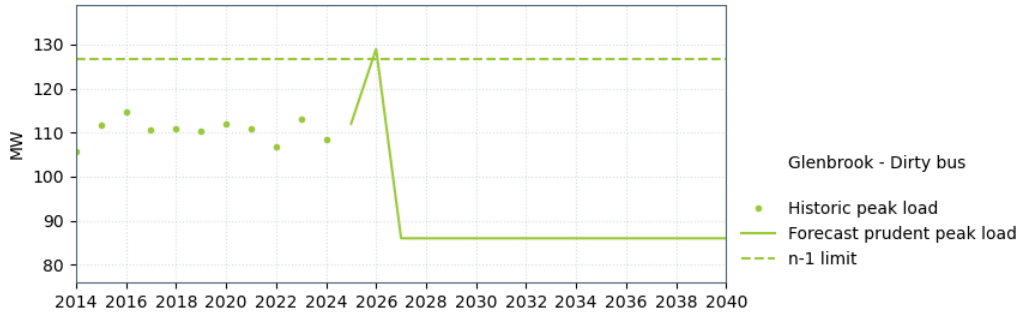
There are two 33 kV supply buses at Glenbrook, a "dirty" bus that supplies the Glenbrook Steel Mill's loads that create significant and regular voltage disturbances, and a "clean" bus. The "clean" bus supplies the rest of the steel mill's load, connects its co-generation plants (owned by Alinta Energy) and supplies the Counties Energy grid exit point.

Two 220/33 kV transformers supply the Glenbrook dirty bus, providing a total nominal installed capacity of 280 MVA. The transformers' capacity is limited by 33 kV switchgear and incomer cables.

Peak load at the Glenbrook dirty bus is within the n-1 capacity of the supply transformers for the forecast period (see Figure 8-7).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-7: Glenbrook dirty bus supply capacity

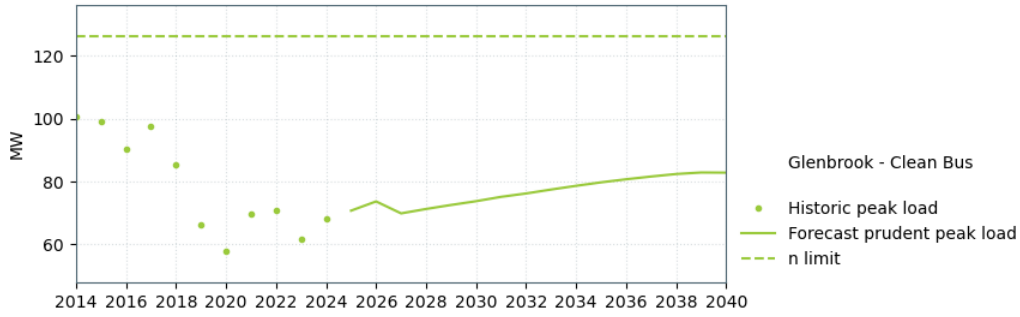


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The Glenbrook clean bus is supplied by a single 220/33 kV, 140 MVA transformer. When this transformer is out of service, one of the two transformers supplying the dirty bus can be switched to supply the clean bus, resulting in switched n-1 security (and also placing the dirty bus on n security). The transformer capacity is limited by its 33 kV switchgear.

Peak load at the Glenbrook clean bus is within the continuous rating of the single supply transformer for the forecast period (see Figure 8-8). The forecast assumed no contribution from the approximately 99 MW of cogeneration at the site, nor from the new 100 MW Battery Energy Storage System (BESS) which is expected to be commissioned in late 2025.

Figure 8-8: Glenbrook clean bus supply capacity without cogeneration and BESS



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

There are no supply capacity issues at either of the Glenbrook 33 kV buses and the customers supplied from the clean bus have not requested a higher level of security. Therefore, we do not have any investments planned at the Glenbrook substation.

8.5.5 Henderson supply capacity

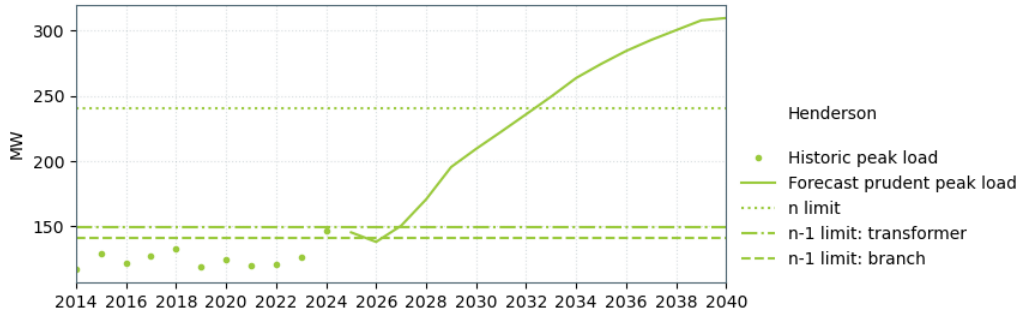
Issue

Two 220/33 kV transformers supply Henderson's load, providing a total nominal installed capacity of 240 MVA. The transformers' capacity is limited by the 33 kV cables and circuit breakers.

Peak load at Henderson is forecast to exceed the n-1 capacity of the supply transformers from winter 2025 and the n capacity from winter 2033 (see Figure 8-9).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-9: Henderson supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

In the short-term, Vector is able to manage this operationally by shifting load between the Henderson and Hepburn Road grid exit points.

At Vector's request we are investigating options to install a third 220/33 kV supply transformer at Henderson to increase the n-1 capacity.

We are discussing development options, investment requirements and timing with Vector.

Customer investments

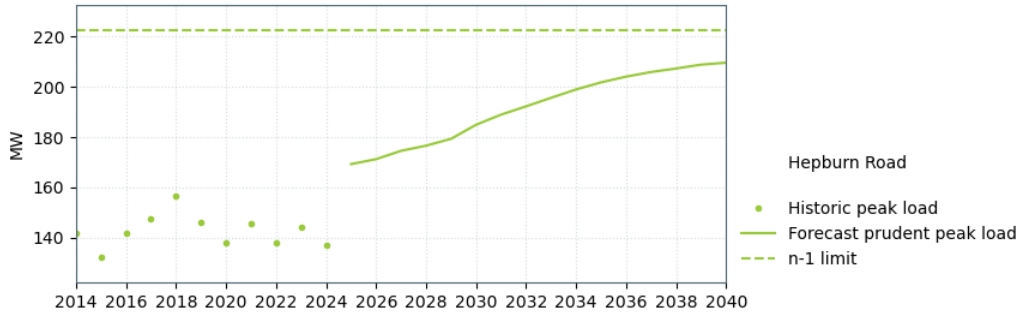
Project name:	Henderson supply capacity
Project description:	Install third 220/33 kV supply transformer at Henderson
Project's state of completion:	Possible
Grid need date:	2025 (Customer initiated)
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.5.6 Hepburn Road supply capacity

Three 110/33 kV transformers supply Hepburn Road's load, providing a total nominal installed capacity of 325 MVA.

Peak load at Hepburn Road is within the n-1 capacity of the supply transformers for the forecast period (see Figure 8-10).

Figure 8-10: Hepburn Road supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

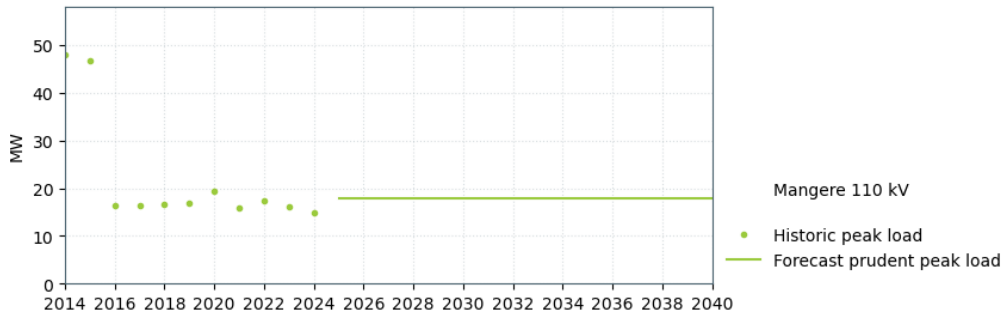
8.5.7 Mangere supply capacity

At Mangere, Vector is supplied at two voltage levels: 110 kV and 33 kV.

Vector has 110 kV feeders connected directly to the Mangere 110 kV bus; their capacity is not reported in the TPR. See Figure 8-11 for the peak load forecast at Mangere 110 kV.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-11: Mangere 110 kV load forecast

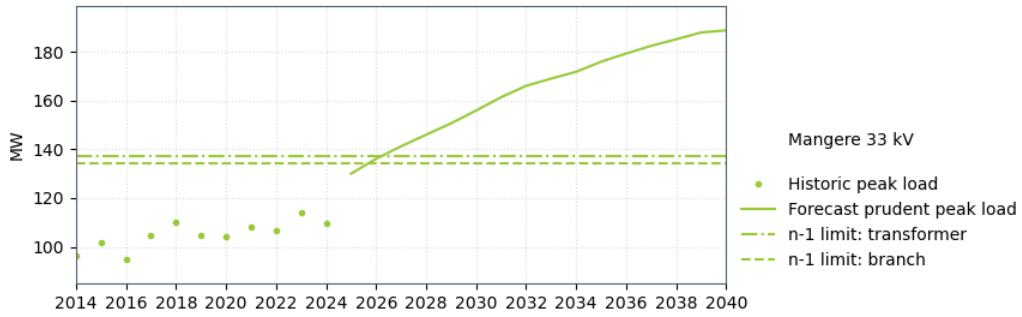


Issue

Two 110/33 kV transformers supply Mangere's 33 kV load, providing a total nominal installed capacity of 240 MVA. The transformers' capacity is limited by the HV disconnectors.

Peak load at Mangere 33 kV is forecast to exceed the n-1 capacity of the supply transformers from winter 2026 (see Figure 8-12).

Figure 8-12: Mangere 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss investment options with Vector. Options include upgrading the existing transformers or installing a third supply transformer to increase the n-1 capacity.

Customer investments

Project name:	Mangere supply capacity
Project description:	Install a third 110/33 kV supply transformer
Project's state of completion:	Possible
Grid need date:	2026 (Customer initiated)
Indicative cost [$ million]:	22
Reliability or Economic investment?	Reliability (Grid Reliability Report)

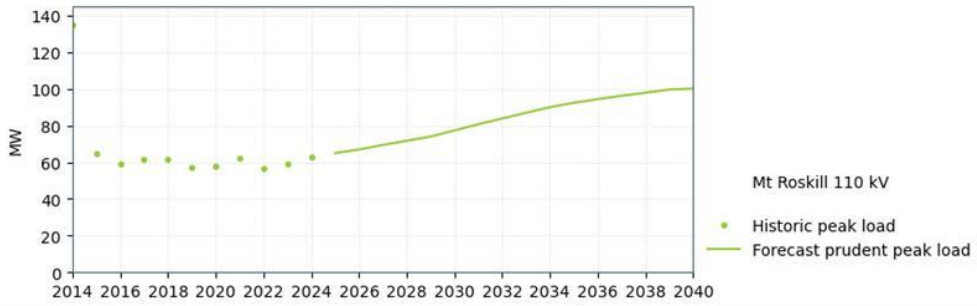
8.5.8 Mount Roskill supply capacity

At Mount Roskill, Vector is supplied at two voltage levels: 110 kV and 22 kV.

Vector has 110 kV feeders connected directly to the Mount Roskill 110 kV bus; their capacity is not reported in the TPR. See Figure 8-13 for the peak load forecast at Mount Roskill 110 kV.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-13: Mount Roskill 110 kV load forecast

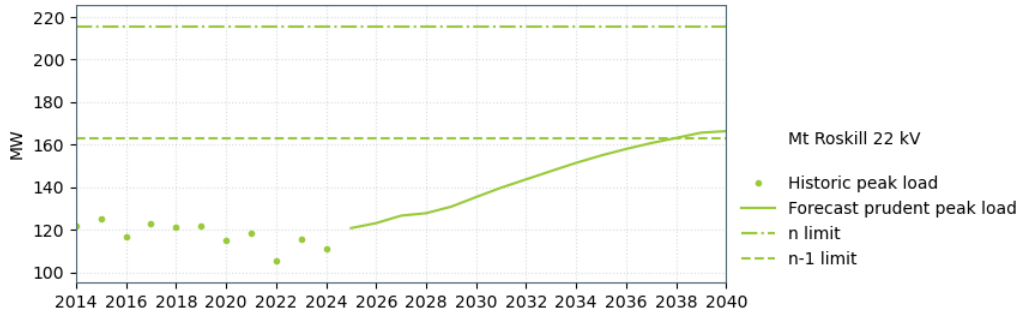


Issue

Three 110/22 kV transformers supply Mount Roskill's 22 kV load, providing a total nominal installed capacity of 220 MVA.

Peak load at Mount Roskill is forecast to exceed the n-1 capacity of the supply transformers from winter 2038 (see Figure 8-14).

Figure 8-14: Mount Roskill 22 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss investment options with Vector closer to the need date. Options include replacing the two older transformers with higher capacity units.

8.5.9 Otahuhu supply capacity

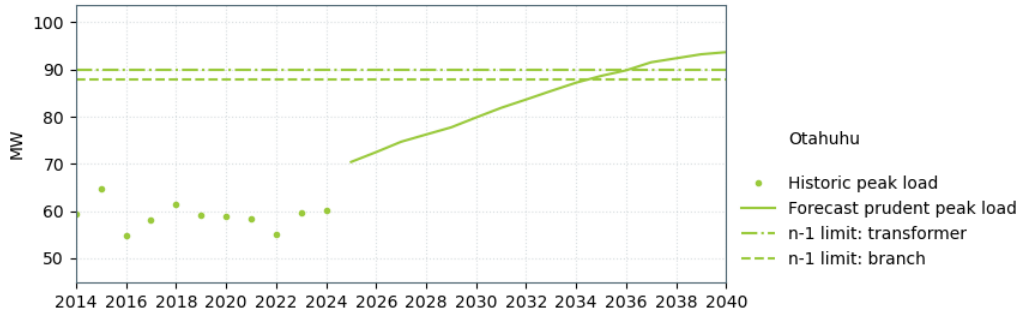
Issue

Two 220/22 kV transformers supply Otahuhu's load, providing a total nominal installed capacity of 160 MVA. The transformers' capacity is limited by 22 kV circuit breakers.

Peak load at Otahuhu is forecast to exceed the n-1 capacity of the supply transformers from winter 2035 (see Figure 8-15).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-15: Otahuhu supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

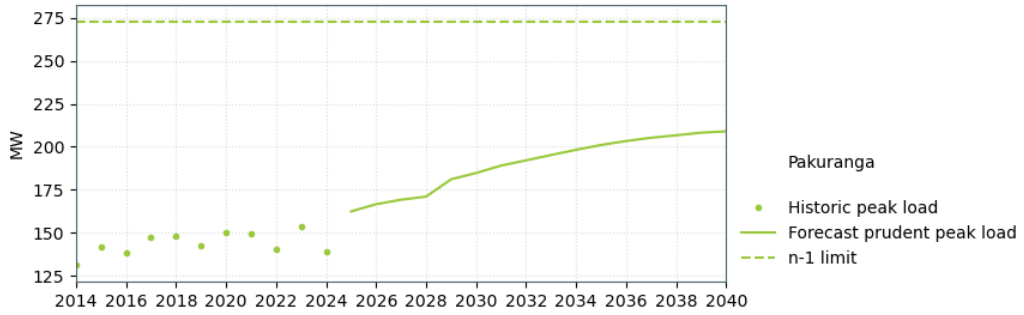
We will discuss investment options with Vector closer to the need date. Options include installing a third supply transformer to increase the n-1 capacity.

8.5.10 Pakuranga supply capacity

Three 220/33 kV transformers supply Pakuranga's load, providing a total nominal installed capacity of 360 MVA. The transformers' capacity is limited by 33 kV incomers.

Peak load at Pakuranga is within the n-1 capacity of the supply transformers for the forecast period (see Figure 8-16).

Figure 8-16: Pakuranga supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

8.5.11 Penrose (KiwiRail) supply capacity and security

A single 220/25 kV traction transformer at Penrose supplies the Auckland passenger rail system. This transformer, along with the single traction transformer at Southdown, provides switched n-1 security. The average transformer loading is low, with high levels of peak load occurring for only a few minutes at a time. Therefore, we do not assess the capacity of traction transformers in the TPR.

8.5.12 Penrose (Vector) supply capacity

At Penrose, Vector is supplied at three voltage levels: 110 kV, 33 kV and 22 kV.

Vector has 110 kV feeders connected directly to the Penrose 110 kV bus which supply the Auckland CBD, see Section 8.5.1.

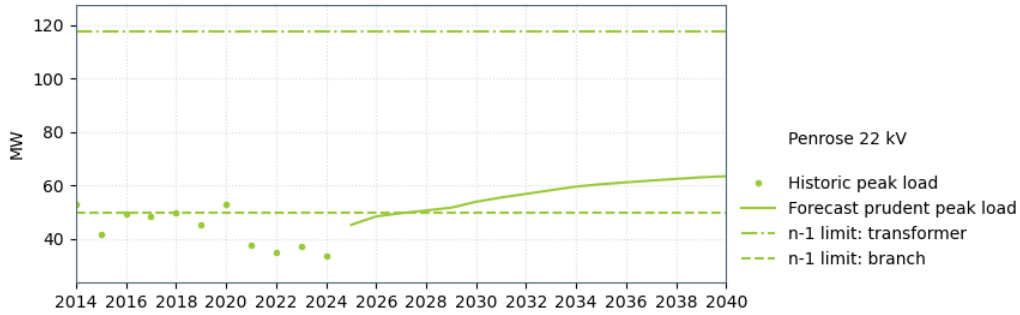
Issue

Three 33/22 kV transformers supply Penrose's 22 kV load, providing a nominal installed capacity of 135 MVA. The transformers' capacity is limited by Vector's LV cable connection arrangement, as there is no 22 kV bus; instead, one or two of Vector's 22 kV feeders are directly connected to each transformer.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Peak load at Penrose 22 kV exceeds the n-1 capacity of the supply transformers from 2028 (see Figure 8-17).

Figure 8-17: Penrose 22 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

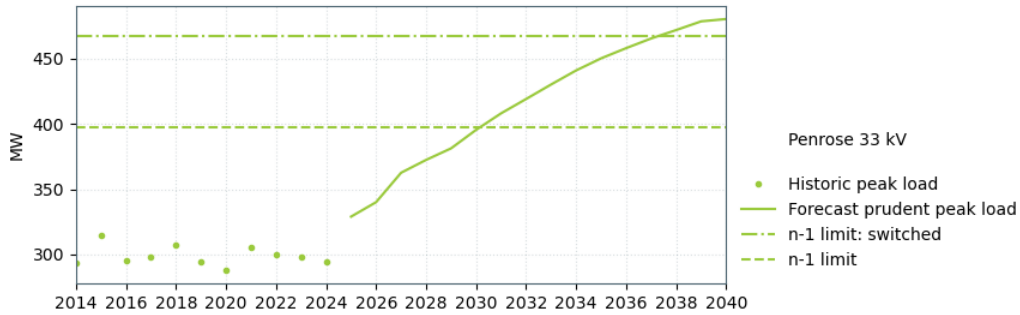
Issue

Three 220/33 kV transformers supply Penrose's 33 kV and 22 kV loads, providing a total nominal installed capacity of 560 MVA[13].

Peak load at Penrose 33 kV is forecast to exceed the n-1 capacity of the supply transformers from winter 2031 (see Figure 8-18).

There is also a fourth 220/33 kV supply transformer on hot-standby at Penrose. It cannot normally be in service because the 33 kV fault level would be too high, but it does enable us to quickly restore capacity following a transformer outage.

Figure 8-18: Penrose 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We expect the 220/33 kV transformer overload to be manageable operationally for the forecast period, either through load control (by Vector), switching in the hot-standby unit following an outage or by transferring load to other grid exit points.

For the 33/22 kV transformers, increasing the LV cable ratings to match the transformer thermal limits will resolve the n-1 capacity exceedance issue during the forecast period.

Vector has consulted with us extensively on developing an alternative grid exit point to supply some of the Penrose loads. The main driver for this is to increase the diversity of its network, as Penrose (33 kV and 22 kV) is currently one of the largest grid exit points in the country with peak load of over 300 MW. More recently, Vector is exploring the possibility of shifting some of its Penrose loads to a new grid exit point at Transpower's Southdown substation.

Discussions are ongoing and no investments are planned at this stage.

[13] The three supply transformers have different impedances and ratings. Therefore, the n capacity of the three transformers is lower than the nominal installed capacity as the lower impedance unit can overload while the parallel banks still have capacity.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Customer investments

Project name:	New 220/33 kV grid exit point at Southdown substation
Project description:	New 220/33 kV grid exit point at Southdown substation
Project's state of completion:	Possible
Grid need date:	2029 (Customer initiated)
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.5.13 Silverdale supply capacity

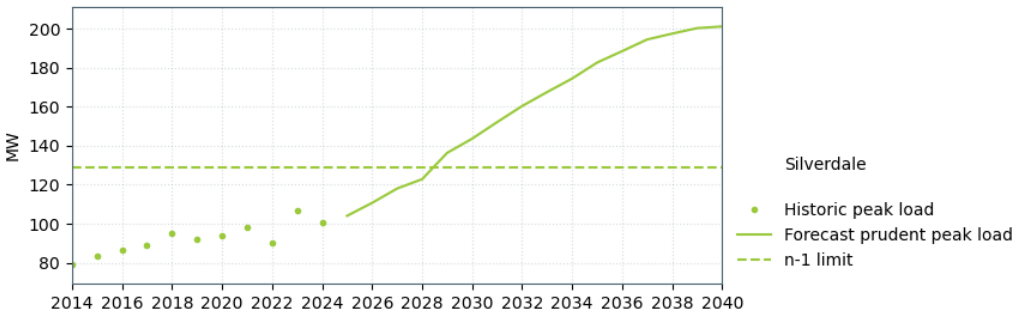
Issue

Two 220/33 kV transformers supply Silverdale's load, providing a total nominal installed capacity of 220 MVA.

There is no 220 kV bus at Silverdale, so an Albany–Silverdale circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[14], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Silverdale is forecast to exceed the n-1 capacity of the transformers from winter 2029 (see Figure 8-19).

Figure 8-19: Silverdale supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We are discussing investment options with Vector. The prefered option includes installing a third supply transformer to increase the n-1 capacity. Future investments will be customer driven.

Customer investments

Project name:	Silverdale supply capacity
Project description:	Install a third 220/33 kV supply transformer
Project's state of completion:	Possible
Grid need date:	2029 (Customer initiated)
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.5.14 Southdown (KiwiRail) supply capacity and security

A single 220/25 kV traction transformer at Southdown supplies the Auckland passenger rail system. This transformer, along with the single traction transformer at Penrose, provides switched n-1 security. The average transformer loading is low, with high levels of peak load

[14] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

occurring for only a few minutes at a time. Therefore, we do not assess the capacity of traction transformers in the TPR.

8.5.15 Takanini supply capacity

Issue

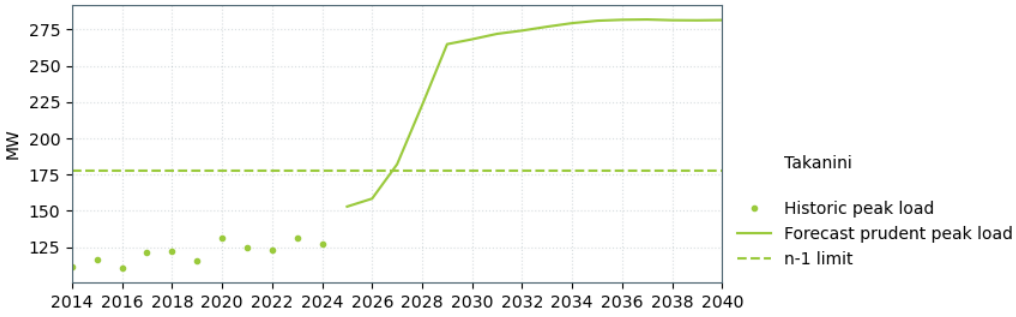
Two 220/33 kV transformers supply Takanini's load, providing a total nominal installed capacity of 300 MVA.

The two transformers are Tee-connected to the Drury–Takanini–Otahuhu circuits, so a circuit outage also disconnects one of the supply transformers. We are required to avoid overloading a transformer for a circuit outage[15], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Takanini is forecast to exceed the n-1 capacity of the supply transformers from winter 2027 (see Figure 8-20).

In addition, a Takanini supply transformer outage during high load periods could cause voltage steps on the Takanini 33 kV bus to exceed our planning guideline threshold of five per cent.

Figure 8-20: Takanini supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss investment options with Vector. One possible option is installing a 220 kV bus and a third supply transformer to increase the n-1 capacity. Future investments will be customer driven.

Customer investments

Project name:	Takanini supply capacity
Project description:	Install a 220 kV bus and third 220/33 kV supply transformer
Project's state of completion:	Possible
Grid need date:	2027 (Customer initiated)
Indicative cost [$ million]:	39
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.5.16 Wairau Road supply capacity

Issue

The load at Wairau Road is supplied by one 220/33 kV transformer (Wairau Road–T7) and one 220/110 kV transformer at Albany (Albany–T5)[16], providing a total nominal installed capacity of 320 MVA. Wairau Road–T7 is limited by Vector's 33 kV switchgear.

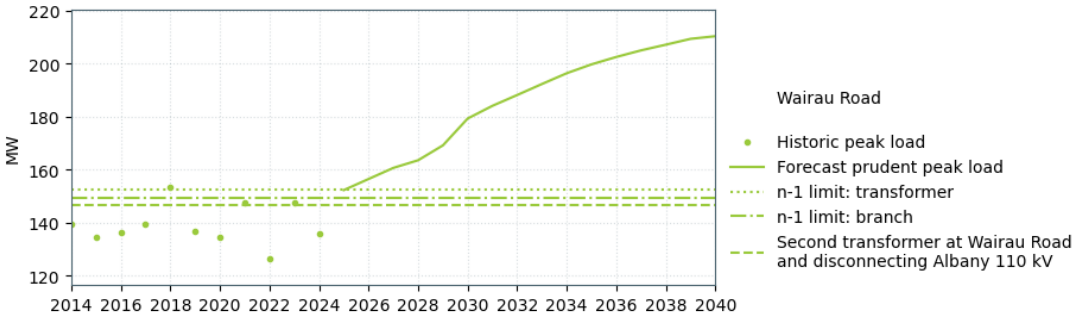
Peak load at Wairau Road is forecast to exceed the n-1 capacity of the transformers from winter 2026 (see Figure 8-21).

[15] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

[16] Albany–T5 is connected to Wairau Road through the Vector owned and operated 110 kV distribution network.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-21: Wairau Road supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We have initiated a project to install a second 220/33 kV supply transformer at Wairau Road. Once the project is completed, the 110 kV connection to Albany will be disconnected, slightly reducing the n-1 capacity compared to the current configuration (see Figure 8-21). We will discuss investment options with Vector. Longer term options include installing a third supply transformer to increase the n-1 capacity. Future investments will be customer driven.

Customer investments

Project name:	Wairau Road supply capacity
Project description:	Second 220/33 kV supply transformer
Project's state of completion:	Committed
Grid need date:	2027
Indicative cost [$ million]:	17.6
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Wairau Road supply capacity
Project description:	Third 220/33 kV supply transformer
Project's state of completion:	Possible
Grid need date:	2027 (Customer initiated)
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.5.17 Wiri supply capacity

Issue

Two 110/33 kV transformers supply Wiri's load, providing a total nominal installed capacity of 200 MVA[17]. There is no 110 kV bus at Wiri, so an outage of a Otahuhu–Wiri circuit also disconnects one of the supply transformers. We are required to avoid overloading a transformer for a circuit outage[18], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Wiri is forecast to exceed the n-1 capacity of the supply transformers from winter 2025 and is also approaching the n-1 limit of the Otahuhu–Wiri circuits towards the end of the forecast period (see Figure 8-22).

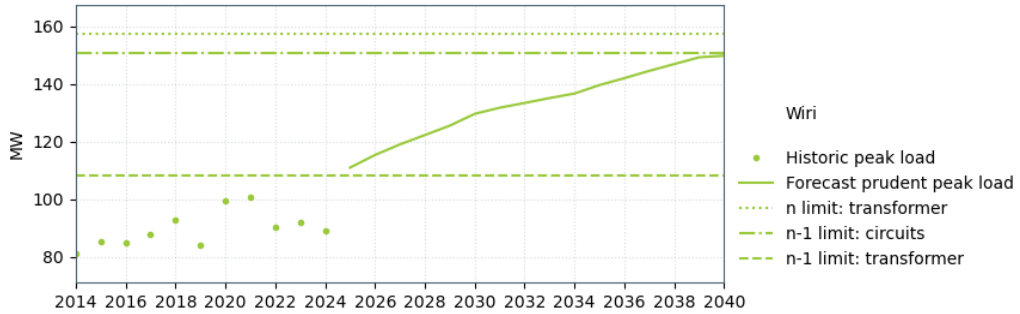
In addition, a Wiri supply transformer outage during high load periods could cause voltage steps on the Wiri 33 kV bus to exceed our planning guideline threshold of five per cent, from 2025.

[17] The two Wiri supply transformers have different impedances but the same ratings. Therefore, the n capacity of the two transformers is lower than the nominal installed capacity as the lower impedance unit can overload while the parallel bank still has capacity.

[18] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 8-22: Wiri supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Currently the supply capacity issues will be managed operationally.

We are discussing investment options to resolve the supply transformer capacity issue with Vector. In the short term, we will be applying 1-hour ratings to the transformers, providing a small increase in pre-contingency capacity.

In the longer term, the preferred option is installing a 110 kV bus and a third supply transformer.

Both existing supply transformers at Wiri are due for risk-based condition replacement in the early 2030s; we will discuss the rating for the replacement transformers with Vector closer to the replacement date.

Customer investments

Project name:	Wiri supply capacity
Project description:	Install 110 kV bus and a third 110/33 kV transformer
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	18.4
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.6 Auckland bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 8-7 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 8-7: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Glenbrook 220 kV	Counties Energy 33 kV supply NZ Steel 'clean' bus load	- - Alinta cogeneration	- - -	Note 1 Note 1 Note 1
Mount Roskill 110 kV	Mount Roskill	-	-	Note 2

1. The Glenbrook 33 kV bus is split so that one side (the 'dirty' bus) supplies the industrial load (that creates significant and regular voltage disturbances) at the steel mill and the other side (the 'clean' bus) supplies the remainder of the steel mill load, connects the mill's cogeneration plants, and supplies Counties Energy's customers (rural and small towns) in the area. The clean bus is supplied by a single transformer; therefore, an outage of the bus section to which it is connected may result in a loss of supply to all Counties Energy customers in the area.
2. The Mount Roskill 110 kV bus consists of a single bus section. We investigated options to increase the bus security at Mount Roskill but determined that no economic options are available. We will continue to monitor the risk and work with Vector to investigate options that may be economic.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Our customers (Counties Energy and Vector) have not requested a higher security level, with the exception of the Mount Roskill 110 kV bus (refer to Table 8-7, Note 2). We do not propose increasing bus security and future investment is likely to be customer-driven. If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

8.7 Other items of interest

8.7.1 110 kV connection between Bombay and Waikato region

Condition assessment indicates that the Bombay–Meremere–A line conductor (a short section of the Arapuni–Bombay circuit) is expected to reach end of life in 2030. The Hamilton–Meremere–B and Meremere–Takanini–A lines (Bombay–Hamilton–1 and 2 circuits) are expected to remain in a satisfactory state until around 2030 but will require extensive refurbishments if they are retained beyond then.

We have a project underway to disconnect the 110 kV circuits south of Bombay to the Waikato region.

We are considering the future of the disconnected 110 kV lines. Some sections of lines south of Bombay may be retained and ownership transferred to other parties, with the remainder of those lines being dismantled between 2025 and 2030.

8.8 Auckland generation opportunities and proposals

This section provides a high-level description of the Auckland region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

Parts of the Auckland region have potential for new generation: solar, on-shore and off-shore wind.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
8.8.1	Generation opportunities by substation
8.8.2	Generation investigations and proposals
8.8.3	Drury busing
8.8.4	Drury–Takanini–Otahuhu circuit rating

8.8.1 Generation opportunities by substation

Envision Opportunities[19] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

[19] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[20]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy.
- winter evening peak – wet/windy
- winter midday high – wet/calm

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

8.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[21]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 8-8 shows generation and grid-scale battery projects in the Auckland region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 8-2 (generation) or Table 8-3 (batteries) instead.

Table 8-8: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Glenbrook-33 kV	BESS	Application confirmed	280[1]
Glenbrook-33 kV	Wind	Application confirmed	80

1. This project is a potential upgrade of the committed 100 MW BESS to 280 MW

We have received additional requests for assessment of generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of selected parts of the grid in the Auckland region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

8.8.3 Drury busing

Drury switching station is connected via the 220 kV Huntly–Bombay–Drury circuit and Drury–Takanini–Otahuhu circuit, providing n-1 security.

Drury could be upgraded by busing the 220 kV Huntly–Bombay–Takanini–Otahuhu circuit into Drury, to improve security to generation in the area and/or to increase the capacity of the transmission system to host generation by ensuring better load sharing across the circuits. Busing the circuit into Drury also increases the security to Bombay and Takanini substations.

In addition, busing at Drury also increases the short-circuit ratio at Glenbrook. This is beneficial for connecting Inverter-Based Resource (IBR) such as solar, BESS and some wind turbine technologies. It also helps improve power quality by reducing the impact of the Steel Mill's operation on voltage quality at the 33 kV buses.

20 "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

21 Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Base E&D capex investment

Project name:	Drury busing
Project description:	Busing 220 kV Huntly–Bombay–Takanini–Otahuhu circuit at Drury
Project's state of completion:	Possible
Grid need date:	2027
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

8.8.4 Drury–Takanini–Otahuhu circuit rating

The 220 kV Drury–Takanini–Otahuhu circuit is an overhead line with a short section of cable at the Otahuhu substation. The overhead line portion is rated at 1140/1254 MVA summer/winter, but is limited by the cable section which is rated at 678/724 MVA. The cable section connects the circuit to the indoor 220 kV bus.

Very high levels of new generation may overload the cable section, especially if the Huntly–Bombay–Takanini–Otahuhu circuit is bused at Drury (see section 8.8.3).

The full capacity of the Drury–Takanini–Otahuhu circuit can be released by a grid reconfiguration at Otahuhu, swapping the Drury–Takanini–Otahuhu–2 and Ohinewai–Otahuhu–2 circuits. The low capacity cable tail from the very high capacity Drury–Takanini–Otahuhu circuit will be replaced with overhead conductors and will connect it to the outdoor substation[22]. This approach is expected to be more practical and lower cost than increasing the rating of the cable tail.

[22] Following this configuration, both circuits from Drury/Huntly will be connected to the outdoor substation and both Ohinewai–Otahuhu circuits will be connected to the Gas Insulated Switchgear at Otahuhu.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

9 Waikato Regional Plan

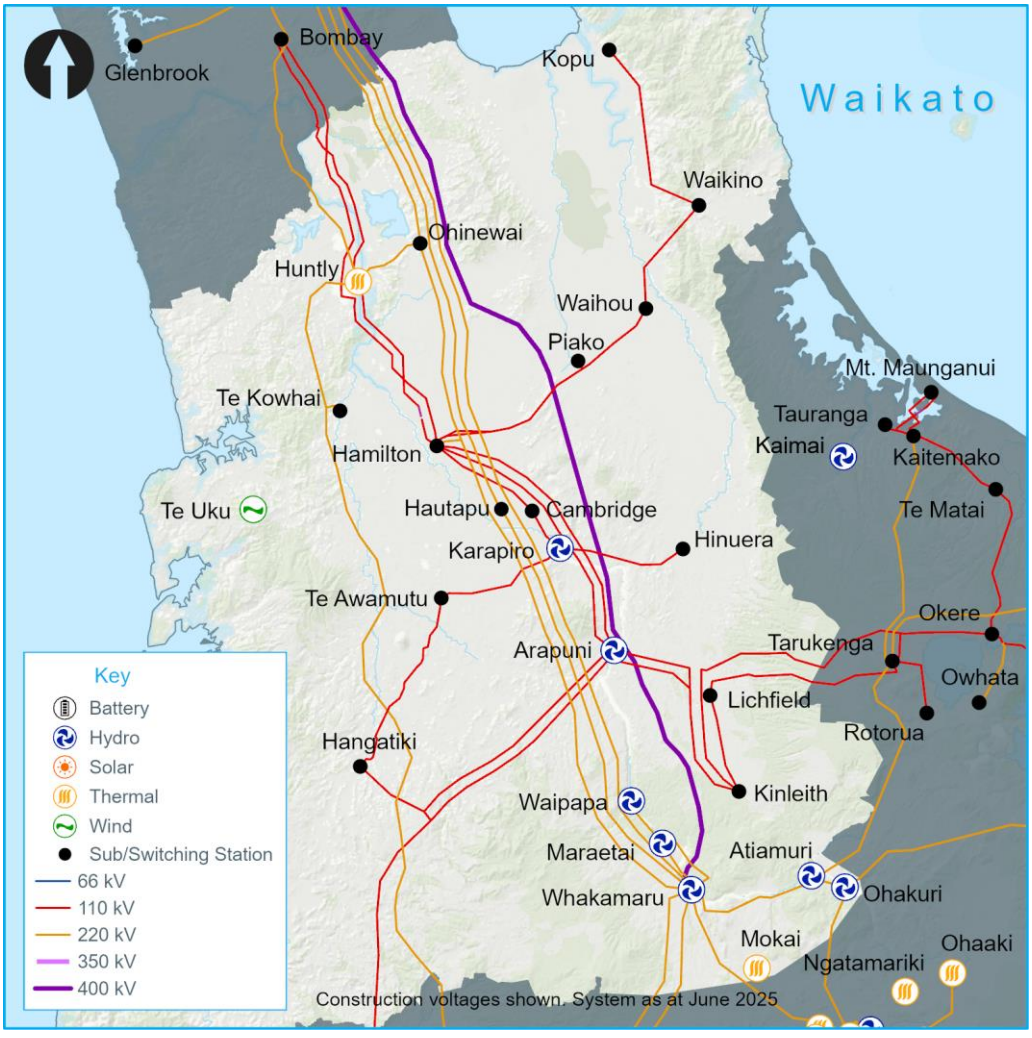
9.1	Regional overview and transmission
9.2	Waikato load and generation forecasts
9.3	Grid enhancement approach and inputs
9.4	Grid asset capability and management within the wider region
9.5	Grid asset capability and management by grid exit point
9.6	Waikato bus security
9.7	Other items of interest
9.8	Waikato generation opportunities and proposals

9.1 Regional overview and transmission

The Waikato region includes the city of Hamilton, together with several large towns and smaller rural localities. Significant industry in the region includes dairying and pulp production.

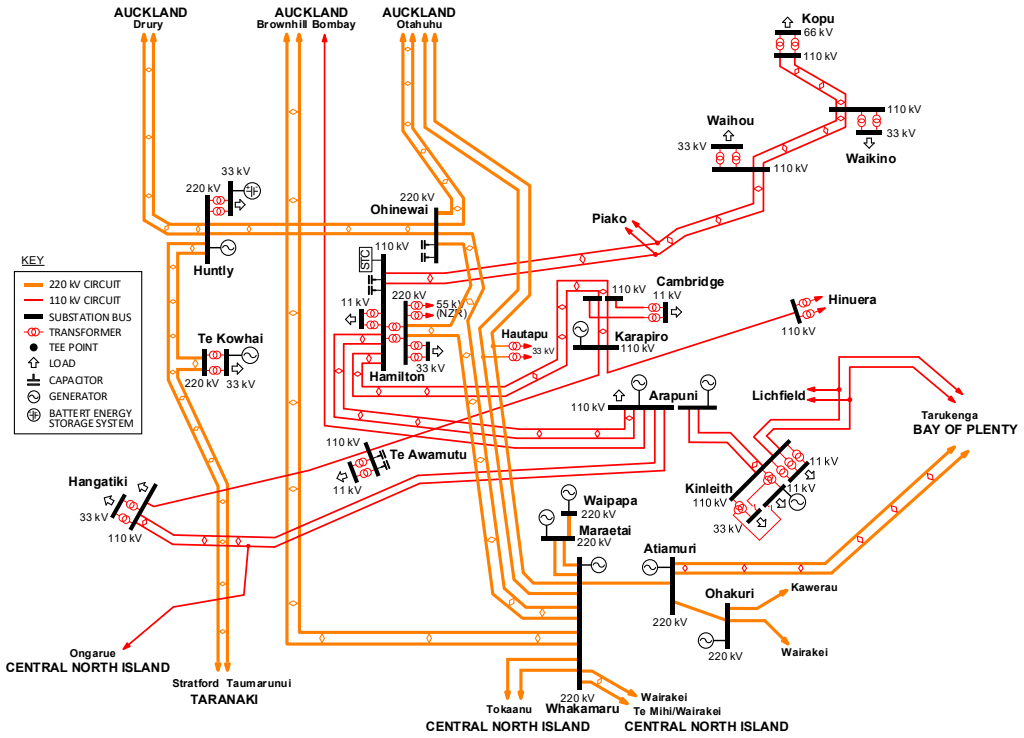
The existing transmission network for the Waikato region is set out geographically in Figure 9-1 and schematically in Figure 9-2. The region comprises two distinct transmission networks, 110 kV and 220 kV, of which the 220 kV network forms part of the grid backbone. The Brownhill–Whakamaru–A line that traverses the region is a 400 kV-capable line but is currently operated at 220 kV.

Figure 9-1: Waikato region transmission network map



2025 Annual Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 9-2: Waikato region transmission schematic



9.1.1 Transmission into the region

Transmission in the Waikato region is complex. The 220 kV circuits form part of the grid backbone (Chapter 6) and connect the region to Stratford (Taranaki), Tokaanu and Wairakei (Central North Island), and Drury and Otahuhu (Auckland). The 110 kV circuits connect the region to Tarukenga (Bay of Plenty), Ongarue (Central North Island), and Bombay (Auckland).

The Waikato region includes a significant portion of total North Island generation capacity, and output from the generators generally exceeds local demand. Surplus generation is exported over the 220 kV transmission network. The 220 kV transmission network has sufficient capacity to provide n-1 security to the local load for the forecast period.

Voltage support is needed to ensure stability in the Waikato and Upper North Island regions. This is provided by static capacitors at the Hamilton, Ohinewai and Te Awamutu substations, and a STATCOM at Hamilton.

9.1.2 Transmission within the region

The 110 kV transmission network within the region supplies and connects the rest of the Waikato region, including most of the regional load and some regional generation.

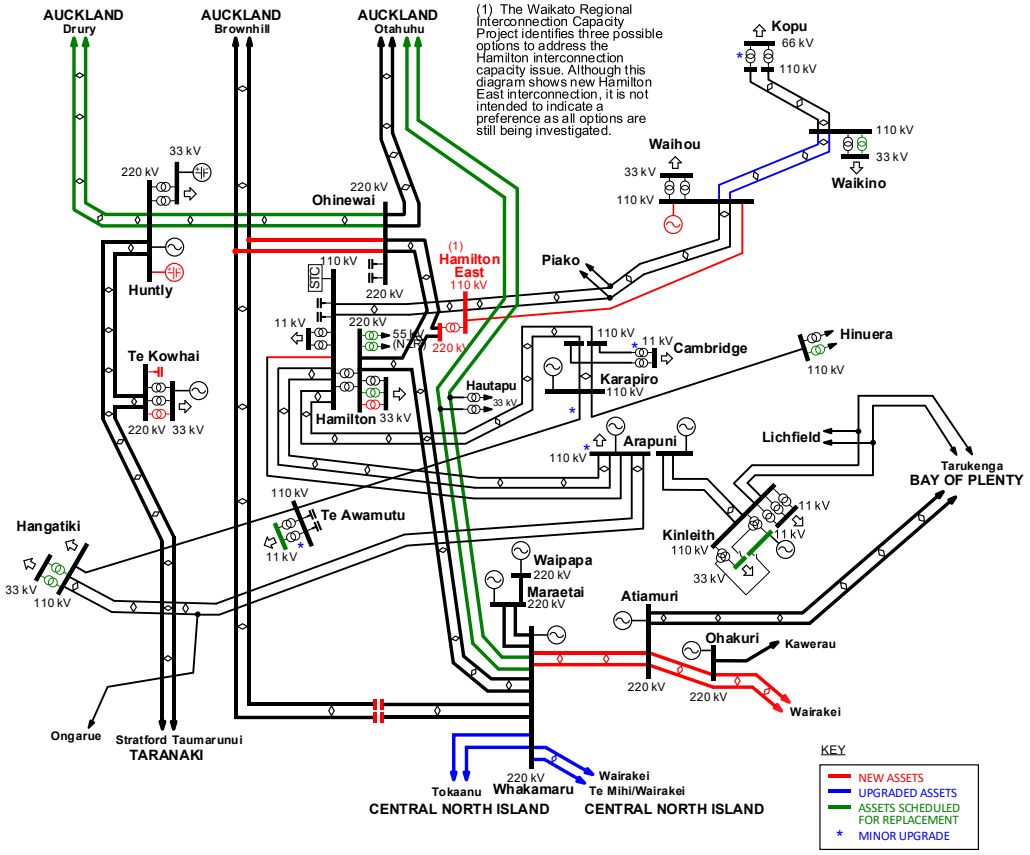
A significant portion of the regional 110 kV network also runs in parallel with the 220 kV network to transfer power between the Waikato region and the Auckland, Bay of Plenty and Central North Island regions. The region's 110 kV circuits are low capacity relative to the local load, generation and parallel 220 kV network.

9.1.3 Possible Waikato transmission configuration

Figure 9-3 shows the possible configuration of Waikato transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 9-3: Possible Waikato transmission configuration in 2040



9.2 Waikato load and generation forecasts

9.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Waikato regional peak demand is forecast to grow by an average 2.8 per cent per annum over the next 15 years, from 650 MW in 2025 to 990 MW by 2040. This is higher than the national average growth rate of 2.6 per cent per annum.

Table 9-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

[1] Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 9-1: Forecast prudent annual peak demand (MW) at Waikato grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Arapuni[6]	0.97	21	21	22	22	22	22	23	23	23	23	23	22
Cambridge[1]	1.00	44	44	66	66	68	70	71	60	62	44	46	43
Hamilton 11 kV[2]	1.00	37	37	38	39	34	35	36	37	37	38	38	40
Hamilton 33 kV[2,3]	1.00	168	175	180	184	185	189	148	152	156	160	165	178
Hamilton NZR[6]	0.94	5	5	5	5	5	5	5	5	5	5	5	5
Hangatiki 33 kV	0.98	35	36	37	38	39	40	41	42	43	44	45	46
Hangatiki 110 kV	0.83	13	13	13	13	13	13	13	13	13	13	13	13
Hautapu[1]	1.00	11	11	24	25	25	25	26	41	41	60	61	72
Hinuera	0.99	32	33	33	34	34	35	35	35	36	36	36	36
Huntly[4]	1.00	45	48	49	50	52	53	79	80	82	83	85	91
Kinleith 11 kV[8]	0.85	30	30	30	30	30	30	30	30	30	30	30	30
Kinleith 33 kV	1.00	24	26	27	27	28	28	29	30	31	32	33	33
Kopu[6]	0.98	53	55	57	59	60	62	63	64	65	65	66	65
Lichfield	0.93	16	16	16	16	16	16	16	16	16	16	16	16
Piako[5]	1.00	47	49	50	51	52	53	53	54	54	55	55	55
Te Awamutu	0.99	49	53	57	60	62	64	65	66	73	74	75	77
Te Kowhai[3,4]	1.00	122	127	145	149	170	175	207	213	220	228	237	268
Waihou[5]	0.99	47	48	49	50	50	51	52	52	52	53	53	52
Waikino	1.00	44	45	46	47	51	55	58	62	63	63	63	62
Whakamaru[7]	0.99	11	12	12	12	13	13	13	13	14	14	14	15

1. High growth at Cambridge from new industrial load and residential development. Some of the Cambridge load will be transferred to the new Hautapu grid exit point over the forecast period.
2. Load shifting of 5 MW from Hamilton 11 kV to Hamilton 33 kV in 2029.
3. Load shifting of 9 MW and 42 MW from Hamilton 33 kV to Te Kowhai in 2029 and 2031, respectively.
4. Load shifting of 26 MW from Te Kowhai to Huntly in 2031.
5. Load shifting of 3.5 MW from Piako to Waihou in 2025.
6. This is a leading power factor.
7. This load is gross, no embedded generation is included.
8. Oji Fibre Solutions announced closure of paper production at Kinleith in 2025.

9.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing coal users to supply electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the Waikato region that are not included in the prudent demand forecast.

9.2.3 Existing and committed generation

The Waikato region's generation capacity is currently 2,560 MW. This excludes embedded solar (PV) generation, which was approximately 59 MW in the Waikato region at the time of publication[2]. The region's generation capacity represents a major portion of New Zealand's generation and significantly exceeds local demand. Surplus generation is exported via the National Grid to other demand centres.

2 Electricity Market Information (EMI): Installed distributed solar generation trends

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 9-2 lists the generation forecast for each grid injection point in the Waikato region for the forecast period. This includes all known and committed generation stations including those embedded within the relevant local lines company network (Waipa Networks, WEL Networks, The Lines Company or Powerco)[3].

Further generation may be developed during the period. Refer to Table 9-8 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 9-2: Existing and committed generation capacity at Waikato grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Arapuni	198	198	198	198	198	198	198	198	198	198	198	198
Atiamuri	84	84	84	84	84	84	84	84	84	84	84	84
Cambridge (Swayne Rd)	3	3	3	3	3	3	3	3	3	3	3	3
Hangatiki (Mangapehi) (Mokauiti) (Speedies Road) (Wairere)	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4	3 2 2 4
Huntly[1]	1204	1204	1204	1204	1204	1204	454	454	454	454	454	454
Huntly (Taiohi Solar)	22	22	22	22	22	22	22	22	22	22	22	22
Karapiro[2]	112	112	112	112	112	112	112	112	112	112	112	112
Kinleith[3] (Kinleith Pulp & Paper)	15	15	15	15	15	15	15	15	15	15	15	15
Kopu (Pamu Ra ki Whitianga Solar)	24	24	24	24	24	24	24	24	24	24	24	24
Maraetai	360	360	360	360	360	360	360	360	360	360	360	360
Ohakuri	112	112	112	112	112	112	112	112	112	112	112	112
Te Awamutu (Anchor Products)	4	4	4	4	4	4	4	4	4	4	4	4
Te Kowhai (Horotiu Landfill) (Te Uku)	1 67	1 67	1 67	1 67	1 67	1 67	1 67	1 67	1 67	1 67	1 67	1 67
Waihou – Tauhei Solar	0	150	150	150	150	150	150	150	150	150	150	150
Waikino (Tirohia Landfill) (Whangamata Diesel)	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2	1 2
Waipapa	51	51	51	51	51	51	51	51	51	51	51	51
Whakamaru	126	126	126	126	126	126	126	126	126	126	126	126
Whakamaru (Mokai)	136	136	136	136	136	136	136	136	136	136	136	136

1. The timing of the three Rankine units' retirement is uncertain. Our assumption of closure date at the end of 2030 is prudent to ensure we can plan for the worst case.
2. Karapiro hydro station is being refurbished which, when completed in 2025, will increase the installed capacity by 17% to 112 MW.
3. Oji Fibre Solutions has indicated the cogeneration output will be about 15 MW following cessation of paper production at Kinleith.

9.2.4 Batteries

Table 9-3 lists the forecast for grid-scale batteries for each grid injection point in the Waikato region for the forecast period. This includes all known and committed batteries – also referred

[3] Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

to as BESS (battery energy storage systems) – including those embedded within local lines company networks[4].

Further grid-scale batteries may be developed during the period. Refer to Table 9-8 for more information on potential new batteries that are not sufficiently advanced to include in our forecasts.

Table 9-3: Existing and committed grid-scale battery capacity at Waikato grid injection points

Grid injection point (location/name if embedded)	Battery capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Waikino (Whangamata BESS)	2	2	2	2	2	2	2	2	2	2	2	2
Huntly BESS	0	100	100	100	100	100	100	100	100	100	100	100
Huntly (Rotohiko BESS)	35	35	35	35	35	35	35	35	35	35	35	35

9.3 Grid enhancement approach and inputs

9.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Waikato region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancement to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 9.4 and 9.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

9.3.2 Waikato significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 9-4 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Waikato region for the next 15 years that may significantly impact related system issues or connected parties.

[4] Only batteries with a capacity greater than 1 MW are listed. Battery capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 9-4: Proposed significant upcoming replacement and refurbishment work for the Waikato region

Description	Tentative year	E&D issue
Arapuni North Runback scheme replacement	2031-2033	9.4.1
Hamilton–T5 supply transformer replacement Hamilton–T7 (traction) transformer refurbishment Hamilton–T8 (traction) transformer bushing replacement	2026-2028 2024-2026 2038-2040	9.5.3 None None
Hangatiki–T1 and T2 transformer replacement	2028-2030	9.5.3
Hinuera–T1 supply transformer replacement	2031-2033	9.5.7
Huntly–Deviation–A line (Huntly–Ohinewai circuits) reconductoring	2027-2029	Chapter 6
Huntly–Otahuhu–A line (Drury–Huntly circuits) reconductoring	2033-2035	Chapter 6
Kinleith 33 kV switchboard replacement Kinleith 11 kV Bus D switchboard replacement	2034-2036 2034-2036	None None
Te Awamutu 11 kV switchboard A replacement	2035-2037	None
Waikino–T1 supply transformer replacement	2033-2035	9.5.16

9.3.3 Waikato asset feedback

The Asset Feedback Register does not contain any E&D-related entries specific to the Waikato region.

9.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Waikato region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

The Waikato 110 kV transmission network is in parallel with the 220 kV network to transfer power through the Waikato between the Auckland, Central North Island and Bay of Plenty regions. Several committed developments will disconnect the 110 kV transmission network between Waikato and the Auckland and Central North Island regions.

110 kV connection to Auckland

We have a committed project to connect the Arapuni–Bombay circuit at Hamilton and disconnect the circuit section from Hamilton to Bombay, in 2026. Other work to reconfigure the 110 kV circuits between Hamilton and Bombay has been completed: in 2024 Bombay–Hamilton–2 was disconnected to enable connection of a Bombay 220/110 kV transformer, and Bombay–Hamilton–1 is operated normally open to maximise transmission capacity. Upon completion of this reconfiguration project, the Waikato region will be decoupled from its 110 kV connection to Auckland.

The staged reconfiguration of the 110 kV network between Hamilton and Bombay increases transmission capacity on the 220 kV grid backbone, reduces overall system losses, and avoids future extensive refurbishment of portions of the 110 kV lines. The Bombay–Meremere–A line conductor (a short section of the Arapuni–Bombay circuit) is estimated to reach its risk-based condition replacement in 2030. The towers of the Hamilton–Meremere–B and Meremere–Takanini–A lines (Bombay–Hamilton–1 and 2 circuits) are expected to remain in a satisfactory state until around 2030 but will require extensive refurbishments if they are retained beyond then.

110 kV connection to Central North Island

From 2026, we will implement a permanent system split at Ongarue on the 110 kV Hangatiki–Rangitoto Hills–Ongarue circuit. This is part of the approved Net Zero Grid Pathways (NZGP) major capex project to increase the 220 kV transmission capacity of the grid backbone through the Central North Island region (see section 6.5.3.1). As a result, the Waikato region will be decoupled from its connection to the Central North Island.

Table 9-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 9-5: Changes within the wider region since the 2023 TPR

Issue	Change
Hamilton–Cambridge–Karapiro 110 kV transmission capacity	Amended. Karapiro Circuit Overload Protection Scheme commissioned to address Cambridge–Karapiro overloads during high Karapiro generation.
Kinleith–Lichfield–Tarukenga 110 kV transmission capacity	Amended. Capacity issue much less severe due to small increase in transmission capacity and reduced load forecast.

The overview of transmission capability within the wider Waikato region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
9.4.1	Arapuni–Hamilton 110 kV transmission capacity
9.4.2	Arapuni–Kinleith–Tarukenga 110 kV transmission capacity **Project name:** Arapuni North Runback Scheme **Project description:** Modify the scheme to include the and Arapuni **Project's state of completion:** Possible **Grid need date:** 2026 **Indicative cost [$ million]:** 0.8 **Reliability or Economic investment?** Reliability (Grid Reliability Report Arapuni–Kinleith–Tarukenga 110 kV transmission capacity
9.4.3	Hamilton–Cambridge–Karapiro 110 kV transmission capacity
9.4.4	Hamilton–Piako–Waihou and Waihou–Waikino 110 kV transmission capacity
9.4.5	Hangatiki and Te Awamutu 110 kV transmission capacity
9.4.6	Waikato 220/110 kV interconnection capacity

9.4.1 Arapuni–Hamilton 110 kV transmission capacity

Issue

The 110 kV load south of Hamilton, which includes Cambridge, Hinuera, Te Awamutu, Hangatiki and Arapuni, is supplied from Hamilton via two circuits to Arapuni and two circuits to Cambridge, along with generation at Karapiro and Arapuni.

After connecting the Arapuni–Bombay circuit into Hamilton (see section 9.4), there will be three 110 kV Arapuni–Hamilton circuits, each rated at 51/62 MVA (summer/winter).

The Arapuni 110 kV bus is normally split into two bus sections[5]:

- North bus: Arapuni G1-4 generators, Arapuni–Bombay, Arapuni–Hamilton–1 and 2, Arapuni–Hangatiki, and Arapuni–Hangatiki–Ongarue circuits.
- South bus: Arapuni–Kinleith–1 and 2 circuits.

The Arapuni G5-G8 generators are selectable between the North and South bus sections. Three of these generators are normally selected to the South bus.

System conditions that may affect the Arapuni–Hamilton 110 kV transmission capacity are:

- During high Arapuni generation coupled with low Waikato 110 kV load, an Arapuni–Hamilton circuit outage may overload the other circuits for power flow from Arapuni towards Hamilton. The post-contingency overload is automatically removed by the Arapuni North Generation Runback Scheme.
- During periods of high Waikato 110 kV load, a minimum level of generation may be required at Arapuni to manage loading on the Arapuni–Hamilton circuits for a loss of the Karapiro–Te Awamutu circuit for power flow from Hamilton towards Arapuni.

5 Cost benefit analysis found this was the most economic normal system configuration.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

What next?

With three Arapuni–Hamilton circuits, the Arapuni North Runback scheme will no longer operate correctly. There is no immediate need for the scheme during normal operation with three Arapuni–Hamilton circuits.

We will monitor system conditions to assess the need for an upgraded scheme. This may be required if generation increases, for example if Arapuni generation is moved from the South bus to the North bus or additional generation is connected in the area. An upgraded scheme may also be required to manage periods of high load and low generation.

Base E&D capex investments

Project name:	Bus the Arapuni–Bombay circuit at Hamilton
Project description:	Bus the Arapuni–Bombay circuit at Hamilton
Project's state of completion:	Delivery
Grid need date:	2026
Indicative cost [$ million]:	2.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Arapuni North Runback Scheme
Project description:	Modify the scheme to include the third circuit between Hamilton and Arapuni
Project's state of completion:	Possible
Grid need date:	2026
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.4.2 Arapuni–Kinleith–Tarukenga 110 kV transmission capacity

The Arapuni bus is normally split with the Kinleith circuits on one side of the split (the South bus); the other side of the split connects the Bombay, Hamilton, and Hangatiki circuits (the North bus). Arapuni generators G5-G8 are selectable to the North or South bus.

The Arapuni–Kinleith–Tarukenga circuits are normally configured as a spur originating from Tarukenga. The Lichfield substation is connected into the Kinleith–Tarukenga circuits via a double Tee connection.

The spur connects a Fonterra dairy factory at Lichfield, Oji's plant at Kinleith, and Powerco's distribution load at Kinleith. Generation connected to the spur includes Oji's co-generation plant at Kinleith and Mercury's Arapuni hydro generator (up to four 27 MW units connectable to the Arapuni South bus).

Issue

Kinleith and Lichfield are supplied through four 110 kV circuits:

- Arapuni–Kinleith–1 rated at 57/70 MVA (summer/winter)
- Arapuni–Kinleith–2 rated at 63/77 MVA (summer/winter)
- Kinleith–Lichfield–Tarukenga–1 rated at 51/62 MVA (summer/winter)
- Kinleith–Lichfield–Tarukenga–2 rated at 63/77 MVA (summer/winter).

The loadings on these circuits may exceed their n-1 capacity under certain operating conditions.

Generation at Kinleith and Arapuni must be managed so that minimum generation is sufficiently high to prevent the Lichfield–Tarukenga circuits exceeding their n-1 capacity. The n-1 capacity issue occurs in the shoulder period, when circuit ratings are near their lowest capacity.

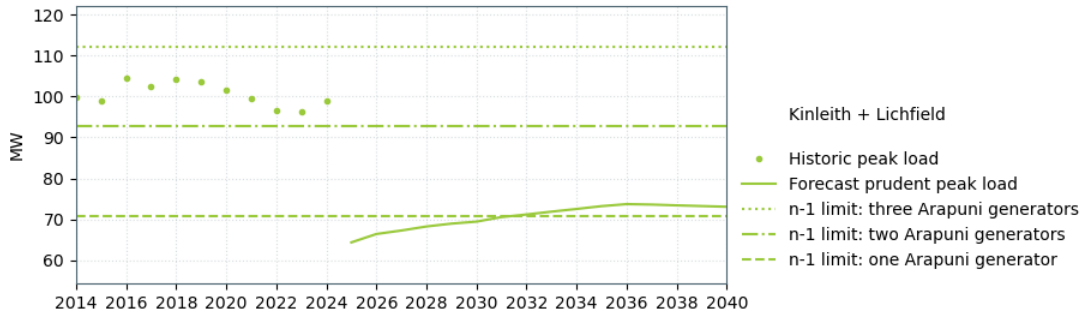
Constraining the minimum and maximum generation connected to the Arapuni South bus may increase other risks. The Kinleith–Lichfield–Tarukenga circuits have variable line ratings[6] applied to minimise the need to constrain on generation at Arapuni during low hydro inflows

[6] Variable line rating (VLR) assigns a different rating to a circuit every two hours of the day for each month, based on the historic wind, ambient temperature and solar gain for each two-hour period. This gives 144 ratings per year.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

(see Figure 9-4). The Arapuni South (Generation) Runback Scheme minimises the need to constrain off Arapuni generation.

Figure 9-4: Lichfield–Tarukenga transmission capacity[7]



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The Lichfield–Tarukenga–1 circuit consists of multiple conductor types. We recently reconductored the lowest rated section (approximately 2 km) to increase the circuit's rating by around 5 MVA under summer seasonal ratings[8]. With some generation from Arapuni, the Lichfield–Tarukenga capacity issue can be managed within the forecast period. Future investment will be customer driven.

9.4.3 Hamilton–Cambridge–Karapiro 110 kV transmission capacity

Background

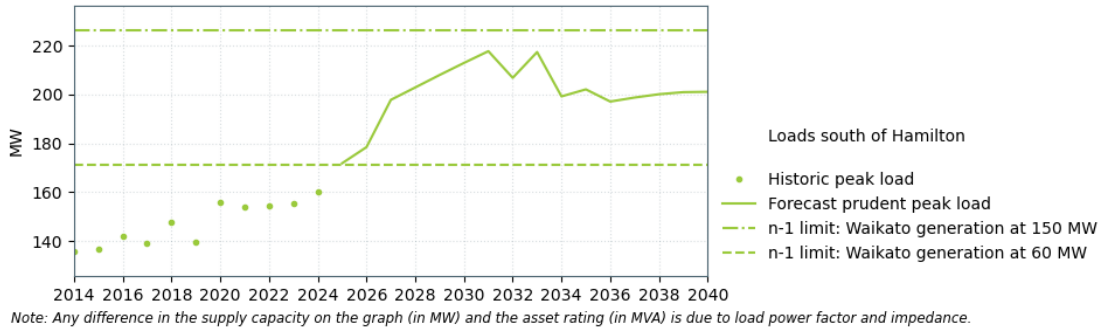
The Karapiro Spur consists of a 110 kV double-circuit line from Hamilton to Karapiro with an intermediate substation at Cambridge (Tee connected). From Karapiro there are 110 kV single-circuit lines to Hinuera and Te Awamutu. A 110 kV single circuit line, owned by Waipa Networks and operated by Transpower, connects Te Awamutu to Hangatiki.

Hamilton–Cambridge transmission capacity

The Hamilton–Cambridge sections of the Karapiro Spur, each with a capacity of 57/70 MVA (summer/winter), constrain transmission capacity into the area[9].

The combined peak load south of Hamilton[10] is expected to exceed the n-1 capacity of the Hamilton–Cambridge circuit sections when generation at Karapiro and Arapuni is low. The peak load is partially offset by minimum generation of 40 MW at Karapiro due to resource consent requirements. However, to meet forecast demand growth for the area south of Hamilton we expect that generation output in excess of the minimum requirements will be needed at Karapiro and Arapuni, especially in winter (see Figure 9-5).

Figure 9-5: Cambridge–Hamilton circuit section capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

7 The analysis assumed no contribution from the Kinleith co-generation. The drop in forecast load is due to the closure of paper production.

8 As the Lichfield–Tarukenga circuits have variable line ratings applied, the actual rating increase depends on the time of day.

9 An outage of a Hamilton–Cambridge–Karapiro circuit may cause the Hamilton–Cambridge section of the remaining circuit to overload.

10 110 kV load south of Hamilton encompasses the Cambridge, Hinuera, Te Awamutu, Hangatiki and Arapuni grid exit points.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

What next?

Generation from Karapiro will be used to manage the loading on the Cambridge–Hamilton circuits in the short to medium term. Generation from Arapuni assists, but is less effective than generation from Karapiro.

The recently commissioned 220/33 kV GXP at Hautapu offsets some load from the Cambridge GXP. Additional transfer of distribution zone substations load to the Hautapu GXP in future, beyond those included in the forecast, will relieve the constraint and reduce the minimum Karapiro generation requirements (see section 9.5.2).

We will continue to monitor this constraint and schedule investigations to look at investment options if required.

Cambridge–Karapiro transmission capacity

The Cambridge–Karapiro sections of the Karapiro Spur, each with a capacity of 57/70 MVA (summer/winter), constrain the maximum Karapiro generation during low load conditions.

Capacity issues are exacerbated by the reduction in load at Hinuera (load transferred to Arapuni North GXP, see section 9.5.7). In addition, Mercury has refurbished its Karapiro generation station, increasing its capacity from 96 MW to approximately 112 MW. The increase in generation capacity will increase the likelihood of overloads on the Cambridge–Karapiro circuit sections following an outage of the parallel Hamilton–Cambridge–Karapiro circuit.

We recently commissioned the Karapiro Circuit Overload Protection scheme to automatically reduce Karapiro generation if a Cambridge–Karapiro circuit overloads due to high generation export. This scheme will avoid the need for pre-contingency generation constraints at Karapiro

9.4.4 Hamilton–Piako–Waihou and Waihou–Waikino 110 kV transmission capacity

The Thames Valley Spur consists of a 110 kV double-circuit line from Hamilton that connects substations at Piako, Waihou, Waikino and Kopu. All four substations have grid exit points supplying Powerco's Waikato distribution network.

Issue

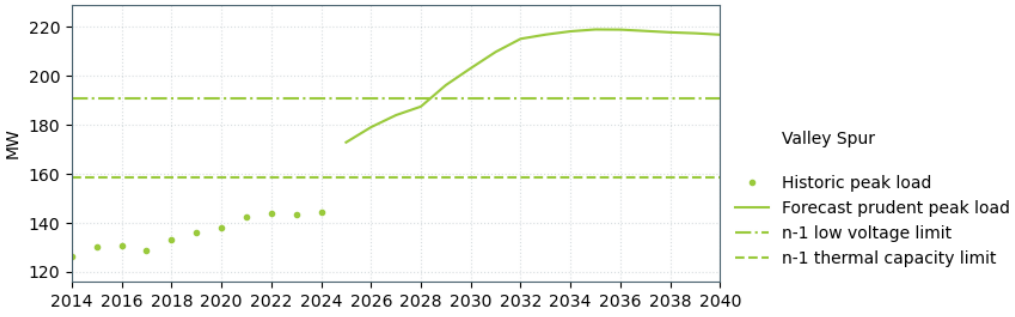
The Valley Spur consists of the following circuits:

- Hamilton–Piako–Waihou–1 and 2 rated at 154/168 MVA (summer/winter)
- Waihou–Waikino–1 and 2 rated at 101/123 MVA (summer/winter)
- Kopu–Waikino–1 and 2 rated at 114/114 MVA (summer/winter)[11].

Peak load on the Valley Spur is forecast to exceed the n-1 capacity of the Hamilton–Morrinsville Tee[12] circuit sections of the Hamilton–Piako–Waihou circuit from winter 2025 (see Figure 9-6) and Morrinsville Tee–Waihou section from 2029.

A Hamilton–Piako–Waihou circuit outage during high load periods already results in supply bus voltage steps exceeding five per cent at Piako, Waihou, Waikino and Kopu. Also, the Kopu 110 kV voltage is forecast to drop below 0.9 pu for this outage from 2029.

Figure 9-6: Valley Spur circuit capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[11] Kopu–Waikino circuit ratings are limited by protection settings followed by disconnectors; with these limits resolved the summer/winter ratings are 147/162 MVA.

[12] Morrinsville Tee refers to the Tee point of the Hamilton–Piako–Waihou three terminal circuits.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

From 2031, the Kopu and Waikino loads are expected to exceed the n-1 capacity of the Waihou–Waikino–1 and 2 circuits. These circuits are fed by the Hamilton–Piako–Waihou–1 and 2 circuits.

With existing and committed solar generation connecting to Valley Spur substations, the Morrinsville Tee–Waihou section of the Hamilton–Piako–Waihou circuit may overload during periods of high solar output if the other Hamilton–Piako–Waihou circuit trips.

What next?

The circuit overloading issue can be managed operationally in the near term. Short term upgrade options include:

- installing a special protection scheme to manage load post-contingency. Such a scheme will also resolve the Kopu 110 kV low voltage issue but not the voltage step issues.
- applying variable line ratings to achieve better ratings during peak demand periods. This option will resolve the thermal capacity issue but not the low voltage or voltage step issues.
- installing capacitors at Waihou and Waikino. This option will resolve voltage step and low voltage issues but only provide a minor relief for the Hamilton–Piako–Waihou thermal capacity issue.

Longer term options to address the transmission issues are:

- Hamilton–Piako–Waihou section:
  - thermal upgrade of the Hamilton–Piako–Waihou circuits and install voltage support along the Valley Spur
  - reconductoring of the Hamilton–Piako–Waihou circuits and install voltage support along the Valley Spur
  - Installation of a third circuit between Hamilton and Waihou. This option would avoid the need to install voltage support along the Valley Spur for the forecast period.
- Waihou and Waikino section:
  - thermally upgrade the Waihou–Waikino circuits

We are working with Powerco to investigate both short- and longer-term options to reinforce capacity to grid exit points along the Valley Spur. Future investment will be customer driven.

The issue caused by high generation along the Valley Spur is manageable[13] with the currently anticipated level of connected generation and load offtake. For more details, refer to section 9.8.4 which discusses the transmission capacity issue if additional generation connections are added.

Customer investments

Project name:	Hamilton–Piako–Waihou constraint
Project description:	Install Hamilton–Piako–Waihou circuit overload protection scheme
Project's state of completion:	Possible
Grid need date:	2027 (Customer initiated)
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Valley Spur transmission capacity
Project description:	A new 110 kV circuit between Hamilton and Waihou
Project's state of completion:	Possible
Grid need date:	2028 (Customer initiated)
Indicative cost [$ million]:	72
Reliability or Economic investment?	Reliability (Grid Reliability Report)

[13] We are working with the generation developer to install a circuit overload protection scheme to runback generation output if an overload is detected.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Project name:	Waihou–Waikino transmission capacity
Project description:	Thermally upgrade Waihou–Waikino circuits
Project's state of completion:	Possible
Grid need date:	2031 (Customer initiated)
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.4.5 Hangatiki and Te Awamutu 110 kV transmission capacity

The Hangatiki–Te Awamutu circuit rated at 106/116 MVA (summer/winter)[14] connects the Hangatiki and Te Awamutu substations. Three 110 kV circuits connect these substations to the grid:

- Arapuni–Hangatiki rated at 57/70 MVA (summer/winter)
- Arapuni–Hangatiki–Ongarue–1 which is made up of three branches:
  - Arapuni–Rangitoto Hills Tee rated at 57/70 MVA (summer/winter)
  - Hangatiki–Rangitoto Hills Tee rated at 63/77 MVA (summer/winter)
  - Ongarue–Rangitoto Hills Tee rated at 57/70 MVA (summer/winter)
- Karapiro–Te Awamutu rated at 63/77 MVA (summer/winter).

A significant proportion of the load at the Hangatiki grid exit point is from the Taharoa iron sands operation which has an estimated 10-15 year operating life before the iron sand resources are depleted.

The Waikato 110 kV network is already constrained and demand growth at Hangatiki and Te Awamutu will eventually result in n-1 overloading of the 110 kV circuits that connect the two grid exit points to the wider grid.

Part of the issue affecting the 110 kV transmission capacity into Hangatiki is the high reactive power consumption at Hangatiki. Two 15 Mvar capacitors at Te Awamutu support the 110 kV network between Hangatiki and Te Awamutu.

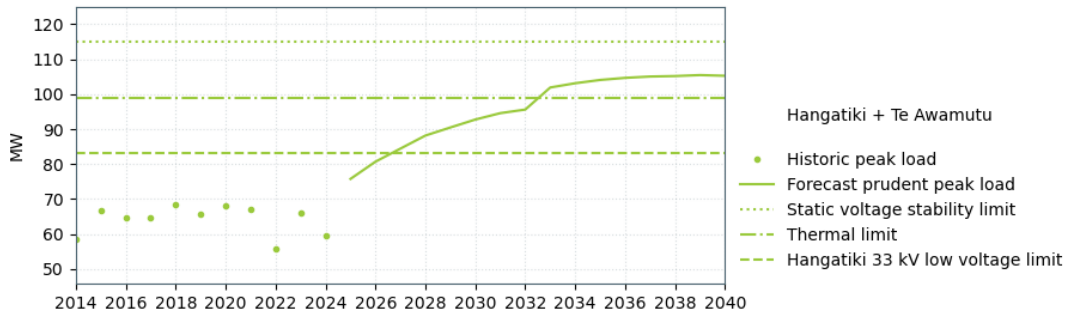
Issue

During periods of low generation at Arapuni and Karapiro:

- a Karapiro–Te Awamutu outage may cause large voltage steps and low voltage at:
  - Hangatiki supply bus from 2027 (see Figure 9-7)
  - Te Awamutu 110 kV bus from 2033
- Karapiro–Te Awamutu may overload for an outage of either Arapuni–Hangatiki–Ongarue or Arapuni–Hangatiki from 2033 (see Figure 9-7).
- Arapuni–Hangatiki–Ongarue and Arapuni–Hangatiki may overload for Karapiro–Te Awamutu outage from 2034.

With the usual generation dispatch patterns at Arapuni and Karapiro the risk of a thermal or voltage constraint binding is low (in the short to medium term).

Figure 9-7: Hangatiki and Te Awamutu maximum transmission capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[14] This single circuit line is owned by Waipa Networks but operated by Transpower.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

In addition, the supply transformers at Hangatiki and Te Awamutu are expected to overload within the forecast period, see sections 9.5.5 and 9.5.13 respectively.

What next?

Replacing the Hangatiki supply transformers with on-load tap changer capability will resolve the low voltage issue. Condition-based transformer replacement is scheduled for 2028-2030 (section 9.5.5).

We will work with The Lines Company and Waipa Networks to develop solutions for increasing transmission capacity to Hangatiki and Te Awamutu. Transmission investment options include:

- a special protection scheme to manage load post-contingency
- thermally upgrading the Karapiro–Te Awamutu circuit.

We will also consider the Arapuni North bus security issue when studying investment options (see section 9.6.1).

Base E&D Capex investments

Project name:	Karapiro–Te Awamutu transmission capacity – short term
Project description:	Install a special protection scheme to manage Karapiro–Te Awamutu circuit constraints
Project's state of completion:	Possible
Grid need date:	2033
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.4.6 Waikato 220/110 kV interconnection capacity

Issue

The Waikato 220 kV and 110 kV networks are interconnected through two 220/110 kV transformers at Hamilton. These transformers provide:

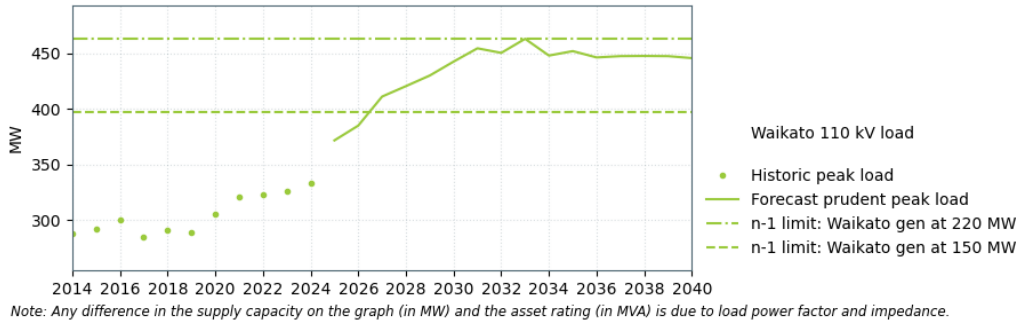
- total nominal installed capacity of 420 MVA
- n-1 capacity of 248/259 MVA (summer/winter).

During periods of high Waikato 110 kV load, the n-1 capacity of the 220/110 kV transformers may be exceeded.

The Waikato 110 kV load limit is determined assuming two Waikato 110 kV generation scenarios. These assumed combined Arapuni North (G1-G5) and Karapiro generation of 150 MW and 220 MW[15]. The 150 MW scenario represents the assumed combined minimum generation output when Waikato 110 kV load is high, while the 220 MW scenario is the combined maximum capacity of the two stations after the Karapiro station upgrade is completed.

The n-1 capacity of the Hamilton 220/110 kV transformers is forecast to be exceeded from winter 2027 when Waikato 110 kV generation is below 150 MW during the peak load period, see Figure 9-8.

Figure 9-8: Waikato 110 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[15] The calculated load limit also assumes the disconnection of the Waikato 110 kV network from the Auckland and Central North Island region.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

What next?

There is a major investigation underway into investment options to resolve or defer the interconnecting transformer capacity issue. Options include:

- migration of additional load from 110 kV to 220 kV
- development of one or more new 220 kV grid exit points within the region to supply new and existing loads presently supplied from the 110 kV Waikato network
- installing a third interconnecting transformer at Hamilton or elsewhere on the Waikato110 kV network. A new 220/110 kV interconnection site will also increase transmission security into the Waikato region during maintenance outages (see section 9.7.1).

Major capex investments

Project name:	Waikato 220/110 kV interconnection capacity
Project description:	Build a new 220/110 kV interconnection
Project's state of completion:	Possible
Grid need date:	2027[16]
Indicative cost [$ million]:	30
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 9-6 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 9-6: Changes at each grid exit point since the 2023 TPR

Issue	Change
Hamilton 110/11 kV supply capacity	Removed. Lower load forecast.
Hinuera supply capacity	Added. Higher load forecast.
Huntly supply capacity	Added. Higher load forecast.
Te Kowhai 220 kV low voltage	Added. Higher load forecast.

The overview of transmission capability for each grid exit point within the Waikato region is listed below. Where an issue is identified we list options to address it.

Section number	Description
9.5.1	Arapuni supply capacity
9.5.2	Cambridge supply capacity
9.5.3	Hamilton (WEL Networks) supply capacity
9.5.4	Hamilton (KiwiRail) supply capacity and security
9.5.5	Hangatiki supply capacity and low voltage
9.5.6	Hautapu supply capacity
9.5.7	Hinuera supply capacity and security
9.5.8	Huntly supply capacity
9.5.9	Kinleith supply capacity and security
9.5.10	Kopu supply capacity
9.5.11	Lichfield supply capacity

[16] Need date based on n-1 capacity limit being exceeded with 150 MW generation and forecast load shift from Cambridge to Waipa Networks' new 220/33 kV grid exit point.

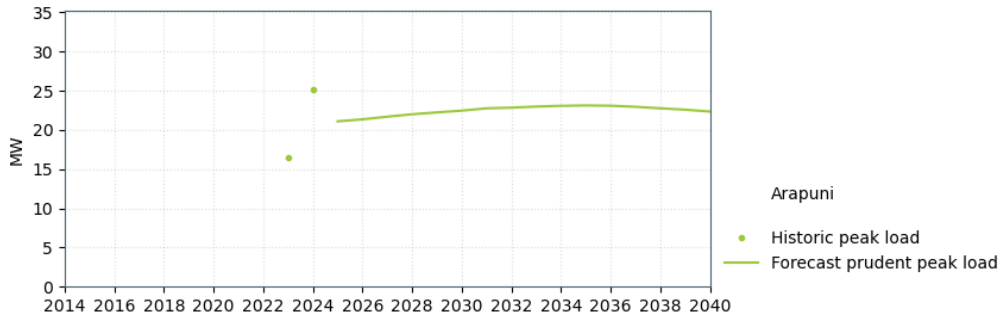
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Section number	Description
9.5.12	Piako supply capacity
9.5.13	Te Awamutu supply capacity
9.5.14	Te Kowhai supply capacity and low voltage
0	Base E&D capex investments **Project name:** Te Kowhai voltage stability **Project description:** Install reactive support at Te Kow **Project's state of completion:** Possible **Grid need date:** 2031 **Indicative cost [$ million]:** TBC **Reliability or Economic investment?** Reliability (Grid Reliability Report
	Waihou supply capacity
9.5.16	Waikino supply capacity

9.5.1 Arapuni supply capacity

Powerco takes a 110 kV connection from the Arapuni North bus. The 110 kV supply at Arapuni is owned by Powerco and is not reported in the TPR. See Figure 9-9 for the peak load forecast.

Figure 9-9: Arapuni load forecast



9.5.2 Cambridge supply capacity

Issue

Two 110/11 kV transformers supply the load at Cambridge, providing a total nominal installed capacity of 80 MVA.

There are no line circuit breakers at Cambridge, so a Hamilton–Cambridge–Karapiro circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[17], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

A special protection scheme installed at Cambridge allows the load to exceed the n-1 capacity of the transformers pre-contingency. The special protection scheme will be effective until Cambridge load exceeds 60 MW, limited by the supply transformer's low voltage bushing.

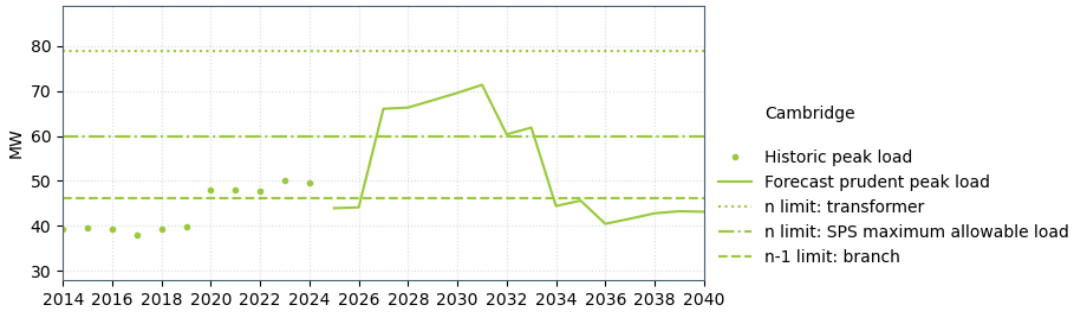
Peak load at Cambridge (see Figure 9-10) is forecast to:

- exceed the n-1 capacity of the supply transformers from 2027.
- exceed the special protection scheme limit from 2027.
- reduce below the n-1 capacity of the supply transformers from 2034, due to load transfer to Hautapu, and remain within the n-1 capacity of the supply transformers for the remainder of the forecast period.

[17] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 9-10: Cambridge supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The new 220/33 kV Hautapu grid exit point has enabled load transfer from Cambridge. Until Waipa Networks can transfer more load to Hautapu, operational measures will be required at Cambridge for loads exceeding 60 MW. We will investigate – in collaboration with Waipa Networks – upgrading the supply transformer LV bushing in order to allow an increase in the the special protection scheme setting, enabling higher levels of pre-contingency transformer loading. Future investment will be customer-driven.

Customer investments

Project name:	Cambridge supply transformer capacity
Project description:	Upgrade 110/11 kV transformer LV bushing
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.5.3 Hamilton (WEL Networks) supply capacity

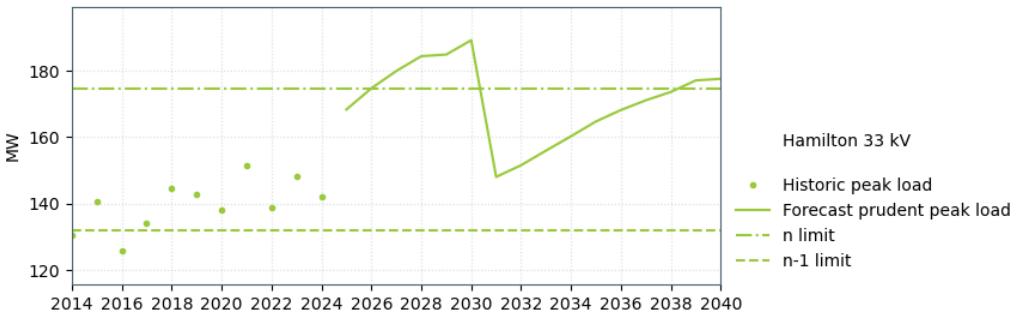
Issue

At Hamilton, WEL Networks is supplied at two voltage levels: 33 kV and 11 kV.

Two 220/33 kV transformers supply the 33 kV load, providing total nominal installed capacity of 220 MVA[18].

Peak load at Hamilton 33 kV already exceeds the n-1 capacity of the 220/33 kV transformers and is expected to exceed the n capacity from 2026 until forecast load transfer to Te Kowhai occurs in 2031 (see Figure 9-11). The 220/33 kV transformers are forecast to exceed the n capacity again from 2039.

Figure 9-11: Hamilton 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

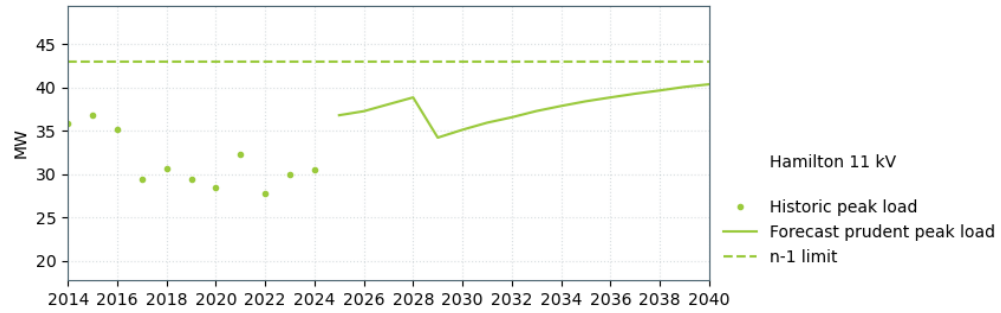
Two 110/11 kV transformers supply the 11 kV load, providing a total nominal installed capacity of 80 MVA. The transformers' capacity is presently limited by 11 kV protection then switchgear.

[18] The two supply transformers have different impedances and ratings. Therefore, the n capacity of the two transformers is lower than the nominal installed capacity as the lower impedance unit can overload while the parallel bank still has capacity available.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Peak load at Hamilton 11 kV is within the n-1 capacity of the 110/11 kV transformers for the forecast period (see Figure 9-12).

Figure 9-12: Hamilton 11 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The lack of n-1 capacity at the Hamilton 33 kV grid exit point is managed operationally by WEL Networks, including load transfer within the distribution network to the Te Kowhai grid exit point (see section 9.5.14 for details on the supply capacity issue at Te Kowhai). Hamilton–T5 is due for risk-based condition replacement within the next five years. We will work with WEL Networks to investigate options to address the 33 kV capacity issue. Options include:

- WEL Networks reinforcing and reconfiguring its distribution network to enable load transfer to other grid exit points.
- installing a third 220/33 kV transformer at Hamilton.

Customer investments

Project name:	Hamilton supply transformer capacity
Project description:	Install a third 220/33 kV transformer
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.5.4 Hamilton (KiwiRail) supply capacity and security

Two 220/55 kV traction transformers at Hamilton supply the KiwiRail North Island Main Trunk railway line. The two transformers are normally operated split, each providing n security to a portion of the railway line. The average transformer loading is low, with high levels of peak load occurring for only a few minutes at a time. Therefore, we do not assess the capacity of traction transformers in the TPR.

9.5.5 Hangatiki supply capacity and low voltage

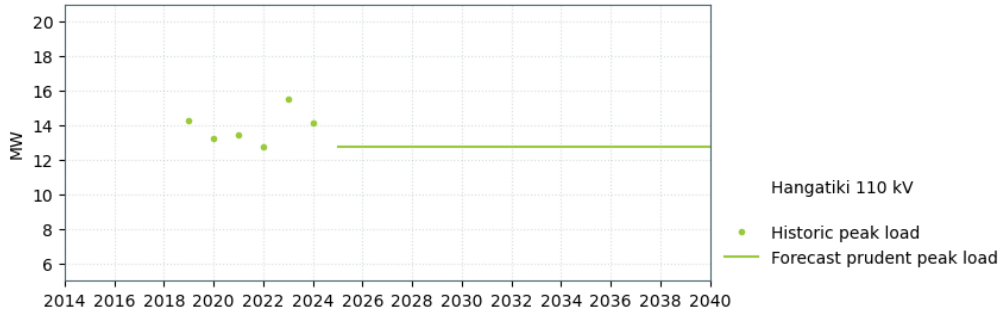
Issue

At Hangatiki, The Lines Company is supplied at two voltage levels: 110 kV and 33 kV.

The 110 kV grid exit point has a single 110/33 kV, 30 MVA supply transformer and a 33 kV bus owned by The Lines Company. This 33 kV bus mainly supplies the Taharoa iron sands operation and is not connected to the 33 kV grid exit point (owned by Transpower). The 110 kV grid exit point is on n security and its capacity is not reported in the TPR. See Figure 9-13 for the peak load forecast.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 9-13: Hangatiki 110 kV load forecast

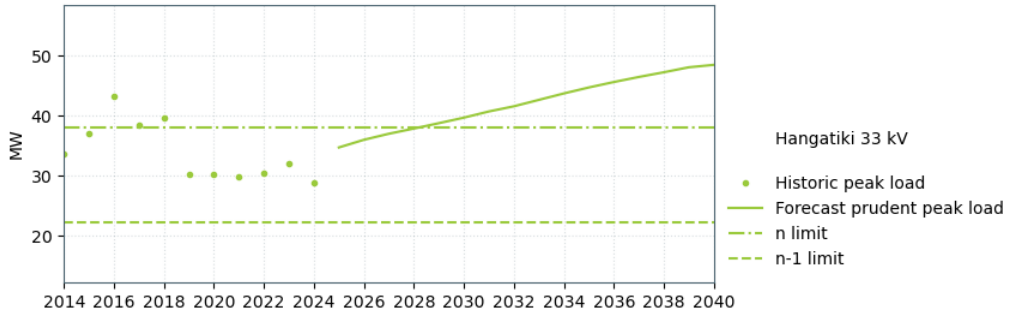


Two 110/33 kV transformers supply the Hangatiki 33 kV grid exit point load, providing a total nominal installed capacity of 40 MVA.

Peak load at Hangatiki 33 kV grid exit point already exceeds the n-1 capacity of the supply transformers. Additionally, the peak load is forecast to exceed the n capacity[19] of the supply transformers from 2029 (see Figure 9-14).

The supply transformers have an overload protection scheme to prevent the loss of one transformer causing significant overloading of the other transformer. When operating close to the n limit of the two transformers, a transformer outage results in the tripping of the remaining transformer causing a total loss of supply.

Figure 9-14: Hangatiki 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The Hangatiki 33 kV supply bus voltage may fall below 0.95 pu following a supply transformer or 110 kV circuit outage during high load periods.

What next?

We will work with The Lines Company to investigate investment options to increase supply capacity and/or security to Hangatiki. Longer term options include upgrading the existing 110/33 kV supply transformers (they are due for risk-based condition replacement in 2030) or constructing a new 220/33 kV grid exit point. Future investments will be customer driven.

9.5.6 Hautapu supply capacity

Two 220/33 kV transformers supply Hautapu 33 kV load, providing a total nominal installed capacity of 160 MVA.

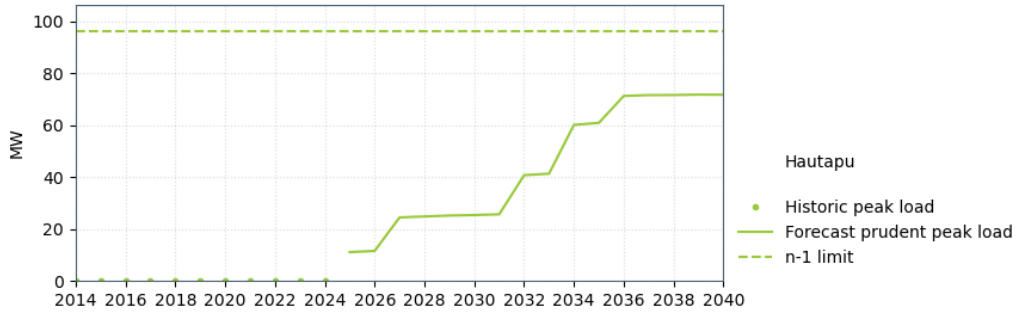
The transformers are tee-connected on the Otahuhu–Hautapu–Whakamaru–1 and 2 circuits, so a circuit outage also disconnects a supply transformer.

Peak load at Hautapu is forecast to remain within the n-1 capacity of the supply transformers for the forecast period (see Figure 9-15).

[19] The n capacity at Hangatiki is limited by the summer rating of Hangatiki–T1.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 9-15: Hautapu supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

9.5.7 Hinuera supply capacity and security

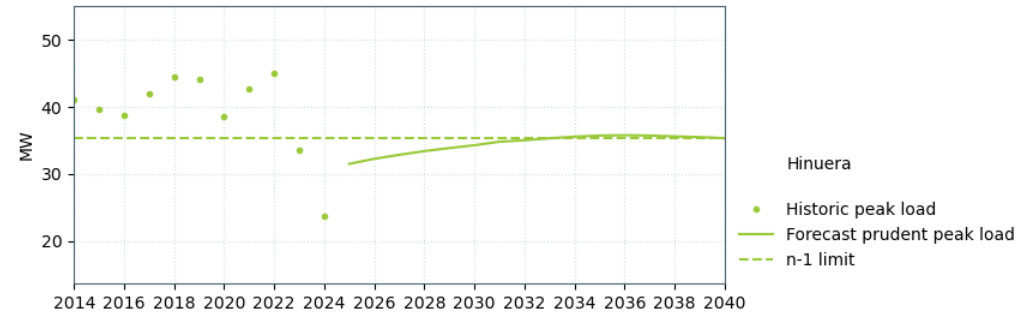
Issue

A single 110 kV circuit from Karapiro supplies Hinuera's load, providing capacity of 63/77 MVA (summer/winter). The single circuit supplying Hinuera results in n security.

Two 110/33 kV transformers (rated at 30 MVA and 50 MVA) supply Hinuera's load, providing a total nominal installed capacity of 80 MVA.

Peak load at Hinuera is forecast to exceed the n-1 capacity of the supply transformers from 2033 (see Figure 9-16).

Figure 9-16: Hinuera supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Powerco is able to backfeed Hinuera load from its Arapuni and Piako grid exit points. During a Hinuera–Karapiro circuit outage, most of the load at Hinuera would be supplied from Arapuni with the remainder transferred to Piako via Powerco's distribution network.

Hinuera–T1 is due for risk-based condition replacement in the early 2030s. Replacing it with a larger capacity unit will resolve the overload issue for the forecast period. We will discuss the requirements of the replacement transformer with Powerco closer to its replacement date. Future investment will be customer driven.

9.5.8 Huntly supply capacity

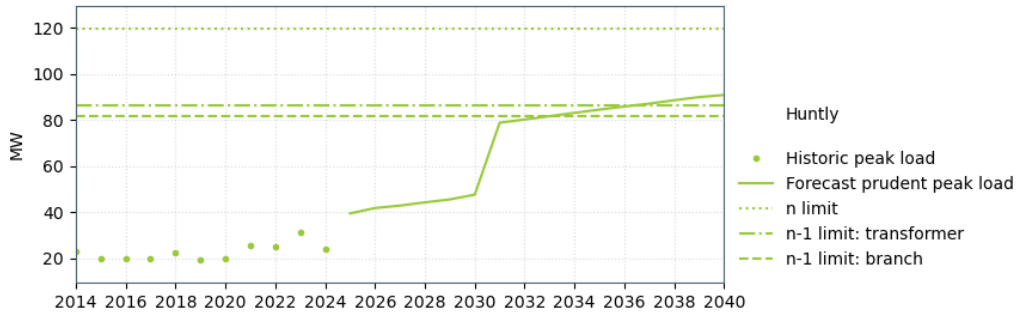
Issue

Two 220/33 kV transformers supply Huntly's load, providing a total nominal installed capacity of 120 MVA. The transformers' capacity is presently limited by the 33 kV incomer cables.

Peak load at Huntly is forecast to exceed the summer n-1 capacity of the supply transformers from 2033 (see Figure 9-17). The step load shown in 2031 is due to a planned load shift from Te Kowhai to Huntly.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 9-17: Huntly supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Removing the cable limit will defer the overload issue to 2037. WEL Networks and its partners recently commissioned a 35 MW battery connected within the distribution network supplied from Huntly. This battery is not included in our analysis. The battery may help provide n-1 transformer capacity during the forecast period. Huntly has enough spare n-1 transformer capacity to charge the battery at its maximum rate, except at times of peak load from the early 2030s. Future investment will be customer driven.

9.5.9 Kinleith supply capacity and security

Issue

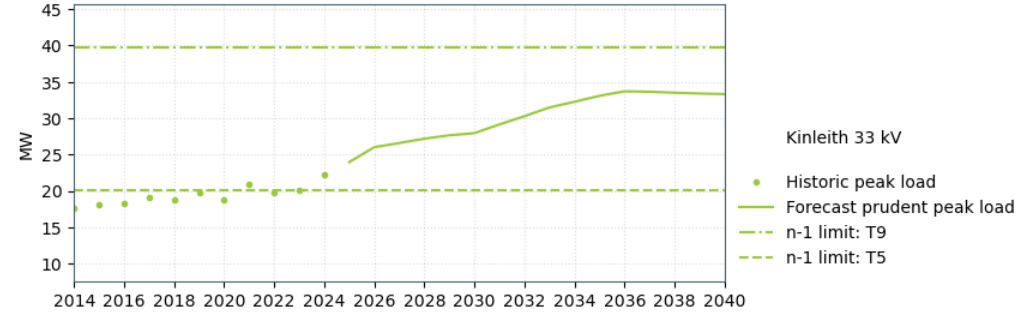
At Kinleith, Powerco is supplied at two voltage levels: 33 kV and 11 kV (via two 110/33/11 kV supply transformers and three 110/11 kV supply transformers).

The two 110/33/11 kV transformers (with 33 kV windings rated at 20 MVA (T5) and 40 MVA (T9)) supply Powerco's 33 kV load, providing a total nominal installed capacity of 60 MVA.

The supply transformers cannot be connected to the 33 kV bus at the same time, due to different vector groups. The load is normally supplied by the 40 MVA transformer and there is a brief loss of supply when transferring load between the two transformers.

The winter peak 33 kV load at Kinleith already exceeds the continuous capacity of T5 but is within the continuous capacity of T9 (see Figure 9-18).

Figure 9-18: Kinleith 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Powerco also supplies Oji Fibre Solutions from Kinleith at 11 kV through five transformers: the 11 kV windings of the two 110/33/11 kV transformers and three dedicated 110/11 kV transformers. Oji may rationalise its 11 kV supply arrangement following the closure of paper production at Kinleith. Future investments will be customer driven.

What next?

The 20 MVA supply is a backup supply to Powerco's 33 kV load and there are currently no plans to upgrade it. We will discuss potential investments with Powerco; any investments will be customer driven.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

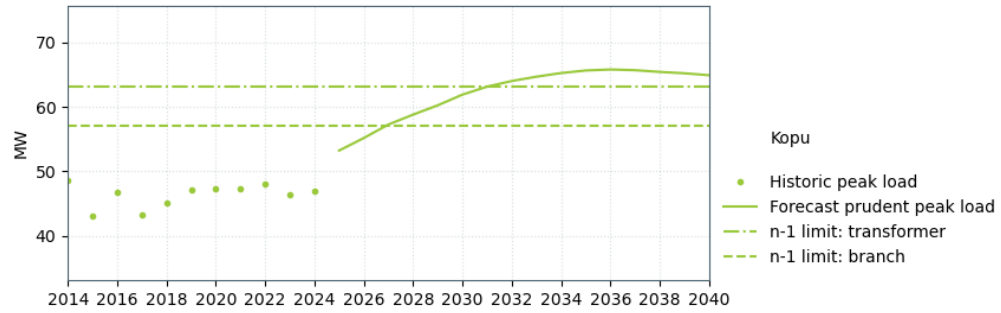
9.5.10 Kopu supply capacity

Issue

Two 110/66 kV transformers supply Kopu's load, providing a total nominal installed capacity of 120 MVA. The transformers' supply capacity is limited by the protection equipment.

Peak load at Kopu is forecast to exceed the n-1 capacity of the supply transformers from winter 2027 (see Figure 9-19).

Figure 9-19: Kopu supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Resolving the protection limits on the supply transformers will defer the n-1 capacity issue until the early 2030s. We will discuss investment options with Powerco closer to the need date; any investments will be customer driven.

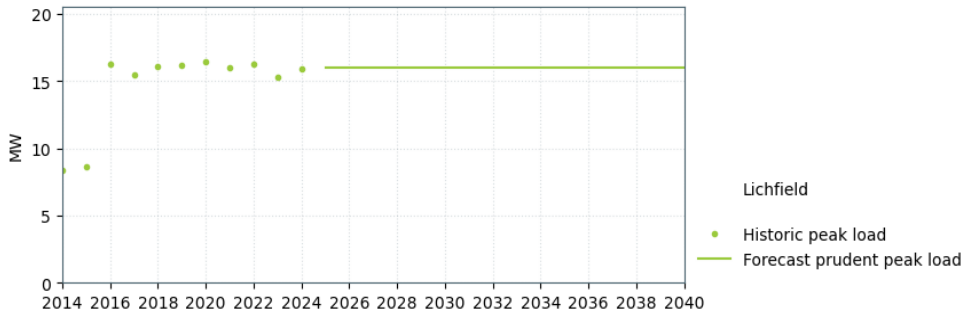
Base E&D capex investments

Project name:	Kopu supply transformer branch limit
Project description:	Remove protection limit on supply transformers
Project's state of completion:	Possible
Grid need date:	2027
Indicative cost [$ million]:	0.1
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.5.11 Lichfield supply capacity

Lichfield load is solely a dairy factory, supplied via Tee connections to the 110 kV Kinleith–Tarukenga–1 and 2 circuits. The 110 kV circuits also connect load and generation at Kinleith and Arapuni South, with local generation vital to maintain n-1 security (see section 9.4.2). The supply transformers at Lichfield are owned by Vector and are not reported in the TPR. See Figure 9-20 for the peak load forecast.

Figure 9-20: Lichfield load forecast



9.5.12 Piako supply capacity

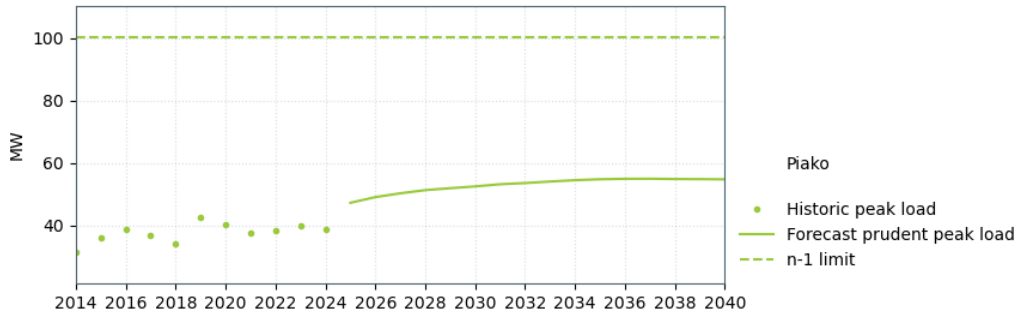
The Piako grid exit point is supplied by the two 110 kV Piako–Morrinsville Tee line sections connected directly to Powerco's 110/33 kV supply transformers.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Peak load at Piako is forecast to remain within the n-1 capacity of the two Piako–Morrinsville Tee line sections, see Figure 9-21.

However, the transmission capacity into Piako and other Valley Spur grid exit points is limited by the Hamilton–Morrinsville Tee sections of the Hamilton–Piako–Waihou–1 and 2 circuits. See 9.4.4 for discussion on development options.

Figure 9-21: Piako supply capacity (Piako–Morrinsville Tee n-1 capacity)



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

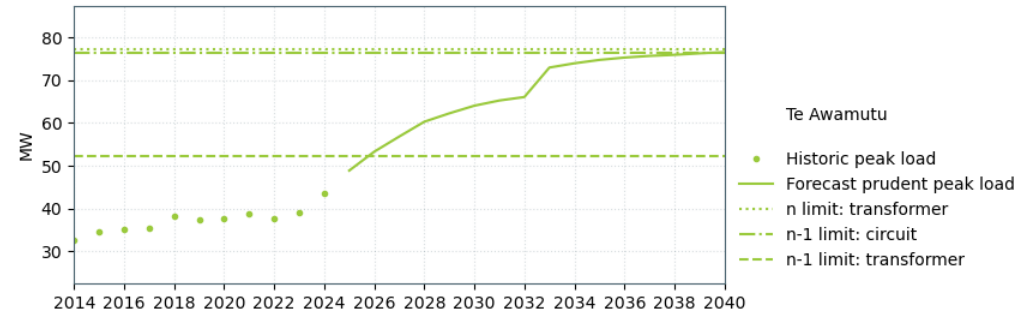
9.5.13 Te Awamutu supply capacity

Issue

Two 110/11 kV transformers supply Te Awamutu's load, providing a total nominal installed capacity of 80 MVA.

Peak load at Te Awamutu is forecast to exceed the n-1 capacity of the transformers from 2026, and Karapiro–Te Awamutu circuit capacity for an outage of Hangatiki–Te Awamutu circuit towards the end of the forecast period (see Figure 9-22).

Figure 9-22: Te Awamutu supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will work with Waipa Networks to identify investment options to resolve longer term capacity issues. Options include:

- upgrading the cooling on the existing supply transformers to further increase their capacity
- installing a transformer overload protection scheme to manage load post-contingency
- replacing the existing supply transformers with 110/33 kV banks and installing a new 33 kV switchboard in conjunction with Waipa Networks upgrading some feeders to 33 kV
- installing a new 220/33 kV grid exit point to offload Te Awamutu.

Future investments will be customer driven.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Customer investments

Project name:	Te Awamutu supply capacity
Project description:	Upgrade transformer cooling
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.5.14 Te Kowhai supply capacity and low voltage

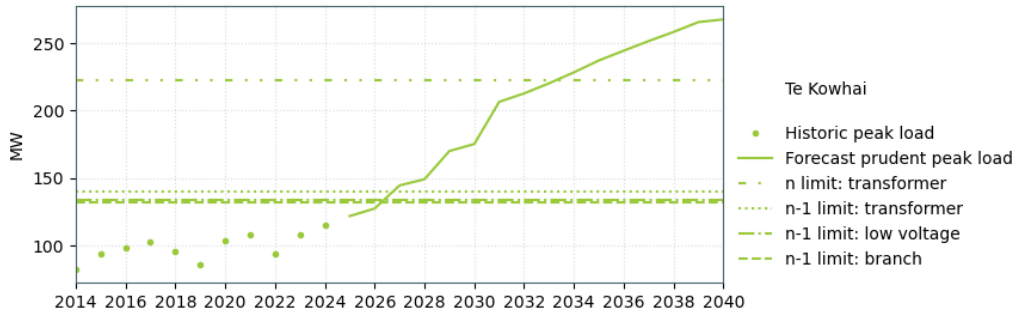
Issue

Two 220/33 kV transformers supply Te Kowhai's load, providing a total nominal installed capacity of 230 MVA. The transformers' capacity is limited by 33 kV branch equipment (cables and internal current transformers).

Peak load at Te Kowhai (excluding contribution from Te Uku generation) is forecast to exceed the n-1 capacity of the 220/33 kV transformers from 2027 and n capacity from 2034.

In addition, an outage of the 220 kV Huntly–Te Kowhai circuit will cause Te Kowhai to be supplied from Stratford (Taranaki region), leading to low voltage at the Te Kowhai 220 kV bus from 2027 (see Figure 9-23).

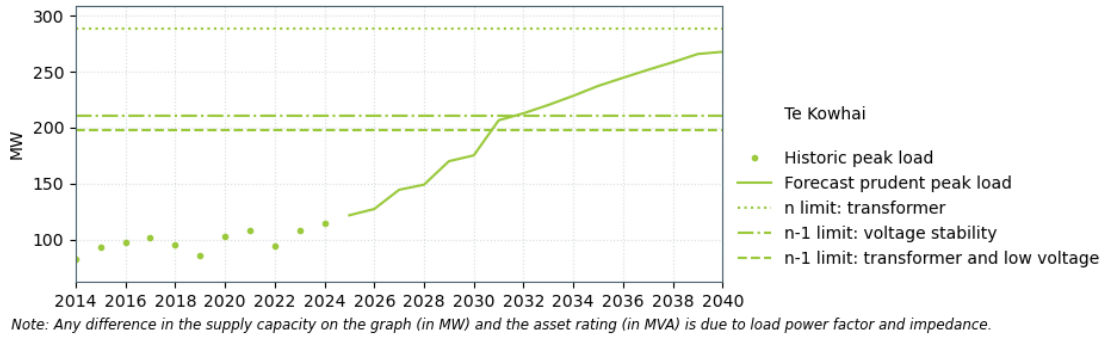
Figure 9-23: Te Kowhai supply capacity and low voltage with no contribution from Te Uku



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Even with maximum output from Te Uku wind farm, the peak load at Te Kowhai is forecast to exceed the n-1 capacity of the 220/33 kV transformers from 2031. Also, the Te Kowhai 220 kV voltage is forecast to fall below 0.9 pu from 2031 and reach the voltage stability limit in 2033 for a 220 kV Huntly–Te Kowhai outage (see Figure 9-24).

Figure 9-24: Te Kowhai supply capacity and low voltage with 64 MW contribution from Te Uku generation



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss long term capacity requirements at Te Kowhai with WEL Networks. The available embedded wind generation may help manage the n-1 capacity and low voltage issues in the short term.

Longer term solutions to manage the transformer capacity issue include a third 220/33 kV transformer. Options to manage the voltage stability issue include:

- installing reactive support

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- reconfiguring the 220 kV connection supplying Te Kowhai to make a connection to both the 220 kV Huntly–Stratford and Huntly–Taumarunui circuits.

Future investments will be customer driven.

Customer investments

Project name:	Te Kowhai supply capacity
Project description:	Install a third 220/33 kV transformer
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Base E&D capex investments

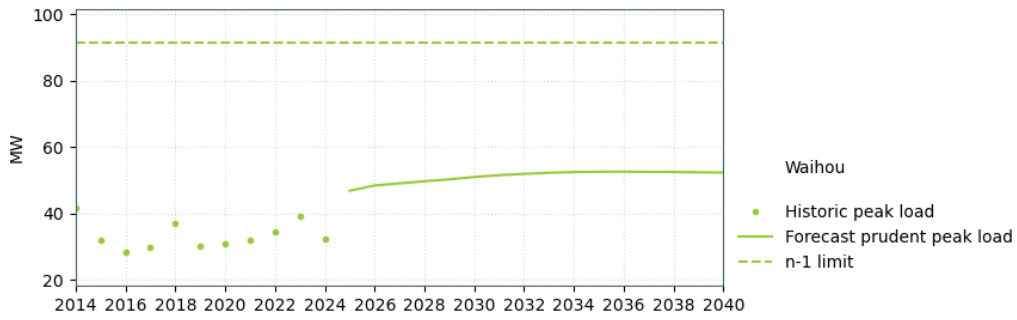
Project name:	Te Kowhai voltage stability
Project description:	Install reactive support at Te Kowhai
Project's state of completion:	Possible
Grid need date:	2031
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.5.15 Waihou supply capacity

Two 110/33 kV transformers supply Waihou's load, providing a total nominal installed capacity of 155 MVA.

Peak load at Waihou is within the n-1 capacity of the supply transformers for the forecast period (see Figure 9-25).

Figure 9-25: Waihou supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

9.5.16 Waikino supply capacity

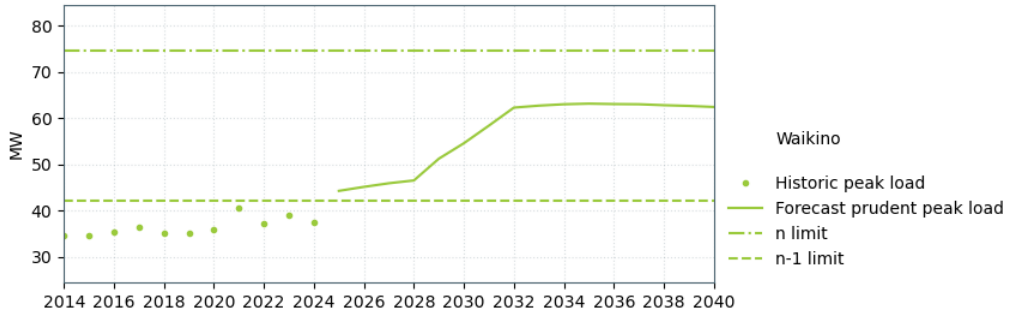
Issue

Two 110/33 kV transformers (T1 rated at 30 MVA and T2 at 60 MVA) supply Waikino's load, providing a total nominal installed capacity of 84 MVA. The branch capacity of T2 is capped by metering limits.

Peak load at Waikino is forecast to exceed the n-1 capacity of the T1 transformer from 2025 (see Figure 9-26).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 9-26: Waikino supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The T1 supply transformer is scheduled for risk-based condition replacement in the mid 2030s; we will discuss the timing and capacity requirements of the replacement unit with Powerco. In the interim, the transformer n-1 capacity issue can be managed through a load shedding special protection scheme.

Customer investments

Project name:	Waikino supply capacity
Project description:	Install a Transformer Overload Protection Scheme
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9.6 Waikato bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 9-7 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 9-7: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Arapuni North 110 kV	Arapuni	-	-	9.6.1
		Arapuni North	-	9.6.1
			Karapiro–Te Awamutu and Cambridge–Hamilton–1 and 2 circuit overloading.	9.6.1
			Large voltage steps and low voltages at Hangatiki.	9.6.1
Arapuni South 110 kV		Arapuni South	-	Note 1
Atiamuri 220 kV		Atiamuri	-	Note 2
			Large voltage steps and low voltages at some Bay of Plenty 220 kV and 110 kV buses.	Note 3
Hamilton 110 kV			Hamilton–Piako–Waihou circuit overloading.	9.4.4
			Hamilton 220/110 kV transformer capacity.	9.4.6
			Low voltages at some supply and 110 kV buses in the Waikato region.	9.6.2

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Hamilton 220 kV	Hamilton 55 kV	-	- Hamilton 220/110 kV transformer capacity. Hamilton 220/33 kV supply transformer capacity.	Note 4 9.4.6 9.5.3
Hangatiki 110 kV	Hangatiki	-	-	Note 5
Hinuera 110 kV	Hinuera	-	-	9.5.6
Karapiro 110 kV	Hinuera	- Karapiro	- -	Note 6 Note 6
Kinleith 110 kV	Kinleith (to Oji Fibre Solutions) Kinleith (to Powerco)	-	-	9.6.3
		-	-	9.6.3
		Kinleith Arapuni South	- -	9.6.3 9.6.3
Ohakuri 220 kV		Ohakuri	-	-
Maraetai 220 kV		Waipapa	-	Note 7
Te Awamutu 110 kV		-	Low voltage at Hangatiki and Te Awamutu 110 kV buses.	9.6.4
Whakamaru 220 kV		Mokai	- Overloads 220 kV circuits.	Note 8 Note 9
Waihou 110 kV	Kopu Waihou Waikino	- - -	- - -	Note 10 Note 10 Note 10
Waikino 110 kV	Kopu Waikino	- -	- -	Note 11 Note 11
Waipapa 220 kV		Waipapa	-	Note 12

1. There is a single 110 kV bus zone protection for the Arapuni South bus. Therefore, a bus fault will disconnect all the Arapuni South bus generation.
2. Atiamuri has two bus zones, but all generation is connected to one of the zones. Therefore, a bus fault of this zone will disconnect all generation.
3. An outage on either of the two Atiamuri 220 kV bus sections may cause low voltages and large voltage steps at some Bay of Plenty 220 kV and 110 kV buses. It may also overload the remaining 220 kV Atiamuri–Tarukenga and/or Edgecumbe–Kawerau circuits (see Chapter 10). The recently approved Western Bay of Plenty Major Capex Proposal project will defer the issue beyond the forecast period.
4. Both Hamilton 220/55 kV transformers are connected to the same 220 kV bus section.
5. There is a single 110 kV bus zone protection at Hangatiki, so a bus fault removes all circuits from service causing a loss of supply.
6. There is a single 110 kV bus zone protection at Karapiro. Therefore, a bus fault will trip all generation and the single circuit supplying Hinuera, causing a loss of supply. See section 9.5.6 for improving transmission security to Hinuera.
7. There is a single circuit between Waipapa and Maraetai. A bus outage at Maraetai disconnects the circuit to Waipapa, disconnecting the Waipapa generation station.
8. Mokai generation station and Mercury's G4 generator at Whakamaru are connected to the grid through a common circuit breaker. A bus section outage at Whakamaru can therefore disconnect the Mokai generation station (as well as Whakamaru G4).
9. Depending on generation scenarios, Whakamaru bus section outages may also cause overloads on the Tokaanu–Whakamaru, Atiamuri–Ohakuri, Hamilton–Whakamaru, Hautapu–Whakamaru–1 and 2, or Ohakuri–Wairakei circuits (see Chapter 6).
10. There is a single 110 kV bus zone protection at Waihou. Therefore, a bus fault will trip all connected circuits and transformers, causing a loss of supply at Waihou, Waikino and Kopu.
11. A 110 kV bus fault at Waikino will cause both Waihou–Waikino circuits to trip. This will cause a total loss of supply to Waikino and Kopu.
12. There is no bus at Waipapa as the single Maraetai–Waipapa circuit connects directly to the generator unit transformer. Any fault at Waipapa will disconnect the generation.

The customers at these grid exit and injection points (KiwiRail, The Lines Company, Powerco, Mercury and Oji Fibre Solutions) have not requested a higher security level. No further action will be taken unless requested by a customer.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

9.6.1 Arapuni North bus security

Issue

The Arapuni 110 kV bus consists of two bus sections and is normally split into the Arapuni North and Arapuni South buses.

A contingency on the North bus disconnects:

- 110 kV Arapuni–Hamilton–1, 2 and 3[20] circuits
- 110 kV Arapuni–Hangatiki–1 circuit
- 110 kV Arapuni–Hangatiki–Ongarue–1 circuit
- 110 kV Arapuni–Bombay–1 circuit
- Mercury Energy's generators connected to the Arapuni North bus
- Arapuni 110 kV load.

This contingency results in the Hangatiki load being supplied from Te Awamutu.

During low generation at Karapiro and high load at Hangatiki and Te Awamutu, an Arapuni North bus outage will overload the 110 kV Karapiro–Te Awamutu and Cambridge–Hamilton circuits. During peak load periods, voltage steps greater than five percent will occur at Hangatiki.

What next?

We will consider this issue when investigating the long-term solution for addressing the Hangatiki 110 kV transmission capacity. Refer to section 9.4.5 for our enhancement approach.

9.6.2 Hamilton 110 kV bus security

Issue

There are two 110 kV bus sections at Hamilton. An outage of one bus section disconnects:

- 150 Mvar STATCOM
- 50 Mvar capacitor bank
- 110/11 kV transformer – T1
- Arapuni–Hamilton–2 circuit (see section 9.4.1)
- Hamilton–Cambridge–Karapiro–2 circuit (see section 9.4.3)
- Hamilton–Piako–Waihou–1 circuit (see section 9.4.4)
- 220/110 kV transformer – T6 (see section 9.4.6).

Assets that remain connected are forecast to exceed their n-1 capacities within the forecast period.

In addition, disconnection of significant amounts of reactive support contributes to large voltage steps and low voltages at a number of buses across the region. The Waikato 110 kV load is forecast to exceed the voltage stability limit by 2030, even with high Arapuni and Karapiro generation.

What next?

Addressing some or all of the overloading and voltage issues along the Valley Spur, Cambridge Spur and at Hamilton will assist in reducing the large voltage steps and defer the voltage stability issue for a Hamilton 110 kV bus outage. Once these issues are addressed, we will consider any remaining voltage issues as part of a Waikato 220/110 kV transformer capacity issue investigation (see section 9.4.6).

9.6.3 Kinleith 110 kV bus security

Issue

There are two 110 kV bus sections at Kinleith.

[20] Arapuni–Hamilton–3 circuit is formed from bussing of Arapuni–Bombay–1 circuit at Hamilton and the northern section between Hamilton and Bombay dismantled (see section 9.4 – 110 kV connection to Auckland).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

An outage of one Kinleith 110 kV bus section disconnects the:

- 110 kV Arapuni–Kinleith–1 and 2 circuits
- 110/33/11 kV Kinleith–T9 supply transformer
- 110/11 kV Kinleith–T7 and T8 supply transformers.

The bus outage results in a partial loss of supply to Powerco and the Oji pulp mill[21]. Also, if the Arapuni bus split is open, there will be a loss of connection for the Mercury generation connected to the Arapuni South bus.

An outage of the other Kinleith 110 kV bus section disconnects the:

- 110 kV Kinleith–Lichfield–1 and 2 circuits
- 110/11 kV Kinleith–T6 supply transformer
- 110/33/11 kV Kinleith–T5 supply transformer.

This bus outage will result in a loss of supply and generation connection at Kinleith. Also, if the Arapuni bus split is open, the Mercury generation connected to the Arapuni South bus and the remaining Kinleith load will be left operating as an island, which is unlikely to be sustainable. Loss of supply for Powerco and Oji and loss of connection for Mercury Energy's generators will be required before normal operation can resume.

What next?

We have discussed options with Powerco and Oji to determine whether it is economic to resolve the issue. Their preferred option is to retain the existing bus arrangement at Kinleith.

9.6.4 Te Awamutu 110 kV bus security

Issue

There are two 110 kV bus sections at Te Awamutu. An outage of one bus section disconnects:

- the Karapiro–Te Awamutu circuit
- two 15 Mvar capacitor banks
- the 110/11 kV T2 supply transformer

This bus outage disconnects the supply from Karapiro generation (section 9.4.5) and 30 Mvar of reactive support, causing large voltage steps and low voltages at both Hangatiki and Te Awamutu. During high load periods, the combined loads at Hangatiki and Te Awamutu may experience voltage stabiltiy issues.

What next?

We will manage the issue operationally and monitor the need to enhance the bus configuration.

9.7 Other items of interest

9.7.1 Hamilton transmission security during maintenance

Issue

The 220 kV Hamilton–Whakamaru and Hamilton–Ohinewai circuits, and the two 220/110 kV interconnecting transformers at Hamilton supply most of the load in the Waikato region.

An outage of a 220 kV circuit to Hamilton or a Hamilton 220/110 kV transformer will place many grid exit points in the region on n security[22].

What next?

No investments are planned to directly resolve this issue. However, it will be considered as part of the investigation to increase 220/110 kV interconnection capacity at Hamilton (see section 9.4.6).

[21] The Kinleith 11 kV buses are normally run split thus there is a partial loss of load for this fault.

[22] The Waikato 110 kV system is split so it does not form a parallel connection with the 220 kV system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

9.8 Waikato generation opportunities and proposals

The maximum generation that can be connected depends on several factors and is usually expressed as a range. Generation developers should consult with us at an early stage of their investigations to discuss connection issues.

9.8.1 Generation opportunities

This section provides a high-level description of the Waikato region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The Waikato region had a high potential for additional generation, principally solar but also some wind generation.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
9.8.2	Generation opportunities by substation
9.8.3	Generation investigations and proposals
9.8.4	Hamilton–Piako–Waihou capacity
9.8.5	Karapiro special protection scheme
9.8.6	Generation connection at 220 kV

9.8.2 Generation opportunities by substation

Envision Opportunities[23] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[24]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy.
- winter evening peak – wet/windy
- winter midday high – wet/calm

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developped at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

[23] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

[24] "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

9.8.3 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[25]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 9-8 shows generation and grid-scale battery projects in the Waikato region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 9-2 (generation) or Table 9-3 (batteries) instead.

Table 9-8: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Waihou 110 kV	Solar	Delivery[1]	200[2]
Waihou 33 kV	Solar + BESS	Delivery[1]	100
Huntly–Otahuhu	Solar	Delivery[1]	314
Otahuhu–Whakamaru–C line	Solar	Delivery[1]	214
Hinuera 33 kV	Solar + BESS	Investigation	80
Huntly–Deviation–A line	Solar	Investigation	300
Waihou–Waikino	Wind	Investigation	157
Huntly–Taumarunui/Huntly–Stratford	Wind	Application	315
Huntly–Stratford/Huntly–Te Kowhai	Wind + BESS	Application	400
Ohinewai 220 kV	Wind	Application	300
Piako 33 kV	Solar	Application	110
Whakamaru 220 kV	BESS	Application	300

1. "Delivery" is a stage in the Transpower generation queue process, it does not denote a final commitment by the developer to build the generation.
2. This is a possible 50 MW extension to the 150 MW Tauhei solar farm, which is currently under construction (see Table 9-2).

We have received additional requests for assessment of generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of select parts of the Waikato region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

9.8.4 Hamilton–Piako–Waihou capacity

Issue

The two Hamilton–Piako–Waihou 110 kV circuits are each rated 154/168 MVA summer/winter. The amount of possible generation connecting at Waihou and along Waihou–Waikino is in excess of the n-1 hosting capacity of the circuits, even after taking into account the load off-take at Waihou, Waikino and Kopu.

What next?

A special protection scheme to automatically and quickly reduce generation post-contingency will allow generation export in excess of the n-1 capacity of the circuits.

If generation connects within the distribution system at Piako, it may also require a special protection scheme to minimise generation constraints.This special protection scheme would be cutomer funded.

The forecast load growth will also cause an n-1 issue on the Hamilton–Piako–Waihou circuits (section 9.4.4). Some options to address this issue caused by load growth will also enable more generation to be hosted in this part of the Grid.

[25] Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

9.8.5 Karapiro special protection scheme

Issue

The capacity of the Karapiro generation station was recently increased (section 9.2.3, Table 9-2) and Powerco transferred load from Hinuera to the new Arapuni North grid exit point (section 9.5.7, Figure 9-16). These two developments mean the Karapiro generation may be constrained at times due to the rating of the Cambridge–Karapiro 110 kV circuits.

Possible generation developments at Hinuera and along the Karapiro–Te Awamutu circuit will greatly exacerbate the frequency and magnitude of the generation constraints. Such generation developments may also require generation constraints due to the rating of the 110 kV circuits along the Karapiro–Te Awamutu and Hangatiki–Arapuni–Hamilton transmission corridors[26].

What next?

We installed a special protection scheme to automatically and quickly reduce generation post-contingency. This allows for unconstrained pre-contingency generation from Karapiro in excess of the n-1 capacity of the circuits. The special protection scheme monitors the loading on the two Cambridge–Karapiro circits.

If generation is connected at Hinuera the special protection scheme will also need to monitor the Karapiro–Te Awamutu circuit and also quickly reduce generation at Hinuera. If generation is connected along the Karapiro–Te Awamutu circuit then a more extensive area-wide special protection scheme is expected to be required.

Upgrading the Cambridge–Karapiro circuits is not expected to be economic. Each circuit is rated 57/70 MVA summer/winter with copper conductor; therefore, the circuits cannot be thermally upgraded. The circuits also have a 1.3 km cable section near Cambridge, rated 99/103 MVA summer/winter, which would need to be considered in any upgrade.

A special protection scheme, circuit upgrade, or other grid upgrade would be customer funded.

9.8.6 Generation connection at 220 kV

There is sufficient transmission capacity to host the proposed solar generation and BESS developments listed in Table 9-8 connecting at 220 kV (Huntly–Otahuhu, Otahuhu–Whakamaru, Huntly Deviation, Huntly–Stratford).

[26] The circuit between Te Awamutu and Hangatiki is rated 106/116 MVA summer/winter, which well in excess of the rating of the other circuits connected at Hangatiki and Te Awamutu. Therefore, it is unlikely to cause a generation constraint.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

10 Bay of Plenty Regional Plan

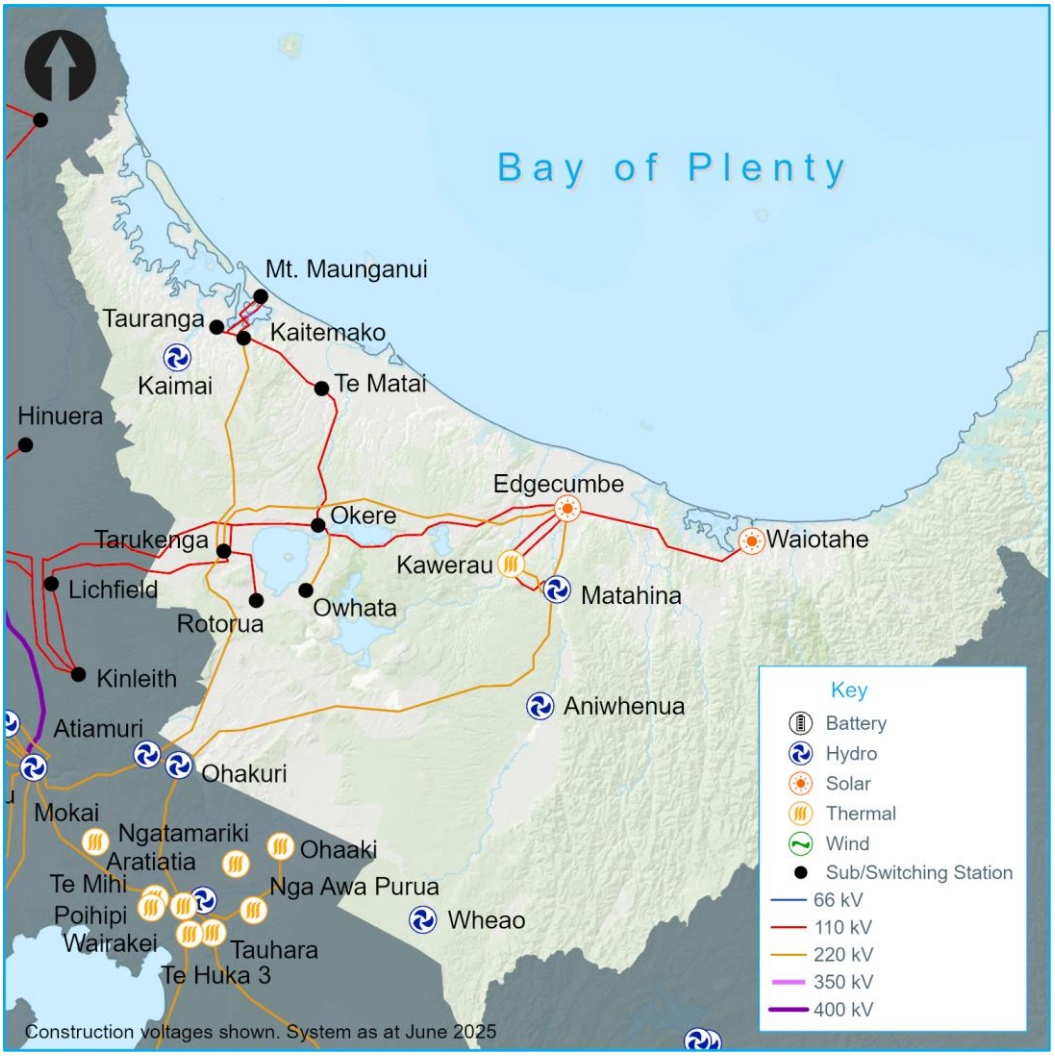
10.1	Regional overview and transmission system
10.2	Bay of Plenty load and generation forecasts
10.3	Grid enhancement approach and inputs
10.4	Grid asset capability and management within the wider region
10.5	Grid asset capability and management by grid exit point
10.6	Bay of Plenty bus security
10.7	Bay of Plenty generation opportunities and proposals

10.1 Regional overview and transmission system

The Bay of Plenty region has a mix of growing provincial cities (Tauranga and Rotorua) together with smaller towns and rural localities (such as Whakatāne, Te Puke, Kawerau and Ōpōtiki).

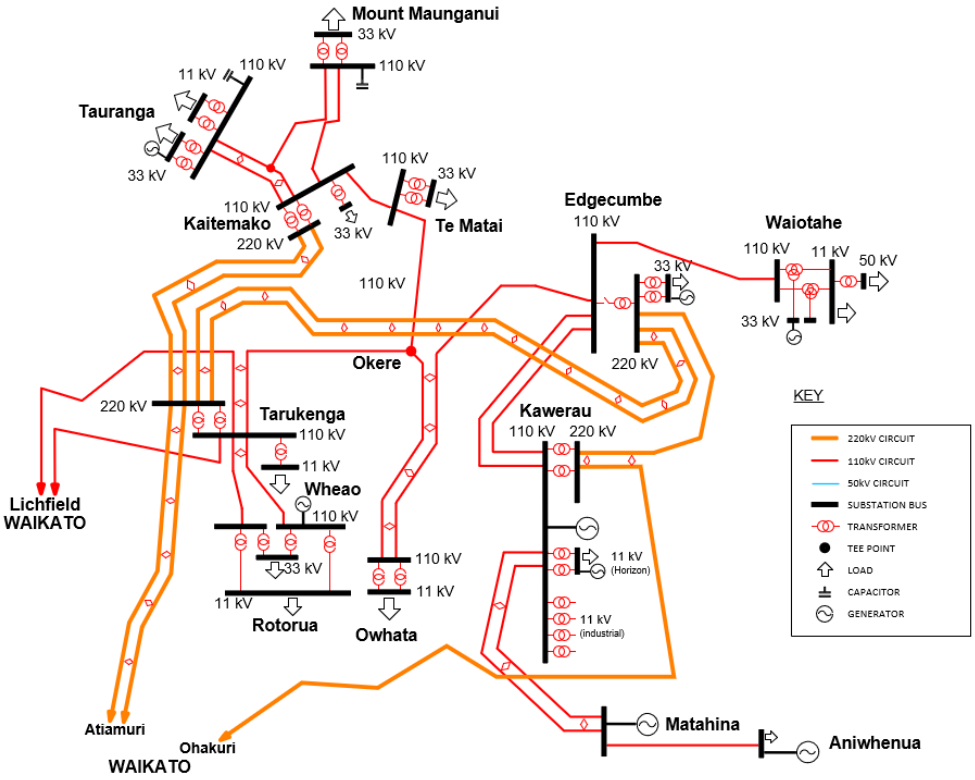
The existing transmission network for the Bay of Plenty region is shown geographically in Figure 10-1 and schematically in Figure 10-2.

Figure 10-1: Bay of Plenty region transmission



2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 10-2: Bay of Plenty region transmission schematic



10.1.1 Transmission into the region

As generation capacity in the Bay of Plenty region is lower than its maximum demand, the deficit is imported through the National Grid during peak load conditions, and any surplus is exported during light load conditions.

The 220 kV Atiamuri–Whakamaru and Ohakuri–Wairakei circuits (see Figure 9-2 in the Waikato chapter) connect the region to the rest of the National Grid. The Bay of Plenty load is predominantly supplied through these two circuits, and the region will be on n security whenever one of these circuits is out of service. These two circuits are part of a grid backbone area known as the Wairakei Ring. The regional 220 kV grid runs in parallel with the Atiamuri–Ohakuri circuit and forms a longer 220 kV route between those two substations via Kawerau, Edgecumbe and Tarukenga. Therefore, there are mutual interactions between the grid backbone and the Bay of Plenty regional grid (refer to Chapter 6 for further discussion).

There is also a low capacity 110 kV Tarukenga–Kinleith–Arapuni line that connects the Bay of Plenty to the Waikato 110 kV regional network. In normal operation this connection is split at Arapuni to prevent overloading[1].

10.1.2 Transmission within the region

The transmission network in the Bay of Plenty region comprises high capacity 220 kV and low capacity 110 kV circuits, with interconnecting transformers located at Tarukenga, Kaitemako, Edgecumbe and Kawerau. In normal operation the interconnecting transformer at Edgecumbe is open on the 110 kV side.

Reactive support is provided by 25 Mvar capacitors at Tauranga and Mount Maunganui as these two areas have a relatively high load with very little local generation.

Most Bay of Plenty generation is at the eastern end of the region (around Kawerau), but the bulk of the load is at the western end (near Rotorua and Tauranga). Therefore, power flow within the

1. See Chapter 9 for more information about the Arapuni bus split.

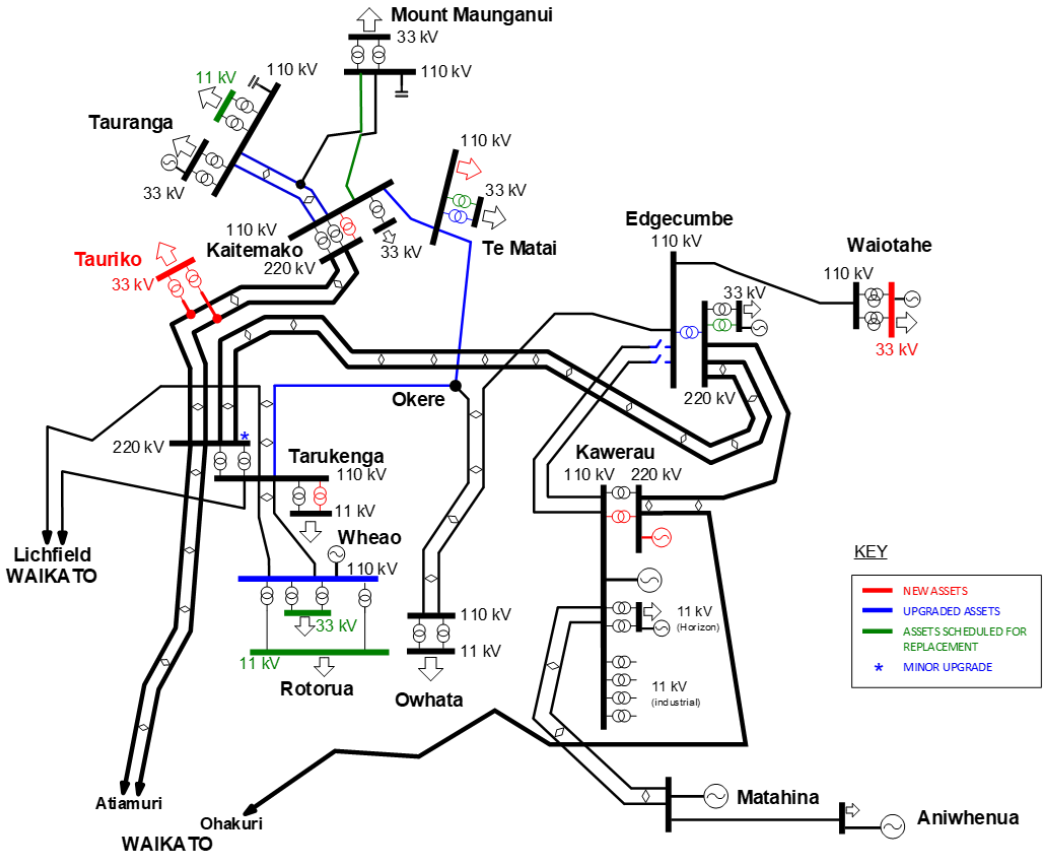
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

region is generally from east to west, which is expected to increase due to solar generation connections in the eastern region and forecast load increases in the western region.

10.1.3 Possible future Bay of Plenty transmission configuration

Figure 10-3 shows the possible configuration of Bay of Plenty transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

Figure 10-3: Possible Bay of Plenty region transmission configuration in 2040



10.2 Bay of Plenty load and generation forecasts

10.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[2].

The Bay of Plenty regional peak demand is forecast to grow by an average 3.2 per cent per annum over the next 15 years, from 380 MW in 2025 to 611 MW by 2040. This is higher than the national average growth rate of 2.6 per cent per annum.

Table 10-1 sets out forecast peak demand (prudent growth) at each grid exit point over the forecast period.

2. Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 10-1: Forecast prudent annual peak demand (MW) at Bay of Plenty grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Edgecumbe[1]	0.99	67	103	105	106	108	109	111	112	114	115	116	117
Kaitemako[2,5]	1.00	43	45	47	49	52	39	40	41	42	43	44	45
Kawerau – Horizon[6]	0.97	20	20	20	20	20	21	21	21	21	21	21	21
Kawerau – T6-T9[5,6]	0.99	22	22	22	22	22	22	22	22	22	22	22	22
Matahina[3,6]	0.99	7	7	7	7	8	8	8	8	8	8	8	8
Mount Maunganui[4]	1.00	68	72	75	76	77	79	60	61	62	63	64	49
Owhata[5]	1.00	17	18	20	21	21	22	22	22	23	23	23	23
Rotorua 11 kV[5]	1.00	29	30	30	31	32	32	32	33	33	33	33	33
Rotorua 33 kV	1.00	53	54	56	57	58	59	59	59	59	63	69	68
Tarukenga 11 kV[5]	1.00	11	11	12	12	13	13	13	14	14	14	14	15
Tauranga 11 kV[5]	1.00	25	26	27	28	29	31	32	33	33	33	34	34
Tauranga 33 kV[2,6]	1.00	90	93	97	101	105	108	135	139	141	144	146	148
Te Matai[4]	1.00	54	64	73	77	85	89	121	126	131	135	139	162
Waiotahe 11 kV	1.00	14	14	14	14	15	15	15	16	16	16	17	17
Waiotahe 50 kV[5]	0.97	2	2	2	2	2	2	2	2	2	2	2	2

1. Horizon advised a 34 MW step load increase at Edgecumbe in 2026, caused by the electrification of the Fonterra dairy plant.
2. Powerco advised a 13 MW load shift from Kaitemako to Tauranga 33 kV in 2030. Several major commercial, industrial and residential load increases are expected in the Tauriko area, which will be supplied from Tauranga 33 kV.
3. This load is supplied by transformers owned by Pioneer Energy and located at Aniwhenua.
4. Powerco advised the following load shifts from Mount Maunganui 33 kV to Te Matai: 18 MW in 2031 and 13.5 MW in 2038.
5. This grid exit point has a leading power factor.
6. This load is a gross demand value. It excludes embedded generation.

10.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing fossil fuel users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the Bay of Plenty region that are not included in the prudent demand forecast.

10.2.3 Existing and committed generation

The Bay of Plenty region's generation capacity is currently 429 MW and is forecast to increase to 536 MW by the end of 2026 due to the planned generation commissioning in the eastern part of the region. These figures exclude embedded solar (PV) generation, which was approximately 15 MW in the Bay of Plenty region at the time of publication[3]. Regional generation capacity is less than regional peak demand so any deficit is imported through the National Grid. At low load the region may import or export power depending on the level of generation dispatched.

Table 10-2 lists the generation forecast for each grid injection point in the Bay of Plenty region for the forecast period. This includes all known and committed generation stations including

3. The capacity of existing embedded solar farms mentioned in Table 10-2 has been subtracted from the total embedded solar generation reported on the Electricity Market Information (EMI) website: Installed distributed generation trends

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

those embedded within the relevant local lines company network (Horizon Networks, Unison, or Powerco)[4].

Further generation may be developed during the period. Refer to section 10.7 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 10-2: Existing and committed generation capacity at Bay of Plenty grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Edgecumbe												
(Bay Milk[1])	10	0	0	0	0	0	0	0	0	0	0	0
(Rangitaiki solar farm)	24	24	24	24	24	24	24	24	24	24	24	24
(Omeheu solar farm)	0	29	29	29	29	29	29	29	29	29	29	29
Kawerau – KAG	107	107	107	107	107	107	107	107	107	107	107	107
Kawerau												
(Onepu[2])	60	60	60	60	60	60	60	60	60	60	60	60
Te Ahi O Maui	24	24	24	24	24	24	24	24	24	24	24	24
TOPP 2	0	55	55	55	55	55	55	55	55	55	55	55
Matahina												
Matahina	80	80	80	80	80	80	80	80	80	80	80	80
(Aniwhenua)	25	25	25	25	25	25	25	25	25	25	25	25
Mount Maunganui												
(Ballance Agri)	7	7	7	7	7	7	7	7	7	7	7	7
Rotorua – Wheao	26	26	26	26	26	26	26	26	26	26	26	26
Rotorua												
(Fletcher Forests)	3	3	3	3	3	3	3	3	3	3	3	3
Tauranga												
(Kaimai[3])	40	40	40	40	40	40	40	40	40	40	40	40
Waiotahe												
(Te Herenga O Te Ra solar farm)	23	23	23	23	23	23	23	23	23	23	23	23

1. Edgecumbe Bay Milk cogeneration decommissioning in 2026.
2. Onepu is the market designation for the aggregation of the following four generators: GDL/KA24 (9 MW), TA2 (16 MW), TA3 (8 MW) and TOPP1 (27 MW).
3. Kaimai is a run-of-river hydro scheme that injects at the Tauranga 33 kV bus. Output from the scheme varies between 14 MW and 40 MW – typically, 14 MW is the minimum generation available from the scheme at peak load, though this relies on sufficient water being available.

10.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Bay of Plenty region.

10.3 Grid enhancement approach and inputs

10.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Bay of Plenty region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancements to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period

4. Only generating stations with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 10.3.3 and 10.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

10.3.2 Bay of Plenty significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 10-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Bay of Plenty region for the next 15 years that may significantly impact related system issues or connected parties.

Table 10-3: Proposed significant upcoming replacement and refurbishment work for the Bay of Plenty region

Description	Tentative year	E&D issue
Edgecumbe–T7 supply transformer replacement	2030-2032	10.5.1
Hairini–Mt Maunganui–A line conductor replacement	2033-2036	10.5.4
Kaitemako intertrip special protection scheme replacement	2023-2025	10.4.3
Kaitemako–Tauranga line protection replacement	2023-2025	10.4.3
Rotorua 110 kV line circuit breakers and line protection installation	2024-2026	10.5.6
Rotorua 33 kV switchboard replacement	2029-2031	None
Rotorua 11 kV switchboard replacement	2039-2040	None
Te Matai–T1 supply transformer replacement	2023-2026	10.5.9
Tauranga 11 kV switchboard replacement	2038-2040	None

10.3.3 Bay of Plenty asset feedback

The Asset Feedback Register does not contain any E&D-related entries specific to the Bay of Plenty region.

10.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Bay of Plenty region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 10-4 lists the specific new issues and those that are no longer relevant within the forecast period compared to the 2023 TPR.

Table 10-4: Changes within the wider region since the 2023 TPR

Issues	Change
Eastern Bay of Plenty area generation constraints	Updated. Larger 220/110 kV transformer commissioned at Kawerau, Edgecumbe–Kawerau 110 kV system split confirmed, Edgecumbe–T5 replacement confirmed.
Atiamuri–Tarukenga and Edgecumbe–Kawerau 220 kV transmission capacity	Removed. Lower regional load forecast.
Western Bay of Plenty low voltage	Removed. The transmission capacity upgrades approved in the Western Bay of Plenty MCP defer the need for additional voltage support to beyond the forecast period.

The overview of transmission capability within the wider Bay of Plenty region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Section number	Description
10.4.1	Western Bay of Plenty Development Plan
10.4.2	Kaitemako 220/110 kV interconnection and Okere–Te Matai transmission capacity
10.4.3	Tauranga and Mount Maunganui transmission capacity and security
10.4.4	Tarukenga–Te Matai–Kaitemako transmission capacity and Te Matai low voltage
10.4.5	Eastern Bay of Plenty area generation constraints

10.4.1 Western Bay of Plenty Development Plan

The 2023 TPR discussed many interrelated issues in the Western Bay of Plenty. We worked with Powerco and other stakeholders to produce a long-term grid upgrade plan for the Western Bay of Plenty[5]. This collaboration identified the preferred transmission and distribution grid upgrades required to address these issues and support regional growth, ensuring that investments in transmission and distribution grids were co-optimised.

The transmission upgrades proposed in the Western Bay of Plenty Development Plan are summarized below:

- install a third 220/110 kV transformer and a third 220 kV bus zone at Kaitemako
- reconductor the two 110 kV circuits into Tauranga from Kaitimako
- reconductor the Tarukenga–Okere–Te Matai and Kaitemako–Te Matai 110 kV circuits
- replace the 110/33 kV supply transformers at Te Matai with larger units
- build a new 220 kV double-circuit line to a new 220/33 kV Tauriko grid exit point
- build two 110 kV feeders at Te Matai to supply a new Powerco-owned 110/33 kV substation.

The first three upgrades in the list above target interconnection assets and will be funded by the Western Bay of Plenty Major Capex Proposal (MCP), which was approved by the Commerce Commission in June 2025. The rest of the upgrades will be funded by Powerco when deemed appropriate by it.

The issues that support the upgrades are further discussed below[6].

10.4.2 Kaitemako 220/110 kV interconnection and Okere–Te Matai transmission capacity

Issue

The main supply for the Western Bay of Plenty 110 kV regional grid is via two 220/110 kV transformers at Kaitemako, with support from the 110 kV Owhata–Tarukenga–Te Matai circuit.

The two Kaitemako 220/110 kV transformers provide:

- total nominal installed capacity of 300 MVA
- n-1 capacity of 223/225 MVA (summer/winter).

The following issues were identified[7]:

- from winter 2028, a Kaitemako interconnecting transformer outage may overload the 110 kV Okere–Te Matai circuit section[8]
- from around winter 2028, a Kaitemako interconnecting transformer outage may overload the other transformer
- from around winter 2030, a 220 kV Kaitemako–Tarukenga outage may overload the 110 kV Okere–Te Matai circuit section
- from around winter 2032, both Kaitemako interconnecting transformers will exceed their nominal rating pre-contingency

5. For more detail on the Western Bay of Plenty upgrade plan see https://www.transpower.co.nz/projects/wbop.
6. New and upgraded interconnection assets are listed as “committed”; we can proceed with these as they have Commerce Commission approval. New and upgraded connection assets are listed as “possible”; Powerco needs to sign a contract with Transpower before the projects are committed.
7. Dates will depend on Kaimai generation levels at peak times.
8. This circuit (Owhata–Tarukenga–Te Matai) and the Kaitemako–Te Matai circuit will also overload due to forecast load growth at Te Matai (see section 10.4.410.5.9).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- From around winter 2033, the Okere–Te Matai circuit section will overload pre-contingency.

What next?

Overloads caused by a Kaitemako interconnecting transformer outage are addressed post-contingency. Post-contingency load curtailment will be required from winter peak 2028.

We will install a third 220/110 kV transformer (and a third 220 kV bus section) at Kaitemako in 2030 as part of our Western Bay of Plenty MCP. This will address the issues described above.

Major capex investments

Project name:	Kaitemako interconnection capacity
Project description:	Install a third 220/110 kV transformer and a third 220 kV bus section at Kaitemako
Project's state of completion:	Committed
Grid need date:	2030
Indicative cost [$ million]:	13.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

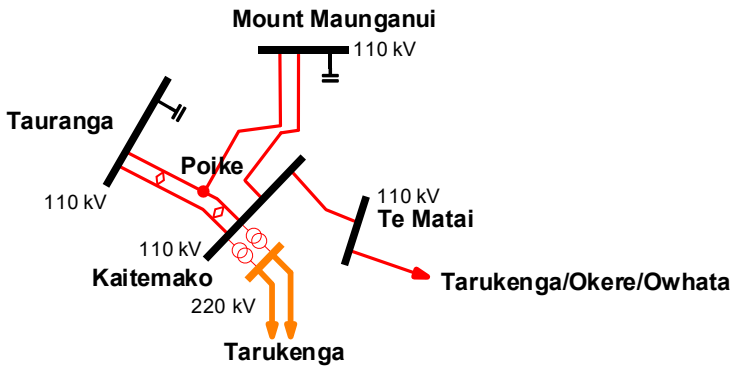
10.4.3 Tauranga and Mount Maunganui transmission capacity and security

Issue

Tauranga and Mount Maunganui are supplied from Kaitemako through the following 110 kV circuits (see Figure 10-4):

- Kaitemako–Tauranga, rated at 96/105 MVA (summer/winter)
- Kaitemako–Mount Maunganui, rated at 63/77 MVA (summer/winter)
- a shared Kaitemako–Tauranga–Mount Maunganui circuit with the following ratings:
  - Kaitemako–Poike section 96/105 MVA (summer/winter)
  - Poike–Tauranga section 96/105 MVA (summer/winter)
  - Poike–Mount Maunganui section 63/77 MVA (summer/winter).

Figure 10-4: Kaitemako 220 kV and 110 kV grid configuration



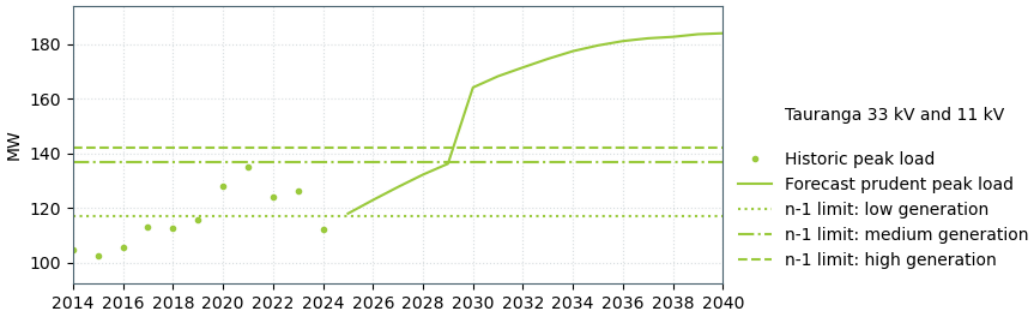
The Kaimai hydro generation is connected within Powerco's distribution network at Tauranga.

Since 2020, with low generation at Kaimai, the peak load has exceeded the n-1 capacity of the two circuits connected at Tauranga (see Figure 10-5). The frequency and duration of the overload is very sensitive to the output of the Kaimai generation. To assist with managing this issue, Powerco transferred its Pyes Pa zone substation load from Tauranga 33 kV to Kaitemako in 2022, reducing the Tauranga peak load by about 13 MW. However, this transfer would lead to capacity issues on the 33 kV network by 2030 and Powerco has therefore included in its load forecast the shift of this zone substation back to Tauranga in 2030.

From winter 2030, dispatching Kaimai generation at maximum output will not prevent the Tauranga peak load from exceeding the Kaitemako–Tauranga n-1 transmission capacity.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 10-5: Kaitemako–Tauranga transmission capacity for low (14 MW), medium (33 MW), and high (40 MW) Kaimai generation levels



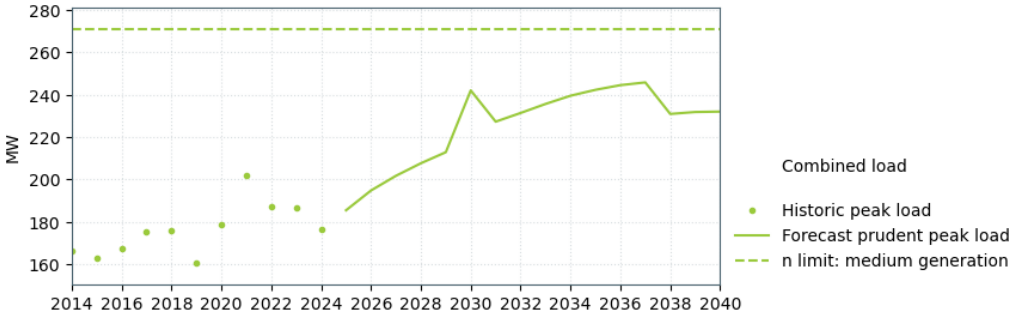
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

An outage of the Kaitemako–Tauranga or Kaitemako–Mount Maunganui circuit may overload the Kaitemako–Poike section. This overload triggers the first stage of the Kaitemako intertrip special protection scheme which reconfigures the grid, putting Tauranga and Mount Maunganui on n security to reduce the loading on the Kaitemako–Poike circuit section.

If the net total load at Tauranga exceeds the Kaitemako–Tauranga n-1 transmission capacity, the first stage of the Kaitemako intertrip special protection scheme is insufficient to remove the overload on Kaitemako–Poike. The second stage of the Kaitemako intertrip special protection scheme will then open the Kaitemako–Tauranga–Mount Maunganui circuit, causing a total loss of supply at Tauranga.

The total load at Tauranga and Mount Maunganui remains below the n capacity of the Kaitemako–Poike circuit section for the forecast period (see Figure 10-6).

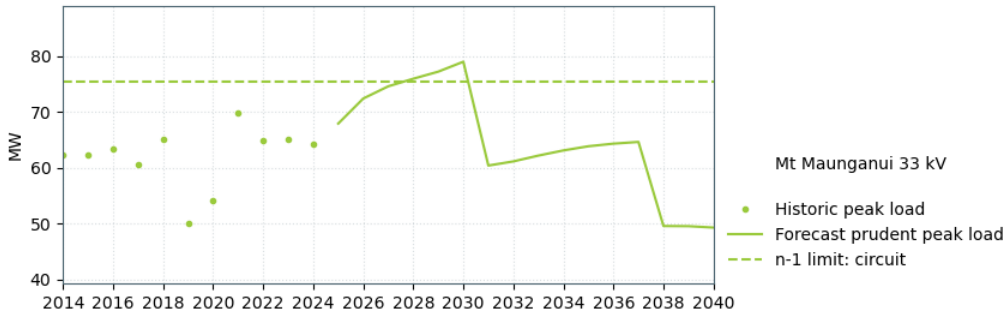
Figure 10-6: Kaitemako–Tauranga and Mount Maunganui transmission capacity for medium (33 MW) Kaimai generation levels



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

For Mount Maunganui, we expect n-1 transmission capacity issues from 2027 until 2031, when they will be addressed by Powerco shifting the Papamoa zone substation load from Mount Maunganui to Te Matai (see Figure 10-7).

Figure 10-7: Mount Maunganui transmission capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

In the short-term, we will address the transmission capacity and security issue into Tauranga by installing a circuit overload special protection scheme on both 110 kV circuits into Tauranga. This scheme will reduce load at Tauranga post-contingency to remove overload on these

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

circuits before the operation of the second stage of the existing Kaitemako intertrip special protection scheme. This work will be delivered in late 2025, together with the planned 110 kV line protection replacements in the area (see section 10.3.2).

In the medium- to long-term, the Western Bay of Plenty Development Plan includes the following upgrades to address the transmission capacity issue into Tauranga:

- reconductoring the existing circuits between Kaitemako and Tauranga to increase their capacity to 200 MVA in 2031[9].
- transfer load from Tauranga to a new 220/33 kV grid exit point in the Tauriko area, connected by a new 220 kV double circuit line to the existing Kaitemako–Tarukenga 220 kV line. This new grid exit point will also address the supply capacity issue at Tauranga 33 kV (see section 10.5.8) and provide diversity of supply to the city of Tauranga.

The Western Bay of Plenty Development Plan also addresses transmission capacity issues into Mount Maunganui by permanently shifting load to the Te Matai grid exit point. This requires planned upgrades for Te Matai to be completed first (see sections 10.4.4 and 10.5.9). Prior to the load shift, a circuit overload special protection scheme on both 110 kV circuits supplying Mount Maunganui may be required to manage the possible n-1 transmission capacity issue on these circuits.

Base E&D capex investments

Project name:	Tauranga transmission capacity – short-term
Project description:	Install a circuit overload special protection scheme on the two 110 kV circuits supplying Tauranga
Project's state of completion:	Delivery
Grid need date:	2025
Indicative cost [$ million]:	0.2
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Mt Maunganui transmission capacity – short-term
Project description:	Install a circuit overload special protection scheme on the two 110 kV circuits supplying Mt Maunganui
Project's state of completion:	Possible
Grid need date:	2028
Indicative cost [$ million]:	0.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Major Capex investments & Customer Investments

Project name:	Tauranga transmission capacity – long-term
Project description:	Reconductor Kaitemako–Tauranga 110 kV circuits (Kaitemako –Poike section)
Project's state of completion:	Committed
Grid need date:	2031
Indicative cost [$ million]:	4.2
Reliability or Economic investment?	Reliability (Grid Reliability Report)

9. Reconductoring the Kaitemako–Poike line section (interconnection asset) will be funded by the Western Bay of Plenty MCP, while reconductoring the Poike–Tauranga line section (connection asset) will be funded by Powerco.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Customer investments

Project name:	Tauranga transmission capacity – long-term
Project description:	Reconductor Kaitemako–Tauranga 110 kV circuits (Poike–Tauranga section)
Project's state of completion:	Committed
Grid need date:	2031
Indicative cost [$ million]:	6.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Tauriko area new GXP
Project description:	Build a new GXP connecting to the Kaitemako–Tarukenga 220 kV circuits
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	26.4
Reliability or Economic investment?	Reliability (Grid Reliability Report)

10.4.4 Tarukenga–Te Matai–Kaitemako transmission capacity and Te Matai low voltage

Issue

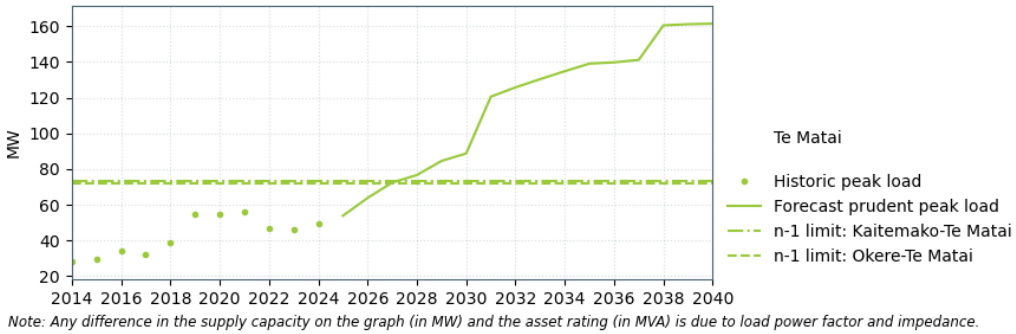
Te Matai is supplied by two 110 kV circuits:

- Kaitemako–Te Matai, rated at 63/77 MVA (summer/winter)
- Owhata–Tarukenga–Te Matai, rated at 63/77 MVA (summer/winter). This is a three-terminal circuit with the tee point at Okere.

Peak load at Te Matai is forecast to exceed the n-1 transmission capacity into Te Matai from winter 2027 (see Figure 10-8).

Without the proposed 220/110 kV capacity upgrade at Kaitemako (see section 10.4.2), the Okere–Te Matai circuit section will also overload pre-contingency from winter 2033.

Figure 10-8: Te Matai transmission capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The replacement of both Te Matai supply transformers would address the low voltage issue at the Te Matai 33 kV bus (see section 10.5.9), but even with this investment the Te Matai 110 kV bus voltage is expected to drop below 0.9 p.u. after a Kaitemako–Te Matai 110 kV circuit outage from winter 2031. This is despite the very good load power factor at Te Matai.

What next?

Resolving the transmission issues into Te Matai is part of the approved Western Bay of Plenty grid enhancement MCP.

Pre-contingency overloads on Okere–Te Matai will be avoided with the third 220/110 kV transformer at Kaitemako (see section 10.4.2).

As part of the MCP, we will reconductor the Kaitemako–Te Matai, Okere–Te Matai and Okere–Tarukenga circuits in 2031-2032 to increase their capacity to 177/195 MVA (summer/winter). This provides a durable solution to both the transmission capacity and low voltage issue at Te Matai.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

In the shorter term, a circuit overload protection scheme is needed to resolve the transmission constraints on Kaitemako–Te Matai and Okere–Te Matai before the transmission capacity increase is completed. Removing the circuit overloads also addresses the Te Matai 110 kV low voltage issue.

Base E&D capex investments

Project name:	Te Matai transmission capacity – short-term
Project description:	Implement a circuit overload special protection scheme on the two 110 kV circuits supplying Te Matai
Project's state of completion:	Possible
Grid need date:	2028
Indicative cost [$ million]:	0.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Major Capex investments

Project name:	Te Matai transmission capacity – long-term
Project description:	Reconductor Kaitemako–Te Matai and Tarukenga–Okere–Te Matai with higher capacity conductor
Project's state of completion:	Committed
Grid need date:	2032
Indicative cost [$ million]:	47.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

10.4.5 Eastern Bay of Plenty area generation constraints

Issue

The Eastern Bay of Plenty is a generation-rich area with 343 MW of generation capacity already connected in the area, predominantly exported to the Western Bay of Plenty. Additional generation is confirmed at Waiotahe (33 MW of solar generation by mid-2026), Edgecumbe (29 MW of solar generation by mid-2026) and Kawerau (55 MW of geothermal generation by late 2025). Additional solar generation at Edgecumbe is in an advanced development stage.

The 110 kV Kawerau–Edgecumbe–Waiotahe circuits connect to the rest of the system via:

- two 250 MVA 220/110 kV transformers at Kawerau[10]
- The low capacity 110 kV Edgecumbe–Owhata circuit, rated at 57/69 MVA summer/winter.

The area also contains the low capacity 110 kV Edgecumbe–Kawerau–1 and 2 circuits, each rated at 48/59 MVA summer/winter. Several special protection schemes minimise the need to impose pre-contingency generation constraints to manage post-contingency overloads.

Issues with high Eastern Bay of Plenty generation export include:

- the 110 kV Edgecumbe–Owhata circuit overloading pre-contingency due to both increased generation in the Eastern Bay of Plenty and load growth in the Western Bay of Plenty.
- a contingency of the 220 kV Edgecumbe–Kawerau–3 circuit overloading the Kawerau–Ohakuri circuit, during periods of high Eastern Bay of Plenty generation and low load.
- With additional committed generation, an outage of a 220 kV Edgecumbe–Tarukenga circuit overloading the other circuit.

What next?

Future transmission investments will depend on the scale of net generation increase in the Eastern Bay of Plenty, together with factors external to this area (i.e., load increase in the Western Bay of Plenty and increased northward power flow through the Wairakei Ring). Committed, proposed and possible upgrade options for a staged development include:

- 110 kV transmission capacity and operational flexibility:

[10] We replaced the 80 MVA interconnecting transformer at Kawerau (T13) with a new 250 MVA unit in 2024 to reduce the risk of generation constraints in the Eastern Bay of Plenty.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

  - 110 kV Edgecumbe–Kawerau system split to avoid pre-contingency generation constraints in the Eastern Bay of Plenty.
  - switch in the Edgecumbe 220/110 kV interconnecting transformer (T5) to retain n-1 security to Owhata and Waiotahe.
  - replace Edgecumbe–T5 with the previous Kawerau–T13 transformer (80 MVA) to avoid pre-contingency overloads on Edgecumbe–T5 at winter peak.
  - reconfigure the Kawerau 110 kV bus to a ring bus to enable connection of new generation and/or to increase operational flexibility during maintenance outages (possible future upgrade).
- 220 kV transmission capacity:
  - Kawerau–Ohakuri circuit special protection scheme to reduce Kawerau generation when the circuit overloads for an Edgecumbe–Kawerau–3 outage (possible upgrade). This special protection scheme may be useful to reduce pre-contingency generation constraints once the 50 MW TOPP 2 geothermal project is completed.
  - Thermal upgrade of both Edgecumbe–Tarukenga 220 kV circuits (possible long-term option).
  - A second 220 kV Edgecumbe–Kawerau circuit (possible long-term option).

Base E&D capex investments

Project name:	Edgecumbe–Kawerau 110 kV system split
Project description:	Open Edgecumbe–Kawerau 110 kV circuits and use Edgecumbe-T5 220/110 kV transformer in normal operation configuration
Project's state of completion:	Committed
Grid need date:	2025
Indicative cost ($ million):	-
Economic or Reliability?	Economic (Grid Economic Investment Report)

Project name:	Edgecumbe–T5 220/110 kV transformer replacement
Project description:	Re-use Kawerau–T13 to replace the Edgecumbe–T5 220/110 kV transformer
Project's state of completion:	Committed
Grid need date:	2026
Indicative cost ($ million):	6.1
Economic or Reliability?	Economic (Grid Economic Investment Report)

Project name:	Kawerau–Ohakuri–1 circuit overload protection scheme
Project description:	Install Kawerau generation runback scheme to address Kawerau–Ohakuri–1 post-contingency overloads
Project's state of completion:	Possible
Grid need date:	2026
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

Project name:	Edgecumbe–Tarukenga 220 kV line thermal upgrade
Project description:	Increase thermal rating of 220 kV Edgecumbe–Tarukenga line
Project's state of completion:	Possible
Grid need date:	Uncertain (generation development dependant)
Indicative cost ($ million):	21.5
Economic or Reliability?	Reliability (Grid Reliability Report)

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Project name:	Kawerau 110 kV bus
Project description:	Install 110 kV ring bus at Kawerau
Project's state of completion:	Possible
Grid need date:	Uncertain (generation development dependant)
Indicative cost ($ million):	3
Economic or Reliability?	Reliability (Grid Reliability Report)

10.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 10-5 lists the specific new issues and those that are no longer relevant within the forecast period compared to the 2023 TPR.

Table 10-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Kaitemako supply capacity	Removed. Lower load forecast.
Mount Maunganui supply capacity	The section now focuses on supply capacity only. Transmission capacity into Mt Maunganui is now discussed in section 10.4.3.
Rotorua 110/33 kV supply capacity	Added. Increased load forecast
Rotorua 110/11 kV supply capacity	Removed. Lower load forecast.

The overview of transmission capability for each grid exit point within the Bay of Plenty region is listed below. Where an issue is identified we list options to address it.

Section number	Description
10.5.1	Edgecumbe supply capacity
10.5.2	Kaitemako supply capacity and security
10.5.3	Kawerau (Horizon Networks) supply capacity
10.5.4	Mount Maunganui supply capacity
10.5.5	Owhata supply capacity
10.5.6	Rotorua security, transmission and supply capacity
10.5.7	Tarukenga supply capacity and security
10.5.8	Tauranga supply capacity
10.5.9	Te Matai supply capacity and low voltage
10.5.10	Waiotahe supply capacity and transmission security

10.5.1 Edgecumbe supply capacity and low voltages

Issue

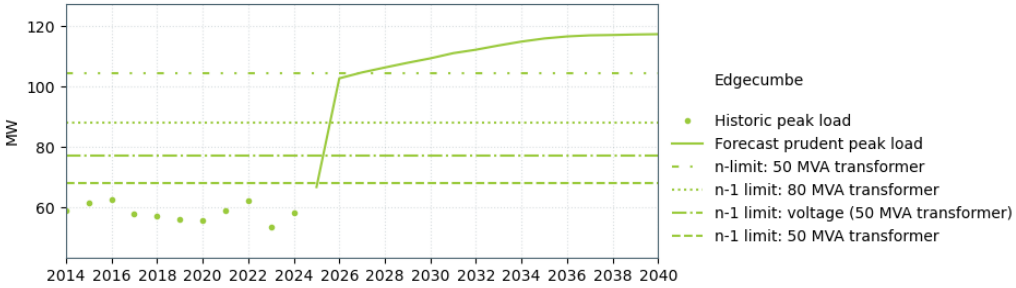
Two 220/33 kV transformers (T4 rated at 80 MVA and T7 rated at 50 MVA) supply Edgecumbe's load, providing a total nominal installed capacity of 130 MVA.

The peak load is forecast to exceed the n-1 capacity of T4 and T7 in 2026 following the planned electrification of Fonterra's dairy plant at Edgecumbe (see Figure 10-9). Pre-contingency overloads on T4 are forecast at winter peak from 2028.

The peak load is also forecast to exceed the n-1 capacity for a 33 kV bus voltage limit of 0.95 p.u. for both T4 and T7 in 2026.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 10-9: Edgecumbe supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will continue to monitor the supply capacity with Horizon Networks.

We are developing a transformer overload protection scheme (TOPS) to automatically curtail Edgecumbe 33 kV load post-contingency if the remaining supply transformer is overloaded. While this TOPS will also address the low voltage issue, a voltage step of up to -5 % may occur immediately after a transformer outage. This TOPS will be commissioned in 2026.

Edgecumbe–T7 is due for risk-based replacement in 2032. We will discuss the rating of the replacement transformer with Horizon closer to the need date. There is considerable interest in connecting solar generation to the 33 kV network. Increasing the capacity of Edgecumbe–T7 would increase the export capability of the connecting generation (see section 10.7.5).

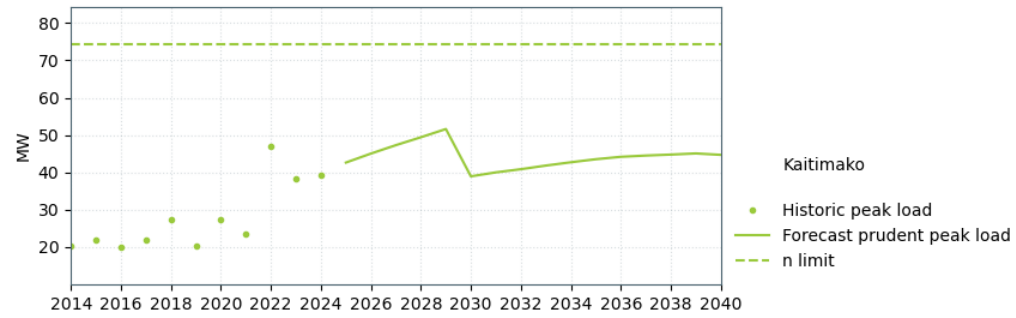
10.5.2 Kaitemako supply capacity and security

Issue

A single 110/33 kV, 75 MVA transformer supplies load at Kaitemako, resulting in n security. The forecast peak load at Kaitemako is within the continuous rating of the supply transformer for the forecast period (see Figure 10-10).

The step load decrease in 2030 is load transfer within Powerco's distribution network to the Tauranga 33 kV grid exit point. This is part of the Western Bay of Plenty upgrade plan (see sections 10.4.3 and 10.5.8).

Figure 10-10: Kaitemako supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Powerco considers the lack of n-1 security is operationally manageable for the forecast period and has not requested a second 110/33 kV supply transformer at Kaitemako. Future investments will be customer-funded.

10.5.3 Kawerau (Horizon Networks) supply capacity

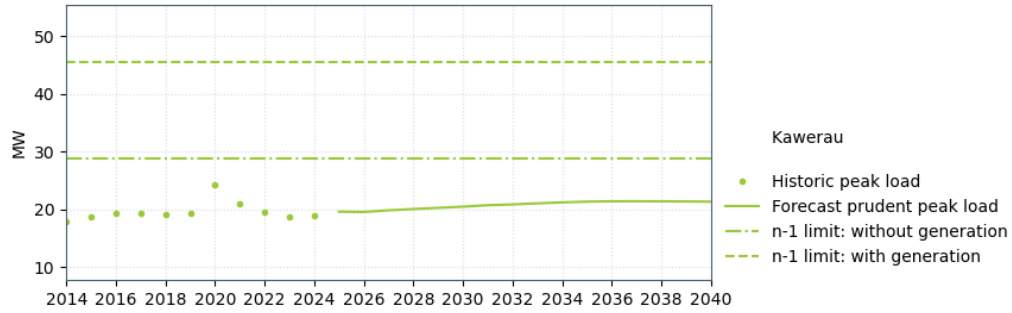
Two 110/11 kV transformers supply Horizon's load at Kawerau, providing a total nominal installed capacity of 60 MVA.

The Te Ahi O Maui geothermal generator, currently connected within Horizon's 11 kV distribution network, will be shifted to a new GIP on the Kawerau 220 kV bus in 2026 as part of Eastland Generation's TOPP2 geothermal project.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Peak load is forecast to stay within the n-1 capacity of the supply transformers for the forecast period (Figure 10-11), even without Te Ahi O Maui generation on the Horizon 11 kV bus.

Figure 10-11: Kawerau (Horizon) supply capacity



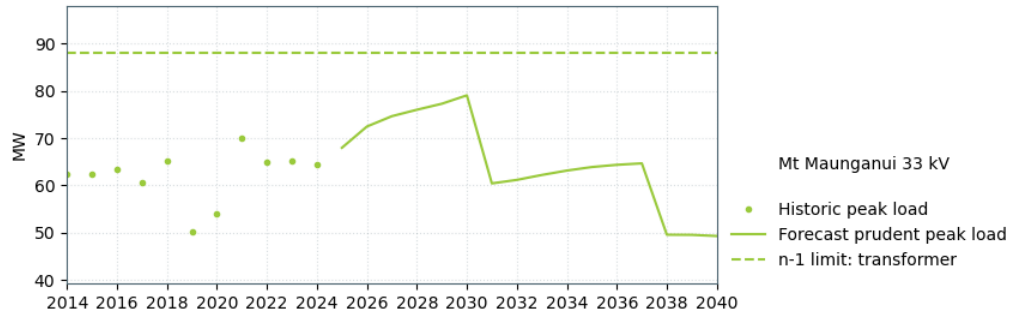
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

10.5.4 Mount Maunganui supply capacity

Two 110/11 kV transformers supply the Mount Maunganui load, providing a total nominal installed capacity of 150 MVA. The transformers' capacity is limited by the 33 kV switchgear.

Peak load at Mt Maunganui is within the n-1 capacity of the supply transformers for the forecast period (see Figure 10-12).

Figure 10-12: Mount Maunganui supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

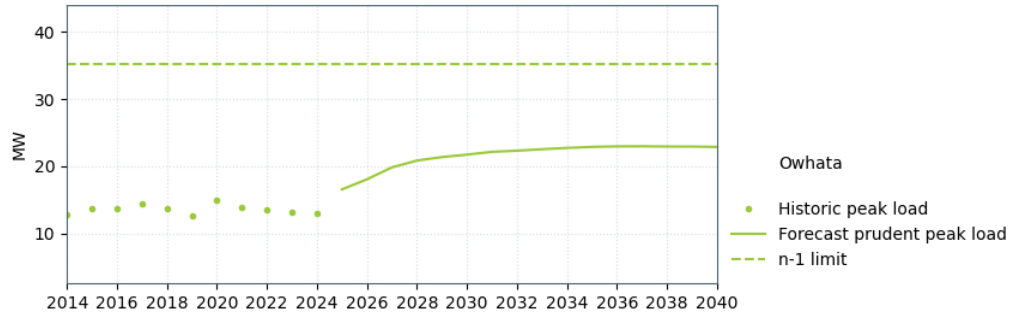
10.5.5 Owhata supply capacity

Two 110/11 kV transformers supply Owhata's load, providing a total nominal installed capacity of 60 MVA.

Peak load at Owhata is within the n-1 capacity of the supply transformers for the forecast period (see Figure 10-13).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 10-13: Owhata supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

10.5.6 Rotorua security, transmission and supply capacity

Rotorua is supplied by two 110 kV Rotorua–Tarukenga circuits. The Rotorua 110 kV bus is split to give two bus sections, each supplied by one Rotorua–Tarukenga circuit.

Two 110/33 kV and two 110/11 kV supply transformers are distributed across the two bus sections. One bus section has a single 110 kV connection to the Wheao hydro generator.

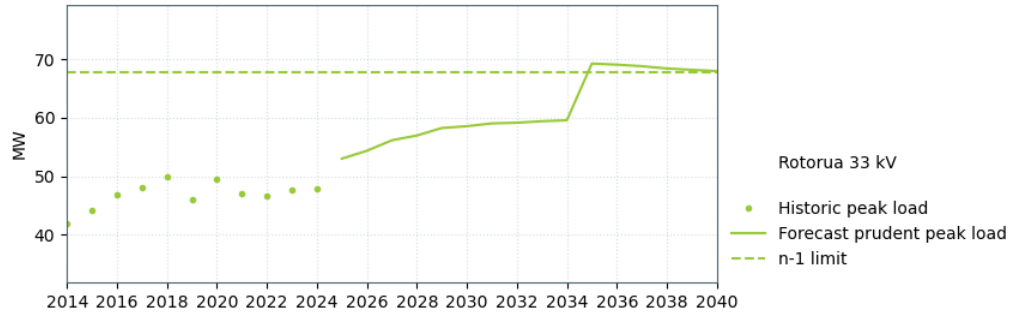
An outage of a Rotorua–Tarukenga circuit will disconnect a Rotorua 110 kV bus section, in turn disconnecting a 110/33 kV and a 110/11 kV supply transformer. The Wheao generator may also be disconnected if its associated bus section is disconnected. We are required to avoid overloading a transformer for a circuit outage[11], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Rotorua 110/33 kV supply

Two 110/33 kV transformers supply Rotorua's 33 kV load, providing a total nominal installed capacity of 120 MVA.

Peak load at Rotorua 33 kV is forecast to exceed the n-1 capacity of the supply transformers from 2035 (see Figure 10-14).

Figure 10-14: Rotorua 110/33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Rotorua 110/11 kV supply

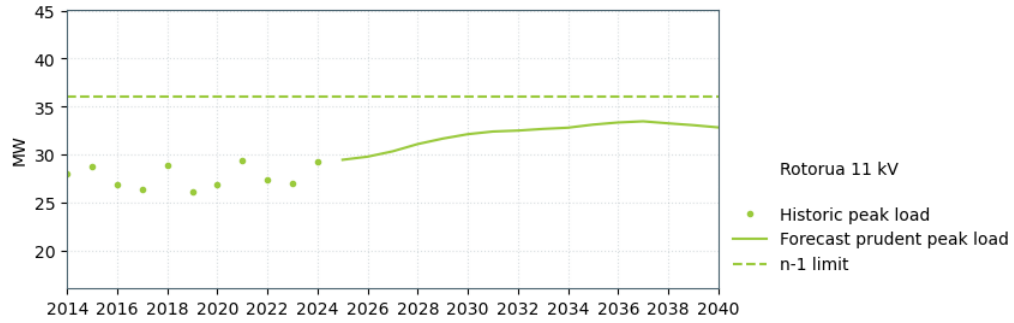
Two 110/11 kV transformers supply Rotorua's 11 kV load, providing a total nominal installed capacity of 70 MVA. The transformers' capacity is limited by the revenue metering accuracy limit, the 11 kV switchgear and the 11 kV cables.

Peak load at Rotorua 11 kV is forecast to remain below the n-1 capacity of the supply transformers until the end of the forecast period (see Figure 10-15).

[11] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 10-15: Rotorua 110/11 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Rotorua–Tarukenga 110 kV circuit capacity and security

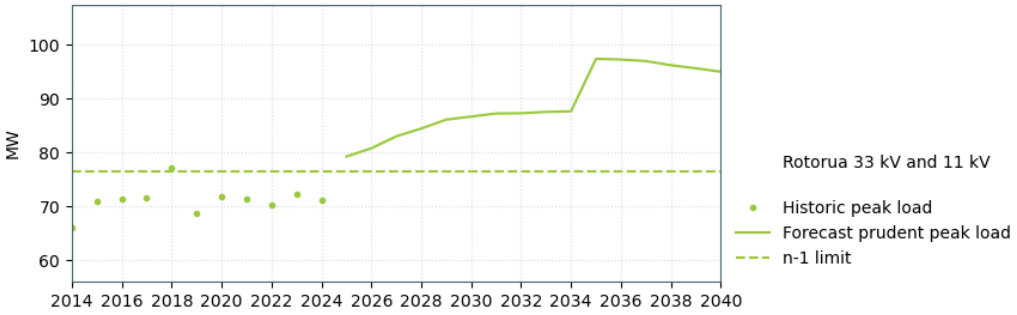
Rotorua is supplied by two 110 kV Rotorua–Tarukenga circuits, each rated at 63/77 MVA (summer/winter).

An outage of the 110 kV Rotorua–Tarukenga–2 circuit:

- disconnects the Wheao generation (i.e., n security)
- overloads Rotorua–Tarukenga–1, as it supplies all load without support from Wheao generation.

Peak load at Rotorua is forecast to exceed the n-1 capacity of the circuits from 2025 (see Figure 10-16).

Figure 10-16: Rotorua–Tarukenga transmission capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Manawa Energy has not requested a higher level of security for its Wheao generator.

We are discussing possible options with Unison to address or defer the Rotorua–Tarukenga transmission capacity issue, which include:

- transfer load from Rotorua to the Owhata or Tarukenga grid exit points. This may also defer the Rotorua supply capacity issue.
- close the Rotorua 110 kV bus split to ensure Wheao generation remains connected to offset part of the Rotorua load[12].
- install a circuit overload special protection scheme on both Rotorua–Tarukenga circuits to reduce the Rotorua load post-contingency to within the circuits' ratings.
- apply variable line rating and/or reconductoring the Rotorua–Tarukenga circuits. Previous investigations indicate this is unlikely to be a low-cost solution.
- build a new 220/33 kV grid exit point connected to the Atiamuri–Tarukenga circuit(s) and transfer load from Rotorua to the new grid exit point.

Future investments will be customer driven.

[12] We have a committed project to replace and upgrade the protection on the Rotorua–Tarukenga circuits and Rotorua 110 kV bus. The protection upgrade includes installing 110 kV line circuit breakers at Rotorua. When completed, the Rotorua 110 kV bus split could be closed, so Wheao generation remains connected for a Rotorua–Tarukenga circuit outage to support the Rotorua load and reduce the loading on the remaining in-service Rotorua–Tarukenga circuit. However, with the 110 kV bus split closed, a 110 kV bus fault will cause a complete loss of supply and loss of connection to the Wheao generator.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

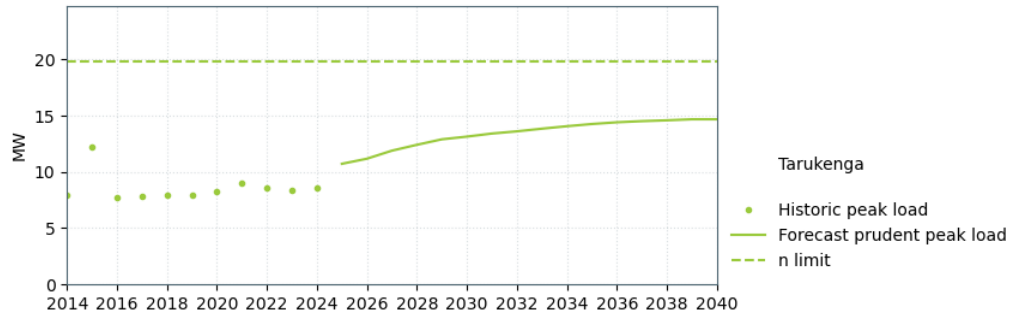
10.5.7 Tarukenga supply capacity and security

Issue

A single 110/11 kV, 20 MVA supply transformer supplies the Tarukenga grid exit point resulting in n security. The forecast peak load at Tarukenga is within the continuous capacity of the supply transformer for the forecast period (see Figure 10-17).

Unison does not have sufficient backfeed 11 kV capacity to always be able to supply the Tarukenga load from alternative grid exit points during an outage of the single supply transformer.

Figure 10-17: Tarukenga supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Upon Unison's request, we investigated options for a second supply transformer to provide n-1 security in the medium term. Unison has not committed to the second supply transformer. Future investments will be customer-driven.

10.5.8 Tauranga supply capacity

Issue

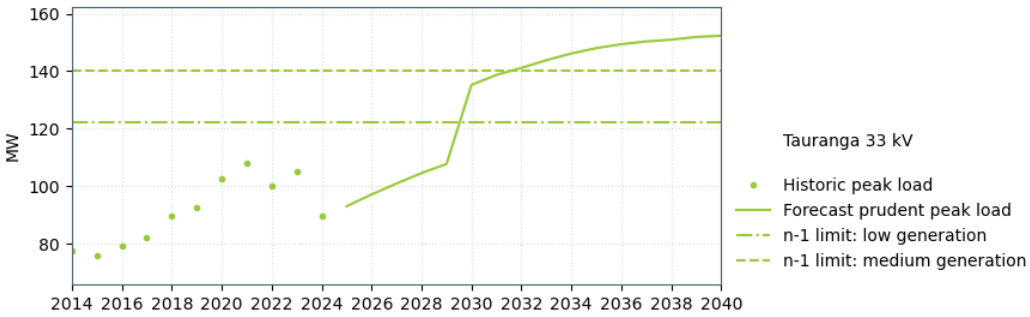
At Tauranga:

- two 110/33 kV transformers supply the 33 kV load, providing a total nominal installed capacity of 210 MVA
- two 110/11 kV transformers supply the 11 kV load, providing a total nominal installed capacity of 60 MVA. The transformers' capacity is limited by the metering accuracy limits, protection settings and the 11 kV switchgear.

The Kaimai hydro generation is connected within Powerco's 33 kV distribution network.

Peak load at Tauranga 33 kV is forecast to exceed the n-1 capacity of the supply transformers from winter 2030 if Kaimai generation is low (14 MW) and from 2032 if Kaimai generation is medium (33 MW) (see Figure 10-18).

Figure 10-18: Tauranga 110/33 kV supply capacity for low (14 MW) and medium (33 MW) Kaimai generation

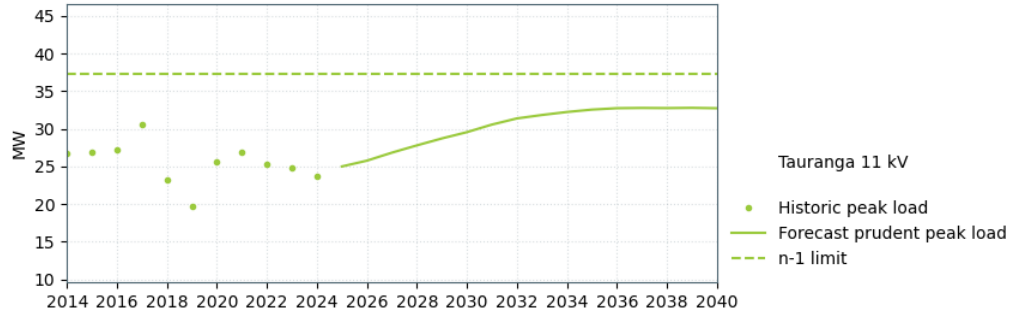


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Peak load at Tauranga 11 kV is expected to remain below the n-1 capacity of the supply transformers until the end of the forecast period (see Figure 10-19).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 10-19: Tauranga 110/11 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The Tauranga supply capacity issue will be addressed as part of the Western Bay of Plenty Development Plan (see section 10.4.1). The Tauranga supply capacity issue needs to be considered together with the Kaitemako–Tauranga transmission capacity issue. Our proposed approach to address both issues is detailed at section 10.4.3.

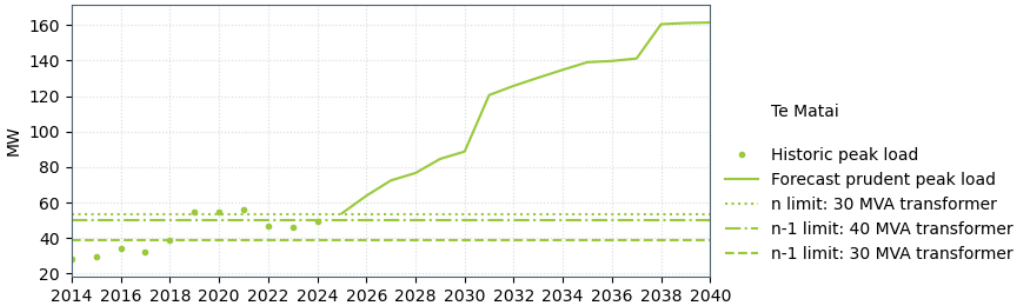
10.5.9 Te Matai supply capacity and low voltages

Issue

Two 110/33 kV transformers (T1 rated at 30 MVA and T2 rated at 40 MVA) supply Te Matai's load, providing a total nominal installed capacity of 70 MVA.

The Te Matai load is forecast to exceed the n-1 capacity of T2 from winter 2025 and the n capacity of T1 from winter 2026 (see Figure 10-20). A strong load increase is expected throughout the forecast period, driven by load shifts from Mount Maunganui GXP and several step load changes.

Figure 10-20: Te Matai supply capacity and supply limits (before T1 replacement)



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

We are replacing Te Matai–T1 with an 80 MVA transformer by the end of 2025. The transformer will have an on-load tap changer, which will allow us to maintain the Te Matai supply voltage within acceptable limits.

After T1 is replaced, T2 will limit the supply capacity at Te Matai. Using the short-term overload capability of T2 allows us to increase the n-1 limit to about 61 MW (with operator action to reduce the load if required). Beyond this level, T2 will need to be switched out of service to prevent damage due to excessive post-contingency overloads, and the Te Matai load will be supplied only by the new T1. In this adjusted n security configuration, the continuous rating of T1 (80 MVA) is forecast to be exceeded at peak time from winter 2029.

The Te Matai load is also forecast to exceed the n-1 transmission capacity of the 110 kV circuits. Section 10.4.4 provides more detail on this issue and our approach to address it.

What next?

After T1 is replaced, T2 will also need to be replaced with an 80 MVA transformer to partially address the supply capacity issue at Te Matai. Replacement and upgrade of Te Matai–T2 will be customer-driven and is currently in the investigation stage.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Replacing T1 and T2 with 80 MVA transformers will not be enough to ensure the load remains within the n-1 capacity of the supply transformers. The Western Bay of Plenty Development Plan (see section 10.4.1) identified the next upgrade stage is a new 110/33 kV connection at Powerco's Wairakei zone substation, supplied by a new double-circuit 110 kV line from Te Matai. This will be funded and built by Powerco and will avoid the need to further upgrade the supply capacity at Te Matai beyond T1 and T2 replacement.

Customer investments

Project name:	Te Matai supply capacity (Stage 1)
Project description:	Replace Te Matai–T2 supply transformer with a higher rated unit (Te Matai–T1 will be replaced as a risk-based policy replacement)
Project's state of completion:	Possible
Grid need date:	2026 (Customer initiated)
Indicative cost [$ million]:	TBA
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Te Matai supply capacity (Stage 2)
Project description:	Add two 110 kV bays at Te Matai to connect Powerco's circuits supplying the new Wairakei 110/33 kV injection point. Install 110 kV bus coupler at Te Matai.
Project's state of completion:	Possible
Grid need date:	2030 (Customer initiated)
Indicative cost [$ million]:	9.6
Reliability or Economic investment?	Reliability (Grid Reliability Report)

10.5.10 Waiotahe supply capacity and transmission security

Issue

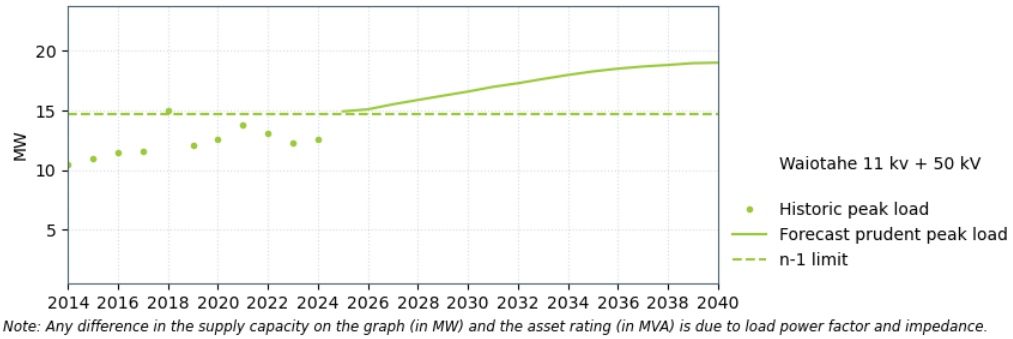
Waiotahe is supplied through a single 110 kV Edgecumbe–Waiotahe circuit providing n security.

Two 110/33/11 kV transformers (T1 and T2) supply Waiotahe's load, providing a total nominal installed capacity of 120 MVA at 33 kV and 30 MVA at 11 kV.

Horizon's load is currently supplied at 11 kV. Horizon also has one 50 kV feeder connected via a 11/50 kV step-up transformer owned by Transpower.

The combined 11 kV and 50 kV peak load is forecast to exceed the n-1 rating of the 11 kV windings of the transformers from winter 2025 (see Figure 10-21).

Figure 10-21: Waiotahe 110/11 kV supply capacity (combined 11 kV and 50 kV load)



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

A single 11/50 kV, 3 MVA transformer supplies the 50 kV load, resulting in n security. The peak load at Waiotahe 50 kV shows minimal load growth over the forecast period and no capacity issues are expected.

What next?

The lack of n-1 transmission security can be managed operationally by Horizon Networks. We have no investments planned to increase transmission security to Waiotahe.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Horizon has committed to shift its supply from 11 kV to 33 kV by winter 2026. This will address the n-1 supply capacity issue for the forecast period.

The lack of n-1 security for the 11/50 kV supply can be managed operationally by Horizon Networks. The 11/50 kV supply will be relinquished when Horizon converts to a 33 kV supply.

10.6 Bay of Plenty bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generators). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 10-6 lists bus outages that cause voltage issues or a total loss of supply. Generators are included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 10-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Edgecumbe 110 kV	Waiotahe	-	-	Note 1
Edgecumbe 220 kV	Edgecumbe	-	-	Note 2
Kaitemako 110 kV	Kaitemako	-	- Kaitemako 220/110 kV overloading Kaitemako–Tauranga overloading Okere–Te Matai overloading	10.6.1
Kaitemako 220 kV			Kaitemako 220/110 kV overloading Okere–Te Matai overloading	10.6.2
Kawerau 110 kV	Kawerau (partial)	- KAG	- -	Note 3 Note 3
Matahina	Aniwhenua	- Matahina Aniwhenua	- - -	Note 4 Note 4 Note 4
Mount Maunganui 110 kV	Mount Maunganui	-	-	Note 2
Owhata 110 kV	Owhata	-	-	Note 2
Rotorua 110 kV		Wheao	- Rotorua–Tarukenga overloading	Note 5 10.5.6
Tarukenga 110 kV	Tarukenga	- Wheao	- - Rotorua–Tarukenga overloading	10.5.7 Note 5 10.5.6
Tarukenga 220 kV			Atiamuri–Tarukenga overloading Westen Bay of Plenty low voltages	10.6.3 10.6.3
Tauranga 110 kV	Tauranga 11 kV Tauranga 33 kV	- -	- -	Note 2 Note 2
Te Matai 110 kV	Te Matai	-	-	Note 2
Waiotahe 110 kV	Waiotahe	-	-	Note 2

1. Waiotahe is supplied from a single 110 kV circuit from Edgecumbe. Therefore, a bus fault at Edgecumbe 110 kV causes a loss of supply at Waiotahe.
2. There are no bus section circuit breakers at Edgecumbe, Mount Maunganui, Owhata, Tauranga, Te Matai and Waiotahe, so a bus fault causes loss of supply.
3. The loss of a 110 kV bus section will cause a partial loss of supply to the Kawerau 110 kV industrial load. Also, the Kawerau Geothermal generator (KAG) connects to one section of the Kawerau 110 kV bus, so a loss of this bus section disconnects the generation.
4. There is no bus section circuit breaker at Matahina. Therefore, a bus fault causes a loss of generation connection to Matahina and Aniwhenua, and a loss of supply to load that is normally supplied from Aniwhenua.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

5. Wheao generation connects to one section of the Rotorua 110 kV bus, which is split and with one circuit to Tarukenga. Therefore, the loss of this bus section at Rotorua or the corresponding bus at Tarukenga disconnects the generation.

Our customers (Horizon Networks, Mercury, Oji Fibre Solutions, Powerco, Pioneer Energy, Unison and Manawa Energy) have not requested a higher security level. We do not propose to increase bus security to secure load at individual grid exit points or grid injection points, and future investment is likely to be customer driven. However, we will investigate options where a bus tripping causes regional transmission overloading, low voltage, or voltage collapse issues.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

10.6.1 Kaitemako 110 kV bus security

Issue

There are three 110 kV bus sections at Kaitemako.

The outage of the Kaitemako 110 kV bus section C disconnects:

- the 220/110 kV Kaitemako–T4 interconnecting transformer
- the 110 kV Kaitemako–Mount Maunganui circuit
- the 110 kV Kaitemako–Te Matai circuit.

An outage of the Kaitemako 110 kV bus section A disconnects:

- the 220/110 kV Kaitemako–T2 interconnecting transformer
- the 110 kV Kaitemako–Tauranga–1 circuit
- the 110/33 kV Kaitemako–T1 supply transformer.

This bus section A outage results in a loss of supply at Kaitemako because there is only one supply transformer. This load can usually be backfed from Tauranga, but the simultaneous loss of the Kaitemako–Tauranga circuit will result in Tauranga being supplied only from the Kaitemako–Mount Maunganui–Tauranga circuit, which may restrict the amount of load that can be transferred to Tauranga.

During periods of high load, Kaitemako bus section A or bus section C outages cause large overloads on the remaining Kaitemako interconnecting transformer and on the Tarukenga–Okere–Te Matai circuit (see section 10.4.2).

Any Kaitemako 110 kV bus section outage will cause constraints at peak load on the circuits to Tauranga, from 2026, even with Kaimai generation at maximum (see section 10.4.3).

What next?

The upgrades proposed in the Western Bay of Plenty MCP (see section 10.4.1) will address the issues caused by Kaitemako 110 kV bus section outages.

10.6.2 Kaitemako 220 kV bus outage and related capacity and voltage issues

Issue

The outage of a Kaitemako 220 kV bus section disconnects:

- one of the two 220/110 kV Kaitemako interconnecting transformers
- one of the two 220 kV Kaitemako–Tarukenga circuits.

During Western Bay of Plenty winter peak load periods, a bus section outage will overload the 110 kV Okere–Te Matai circuit from 2026, and the remaining Kaitemako 220/110 kV interconnecting transformer from 2028.

What next?

The upgrades proposed in the Western Bay of Plenty MCP (see section 10.4.1) will address the issues caused by a Kaitemako 220 kV bus section outage. In particular, installing a third 220/110 kV transformer at Kaitemako (see section 10.4.2) includes upgrading the Kaitemako 220 kV bus to three bus sections.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

10.6.3 Tarukenga 220 kV bus outages

Issue

The outage of Tarukenga 220 kV bus section B disconnects:

- a 220/110 kV Tarukenga interconnecting transformer
- a 220 kV Atiamuri–Tarukenga circuit
- a 220 kV Kaitemako–Tarukenga circuit
- both 220 kV Edgecumbe–Tarukenga circuits.

This will likely, in turn, cause the 110 kV Edgecumbe–Owhata circuit to overload, and its special protection scheme to automatically open the circuit to remove the overload. The loss of the circuit removes support provided by the Kawerau generation to the Western Bay of Plenty area and leaves the area supplied only by the remaining Atiamuri–Tarukenga 220 kV circuit.

From 2025, a bus section B outage may result in overloading of the remaining Atiamuri–Tarukenga 220 kV circuit and low voltages in the Western Bay of Plenty area. From about 2034, voltage collapse in the Western Bay of Plenty could occur during periods of peak load and low generation in the area.

What next?

In the short-term, this issue can be managed operationally by constraining on generation. However, even very high generation dispatch in the region quickly becomes insufficient to completely avoid the consequences of a Tarukenga bus section B outage.

This issue could be resolved by reconfiguring Tarukenga 220 kV such that each Edgecumbe–Tarukenga circuit is connected to a different bus section.

We will continue to monitor the risk associated with the loss of Tarukenga bus section B and investigate if the solution proposed above becomes economically viable.

Base E&D capex investments

Project name:	Tarukenga 220 kV bus security
Project description:	Move Edgecumbe–Tarukenga–2 connection from Tarukenga 220 kV bus section B to bus section A
Project's state of completion:	Possible
Grid need date:	2034
Indicative cost [$ million]:	4
Reliability or Economic investment?	Reliability (Grid Reliability Report)

10.7 Bay of Plenty generation opportunities and proposals

This section provides a high-level description of the Bay of Plenty region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

There is significant solar and geothermal generation potential in the Bay of Plenty region, particularly the eastern area around Edgecumbe and Kawerau. Some parts of the region have little remaining capacity to host additional generation.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Section number	Description
10.7.1	Generation opportunities by substation
10.7.2	Generation investigations and proposals
10.7.3	Atiamuri–Whakamaru transmission capacity
10.7.4	Eastern Bay of Plenty generation constraints
10.7.5	Edgecumbe 33 kV capacity
10.7.6	Edgecumbe–Waiotahe capacity and security
10.7.7	Kawerau–Matahina 110 kV transmission capacity and security
10.7.8	Generation development near Okere Falls and Lake Rotoiti

10.7.1 Generation opportunities by substation

Envision Opportunities[13] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[14]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy
- winter evening peak – wet/windy
- winter midday high – wet/calm.

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

10.7.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[15]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 10-7 shows generation and grid-scale battery projects in the Bay of Plenty region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 10-2 instead.

Table 10-7: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Edgecumbe	Solar	Delivery[1]	115
Waiotahe	Solar	Delivery[1]	33
Edgecumbe–Tarukenga	Hydro and Geothermal	Application	56

1. "Delivery" is a stage in the Transpower generation queue process, it does not denote a final commitment by the developer to build the generation.

[13] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

[14] "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

[15] Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

We have also other preliminary requests for generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of selected parts of the Bay of Plenty region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

10.7.3 Atiamuri–Whakamaru transmission capacity

The 220 kV Atiamuri–Whakamaru circuit is part of the Wairakei Ring in the grid backbone (see Chapter 6). During periods of high regional generation and low load, power will flow from the region through Atiamuri–Whakamaru to the rest of the grid.

The capacity of the Atiamuri–Whakamaru circuit may cause generation constraints for existing and/or new generation within the region during periods of low load and high regional generation. We are investigating the constraints due to the capacity of the Wairakei Ring and will consult with stakeholders on options for addressing the issue.

10.7.4 Eastern Bay of Plenty generation constraints

Issue

The committed solar generation developments at Edgecumbe 33 kV and Waiotahe, and possible further generation developments in the wider Eastern Bay of Plenty, cause a number of transmission issues.

What next?

See section 10.4.5 for a discussion of the generation issues, the transmission upgrade path, and how the upgrade path integrates with upgrades required due to load growth.

Any further generation development in the Eastern Bay of Plenty (in addition to the existing and committed generation) may trigger post-contingency capacity constraints on the Edgecumbe–Tarukenga 220 kV circuits.

Any further generation development at Kawerau may trigger post-contingency capacity constraints on the Kawerau–Ohakuri 220 kV circuit.

10.7.5 Edgecumbe 33 kV capacity

Issue

Two 220/33 kV transformers (T4 rated at 80 MVA and T7 rated at 50 MVA) supply Edgecumbe's load, providing a total nominal installed capacity of 130 MVA.

There is existing generation connected within the distribution network. After completion of the committed and highly likely solar projects at Edgecumbe 33 kV, we expect that:

- minor generation constraints will be required to remain within the continuous capacity of both supply transformers during periods of light load and high solar generation
- significant generation constraints will be required when one supply transformer is out of service. These constraints are prevented by a transformer overload protection scheme which will runback or trip generation until post-contingency supply transformer overloads are cleared.

If more generation is connected at Edgecumbe 33 kV beyond what is already committed, the frequency and magnitude of the required generation constraints will increase.

The Aniwhenua hydro generation is normally connected to the grid at Matahina. When the Matahina–Aniwhenua single 110 kV circuit is unavailable, this generation is transferred to the Edgecumbe 33 kV grid exit point via the distribution network. During this temporary configuration, more generation is likely going to be constrained at Edgecumbe.

What next?

The peak load at Edgecumbe exceeds the n-1 capacity of Edgecumbe–T7 (see section 10.5.1). Edgecumbe–T7 is also due for risk-based condition replacement in 2032. Due to the forecast load increase, the replacement transformer will have a higher rating (at least 80 MVA to match Edgecumbe–T4). The bigger replacement transformer will also enable more generation to

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

connect within the distribution network (or remove constraints for committed solar generation if no additional generation is built).

Bringing forward the Edgecumbe–T7 replacement would be customer driven.

10.7.6 Edgecumbe–Waiotahe capacity and security

Issue

Waiotahe is supplied by a single Edgecumbe–Waiotahe 110 kV circuit, rated 48/54/59 MVA summer/shoulder/winter. The circuit rating plus normal day-time minimum load is less than the solar capacity being installed at Waiotahe. Therefore, generation constraints are expected to be required.

An outage of the single circuit or an Edgecumbe 110 kV bus outage will cause a total loss of generation connection.

What next?

We have no plans to increase the capacity of the Edgecumbe–Waiotahe circuit or install a second circuit to increase capacity and improve security. Future investment will be customer-driven.

10.7.7 Kawerau–Matahina 110 kV transmission capacity and security

Issue

The 110 kV Kawerau–Matahina line comprises two circuits each rated at 88/98 MVA (summer/winter).

The circuits have variable line ratings applied. The loss of one Kawerau–Matahina circuit may slightly overload the remaining circuit in late morning and early afternoon during part of the year if there is high generation output at Matahina and Aniwhenua.

What next?

The overload can be managed operationally by constraining generation at Matahina and Aniwhenua. Alternatively, the Aniwhenua generation could be reconfigured to inject some of its output into Horizon's 33 kV network, removing the overload. With the committed connection of solar generation on the Edgecumbe 33 kV grid exit point, transferring the Aniwhenua generation may lead to generation constraints both within Horizon's 33 kV network and on the Edgecumbe 220/33 kV transformers (see section 10.7.5).

No further investments are planned to increase the transmission capacity. If additional generation does connect at Edgecumbe, a special protection scheme will be required to automatically reduce generation if one circuit is out of service.

10.7.8 Generation development near Okere Falls and Lake Rotoiti

Issue

Some generation prospects (mostly geothermal) exist close to Okere Falls and Lake Rotoiti. Potential connection options include:

- A direct connection on the Edgecumbe–Owhata or Owhata–Te Matai–Tarukenga 110 kV circuits: these circuits have low ratings (57/63/69 MVA summer/shoulder/winter) and are already highly loaded during periods of high Eastern Bay of Plenty generation. Pre-contingency capacity constraints will occur at times if more than about 25 MW of generation is connected.
- A connection on the Owhata 11 kV grid exit point: the same 110 kV transmission constraint will apply. This transmission constraint is expected to bind before the local 110/11 kV supply transformer capacity constraint.
- A direct connection to one or both Edgecumbe–Tarukenga 220 kV circuits: as explained in section 10.7.4, additional generation connected in the Eastern Bay of Plenty or directly on the Edgecumbe–Tarukenga 220 kV circuits may trigger post-contingency capacity constraints on these circuits.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

What next?

As part of our Western Bay of Plenty MCP, we will increase the capacity of the Okere–Tarukenga and Okere–Te Matai sections of the Owhata–Te Matai–Tarukenga 110 kV circuit to 195 MVA in 2031-2032 (see section 10.4.4). Once this upgrade is completed, current known generation prospects in the region could connect to these 110 kV circuit sections without facing regional constraints. The upgrade of the Okere–Owhata circuit section is not proposed because it is not required for the increase of the transmission capacity into Te Matai.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

11 Central North Island Regional Plan

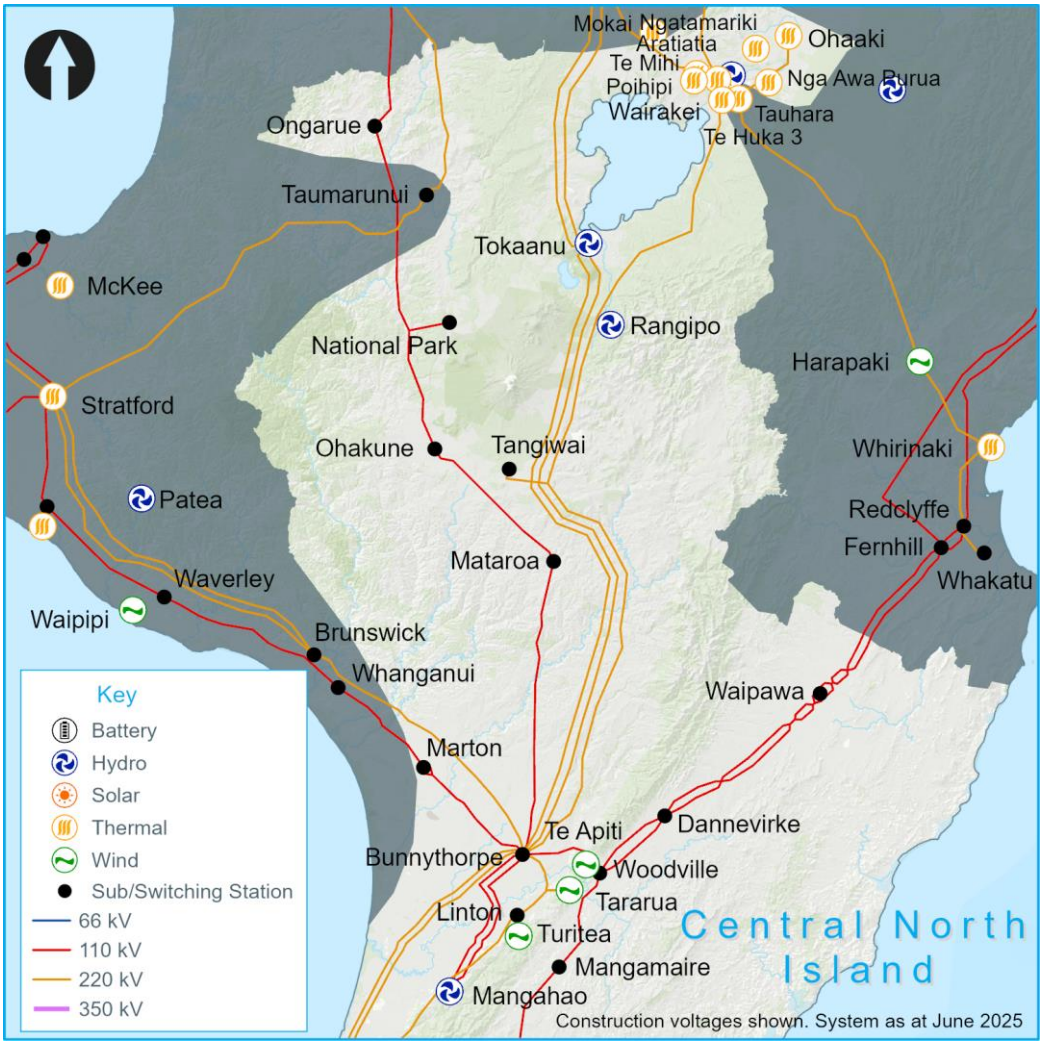
11.1	Regional overview and transmission system
11.2	Central North Island load and generation forecasts
11.3	Grid enhancement approach and inputs
11.4	Grid asset capability and management within the wider region
11.5	Grid asset capability and management by grid exit point
11.6	Central North Island bus security
11.7	Other items of interest
11.8	Central North Island generation opportunities and proposals

11.1 Regional overview and transmission system

The Central North Island region is home to a variety of loads including the city of Palmerston North and its environs (supplied from Bunnythorpe and Linton), and numerous medium to small loads. A number of generating stations are also located in the region.

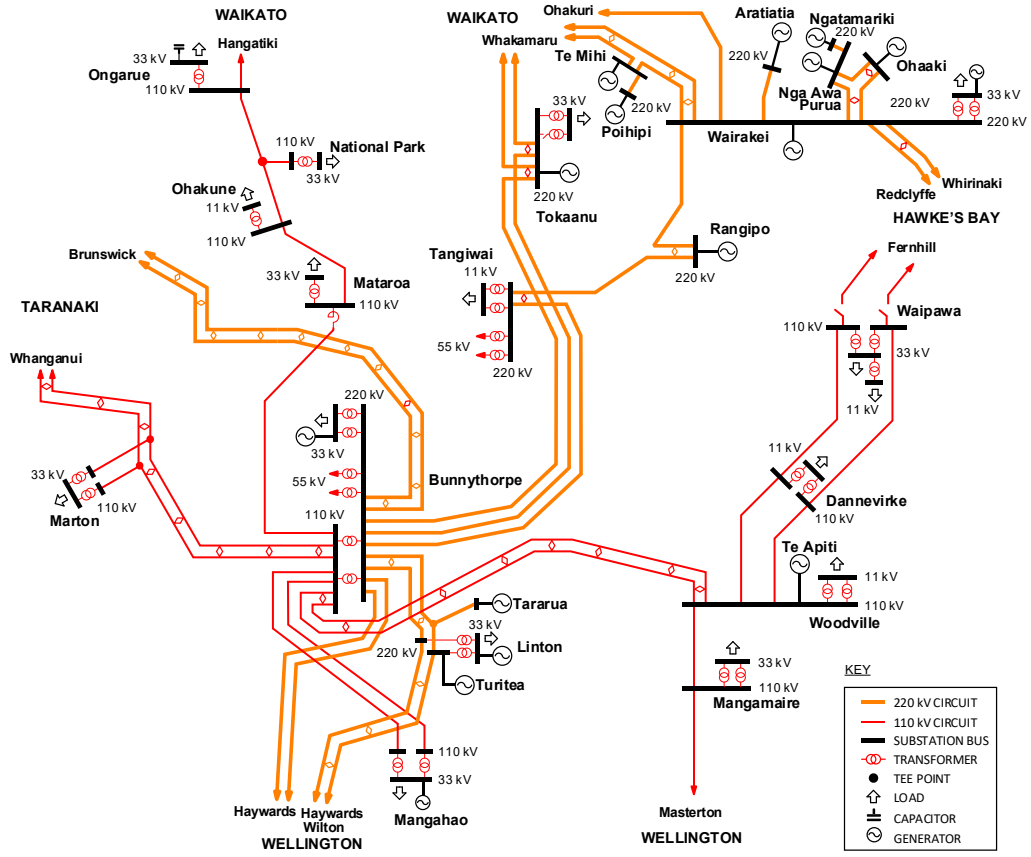
The existing transmission network is shown geographically in Figure 11-1 and schematically in Figure 11-2.

Figure 11-1: Central North Island region transmission map



2025 Annual Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Figure 11-2: Central North Island region transmission schematic



11.1.1 Transmission into the region

The Central North Island region comprises 220 kV and 110 kV transmission circuits with interconnecting transformers located at Bunnythorpe. The direction of power flow through the region, north or south, is determined by generation, direction of HVDC flow and loads outside the region.

All the 220 kV circuits form part of the grid backbone. The 110 kV transmission network is mainly supplied through the 220/110 kV interconnecting transformers at Bunnythorpe, as well as through low-capacity connections to other regions.

The Central North Island region is a main corridor for 220 kV transmission circuits through the North Island. The 220 kV transmission system connects the Central North Island to the Wellington region to the south, the Taranaki region to the west, the Waikato region to the north, and the Hawke's Bay region to the east.

Most of the Central North Island's generation capacity is connected to the 220 kV circuits and output significantly exceeds the local demand. The National Grid enables surplus generation to be exported to other demand centres.

11.1.2 Transmission within the region

The 110 kV transmission system within the Central North Island region consists mainly of low-capacity circuits. The transmission system may become constrained under certain operating conditions, and operational measures are required to ensure the 110 kV circuits operate within their thermal capacity. These are:

- normally splitting the 110 kV system at Waipawa, for the Fernhill–Waipawa circuits
- managing generation output to avoid overloading the 110 kV:
  - Bunnythorpe–Woodville circuits
  - circuits between Bunnythorpe and Arapuni (Waikato region)
  - circuits between Bunnythorpe and Stratford (Taranaki region).

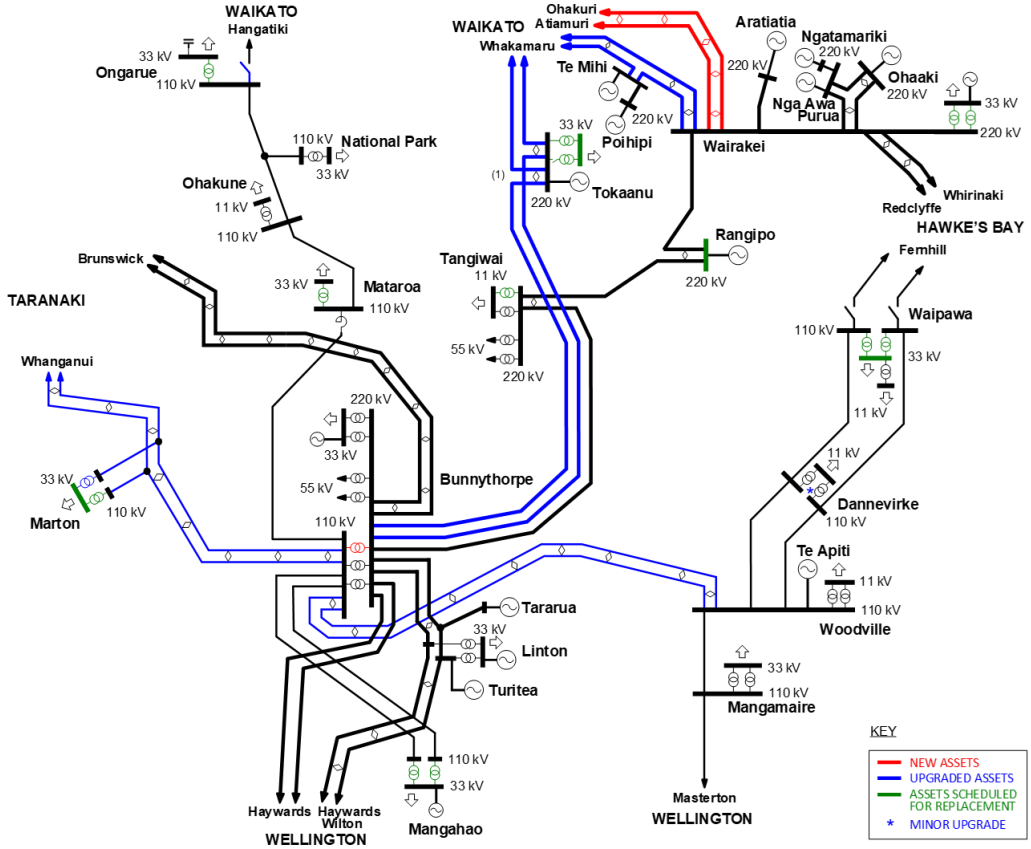
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Special protection schemes at Mataroa, Tokaanu, Mangamaire and Woodville are also used to automatically reconfigure the grid or reduce generation to ensure the circuits operate within their thermal capacity.

11.1.3 Possible Central North Island transmission configuration

Figure 11-3 shows the possible configuration of Central North Island transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

Figure 11-3: Possible Central North Island transmission configuration in 2040



11.2 Central North Island load and generation forecasts

11.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 percent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Central North Island regional peak demand is forecast to grow by an average 1.7 per cent per annum over the next 15 years, from 278 MW in 2025 to 360 MW by 2040. This is lower than the national average growth rate of 2.6 per cent per annum. Table 11-1 sets out forecast peak demand (prudent growth) at each grid exit point over the forecast period.

[1] Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Table 11-1: Forecast prudent annual peak demand (MW) at Central North Island grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Bunnythorpe 33 kV[1,2]	1.00	101	100	87	90	92	93	95	96	97	98	99	99
Bunnythorpe – NZR	0.95	6	6	6	6	6	6	6	6	6	6	6	6
Dannevirke	1.00	16	16	20	20	21	21	21	22	22	22	23	23
Linton[1,3]	1.00	74	79	83	87	90	91	92	93	94	95	96	96
Mangahao	0.99	43	44	45	45	46	48	49	49	50	50	52	52
Mangamaire	0.98	16	17	17	17	17	17	17	17	17	18	18	17
Marton[2,4]	0.99	18	20	38	39	41	43	45	46	48	50	50	49
Mataroa	1.00	8	8	8	8	8	8	8	8	9	9	9	8
National Park	1.00	5	5	5	5	6	6	6	6	6	6	6	7
Ohakune	0.99	9	9	9	10	10	10	10	10	11	11	11	12
Ongarue	1.00	9	9	9	10	10	12	12	12	12	13	13	14
Tangiwai 11 kV	0.99	0	0	0	0	0	0	0	0	0	0	0	0
Tangiwai – NZR	0.92	6	6	6	6	6	6	6	6	6	6	6	6
Tokaanu[5]	0.98	8	9	9	10	10	10	10	11	11	11	11	12
Waipawa[6]	0.98	31	31	32	31	33	33	34	34	35	35	35	35
Wairakei[7,8]	0.98	51	51	49	49	47	46	45	44	43	42	43	44
Woodville[5]	0.97	3	3	3	3	4	4	4	4	4	4	4	4

1. Powerco has advised a 3 MW load shift from Bunnythorpe to Linton in 2026.
2. Powerco has advised a 15 MW load shift from Bunnythorpe to Marton in 2027.
3. Powerco has advised 6 MW of industrial load increases at Linton across 2026-2028
4. Powerco has advised 7 MW of industrial load increases at Marton across 2030-2034.
5. This is a leading power factor.
6. Centralines has advised 10 MW of load increase from heavy industry and residential development at Waipawa across 2025-2028.
7. Wairakei load is a gross demand value. It excludes embedded generation.
8. Unison has advised a 37 MW load shift in total across 2025-2034 from Wairakei to Tauhara (Hawke's Bay region).

11.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing coal users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast. We are not aware of any reasonably advanced proposals for additional demand in the Central North Island region that are not included in the prudent demand forecast.

11.2.3 Existing and committed generation

The Central North Island's generation capacity is currently 1,704 MW. This excludes solar (PV) generation connected within distribution networks, which was approximately 23.4 MW in the Central North Island region at the time of publication[2]. This represents a significant portion of total North Island generation and exceeds local demand. Surplus generation is exported over the National Grid.

Table 11-2 lists the generation forecast for each grid injection point in the Central North Island region for the forecast period. This includes all known and committed generation stations,

[2] See embedded solar generation reported on the Electricity Market Information (EMI) website: Installed distributed solar generation trends

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

including those embedded in local lines company networks (Centralines, Electra, Powerco, Scanpower, The Lines Company or Unison)[3].

Further generation may be developed during the period. Refer to Table 11-7 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 11-2: Existing and committed generation capacity at Central North Island grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Aratiatia	78	78	78	78	78	78	78	78	78	78	78	78
Bunnythorpe (Tararua Wind – North)	34	34	34	34	34	34	34	34	34	34	34	34
Linton (Tararua Wind – South)	34	34	34	34	34	34	34	34	34	34	34	34
Linton – Turitea Wind	221	221	221	221	221	221	221	221	221	221	221	221
Mangahao (Mangahao)	30	30	30	30	30	30	30	30	30	30	30	30
Ngā Awa Pūrua	140	140	140	140	140	140	140	140	140	140	140	140
Ngā Awa Pūrua – Ngā Tamariki[1]	82	128	128	128	128	128	128	128	128	128	128	128
Ohaaki	56	56	56	56	56	56	56	56	56	56	56	56
Ongarue (Mokauiti, Kuratau and Wairere Falls)	13	13	13	13	13	13	13	13	13	13	13	13
Poihipi	51	51	51	51	51	51	51	51	51	51	51	51
Rangipo	120	120	120	120	120	120	120	120	120	120	120	120
Tararua Wind Central – Tararua Wind Stage 3	93	93	93	93	93	93	93	93	93	93	93	93
Tararua Wind Central – Te Rere Hau	49	49	49	49	49	49	49	49	49	49	49	49
Te Mihi[2]	175	175	276	276	276	276	276	276	276	276	276	276
Tokaanu	240	240	240	240	240	240	240	240	240	240	240	240
Wairakei[2]	132	132	67	67	67	67	67	0	0	0	0	0
Wairakei (Hinemaiaia) (Rotokawa) (Te Huka)	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30	 6 30 30
Woodville – Te Apiti	90	90	90	90	90	90	90	90	90	90	90	90

1. Mercury is building a 46 MW expansion to its Ngā Tamariki geothermal plant. First power is expected late 2025.
2. Contact Energy confirmed, in November 2024, its redevelopment plan for the Wairakei steam field. A new 101 MW geothermal plant will be built in late 2027 at Te Mihi (Te Mihi Stage 2). Contact will retain 67 MW of capacity at the Wairakei station from mid-2027 until mid-2031.

11.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Central North Island region.

11.3 Grid enhancement approach and inputs

11.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Central North Island region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-

3 Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

term development opportunities). In developing grid enhancement to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 11.4 and 11.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

11.3.2 Central North Island significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 11-3 lists the significant upcoming risk-based replacement and refurbishment work proposed for the Central North Island region for the next 15 years that may significantly impact related system issues or connected parties.

Table 11-3: Proposed significant upcoming replacement and refurbishment work for the Central North Island region

Description	Tentative year	E&D issue
Bunnythorpe–T9/T10 supply transformers refurbishment	2028-2030	11.5.1
Bunnythorpe–T15/T16 (traction) transformers' bushing replacement	2028-2030	None
Bunnythorpe–Woodville special protection scheme replacement	2028-2029	11.4.3
Haywards–Wilton–Linton–1 and 2 circuits: reconductor Judgeford to Wilton section reconductor 19 km north from Judgeford towards Linton	 2019-2025 2028-2030	 None None
Linton–T3 supply transformer replacement	2037-2039	11.5.4
Mangahao supply transformers replacement	2028-2030	11.5.5
Marton 33 kV outdoor to indoor conversion Marton–T1/T2 supply transformer replacement	2025-2026 2032-2034	11.5.7
Mangamaire auto-changeover scheme replacement Mangamaire–T2/T3 supply transformers' bushing replacement	2026-2028 2026-2028	11.4.3 11.5.6
Mataroa supply transformer replacement	2032-2034	11.5.8
Ongarue supply transformer replacement	2036-2038	11.5.11
Rangipo protection replacement and outdoor switchyard upgrade Rangipo 220 kV gas insulation substation and 220 kV cable replacement	2027-2030 2030-2035	Note 1
Tangiwai-T2/T3 (traction) transformers' bushing replacement	2038-2040	None
Tokaanu 33 kV outdoor to indoor conversion Tokaanu supply transformers' bushing replacement Tokaanu supply transformers replacement	2026-2028 2024-2026 2035-2037	None None None
Waipawa 33 kV outdoor to indoor conversion Waipawa supply transformers replacement Waipawa Benchmark Agreement protection upgrade	2024-2026 2033-2035 2025-2027	11.5.15
Wairakei supply transformers replacement	2022-2025	11.5.16

1. The ratings of the 220 kV cable sections at Rangipo limits the potential for upgrading the through-transmission on the Bunnythorpe–Wairakei A line. The cable limitation will be addressed as part of the Rangipo gas insulation substation and cable replacement.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

11.3.3 Central North Island asset feedback

The Asset Feedback Register includes no E&D-related entries specific to the Central North Island region.

11.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Central North Island region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 11-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 11-4: Changes within the wider region since the 2023 TPR

Issues	Change
Palmerston North supply capacity	Removed. Reduced load forecast.
Bunnythorpe–Marton–Whanganui 110 kV transmission capacity	Added. Increased load forecast.
Dannevirke–Woodville 110 kV transmission capacity	Added. Increased load forecast.

The overview of transmission capability within the wider Central North Island region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
11.4.1	Bunnythorpe interconnecting transformer capacity
11.4.2	Bunnythorpe–Mataroa 110 kV transmission capacity
11.4.3	Bunnythorpe–Woodville 110 kV transmission capacity
11.4.4	Bunnythorpe–Marton–Whanganui 110 kV transmission capacity
11.4.5	Dannevirke–Woodville 110 kV transmission capacity

11.4.1 Bunnythorpe interconnecting transformer capacity

Issue

Two 220/110 kV interconnecting transformers at Bunnythorpe supply the majority of the 110 kV transmission network in the Central North Island, parts of the Wairarapa load in the Wellington region and also parts of the load in the Taranaki region.

The Bunnythorpe interconnecting transformers provide:

- a total nominal installed capacity of 300 MVA
- n-1 capacity of 178/178 MVA (summer/winter). The transformers' capacity is limited by 110 kV disconnectors and bus conductor; with these limits resolved, the n-1 capacity will be 222/232 MVA (summer/winter).

The loading of these interconnecting transformers depends on the load and generation levels in the Central North Island, Taranaki and Wellington regions, and on the HVDC transfer level.

During periods of low generation and high load in these three regions, and low or no HVDC north transfer, an outage of one interconnecting transformer at Bunnythorpe can overload the 110 kV disconnectors and bus conductor associated with the parallel transformer, towards the end of the forecast period.

What next?

We will monitor the interconnecting transformer capacity issue. Closer to the need date we will upgrade the 110 kV disconnectors and bus conductor to release the transformers' full post-contingency rating.

Potential generation developments on the 110 kV network may create loading constraints due to high power flows from 110 kV to 220 kV during periods of low load and high generation. This may bring forward the need for the Bunnythorpe interconnection capacity upgrade, see section 11.8.6.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Base E&D capex investments

Project name:	Bunnythorpe interconnecting transformer capacity release
Project description:	Replace 110 kV disconnectors and bus conductor for T2 and T3
Project's state of completion:	Possible
Grid need date:	2034
Indicative cost [$ million]:	1.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

11.4.2 Bunnythorpe–Mataroa 110 kV transmission capacity

Issue

The Bunnythorpe–Mataroa single circuit is rated at 57/70 MVA (summer/winter). This circuit can overload for some generation dispatch patterns (such as high HVDC north transfer, high wind generation in the lower North Island, or low Arapuni generation) and an outage of a 220 kV Hamilton–Whakamaru, Tokaanu–Whakamaru, Huntly–Stratford, Stratford–Taumarunui, Bunnythorpe–Tokaanu, Huntly–Te Kowhai, Taumarunui–Te Kowhai, Bunnythorpe–Tangiwai or Rangipo–Wairakei circuit.

The frequency and magnitude of the circuit overload increases with:

- increasing load supplied from the 110 kV system along the Bunnythorpe–Ongarue–Arapuni–Hamilton corridor.
- increasing levels of generation injection into Bunnythorpe, from existing or new generation.
- decreasing levels of generation output at Arapuni or Karapiro.

The series reactor and special protection scheme at Mataroa help manage this issue[4].

What next?

As part of our NZGP1 Major Capex Project, we will introduce a permanent 110 kV system split at Ongarue by mid-2026. This system split will prevent overloads on the Bunnythorpe–Mataroa 110 kV circuit, thereby allowing better use of the upgraded 220 kV Bunnythorpe–Tokaanu–Whakamaru 220 kV corridor to send power northwards (see Chapter 6). This proposed system split would put Mataroa, Ohakune, National Park and Ongarue on switched n-1 security. A load restoration scheme would be implemented to minimise outage time. See section 11.8.3 for further details. Once this system split is implemented, the Mataroa series reactor will be normally bypassed and the Bunnythorpe–Mataroa circuit overload special protection scheme will be normally disabled.

11.4.3 Bunnythorpe–Woodville 110 kV transmission capacity

Issue

The Bunnythorpe–Woodville circuits are rated at 57/70 MVA (summer/winter). The loading on these circuits depends on the HVDC transfer direction and magnitude, Te Apiti generation and the loads in Wellington, Wairarapa, Dannevirke, and Waipawa. The circuits may overload for an outage of:

- a Bunnythorpe–Woodville circuit, overloading the parallel circuit during high HVDC south flow and low Te Apiti generation.
- a 220 kV Bunnythorpe–Paraparaumu–Haywards, Bunnythorpe–Linton or Haywards–Wilton–Linton circuit during high HVDC south flow and low Te Apiti generation.
- a 220 kV bus at Bunnythorpe, Linton or Tararua Central overloading both Bunnythorpe–Woodville circuits during high HVDC south flow and low Te Apiti generation.
- both 110 kV circuits between Haywards and Greytown due to a 110 kV bus fault at Upper Hutt (see Chapter 14).

[4] The special protection scheme will open the Mataroa–Ohakune circuit if a sustained overload is detected on the Bunnythorpe–Mataroa circuit. This leaves Ongarue, National Park, Ohakune and Mataroa on n security.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

What next?

For a 220 kV circuit outage between Bunnythorpe and Haywards, we manage the overloading operationally by:

- restricting HVDC south flow, or
- opening the 110 kV Mangamaire–Masterton circuit at Mangamaire, leaving Mangamaire on n security. The Mangamaire auto-changeover scheme will automatically restore supply to Mangamaire from Masterton following a Mangamaire–Woodville outage.

Our investigation shows that the risk of the Bunnythorpe–Woodville circuits overloading at present is very low.

There is also an existing special protection scheme to manage overloading on a Bunnythorpe–Woodville circuit if the other Bunnythorpe–Woodville circuit trips (but not if both Bunnythorpe–Woodville circuits overload simultaneously). The scheme is scheduled for risk-based condition replacement in 2028-2029, as set out in Table 11-3. As part of the replacement, we will upgrade the scheme to operate for simultaneous overloads on both Bunnythorpe–Woodville circuits.

There is also significant potential for development of additional generation on the 110 kV system between Greytown (Wairarapa) and Waipawa (southern Hawke's Bay). If built, this generation will increase the frequency and magnitude of overloading of the Bunnythorpe–Woodville circuits for power flows from Woodville to Bunnythorpe. See section 11.8.5 for more details.

11.4.4 Bunnythorpe–Marton–Whanganui 110 kV transmission capacity

Issue

The Bunnythorpe–Marton–Whanganui circuits are rated at 66/80 MVA (summer/winter). The loading on these circuits depends on the load and generation levels in Taranaki, the load at Marton and the amount of generation excess flowing northward from Bunnythorpe (from wind generation and/or the HVDC link).

During periods of high load, low Taranaki 110 kV generation and high HVDC north transfer, an outage of a 110 kV Bunnythorpe–Marton–Whanganui circuit may cause the circuit section between Marton and Bunnythorpe on the parallel circuit to overload from winter 2030.

What next?

There is currently a committed project for a new 220/110 kV substation near Hawera within the Taranaki region. The commissioning of this substation will alleviate the constraints on these circuits. However, during extreme scenarios (peak Taranaki load and no generation at the Waipipi wind farm), we may still see transmission issues towards the second half of the forecast period. This issue is also heavily influenced by load increase at Marton. The proposed special protection scheme to manage n-1 capacity issues on the Marton supply transformers (see section would also address the Bunnythorpe–Marton–Whanganui transmission capacity issue.

We will continue to monitor the transmission capacity in this region. See the Taranaki chapter (Chapter 12) for more information on issues and developments in this area.

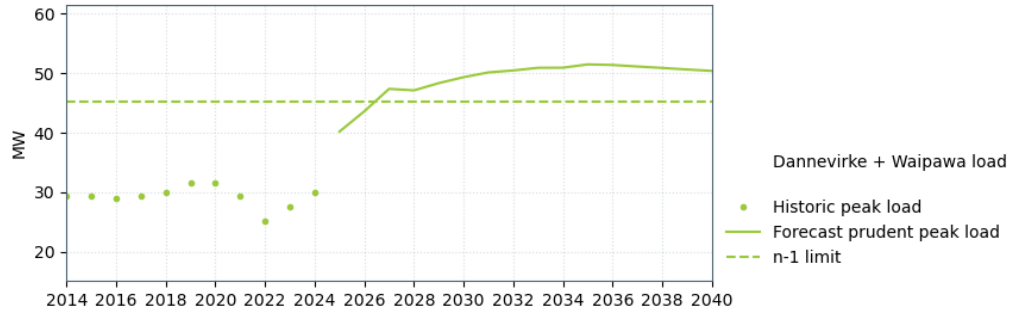
11.4.5 Dannevirke–Woodville 110 kV transmission capacity

Issue

The Dannevirke–Woodville section of the Woodville–Dannevirke–Waipawa double-circuit line is rated at 50/62 MVA per circuit (summer/winter). As the 110 kV network is normally split between Fernhill and Waipawa, the loading on this line section depends on the load at Dannevirke and Waipawa. During peak load periods, this section may overload for an outage of the parallel Woodville–Dannevirke–Waipawa circuit. See Figure 11-4 below.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Figure 11-4: Dannevirke–Woodville 110 kV circuit capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss this issue with the impacted customers, Scanpower and Centralines. The load forecast provided by the customers includes about 4 MW of relatively uncertain step loads.

Possible options include:

- implementing a circuit overload special protection scheme on both Woodville–Dannevirke–Waipawa 110 kV circuits to allow them to operate above their n-1 limit. The scheme would reduce load at Dannevirke and/or Waipawa when an outage of one of the circuits overloads the parallel circuit.
- thernally upgrading both Dannevirke–Woodville circuit sections to increase the transmission capacity.

Base E&D capex investments

Project name:	Dannevirke–Woodville special protection scheme
Project description:	Protect the Dannevirke–Woodville section of the Woodville–Dannevirke–Waipawa circuit from overloads following a 110 kV circuit outage.
Project's state of completion:	Possible
Grid need date:	2027
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

11.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 11-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 11-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Bunnythorpe supply capacity	Removed. Reduced load forecast
Ongarue supply capacity	Removed. Reduced load forecast
Tangiwai supply capacity	Removed. Load no longer exists due to mill closure
Wairakei supply capacity	Removed. Supply transformers upgraded
Woodville supply capacity	Removed. Reduced load forecast

The overview of transmission capability for each grid exit point within the Central North Island region is listed below. Where an issue is identified we list options to address it.

Section number	Description
11.5.1	Bunnythorpe (Powerco) supply capacity

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Section number	Description
11.5.2	Bunnythorpe (KiwiRail) supply capacity
11.5.3	Dannevirke supply capacity
11.5.4	Linton supply capacity
11.5.5	Mangahao supply capacity
11.5.6	Mangamaire supply capacity
11.5.7	Marton supply capacity and low voltage
11.5.8	Mataroa supply capacity, security and low voltage
11.5.9	National Park supply capacity and security
11.5.10	Ohakune supply capacity and security
11.5.11	Ongarue supply capacity, security
11.5.12	Tangiwai supply capacity
11.5.13	Tangiwai (KiwiRail) supply capacity
11.5.14	Tokaanu supply security
11.5.15	Waipawa supply capacity, security and low voltage
11.5.16	Wairakei supply capacity
11.5.17	Woodville supply capacity

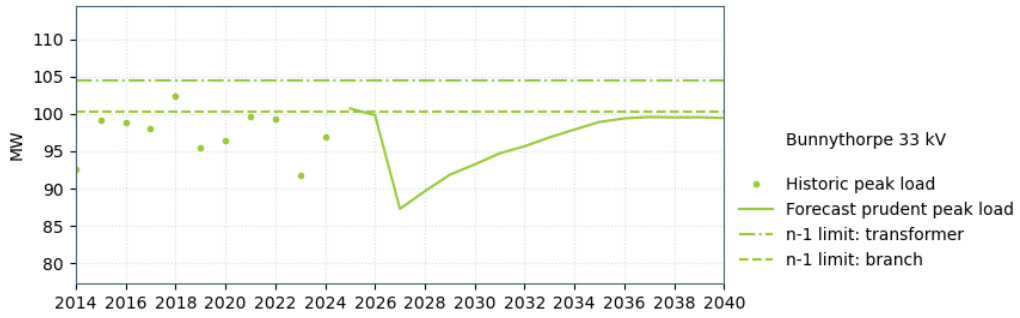
11.5.1 Bunnythorpe (Powerco) supply capacity

Two 220/33 kV transformers (T9 and T10) supply the load at Bunnythorpe, providing a total nominal installed capacity of 166 MVA. The transformers' capacity is limited by the 33 kV cable on T9.

Peak load at Bunnythorpe is forecast to reach the n-1 capacity of the supply transformers in winter 2025 before decreasing due to permanent load transfers to Linton and Marton (see Figure 11-5).

Tararua wind generation (North) is connected to the Bunnythorpe 33 kV bus; the forecast conservatively assumes that the wind farm is not generating during peak load periods.

Figure 11-5: Bunnythorpe supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

11.5.2 Bunnythorpe (KiwiRail) supply capacity

Two 220/55 kV traction transformers at Bunnythorpe supply the KiwiRail North Island Main Trunk railway line. The two transformers are operated normally split, each providing n security to a portion of the railway line. The average transformer loading is low, with high levels of peak load occurring for only a few minutes at a time. Therefore, we do not assess the capacity of traction transformers in the TPR.

11.5.3 Dannevirke supply capacity

Issue

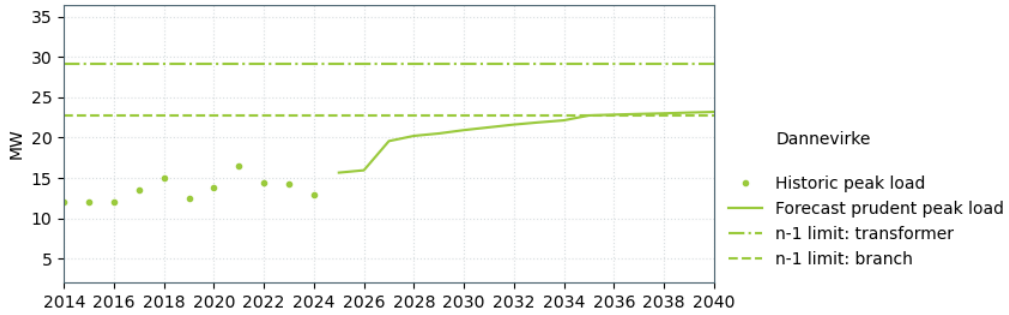
Two 110/11 kV transformers supply Dannevirke's load, providing a total nominal installed capacity of 40 MVA. The transformers' capacity is currently limited first by a metering limit and then by 11 kV cables on both transformers.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

There are no line circuit breakers at Dannevirke, so a Woodville–Dannevirke–Waipawa circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[5], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Dannevirke is forecast to exceed the n-1 capacity of the supply transformers from winter 2036 (see Figure 11-6).

Figure 11-6: Dannevirke supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will take advantage of the required recalibration of the revenue metering units (RMU) around the end of 2028 to remove the metering limit. We will investigate the use of cyclic ratings for the transformers' 11 kV cables closer to the need date. This would address the Dannevirke supply capacity issue for the forecast period.

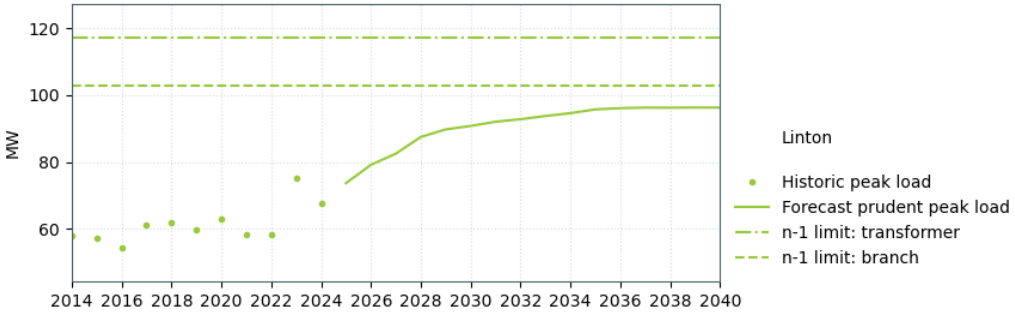
11.5.4 Linton supply capacity

Two 220/33 kV transformers (rated at 100 MVA and 120 MVA) supply Linton's load, providing a total nominal installed capacity of 220 MVA. The transformers' capacity is limited by protection settings.

Peak load at Linton is within the n-1 capacity of the supply transformers for the forecast period (see Figure 11-7).

Tararua wind generation (South) is connected to the Linton 33 kV bus; the forecast conservatively assumes that the wind farm is not generating during peak load periods.

Figure 11-7: Linton supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

11.5.5 Mangahao supply capacity

Issue

The Mangahao load is supplied by:

- two 110 kV circuits from Bunnythorpe, each rated at 48/59 MVA (summer/winter)

[5] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

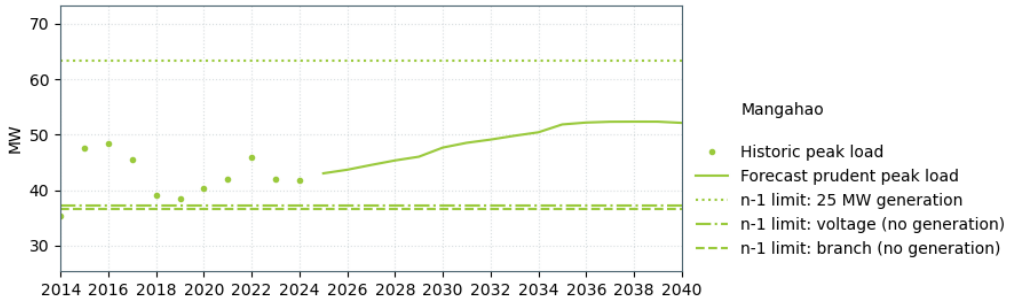
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- two 110/33 kV transformers providing a total nominal installed capacity of 60 MVA.

There is no 110 kV bus at Mangahao, so a Bunnythorpe–Mangahao circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[6], which is done restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Mangahao already exceeds the n-1 capacity of the supply transformers (see Figure 11-8). The forecast conservatively assumes the Mangahao power station, connected to the 33 kV bus, is not generating. When Mangahao is not generating, low 33 kV voltage following an outage of either a circuit or supply transformer will also limit the supply capacity. This low voltage is due to the lack of on-load tap changers on the 110/33 kV transformers.

Figure 11-8: Mangahao supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The supply transformer overload and low voltage issues are managed operationally as Mangahao generation (25 MW) is usually available during peak load periods. In addition, we have implemented one-hour emergency ratings on the Mangahao supply transformers. The resulting supply capacity increase is not large enough to prevent the n-1 issue without Mangahao generation.

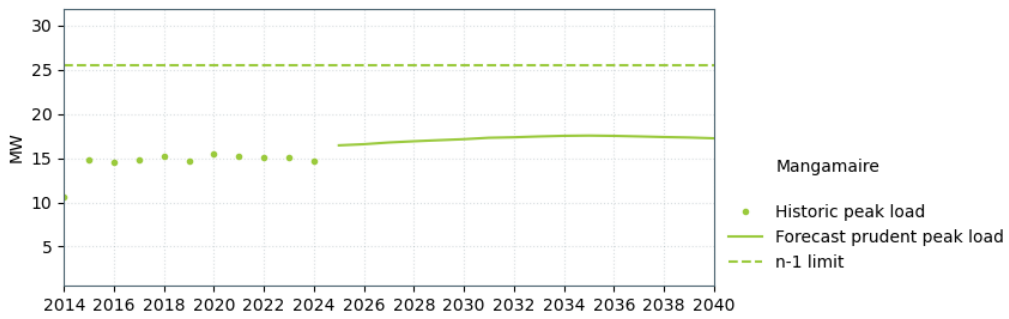
Electra is investigating a new 220/33 kV grid exit point close to Levin on the Bunnythorpe–Haywards 220 kV line to supply its northern network more efficiently. If this progresses, then the Mangahao GXP will be decommissioned and the hydro generation will be embedded in the Electra network. Alternatively, if the Mangahao GXP is kept in service, we would take advantage of the planned supply transformer risk-based condition replacement around 2028-2030 to install higher rated transformers with on-load tap changers.

11.5.6 Mangamaire supply capacity

Two 110/33 kV transformers supply Mangamaire's load, providing a total nominal installed capacity of 60 MVA. The transformers' capacity is limited by a metering limit.

Peak load at Mangamaire is within the n-1 capacity of the supply transformers for the forecast period (see Figure 11-9).

Figure 11-9: Mangamaire supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[6] The System Operator's Principal Performance Objectives require that it anticipates and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

11.5.7 Marton supply capacity and low voltage

Issue

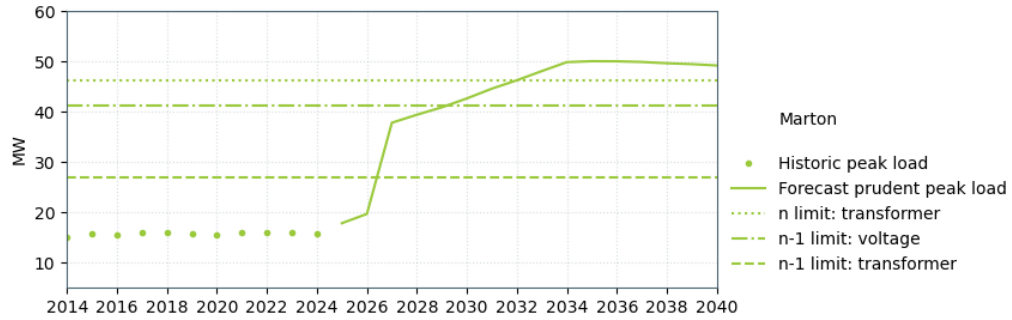
Two 110/33 kV transformers (rated at 20 MVA and 30 MVA) supply Marton's load, providing a total nominal installed capacity of 50 MVA.

There are no line circuit breakers at Marton, so a Bunnythorpe–Marton–Whanganui circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[7], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Powerco plans to permanently shift some load from Bunnythorpe to Marton in in 2027[8]. With this load transfer, the peak load at Marton is forecast to exceed the n-1 capacity of the supply transformers from winter 2027 (see Figure 11-10). The Marton supply bus voltage may drop below 0.95 pu for an outage of a supply transformer or Bunnythorpe–Marton–Whanganui circuit at peak load from winter 2029.

The n capacity of the smaller transformer (T2) is forecast to be exceeded at peak time from winter 2032.

Figure 11-10: Marton supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We discussed the options to manage the Marton low voltage and supply capacity issues with Powerco. The preferred solution consists of:

- managing supply bus low voltage by changing the transformers' fixed tap position as load grows
- implementing a special protection scheme to manage the transformers' overload and low voltage issue by tripping load post-contingency.

In the longer-term, we will take advantage of risk-based condition replacement of the two supply transformers, currently scheduled in 2034, to install higher capacity units. This replacement may be brought forward slightly to prevent n capacity issues. We will refine the timing of the replacement and the ratings of the new transformers closer to the need date.

Customer investments

Project name:	Marton supply capacity – short term
Project description:	Install overload protection scheme on the Marton supply transformers
Project's state of completion:	Committed
Grid need date:	2027
Indicative cost [$ million]:	0.65
Reliability or Economic investment?	Reliability (Grid Reliability Report)

[7] The System Operator's Principal Performance Objectives require that it anticipates and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

[8] The load transfer from Bunnythorpe to Marton depends on the commissioning date of the Marton 33 kV ODID project.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

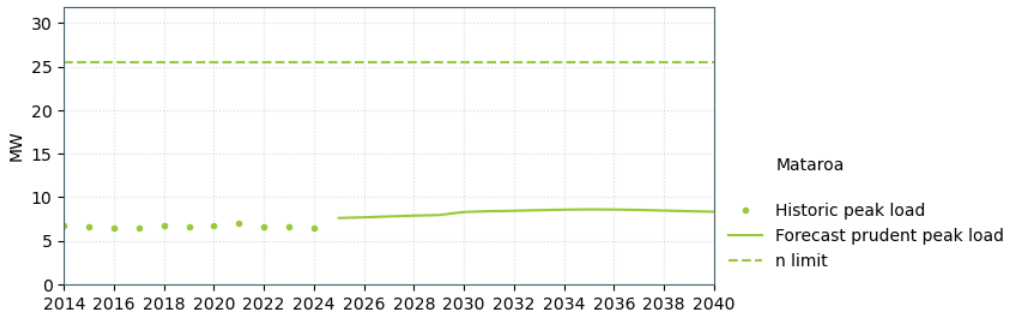
11.5.8 Mataroa supply capacity, security and low voltage

Issue

The load at Mataroa is supplied by a single 110/33 kV, 26 MVA supply transformer comprising three single-phase units, resulting in n security. The transformer's capacity is limited by a metering limit.

Peak load at Mataroa is within the capacity of the supply transformer for the forecast period (see Figure 11-11).

Figure 11-11: Mataroa supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

A spare on-site unit may be able to provide backup following a unit failure, with replacement taking 8-14 hours. However, this is an uncontracted spare and may not be available when needed.

As part of our NZGP1 Major Capex Project, a 110 kV system split will be introduced at Ongarue by mid-2026. This will put Mataroa, Ohakune, National Park and Ongarue on switched n-1 security, normally supplied from Bunnythorpe. See section 11.8.3 for details.

The supply bus voltage at Mataroa is forecast to fall below 0.95 pu following an outage of the Bunnythorpe–Mataroa circuit towards the second half of the planning period. With the Ongarue system split in place, the low supply bus voltage is seen at Mataroa after the regional supply is restored from the Waikato region (Arapuni) The supply transformer is not equipped with an on-load tap changer.

What next?

Powerco considers the lack of n-1 transformer security can be managed operationally during the forecast period. We have not planned any investments to increase security at Mataroa.

The supply transformer is due for condition-based replacement around 2032-2034. The replacement transformer will be equipped with an on-load tap changer.

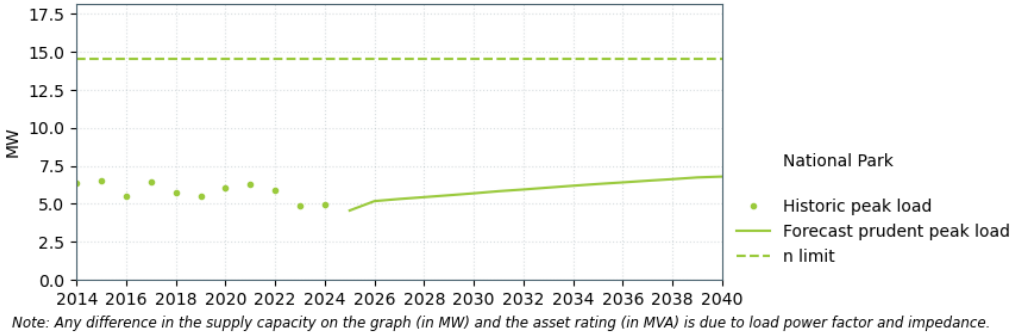
11.5.9 National Park supply capacity and security

Issue

The load at National Park is supplied through a single Ohakune–National Park–Ongarue 110 kV circuit and a single 110/33 kV, 15 MVA supply transformer, resulting in n security.

Peak load at National Park is within the capacity of the supply transformer for the forecast period (see Figure 11-12).

Figure 11-12: National Park supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

The substation allows the connection of our mobile substation for transformer maintenance outages, subject to its availability and location.

As part of our NZGP1 Major Capex Project, a 110 kV system split will be introduced at Ongarue by mid-2026. This will put Mataroa, Ohakune, National Park and Ongarue on switched n-1 security, normally supplied from Bunnythorpe. See section 11.8.3 for details.

What next?

Some load can be backfed through The Lines Company's distribution system. The Lines Company considers the lack of n-1 security is operationally manageable for the forecast period. We have not planned any investments to increase security at National Park.

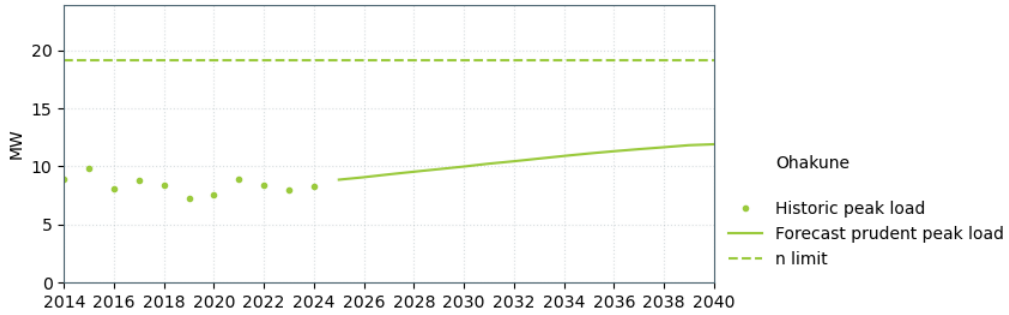
11.5.10 Ohakune supply capacity and security

Issue

The load at Ohakune is supplied by a single 110/11 kV, 20 MVA supply transformer, resulting in n security.

Peak load at Ohakune is within the capacity of the supply transformer for the forecast period (see Figure 11-13).

Figure 11-13: Ohakune supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The substation allows the connection of our mobile substation for transformer maintenance outages, subject to its availability and location.

As part of our NZGP1 Major Capex Project, a 110 kV system split will be introduced at Ongarue by mid-2026. This will put Mataroa, Ohakune, National Park and Ongarue on switched n-1 security, normally supplied from Bunnythorpe. See section 11.8.3 for details.

What next?

Some of The Lines Company's load can be backfed from Tangiwai. Our customers, The Lines Company and Powerco, have not requested a higher security level at Ohakune. We have not planned any investments to increase security at Ohakune.

11.5.11 Ongarue supply capacity, security and low voltage

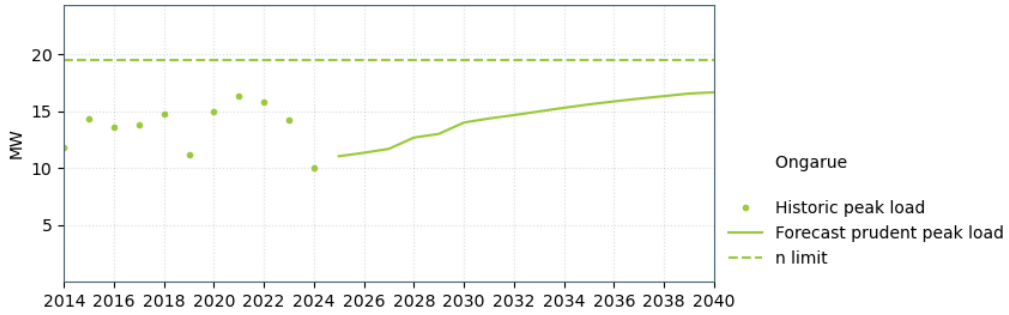
Issue

The load at Ongarue is supplied by a single 110/33 kV, 20 MVA supply transformer comprising three single-phase units, resulting in n security.

Peak load at Ongarue is within the capacity of the supply transformer for the forecast period (see Figure 11-14).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 11-14: Ongarue supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

As part of our NZGP1 Major Capex Project, a 110 kV system split will be introduced at Ongarue by mid-2026. This will put Mataroa, Ohakune, National Park and Ongarue on switched n-1 security, normally supplied from Bunnythorpe. See section 11.8.3 for details.

What next?

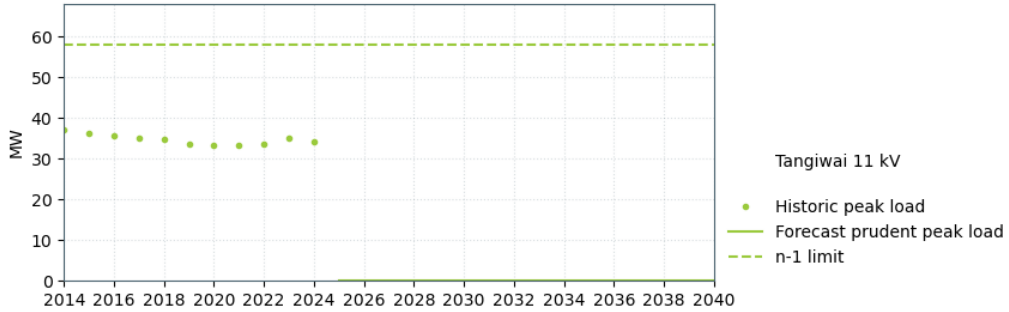
The lack of n-1 security can be managed by backfeeding the load through The Lines Company's distribution system. We have no investments planned to increase supply security at Ongarue.

11.5.12 Tangiwai supply capacity

Two 220/11 kV transformers supply Tangiwai's load, providing a total nominal installed capacity of 120 MVA.

Following Winstone Pulp International's decision to indefinitely close its Tangiwai Sawmill and Karioi Pulpmill in 2024, no load is supplied by the Tangiwai 220/11 kV transformers (see Figure 11-15).

Figure 11-15: Tangiwai 11 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The Lines Company may still use the GXP to operationally backfeed some of their load during outages. There is also interest in connecting potential solar generation at Tangiwai.

11.5.13 Tangiwai (KiwiRail) supply capacity

Two 220/55 kV traction transformers at Tangiwai supply the KiwiRail North Island Main Trunk railway line. The two transformers are operated normally split, each providing n security to a portion of the railway line. The average transformer loading is low, with high levels of peak load occurring for only a few minutes at a time. Therefore, we do not assess the capacity of traction transformers in the TPR.

11.5.14 Tokaanu supply security

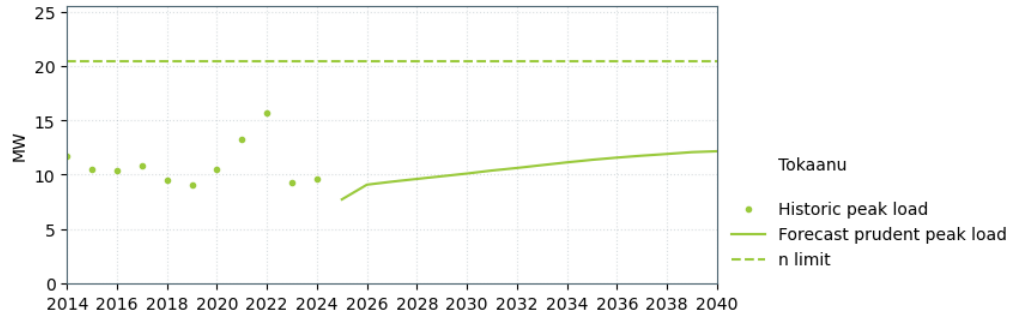
Issue

The load at Tokaanu is supplied by a single 220/33 kV, 20 MVA supply transformer, with a second transformer that can be manually switched into service when required. This means Tokaanu does not have no-break transformer security. Tripping the on-load transformer will result in a loss of supply until the other transformer is manually switched into service.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Peak load at Tokaanu is within the capacity of the supply transformer for the forecast period (see Figure 11-16).

Figure 11-16: Tokaanu supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The Lines Company has not requested a higher level of security at Tokaanu. We have no investments planned to increase supply security at Tokaanu.

11.5.15 Waipawa supply capacity, security and low voltage

Issue

Waipawa is normally supplied at 110 kV from Woodville via Dannevirke. Waipawa has loads at 33 kV and 11 kV. The 11 kV is supplied from the 33 kV via a single 33/11 kV transformer.

Two 110/33 kV transformers (rated at 20 MVA and 30 MVA) supply Waipawa's combined 33 kV and 11 kV load, providing a total nominal installed capacity of 50 MVA. The transformers' capacity is limited by the 33 kV protection settings.

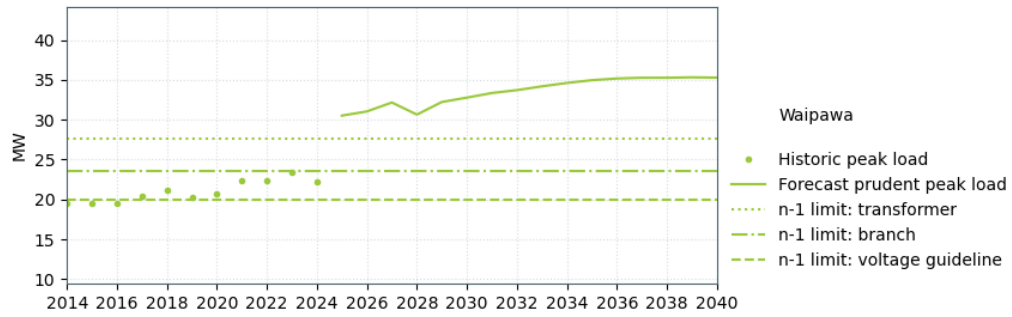
There is currently no 110 kV bus at Waipawa, so a Woodville–Dannevirke–Waipawa circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[9], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Waipawa 33 kV (combined 33 kV and 11 kV load) is forecast to exceed the n-1 capacity of the supply transformers from winter 2025 (see Figure 11-17). Peak load at Waipawa is also limited by low 33 kV bus voltage for an outage of a Woodville–Dannevirke–Waipawa circuit.

The Waipawa supply transformers have off-load tap changers, so these transformers cannot be used to manage the post-contingent voltage. This low voltage issue is influenced not only by the size of the load at Waipawa, but also by the size of the load at Dannevirke, as both GXPs are normally supplied by the same 110 kV circuits.

The Bunnythorpe interconnecting transformers which have on-load tap changers can assist with, but not eliminate, the low voltage issue.

Figure 11-17: Waipawa 110/33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[9] The System Operator's Principal Performance Objectives require that it anticipates and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

A single 33/11 kV, 10 MVA transformer supplies Waipawa's 11 kV load, resulting in n security. Peak load at Waipawa 11 kV is within the capacity of the supply transformer for the forecast period.

What next?

The Waipawa 110 kV disconnectors are motorised and can be controlled remotely via SCADA. Therefore, if a low voltage occurs post-contingency, load can be quickly transferred from the Central North Island to the Hawke's Bay region.

A project is underway to convert the Waipawa 33 kV outdoor switchyard to an indoor switchboard. The protection limit be removed as part of the project, which will ease but not resolve the overloading issue for the forecast period.

A protection upgrade at Waipawa is scheduled for completion by 2027. As part of this work a solid 110 kV bus is proposed for Waipawa. If implemented, an outage of a Woodville–Dannevirke–Waipawa circuit would no longer also disconnect a 110/33 kV supply transformer, and therefore load could be allowed above the n-1 limit pre-contingency.

We will monitor the low voltage and capacity issues and discuss options with Centralines.

Possible options include:

- installing a capacitor bank on the 33 kV bus to address the low voltage
- installing a special protection scheme to provide overload protection on the remaining supply transformer to trip some load following an outage of the parallel transformer
- bringing forward the planned risk-based replacement of one or both supply transformers (currently scheduled for 2033-2035). This would resolve both the capacity issue and the low voltage issue, as new transformers would have higher capacity and on-load tap changers.

Further investments to address the supply capacity issue will be customer funded.

Centralines will manage the lack of n-1 security for Waipawa's 11 kV load operationally. We have no investments planned to increase security to the Waipawa 11 kV load.

Customer investments

Project name:	Waipawa supply capacity
Project description:	Install overload protection scheme on the Waipawa supply transformers
Project's state of completion:	Possible
Grid need date:	2025 (Customer initiated)
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

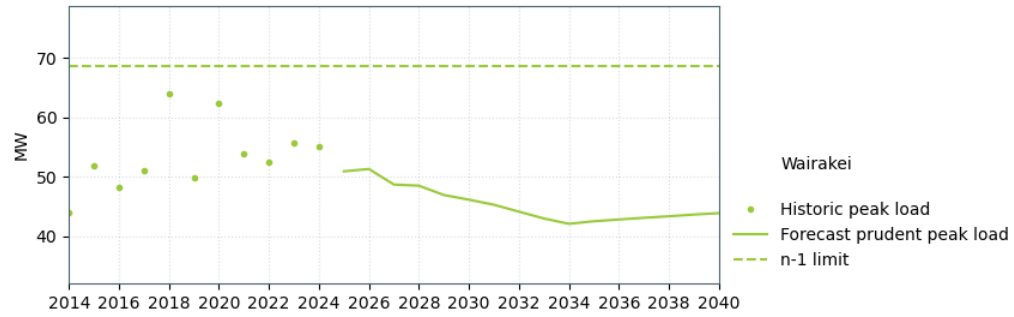
11.5.16 Wairakei supply capacity

Both 220/33 kV supply transformers at Wairakei will be replaced by transformers with a nominal capacity of 60 MVA by the end of 2025 under a replacement and refurbishment project. The supply capacity analysis assumes the new transformers are commissioned.

Peak load at Wairakei is within the n-1 capacity of the supply transformers for the forecast period (see Figure 11-18). There are two geothermal generators and a hydro generator connected within the distribution network supplied from the Wairakei 33 kV bus, and the forecast conservatively assumes they are not generating during peak load periods.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Figure 11-18: Wairakei supply capacity



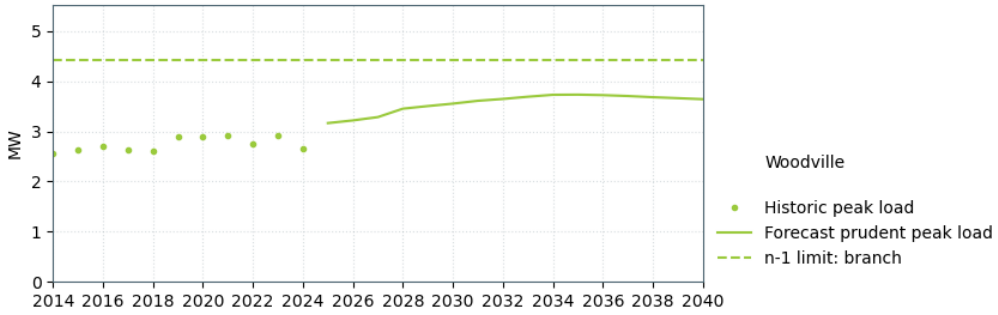
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

11.5.17 Woodville supply capacity

Two 110/11 kV transformers supply Woodville's load, providing a total nominal installed capacity of 20 MVA. The transformers' capacity is currently limited by metering limits.

Peak load at Woodville is within the n-1 branch capacity of the supply transformers for the forecast period (see Figure 11-19).

Figure 11-19: Woodville supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

11.6 Central North Island bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 11-6 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 11-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Aratiatia 220 kV	-	Aratiatia	-	Note 1
Bunnythorpe 110 kV	-	-	Bunnythorpe–Woodville overloading Regional low voltage Short loss of supply to several GXPs	11.4.3 Note 2 Note 2
Bunnythorpe 220 kV	-	-	Bunnythorpe–Woodville overloading Regional low voltage	11.6.1
Linton 220 kV	-	Turitea	-	Note 3
Mangamaire 110 kV	Mangamaire	-	-	Note 1
Mataroa 110 kV	Mataroa	-	-	Note 1

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Ngā Awa Pūrua 220 kV	-	Ngā Awa Pūrua Ngā Tamariki	- -	Note 4 Note 4
Ohaaki 220 kV	-	Ohaaki	-	Note 5
Ohakune 110 kV	Ohakune National Park	- -	- -	Note 1 Note 6
Ongarue 110 kV	Ongarue	-	-	Note 1
Rangipo 220 kV	-	Rangipo	-	Note 1
Tokaanu 220 kV	Tokaanu	-	-	11.5.14
Upper Hutt 110 kV (Wellington region)	Upper Hutt (Wellington region)	-	Bunnythorpe–Woodville overloading	11.4.3
Woodville 110 kV	Dannevirke Waipawa Woodville -	- - - Te Apiti	- - - -	Note 7 Note 7 Note 1 Note 1
Wairakei 220 kV	- -	Aratiatia Wairakei	- -	Note 8 Note 9

1. There is only a single bus section at Aratiatia, Mangamaire, Mataroa, Ohakune, Ongarue, Rangipo and Woodville. Therefore, a bus fault will cause loss of generation and/or loss of supply.
2. An outage of a Bunnythorpe 110 kV bus section will also disconnect several circuits which may cause low voltage at Marton (see section 11.5.7), Mataroa (see section 11.5.8) and Waipawa (see section 11.5.15).
   After a system split is implemented at Ongarue (see 11.8.3), an outage of the Bunnythorpe 110 kV bus that disconnects the Bunnythorpe–Mataroa circuit will also cause a short loss of supply at Mataroa, Ohakune, National Park and Ongarue.
3. Linton has a split 220 kV bus. The Turitea wind farm is connected to only one bus section and an outage of this bus section disconnects the wind farm.
4. Ngā Awa Pūrua has a single bus, with a single connection to Ngā Tamariki. A bus outage at Ngā Awa Pūrua will disconnect all generation at Ngā Awa Pūrua and Ngā Tamariki.
5. Ohaaki has two bus sections and two generators, although only one generator is used. Therefore, an outage of the bus with the generator in service will disconnect all generation at Ohaaki.
6. National Park is supplied from the Ohakune–National Park–Ongarue circuit. Because there is no bus zone protection at Ohakune, a fault on the Ohakune 110 kV bus will disconnect the circuit, causing loss of supply at National Park.
7. Dannevirke and Waipawa are normally supplied via the Waipawa–Dannevirke–Woodville circuits as a spur from Woodville. An outage of the Woodville 110 kV bus disconnects both circuits, causing loss of supply.
8. Aratiatia is connected to Wairakei through a single circuit. A Wairakei bus outage that disconnects this circuit disconnects the Aratiatia generation station.
9. All generators at Wairakei connect to the same bus section, so an outage of this bus section disconnects all generators. The generators embedded behind the Wairakei 33 kV bus would remain connected.

The customers at these grid exit and injection points (Mercury, Contact Energy, Genesis Energy, Meridian Energy, Manawa Energy, Scanpower, Powerco, The Lines Company, and Centralines) have not requested a higher security level. Unless otherwise noted, we do not propose increasing bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

11.6.1 Bunnythorpe 220 kV bus security

Issue

The Bunnythorpe 220 kV bus is divided into three bus sections. One of the sections connects the following:

- 220 kV Brunswick–Bunnythorpe–1 circuit
- 220 kV Bunnythorpe–Paraparaumu–Haywards–1 circuit
- 220 kV Bunnythorpe–Linton–2 circuit
- 220 kV Bunnythorpe–Tokaanu–2 circuit
- 220/110 kV Bunnythorpe–T3 interconnecting transformer
- 220/33 kV Bunnythorpe–T10 supply transformer.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

A contingency on this bus section can lead to low supply bus voltages in the Central North Island when the regional load is very high and the wind and hydro (Mangahao) generation in the region is very low.

This outage may also cause both Bunnythorpe–Woodville 110 kV circuits to overload for very high south flows on the grid backbone. This overload is not removed by the Bunnythorpe–Woodville special protection scheme (see section 11.4.3).

What next?

We monitor this issue and, if it becomes significant, will consider options including rearranging the bus connections at Bunnythorpe and/or installing a fourth 220 kV bus section to reduce the impact of a bus section contingency.

The Bunnythorpe–Woodville special protection scheme is due for risk-based condition replacement (see Table 11-3). We will modify the replacement scheme to also remove the overload for a Bunnythorpe 220 kV bus section outage.

11.7 Other items of interest

11.7.1 Linton 220 kV bus coupler

Issue

Linton has two 220 kV bus sections, with the circuits and supply transformers distributed evenly across the two bus sections.

During outages of the Haywards–Wilton–Linton–1 circuit, Linton Bus B is connected to the grid only through the Bunnythorpe–Tararua–Linton–1 circuit. An outage of this circuit will disconnect the following generation:

- Turitea (221 MW), connected to Linton Bus B
- Tararua Central (93 MW), tee-connected to Bunnythorpe–Tararua–Linton–1
- Te Rere Hau (49 MW), connected at Tararua Central.

It may also disconnect:

- Tararua North (34 MW), connected within the distribution network supplied from Bunnythorpe
- Tararua South (34 MW), connected within the distribution network supplied from Linton.

The Tararua North and South generation may disconnect due to the disturbance caused by the fault and tripping of Bunnythorpe–Tararua–Linton–1.

The total generation that may be tripped is 431 MW, which will usually set the reserve risk in the North Island, increasing costs of procuring reserves.

What next?

Connecting the two 220 kV buses at Linton by installing a bus coupler circuit breaker will address the issue. Turitea generation would remain connected following the tripping of Bunnythorpe–Tararua–Linton–1, so only 210 MW of generation would be disconnected.

Base E&D capex investments

Project name:	Linton 220 kV bus coupler
Project description:	Close the Linton 220 kV split bus by installing a circuit breaker
Project's state of completion:	Possible
Grid need date:	2028
Indicative cost [$ million]:	9.5
Reliability or Economic investment?	Economic

11.8 Central North Island generation opportunities and proposals

This section provides a high-level description of the Central North Island region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The Central North Island region has large and long-established generation: hydro, geothermal and wind. Developers are also investigating additional generation, principally solar but also wind and geothermal in the longer term.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
11.8.1	Generation opportunities by substation
11.8.2	Generation investigations and proposals
11.8.3	Grid backbone 220 kV capacity
11.8.4	Bunnythorpe–Ongarue 110 kV system split
11.8.5	Bunnythorpe–Woodville 110 kV circuit capacity
11.8.6	Bunnythorpe 220/110 kV interconnecting transformer capacity
11.8.7	Bunnythorpe–Marton–Whanganui 110 kV circuit capacity

11.8.1 Generation opportunities by substation

Envision Opportunities[10] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[11]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy.
- winter evening peak – wet/windy
- winter midday high – wet/calm

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

11.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[12]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

[10] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

[11] "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

[12] Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Table 11-7 shows generation and grid-scale battery projects in the Central North Island region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 11-2 instead.

Table 11-7: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Dannevirke 11 kV	Solar	Delivery[1]	25
Mangamaire–Masterton	Wind	Investigation	90
Tangiwai 220 kV	Solar + BESS	Investigation	110
Bunnythorpe–Linton	Wind	Investigation	126
Waipawa 33 kV	Solar	Investigation	43
Marton 110 kV	Solar + BESS	Investigation	50
Bunnythorpe 220 kV	Solar + BESS	Investigation	300
Waipawa 110 kV (South)	Solar	Investigation	100
Bunnythorpe–Tangiwai	Wind	Investigation	275
Dannevirke 110 kV	Solar + BESS	Investigation	72
Te Mihi	Geothermal	Investigation	90[2]
Marton 33 kV	Solar	Investigation	25
Marton 33 kV	Solar	Investigation	29
Bunnythorpe–Haywards	Solar	Investigation	180
Mangamaire 110/33 kV	Wind	Investigation	50
Mangamaire–Masterton 110 kV or Linton 220 kV	Wind	Application	100
Mangahao 33 kV	Solar	Application	30
Tangiwai 220 kV	Solar + BESS	Application	120
Bunnythorpe 220 kV	Solar + BESS	Application	525
Bunnythorpe–Brunswick	Solar + BESS	Application	200
Tokaanu–Whakamaru	Solar	Application	500
Linton 220 kV	Wind	Application	230
Mangamaire 33 kV	Solar	Application	40

1. "Delivery" is a stage in the Transpower generation queue process, it does not denote a final commitment by the developer to build the generation.
2. This is a possible further 90 MW expansion of the Te Mihi geothermal plant, on top of the 101 MW scheduled to be commissioned in 2027 (See Table 11-2).

We have received additional requests for assessment of generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of selected parts of the grid in the Central North Island region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

11.8.3 Grid backbone 220 kV capacity

The 220 kV circuits in the Central North Island all form part of the grid backbone.

As part of our Net Zero Grid Pathway Stage 1 (NZGP1) MCP, we are undertaking a staged upgrade plan of the Central North Island 220 kV grid. These upgrades increase the capacity of the transmission system to send power from Bunnythorpe north to Whakamaru and host future new generation connected directly or indirectly to the 220 kV system in the Central North Island region. For further details on the NZGP1 upgrade plan, see Chapter 6.

As more generation is developed around the Taupō area, and in the Hawke's Bay and Bay of Plenty regions, the 220 kV transmission capacity between Wairakei and Whakamaru (Wairakei Ring) may require pre-contingency generation constraints in these areas. See Chapter 6 for more details on this issue and possible solutions.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

11.8.4 Bunnythorpe–Ongarue 110 kV system split

The 110 kV system between Bunnythorpe and Ongarue will be normally split north of Ongarue by mid-2026 as part of our NZGP1 upgrade plan. This will extract the full capacity of the 220 kV Tokaanu–Whakamaru–1 and 2 circuit upgrades to maximise transmission capacity for generation export north from Bunnythorpe for existing and new generation.

This will put Mataroa, Ohakune, National Park and Ongarue on switched n-1 security, normally supplied from Bunnythorpe. There will be a brief loss of supply for 110 kV circuit trips between Bunnythorpe and Ongarue, for 110 kV bus faults at Bunnythorpe (bus section A), Mataroa and Ohakune, and for faults on the Mataroa 110/33 kV supply transformer[13]. This brief loss of supply will only occur at GXPs north of the faulted asset. We are developing an automatic load restoration scheme at Ongarue to minimise the impact of the 110 kV system split on the regional supply.

11.8.5 Bunnythorpe–Woodville 110 kV circuit capacity

There is significant scope for new solar and wind generation developments in the 110 kV area bounded by Bunnythorpe, Waipawa, Mangamaire, and Masterton/Greytown in the Wellington region. This will cause pre- and post-contingency overloading issues on the Bunnythorpe–Woodville circuits.

The Bunnythorpe–Woodville circuits are rated at 57/70 MVA (summer/winter). The circuits have a special protection scheme to manage post-contingency overloads by reconfiguring the grid and reducing generation at Te Apiti. The scheme normally ensures the low rating of the Bunnythorpe–Woodville circuits are not the cause of pre-contingency generation constraints on Te Apiti or HVDC transfer, although constraints are occasionally required.

This special protection scheme could be upgraded to include additional generation developed in the area on the generation curtailment list. Even with this upgrade, additional generation in the region would increase the frequency, duration, and magnitude of pre- and post-contingency generation constraints.

Significant additional generation could be hosted by reconductoring the Bunnythorpe–Woodville circuits to increase their ratings. It would allow more generation to be connected at Woodville or along the line and enable multiple other new generators to be easily connected in the area:

- The Woodville–Dannevirke–Waipawa–1 and 2 circuits are rated 50/62 MVA summer/winter and are a spur connection from Woodville (the system is split at Waipawa). The spur could host generation above the n-1 capacity with a special protection scheme to automatically and quickly reduce generation following a circuit outage.
- The Woodville–Mangamaire–Masterton–Greytown transmission corridor has potential to host significant new generation with a special protection scheme that reconfigures the grid to manage post-contingency circuit overloads.

The low rating of the Bunnythorpe–Woodville circuits can also cause them to overload for some contingencies due to load growth; see section 11.4.3. Reconductoring of the Bunnythorpe–Woodville circuits may be required in future to address this issue even if no new generation connects to the 110 kV area bounded by Bunnythorpe, Waipawa, Mangamaire, and Masterton/Greytown in the Wellington region.

We are undertaking a Major Capital Proposal (MCP) investigation for the Tararua and Wairarapa regions. This will determine an economic level of investment to enable the connection of new generation. As a part of this investigation, we will assess whether an upgrade of the Bunnythorpe–Woodville circuits is justified. It will also consider the Bunnythorpe interconnection capacity (section 11.4.1) and the Upper Hutt–Greytown line capacity (section 14.8.3).

A regional special protection scheme is also being investigated, which would co-ordinate the management of all the previously mentioned overloads.

[13] The Mataroa supply transformer has no dedicated 110 kV circuit breaker. A transformer protection operation trips the line circuit breakers on Bunnythorpe–Mataroa and Mataroa–Ohakune, interrupting through-transmission.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

Major capex investments

Project name:	Bunnythorpe–Woodville capacity increase
Project description:	Reconductor Bunnythorpe–Woodville circuits
Project's state of completion:	Possible
Grid need date:	Generation dependent
Indicative cost [$ million]:	25
Reliability or Economic investment?	Economic

11.8.6 Bunnythorpe 220/110 kV interconnecting transformer capacity

Bunnythorpe has two 220/110 kV transformers with an installed capacity of 300 MVA. At present, power flow is predominantly from the 220 kV to the 110 kV to supply load.

There is a very large potential for solar and wind generation in the area that could connect directly to the Bunnythorpe 110 kV bus or indirectly through the Bunnythorpe–Woodville circuits (see section 11.8.5) or Bunnythorpe–Marton–Whanganui circuits (see section 11.8.7). The effect on the Bunnythorpe 220/110 kV transformers is (in order of increasing new generation):

- change the direction of power flow, so it is from the 110 kV to the 220 kV
- overload the 110 kV disconnectors and conductors associated with the transformers
- overload the transformers.

Generation constraints would be required to manage the overloading.

To release the full post-contingency capacity of the existing transformers (from 178 MVA to 222/232 MVA summer/winter) will require the 110 kV disconnectors and conductor to be replaced. This upgrade may be required to meet load growth towards the end of the forecast period (see section 11.4.1) but would be brought forward if necessary to meet growth in generation.

We are undertaking a Major Capital Proposal (MCP) investigation for the Tararua and Wairarapa regions. This will determine an economic level of investment to enable the connection of new generation. As a part of this investigation, we will assess whether an upgrade of the Bunnythorpe interconnecting transformers is justified. It will also consider the Bunnythorpe-Woodville line capacity (section 11.8.5) and the Upper Hutt–Greytown line capacity (section 14.8.3).

If new generation connections exceed the capacity of the two existing transformers, a third 220/110 kV transformer can be installed at Bunnythorpe.

Major capex investments

Project name:	Bunnythorpe third 220/110 kV transformer
Project description:	Install third 220/110 kV transformer at Bunnythorpe
Project's state of completion:	Possible
Grid need date:	Generation dependent
Indicative cost [$ million]:	16
Reliability or Economic investment?	Economic

11.8.7 Bunnythorpe–Marton–Whanganui 110 kV circuit capacity

The potential solar generation developments at and near Marton substation are in excess of the n-1 and n capacity of the Bunnythorpe–Marton–Whanganui–1 and 2 circuits. The circuits are rated at 66/80 MVA summer/winter and the Marton–Whanganui sections have a special protection scheme to manage post-contingency overloads by reducing the Waipipi wind generation connected at Waverley.

It is possible to host solar generation at Marton and install a second special protection scheme in the region, which would coordinate with the Marton–Whanganui special protection scheme to manage post-contingency overloads. This second special protection scheme could be used in place of or in addition to a thermal upgrade of the circuits.

Generation developers are advised to make their own assessment of possible transmission and electricity market constraints for generation connected at or near Marton. The assessment

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

should include consideration of generation constraints that could occur due to the rating of the 110 kV Hawera–Stratford circuit in the Taranaki region.

Solar generation connected to the Marton 33 kV bus may also be constrained by the rating of the 110/33 kV supply transformers. Transformer overloads due to generation export would be managed by a transformer special protection scheme to automatically and quickly reduce generation post-contingency.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025.All rights reserved.

12 Taranaki Regional Plan

12.1	Regional overview and transmission system
12.2	Taranaki load and generation forecasts
12.3	Grid enhancement approach and inputs
12.4	Grid asset capability and management within the wider region
12.5	Grid asset capability and management by grid exit point
12.6	Taranaki bus security
12.7	Other items of interest
12.8	Taranaki generation opportunities and proposals

12.1 Regional overview and transmission system

The Taranaki transmission system supplies the city of New Plymouth (from the Carrington Street and Huirangi grid exit points) and other towns in the Taranaki region including Stratford, Hawera, Waverley, and Whanganui.

Major oil and gas facilities in the region include both upstream and downstream facilities. These receive electricity supply from our Opunake, Kapuni, Hawera (Kupe), Huirangi, and Motunui grid exit points. Due to the region's gas resources, a significant portion of the country's remaining thermal generation is in Taranaki.

As with many of the regions, Taranaki has a strong dairy industry that relies on the transmission system. One of the world's largest dairy factories, Whareroa, is connected at Hawera; most of its electricity load is presently offset by onsite gas-fired cogeneration. Fonterra has announced the first stage of its energy transformation at its Whareroa plant, which includes the installation of two electrode boilers and reducing its reliance on the onsite gas-fired cogeneration.

Developers have shown interest in the significant generation opportunities in the region for solar, additional on-shore wind, and off-shore wind developments.

The existing transmission network for the Taranaki region is set out geographically in Figure 12-1 and schematically in Figure 12-2.

Figure 12--1: Taranaki region transmission network map

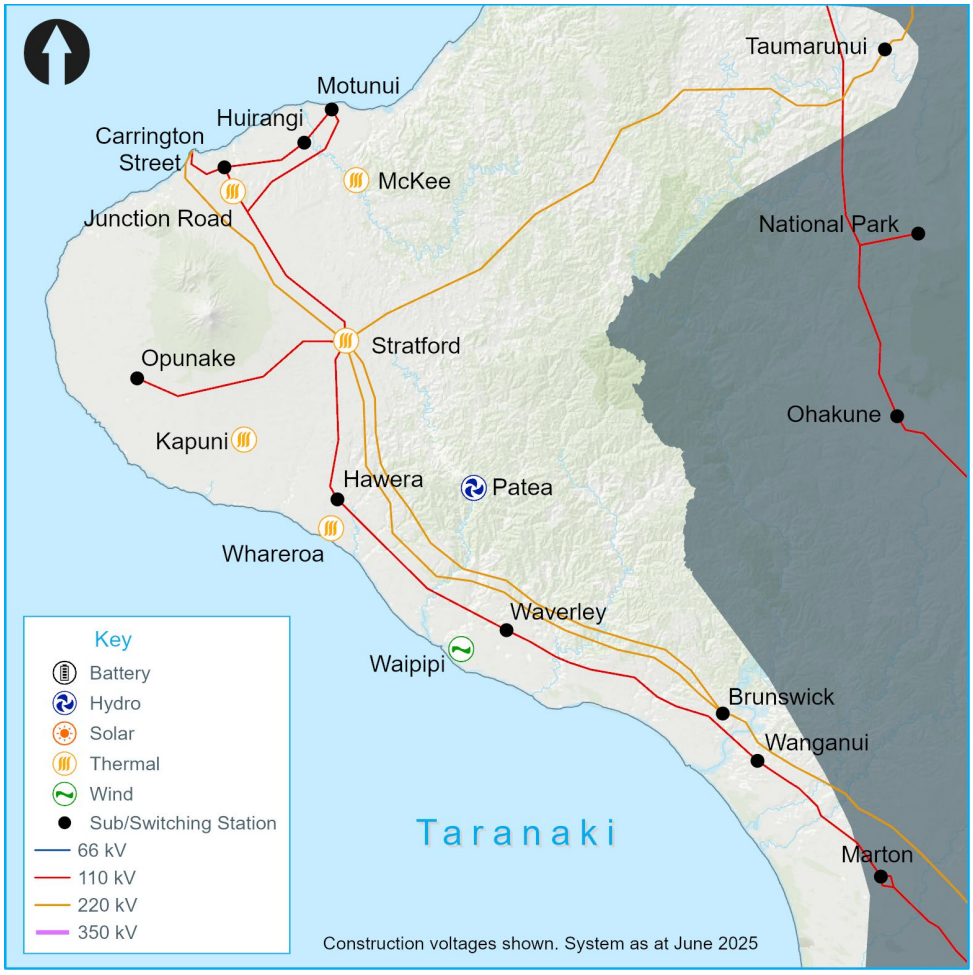
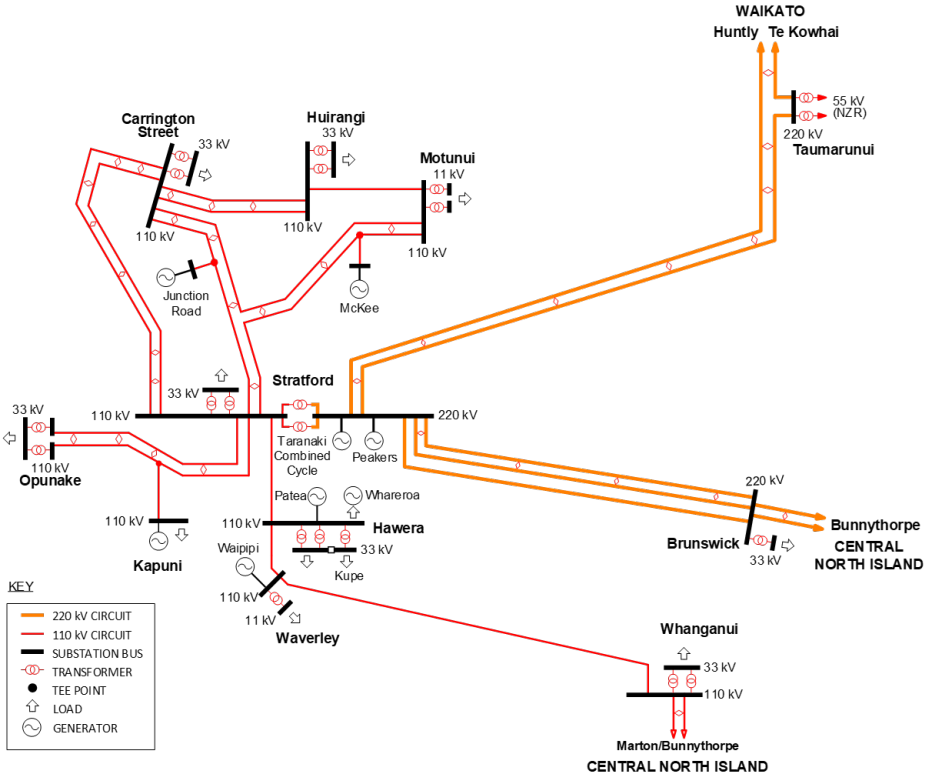


Figure 12-2: Taranaki region transmission schematic



12.1.1 Transmission into the region

The Taranaki region connects to the National Grid through 220 kV circuits that run north-east to Huntly and south-east to Bunnythorpe. Local generation exceeds regional demand and any excess power is exported to other parts of the country via the National Grid.

Two interconnecting transformers at Stratford supply Taranaki's regional 110 kV load as well as assisting with through-transmission on the 110 kV transmission network running in parallel with the 220 kV line between Bunnythorpe and Stratford.

12.1.2 Transmission within the region

Transmission within the Taranaki region comprises:

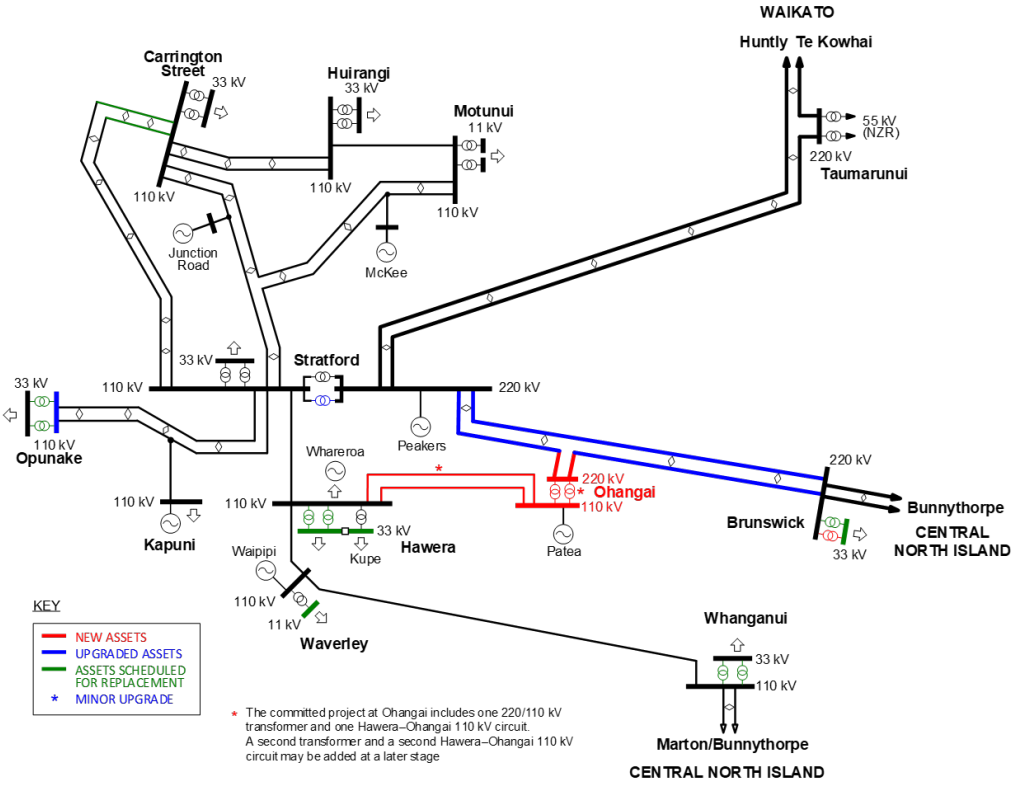
- the 220 kV circuits entering the region from Bunnythorpe and Huntly
- the 110 kV circuit entering the region from Bunnythorpe (via Marton)
- interconnecting transformers located at Stratford.

There are significant generation stations located within the 110 kV network.

12.1.3 Possible Taranaki transmission configuration

Figure 12-3 shows the possible configuration of Taranaki transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

Figure 12-3: Possible Taranaki transmission configuration in 2040



12.2 Taranaki load and generation forecasts

12.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify potential issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying

demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Taranaki regional peak demand is forecast to grow by an average 2.4 per cent per annum over the next 15 years, from 223 MW in 2025 to 317 MW by 2040. This is lower than the national average growth rate of 2.6 per cent per annum.

Table 12-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

Table 12-1: Forecast prudent annual peak demand (MW) at Taranaki grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Brunswick	0.99	34	35	36	37	38	38	38	39	39	39	39	39
Carrington Street[4]	1.00	72	73	75	76	77	78	80	80	81	84	85	85
Huirangi	0.99	31	32	33	34	35	36	37	37	37	38	38	38
Hawera	0.99	30	30	31	31	32	32	32	32	33	35	35	34
Hawera 110 kV[3] - Whareroa	0.93	40	108	108	108	108	108	108	108	108	108	108	108
Hawera (Kupe)[1]	0.98	11	10	8	8	7	7	7	7	7	7	7	7
Kapuni[3]	0.90	8	8	8	8	8	8	8	8	8	8	8	8
Motunui	0.97	19	19	20	20	20	20	20	20	20	20	20	20
Opunake	0.93	13	13	13	14	14	14	14	14	14	14	15	15
Stratford 33 kV[2]	0.95	30	31	31	32	32	33	33	34	34	40	40	40
Taumarunui	0.96	7	7	7	7	7	7	7	7	7	7	7	7
Waverley	0.93	6	6	6	7	7	7	7	7	7	7	7	7
Whanganui	0.99	33	35	37	38	42	43	44	44	44	44	44	43

1. Load reduction from industrial sectors from 2026.
2. Step increase of 4.67 MW in 2034 from industrial sector as mentioned in the RETA (Regional Energy Transition Accelerator) report for the Taranaki region.
3. This is a gross load. Embedded generation has been excluded.
4. This is a leading power factor.

12.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing fossil fuel users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

It is expected there will be additional load growth beyond what is included in Table 12-1, mainly due to industrial businesses converting from fossil fuels to electricity, particularly at Hawera where Fonterra has indicated further electrification beyond what is shown above.

12.2.3 Existing and committed generation

The Taranaki region's generation capacity is currently 1,065 MW. This excludes any embedded solar (PV) generation, which was approximately 12.7 MW at the time of publication[2]. Depending on generation dispatch, the region may import power from, or export it to, the National Grid.

1 Refer to Chapter 3 for further information on demand forecasting.

2 The capacity of existing embedded solar farms mentioned in Table 12-2 has been subtracted off the total embedded solar generation reported on the Electricity Market Information (EMI) website: Electricity Market Information (EMI): Installed distributed solar generation trends

Table 12-2 lists the generation forecast at each grid injection point in the Taranaki region for the forecast period. This includes all known and committed generation stations including those embedded within Powerco's local network[3].

Further generation may be developed during the period. Refer to section 12.8 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 12-2: Existing and committed generation capacity at Taranaki grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Carrington St												
(Mangorei)	5	5	5	5	5	5	5	5	5	5	5	5
Hawera												
(Patea)	32	32	32	32	32	32	32	32	32	32	32	32
(Whareroa)	64	20	20	20	20	20	20	20	20	20	20	20
(Kapuni Solar)	2	2	2	2	2	2	2	2	2	2	2	2
(Origin Hawera)	1	1	1	1	1	1	1	1	1	1	1	1
Huirangi												
(Mangahewa)	11	11	11	11	11	11	11	11	11	11	11	11
(Motukawa)	5	5	5	5	5	5	5	5	5	5	5	5
Junction Road	98	98	98	98	98	98	98	98	98	98	98	98
Kapuni												
(Kapuni)	24	24	24	24	24	24	24	24	24	24	24	24
McKee	94	94	94	94	94	94	94	94	94	94	94	94
Stratford – Taranaki Combined Cycle[1]	383	0	0	0	0	0	0	0	0	0	0	0
Stratford – Peaker Plants	220	220	220	220	220	220	220	220	220	220	220	220
Stratford												
(Stratford Austral Pacific)	3	3	3	3	3	3	3	3	3	3	3	3
Waverley – Waipipi	130	130	130	130	130	130	130	130	130	130	130	130

1. The generator is assumed to remain in service until the end of winter 2025.

12.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Taranaki region.

12.3 Grid enhancement approach and inputs

12.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Taranaki region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancements to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

3 Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 12.4 and 12.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

12.3.2 Taranaki significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 12-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Taranaki region for the next 15 years that may significantly impact related system issues or connected parties.

Table 12-3: Proposed significant upcoming replacement and refurbishment work for the Taranaki region

Description	Tentative year	E&D issue
Brunswick–Stratford–A and B lines reconductoring	2032-2035	Section 6.5
Brunswick–T1 supply transformer replacement	2025-2027	12.5.1
Carrington Street–New Plymouth–A line reconductoring	2034-2035	None
Hawera–T1/T2 supply transformers replacement	2031-2033	12.5.4
Motunui–T3/T4 supply transformers' bushing replacement	2032-2034	None
Opunake–T4/T5 supply transformers replacement	2036-2038	None
Waverley 11 kV outdoor to indoor conversion	2024-2026	None
Whanganui–T1 supply transformer replacement	2036-2038	12.5.13
Whanganui–T2 supply transformer replacement	2026-2028	12.5.13

12.3.3 Taranaki asset feedback

The Asset Feedback Register includes the following E&D-related entry specific to the Taranaki region:

- Opunake 110 kV bus switch, see section 12.7.2.

12.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Taranaki region can reasonably be expected to meet an n-1 level of security over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 12-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 12-4: Changes within the wider region since the 2023 TPR

Issues	Change
Hawera–Ohangai circuit capacity[4]	Added. Whareroa load increase.

The overview of transmission capability within the wider Taranaki region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

[4] Transpower is building a new 220/110 kV substation near Ohangai, as described in section 12.4.1/12.4.3.

Section number	Description
12.4.1	South Taranaki circuit capacity and voltage quality
12.4.2	Taranaki 220/110 kV interconnecting transformer capacity
12.4.3	Hawera–Ohangai circuit capacity

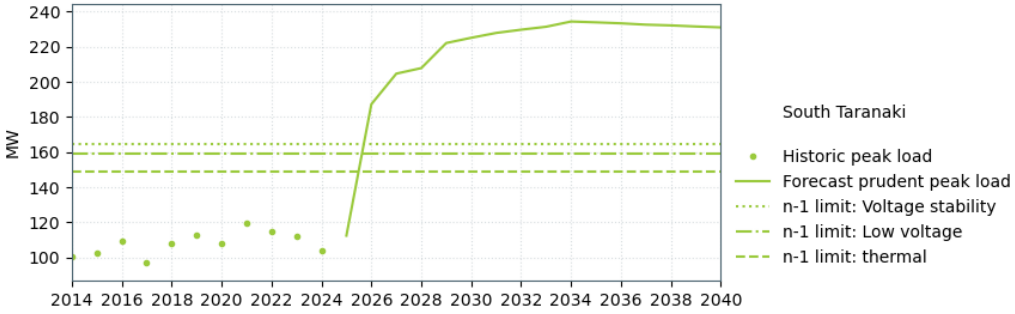
12.4.1 South Taranaki 110 kV transmission capacity and voltage quality

Issue

An outage of the Hawera–Stratford circuit leaves Hawera, Waverley, Whanganui and Marton supplied only via the two Bunnythorpe–Marton–Whanganui 110 kV circuits and can result in low voltages and voltage drops greater than five per cent.

Following the planned load increase at Fonterra's Whareroa dairy factory in 2026, this same circuit outage will result in overloads on the Bunnythorpe–Marton section of both Bunnythorpe–Marton–Whanganui 110 kV circuits and regional voltage stability issues during periods of high load (see Figure 12-4).

Figure 12-4: South Taranaki transmission capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We have committed to a new 220/110 kV substation near Ohangai to support the 2026 load increase at Whareroa. The new Ohangai substation will connect into the 220 kV Brunswick–Stratford–1 circuit and host one 220/110 kV, 250 MVA transformer. The customer-owned Hawera–Patea 110 kV line will be bused at Ohangai.

The Ohangai substation will resolve the post-contingency thermal and voltage issues on the 110 kV network between Bunnythorpe and Hawera. However, n-1 transmission capacity issues are expected on the Hawera–Ohangai 110 kV circuit (see section 12.4.3).

Base E&D capex investments

Project name:	Ohangai substation (Stage 1)
Project description:	Build new interconnection point to support Whareroa load increase
Project's state of completion:	In Delivery
Grid need date:	2026
Indicative cost [$ million]:	15.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Customer investments

Project name:	Ohangai substation (Stage 1) – Customer contribution
Project description:	Build new interconnection point to support Whareroa load increase
Project's state of completion:	In Delivery
Grid need date:	2026
Indicative cost [$ million]:	19
Reliability or Economic investment?	Reliability (Grid Reliability Report)

12.4.2 Taranaki 220/110 kV interconnecting transformer capacity

Issue

Two interconnecting transformers (rated 100 MVA and 200 MVA) at Stratford supply Taranaki's regional 110 kV load as well as assisting with through-transmission on the 110 kV transmission network between Bunnythorpe and Stratford.

The Stratford interconnecting transformers provide a total nominal installed capacity of 300 MVA.

An outage of the larger transformer may cause the remaining transformer to exceed its n-1 capacity when there is low generation on the 110 kV network and high load in the region. Post-contingency voltages in the region may fall below 0.95 pu.

At times the smaller transformer may exceed its n-1 capacity during high generation and low load conditions. Also, proposed new solar and wind generation may require a transformer upgrade to prevent pre-contingency generation constraints.

What next?

The new Ohangai 220/110 kV substation built to support the load increase at Whareroa (see section 12.4.1) will resolve the post-contingency thermal and voltage issues associated with the outage of the larger Stratford interconnecting transformer.

12.4.3 Hawera–Ohangai circuit capacity

Issue

Fonterra is committed to electrifying its Whareroa plant with the installation of two electrode boilers, while reducing reliance on its gas-fired cogeneration. Transpower is building a new 220/110 kV substation near Ohangai to support the load increase at the Whareroa plant (section 12.4.1). The new Ohangai substation will be built where the Hawera–Patea circuit intersects the 220 kV Brunswick–Stratford circuits. The newly formed 110 kV Hawera–Ohangai circuit is forecast to overload for a Hawera–Stratford outage from summer 2026.

What next?

In the short term a Circuit Overload Protection Scheme (COPS) will be installed as part of Ohangai substation to manage overloads on the Hawera–Ohangai circuit post-contingency.

In the medium term, we may address the Hawera-Ohangai circuit capacity with a thermal upgrade.

In the long-term, we may also need to install a second 220/110 kV transformer at Ohangai and build a second Hawera–Ohangai 110 kV circuit to address the Hawera–Ohangai transmission capacity and security.

Base E&D capex investments

Project name:	Hawera–Ohangai circuit capacity upgrade (medium term)
Project description:	Thermally upgrade Hawera–Ohangai circuit
Project's state of completion:	Possible
Grid need date:	2028
Indicative cost [$ million]:	20
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Base E&D capex investments

Project name:	Ohangai substation (Stage 2)
Project description:	Install second 220/110 kV transformer at Ohangai
Project's state of completion:	Possible
Grid need date:	TBC
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Base E&D capex investments

Project name:	Ohangai substation (Stage 2)
Project description:	Build a second Hawera–Ohangai 110 kV circuit
Project's state of completion:	Possible
Grid need date:	2028
Indicative cost [$ million]:	25
Reliability or Economic investment?	Reliability (Grid Reliability Report)

12.5 Grid asset capability and management by grid exit point

This transmission capability section reports on whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 12-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 12-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
No changes to report	

The overview of transmission capability for each grid exit point within the Taranaki region is listed below. Where an issue is identified we list options to address it.

Section number	Description
12.5.1	Brunswick supply capacity and security
12.5.2	Carrington Street supply capacity
12.5.3	Hawera (Kupe) supply capacity and security
12.5.4	Hawera (Powerco) supply capacity
12.5.5	Hawera (Whareroa) supply capacity
12.5.6	Huirangi supply capacity
12.5.7	Kapuni supply capacity and security
12.5.8	Motunui supply capacity and security
12.5.9	Opunake supply capacity
12.5.10	Stratford supply capacity
12.5.11	Taumarunui supply capacity
12.5.12	Waverley supply capacity and security
12.5.13	Whanganui supply capacity and low voltage

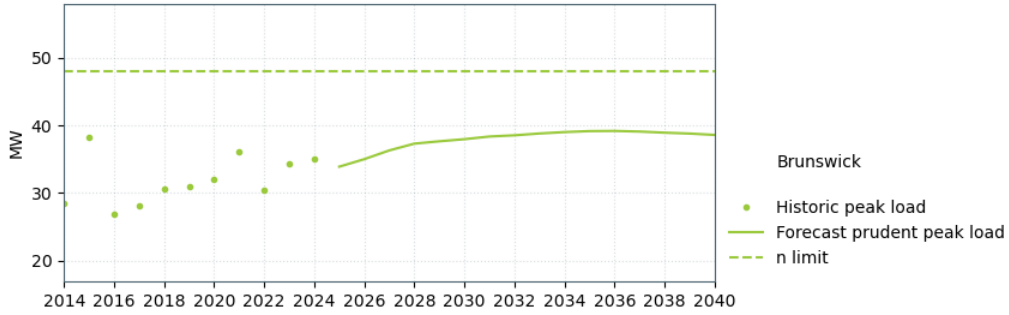
12.5.1 Brunswick supply capacity and security

Issue

The Brunswick load is supplied by a single 220/33 kV, 50 MVA transformer, resulting in n security. This transformer is due for risk-based condition replacement around 2025-2027.

Peak load at Brunswick is within the capacity of the supply transformer for the forecast period (see Figure 12-5).

Figure 12-5: Brunswick supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

A transformer unit failure can be managed by transferring load to the Whanganui grid exit point via Powerco's network. Some load curtailment may be necessary during peak periods as Powerco's distribution network may not have the capacity to shift the entire load to Whanganui (see section 12.5.13). As there is a non-contracted spare transformer on-site, replacement of a failed unit may be possible within 8-14 hours (provided the spare unit is available).

We are investigating a second transformer at Brunswick to provide n-1 security. This will be customer funded. The existing supply transformer is also due for risk-based condition replacement in 2027; its replacement will follow commissioning of the second transformer if this proceeds.

Customer investments

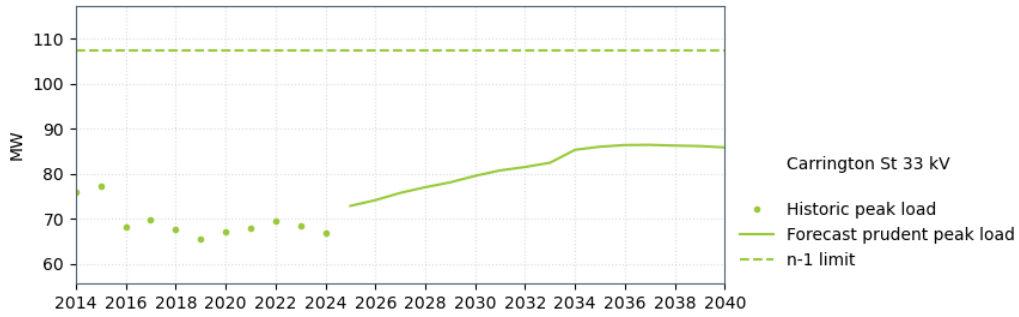
Project name:	Brunswick supply security
Project description:	Install a second transformer
Project's state of completion:	Possible
Grid need date:	2027
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

12.5.2 Carrington Street supply capacity

Two 110/33 kV transformers supply Carrington Street's load, providing a total nominal installed capacity of 150 MVA.

Peak load at Carrington Street is within the n-1 capacity of the supply transformers for the forecast period (see Figure 12-6).

Figure 12-6: Carrington Street supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

12.5.3 Hawera (Kupe) supply capacity and security

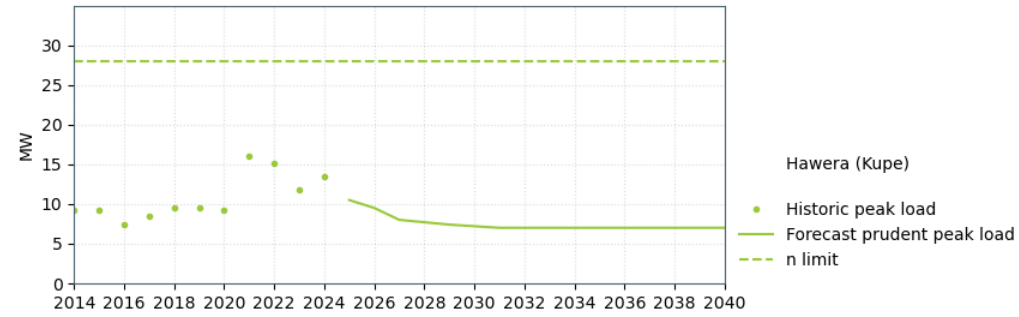
Issue

A single 110/33 kV, 30 MVA supply transformer (T3) supplies the Beach Energy Kupe load, resulting in n security.

Peak load at Kupe is within the capacity of the supply transformer for the forecast period (see Figure 12-7).

The Kupe load can be transferred to the other supply transformers at Hawera (Powerco supply from T1 and T2, see section 12.5.4) when T3 is out of service, by closing the 33 kV bus coupler. This often results in the combined Kupe plus Powerco load exceeding the n-1 capacity of T1 and T2.

Figure 12-7: Hawera (Kupe) supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We are currently implementing a transformer overload protection scheme (TOPS) to maintain security to the Powerco load when Kupe is connected to the Powerco 33 kV bus. Security to the Powerco load will be unaffected, but Kupe will be on n security and tripped following a transformer contingency.

Customer investments

Project name:	Kupe supply security
Project description:	Install a TOPS on Hawera T1 and T2
Project's state of completion:	Committed
Grid need date:	2025
Indicative cost [$ million]:	0.4
Reliability or Economic investment?	Reliability (Grid Reliability Report)

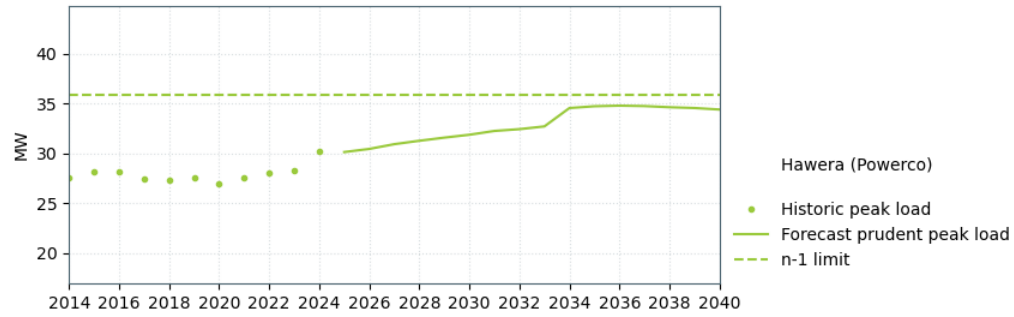
12.5.4 Hawera (Powerco) supply capacity

Issue

Two 110/33 kV transformers supply Hawera's load, providing a total nominal installed capacity of 60 MVA.

Peak load at Hawera is within the capacity of the supply transformer for the forecast period (see Figure 12-8).

Figure 12-8: Hawera (Powerco) supply capacity

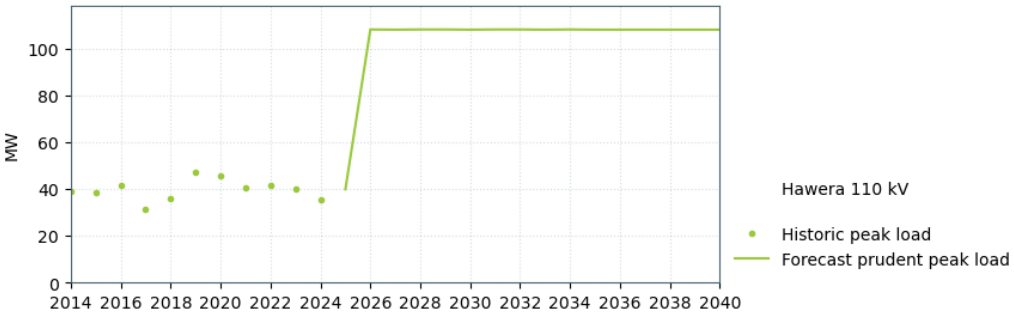


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

12.5.5 Hawera (Whareroa) supply capacity

Fonterra has feeders connected directly to the Hawera 110 kV bus; their capacity is not reported in the TPR. See Figure 12-9 for the peak load forecast at Hawera 110 kV.

Figure 12-9: Hawera (Whareroa) supply capacity



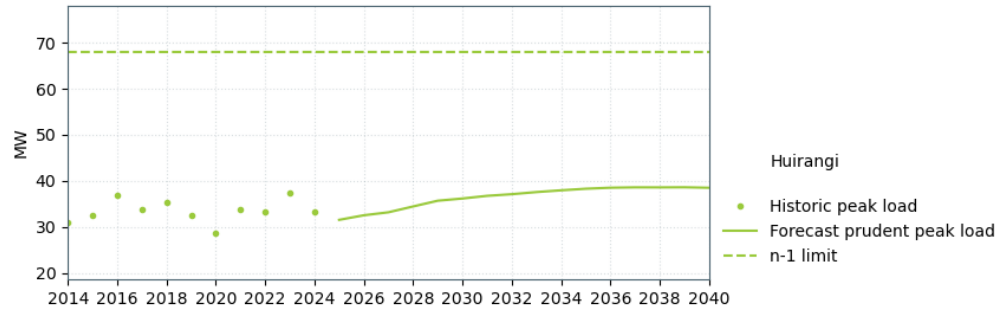
See also section 12.4.1 for how the step load increase affects the South Taranaki 110 kV network, and the proposed upgrades in the area.

12.5.6 Huirangi supply capacity

Two 110/33 kV transformers supply Huirangi's load, providing a total nominal installed capacity of 120 MVA. The transformers' capacity is limited by the 33 kV circuit breaker.

Peak load at Huirangi is within the n-1 capacity of the supply transformers for the forecast period (see Figure 12-10).

Figure 12-10: Huirangi supply capacity



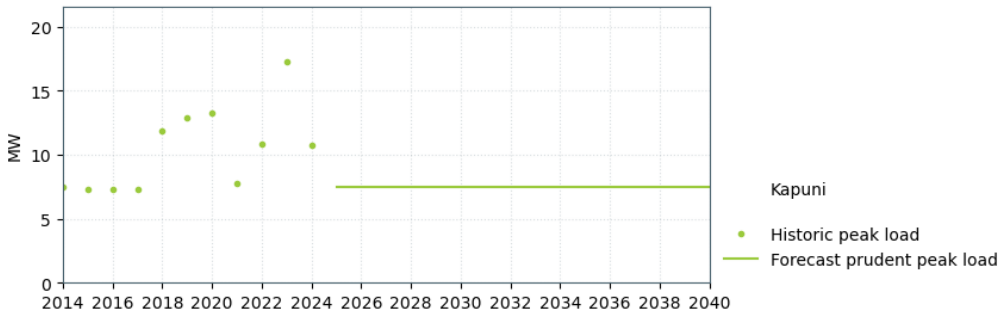
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

12.5.7 Kapuni supply capacity and security

Issue

Kapuni load and generation is connected to the grid through a single 110 kV circuit (owned by Nova Energy) which is tee-connected to the 110 kV Opunake–Stratford–2 circuit, resulting in n security. The capacity of the assets owned by Nova Energy is not reported in the TPR. See Figure 12-11 for the peak load forecast.

Figure 12-11: Kapuni load forecast



In addition, bus section contingencies at either Stratford or Opunake would result in loss of supply to Kapuni (see section 12.6.1).

What next?

Our customer, Todd Generation Taranaki Limited, has not requested a higher level of security. Future investment will be customer-driven.

12.5.8 Motunui supply capacity and security

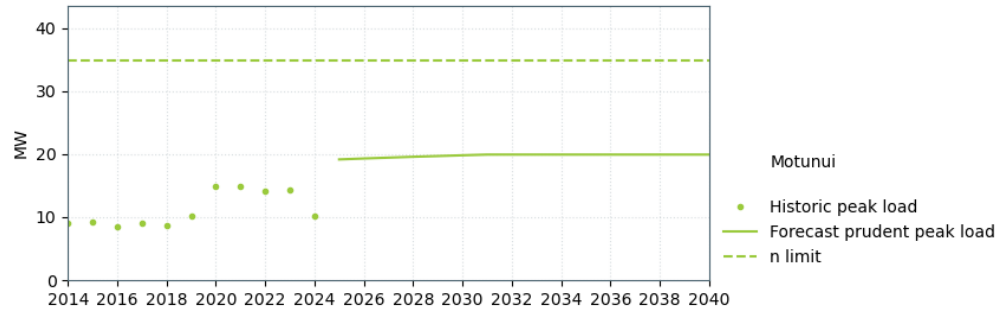
Issue

Two 110/11 kV supply transformers supply Motunui's load, providing a total nominal installed capacity of 80 MVA. The transformers' capacity is limited by the 11 kV bus.

The 11 kV bus at Motunui is operated split. Tripping either supply transformer may result in a partial loss of supply, which can be restored via the customers' network.

Peak load at Motunui is within the n capacity of the supply transformers for the forecast period (see Figure 12-12).

Figure 12-12: Motunui supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

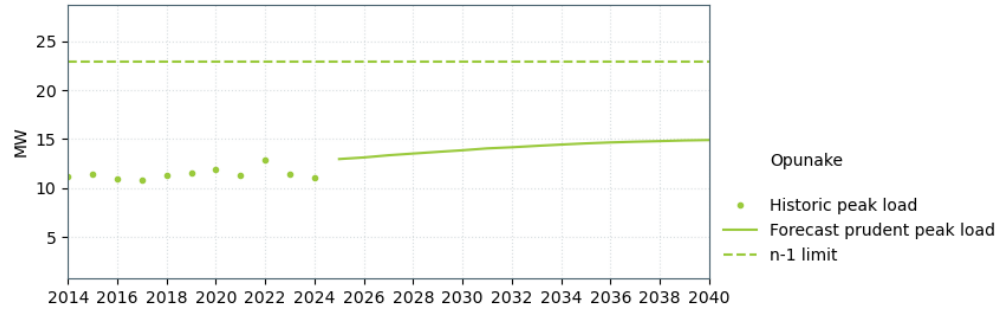
The customers (Methanex and OMV Production) have not requested a higher level of security at Motunui. Future investment will be customer-driven.

12.5.9 Opunake supply capacity

Two 110/33 kV supply transformers supply Opunake's load, providing a total nominal installed capacity of 60 MVA.

Peak load at Opunake is within the n-1 capacity of the supply transformers for the forecast period (see Figure 12-13).

Figure 12-13: Opunake supply capacity



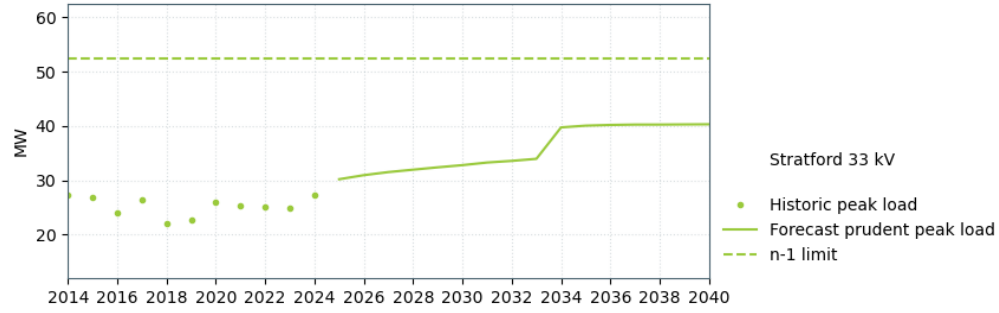
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

12.5.10 Stratford supply capacity

Two 110/33 kV transformers supply Stratford's load, providing a total nominal installed capacity of 80 MVA. The transformers' capacity is limited by a metering limit.

Peak load at Stratford is within the n-1 capacity of the supply transformers for the forecast period (see Figure 12-14).

Figure 12-14: Stratford supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

12.5.11 Taumarunui supply capacity

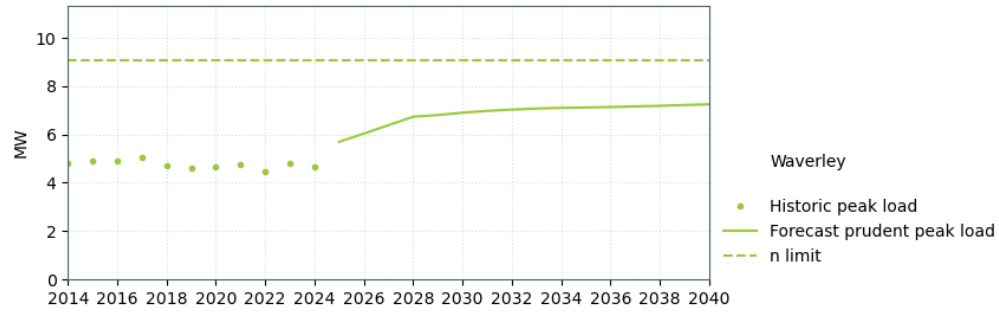
Two 220/55 kV traction transformers at Taumarunui supply the KiwiRail North Island Main Trunk railway line. The two transformers are normally operated split, each providing n security to a portion of the railway line. The average transformer loading is low, with high levels of peak load occurring for only a few minutes at a time. Therefore, we do not assess the capacity of traction transformers in the TPR.

12.5.12 Waverley supply capacity and security

Issue

A single 110/11 kV, 10 MVA transformer supplies load at Waverley resulting in n security. The peak load is within the capacity of the supply transformer for the forecast period (see Figure 12-15).

Figure 12-15: Waverley supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Powerco can manage the n security issue during maintenance outages for the forecast period. There is a national spare transformer located off-site that would enable replacement within 2-4 weeks following a unit failure.

Powerco has not requested a higher level of security at this grid exit point. Future investment will be customer-driven.

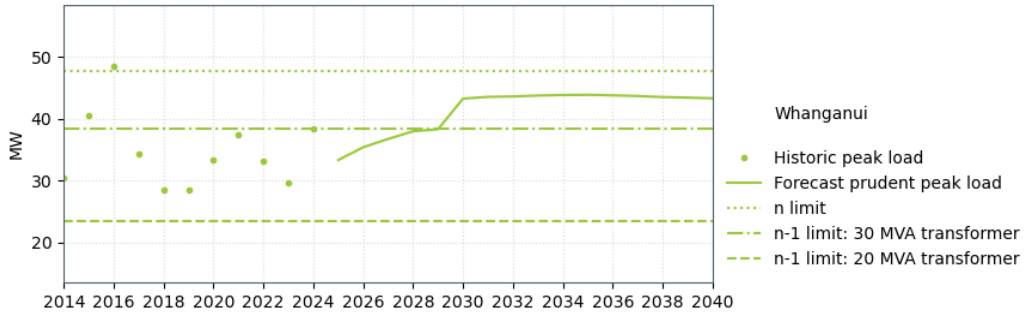
12.5.13 Whanganui supply capacity and low voltage

Issue

Two 110/33 kV transformers (rated 20 MVA and 30 MVA) supply Whanganui's load, providing a total nominal installed capacity of 50 MVA. The transformers' capacity is limited by the transformer 33 kV bushing.

Peak load at Whanganui already exceeds the n-1 capacity of the supply transformers (see Figure 12-16). The Whanganui supply bus voltage may drop below 0.95 pu for an outage of one supply transformer or a Bunnythorpe–Marton–Whanganui circuit at peak load. The supply transformer is not equipped with an on-load tap changer.

Figure 12-16: Whanganui supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

At present, Powerco has elected not to maintain full n-1 security at the Whanganui grid exit point. Following a contingency, it can shift some load to the Brunswick grid exit point via its distribution network, which it is planning to upgrade. Load shifting capacity is currently limited by both the Powerco network and the Brunswick supply transformer (see section 12.5.1).

Whanganui–T2 (20 MVA) is due for risk-based condition replacement in 2028 at which point it will be replaced with a 30 MVA unit.

12.6 Taranaki bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 12-6 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 12-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Hawera 110 kV A Hawera 110 kV B	Hawera (Kupe)	-	- South Taranaki voltage stability	Note 1 12.4.1
Ohangai		Patea	-	12.4.3
Opunake 110 kV	Kapuni	- Kapuni	- -	12.6.1 12.6.1
Stratford 110 kV A1	Kapuni	- Kapuni	- -	12.6.1 12.6.1
Whanganui 110 kV	Whanganui	-	-	Note 2
Waverley 110 kV	Waverley	- Waipipi	- -	Note 2 Note 2

1. Kupe has a single connection to the Hawera 110 kV bus. The Kupe load can be transferred to the Powerco 33 kV bus during an outage of Hawera–T3 or Hawera 110 kV bus section A (switched n-1 security).
2. There is only a single bus section at Whanganui and Waverley. Therefore, a bus fault will cause loss of generation and/or loss of supply.

Our customers in the Taranaki region (Manawa, Todd Generation Taranaki Limited, Beach Energy, Powerco, and Mercury) have not requested a higher bus security level. Unless otherwise noted, we do not propose increasing bus security and future investment is likely to be customer-driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

12.6.1 Kapuni and Opunake security

Issue

The Kapuni generation is tee-connected to the 110 kV Opunake–Stratford–2 circuit. An outage of the Stratford bus section that connects this circuit will also disconnect the Kapuni generation.

There is no bus zone protection at the Opunake 110 kV bus (split bus with no incoming 110 kV line circuit breakers). A fault on the Opunake bus section, connecting the Opunake–Stratford–2 circuit, will be cleared by the line protection at Stratford, disconnecting the Kapuni generators.

What next?

Our customer, Todd Generation Taranaki Limited, has not requested a higher level of security, so no investments are planned to resolve this issue (see also sections 12.5.7 and 12.7.2).

12.7 Other items of interest

12.7.1 Brunswick–Stratford transmission capacity

The three 220 kV Brunswick–Stratford circuits are part of the grid backbone connecting Taranaki to the rest of the National Grid. The loading on these three circuits is approximately equal, which maximises their transfer capacity. The capacity of the Brunswick–Stratford circuits may constrain the amount of generation that can be exported from the Taranaki region depending on HVDC power flow and direction.

In addition, the conductor on the Brunswick–Stratford–A and B lines is due for replacement within 10 years (see section 12.3.2). Refer to Chapter 6, Grid Backbone, for more information on the Brunswick–Stratford constraint.

12.7.2 Opunake 110 kV bus switch

Issue

The 110 kV bus at Opunake is normally split, with only disconnectors to split the bus.

Some outages require the Opunake 110 kV split to be closed. Switching to close or open the split requires a short interruption of supply to Opunake, which includes supply to major gas production plant. This issue may become more significant if solar generation connects at Opunake.

What Next?

We are considering upgrading the Opunake site to install 110 kV line circuit breakers and bus zone protection to allow the 110 kV bus to be closed. This upgrade will be coordinated with solar farm connection work at the site (see Table 12-7 for details).

12.8 Taranaki generation opportunities and proposals

The maximum generation that can be connected depends on several factors and is usually expressed as a range. Generation developers should consult with us at an early stage of their investigations to discuss connection issues.

The Taranaki region has potential for new generation: solar, on-shore wind and off-shore wind.

This section provides a high-level description of the Taranaki region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
12.8.1	Generation opportunities by substation
12.8.2	Generation investigations and proposals
12.8.3	Stratford 220/110 kV transformer capacity
12.8.4	Carrington Street–Huirangi transmission capacity
12.8.5	Transmission capacity of 110 kV Whanganui–Waverley–Hawera–Stratford corridor

12.8.1 Generation opportunities by substation

Envision Opportunities[5] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities uses a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[6]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy
- winter evening peak – wet/windy
- winter midday high – wet/calm.

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

12.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation investigation queue[7]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 12-7 shows generation and grid-scale battery projects in the Taranaki region that are in the generation investigation queue (as at the time of writing).

5 Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

6 "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

7 Link to the Generation Investigation Queue: Connection enquiry information | Transpower

Table 12-7: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Huirangi	Solar	Investigation	75
Huirangi	Solar	Investigation	68
Opunake	Solar	Investigation	77
Stratford 33 kV	Solar	Investigation	32
Opunake	Solar	Application	86
Brunswick–Stratford	Solar + Wind	Application	750
Brunswick–Stratford	Solar	Application	200

We have additional preliminary requests for generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of selected parts of the Taranaki region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

12.8.3 Stratford 220/110 kV transformer capacity

Issue

Stratford has two 220/110 kV transformers, with nominal ratings of 200 MVA (T9) and 100 MVA (T10).

All generation proposals listed in Table 12-7 would connect directly to the 110 kV network or through 110/33 kV supply transformers. The proposals are in addition to ten existing generators[8]. During periods when generation exceeds the load, excess power flows through the Stratford 220/110 kV transformer from the 110 kV into the 220 kV transmission system.

Depending on the total output, proposed and existing generation may need to be constrained to prevent the lower-rated Stratford transformer (T10) from exceeding its nominal rating pre-contingency. Generation may also need to be constrained post-contingency for an outage of the higher-rated transformer (T9) overloading the lower-rated transformer (T10).

What next?

In the short term we will rely on generation constraints to prevent overloading of the Stratford 220/110 kV transformers. The proposed generation is all solar, and it is likely the solar generation would be dispatched before the thermal generation in the electricity market.

In the medium-term, generation constraints will be eased with the new Ohangai 220/110 kV connection and increased load at Hawera (section 12.4.1).

In the longer term it may be economic to replace the smaller transformer (T10) with a higher-rated transformer to relax generation constraints. We will continue to monitor the issues and replace the smaller 220/110 kV transformer (T10) when economically justified.

12.8.4 Carrington Street–Huirangi transmission capacity

Issue

Proposed generation connected at Huirangi may be constrained due to the 15 km long 110 kV Carrington Street–Huirangi–1 and 2 circuits, rated at 63/77 MVA summer/winter. All other 110 kV circuits in the immediate area are rated 95/105 MVA summer/winter.

What next?

It is possible to thermally upgrade the 110 kV Carrington Street–Huirangi circuits to match or slightly exceed the rating of the other 110 kV circuits in the immediate area.

[8] See Table 12-2. Existing regional generation connected directly to 110 kV or through 110/33 kV supply transformers has a total capacity of 368 MW. Only the Taranaki Combined Cycle generator and the Stratford peakers are connected to the 220 kV.

It is unlikely to be economic to thermally upgrade the other 110 kV circuits in the immediate area, because the increase in rating will be small and the total circuit length is much greater than 15 km.

A special protection scheme to automatically reduce generation post-contingency to manage Carrington Street–Huirangi circuit overloads is also likely to be feasible, but would need to be confirmed by a detailed study.

Base E&D capex investments

Project name:	Carrington Street–Huirangi transmission capacity
Project description:	Increase thermal rating of circuit
Project's state of completion:	Possible
Grid need date:	generation dependent
Indicative cost [$ million]:	3
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

12.8.5 Transmission capacity of 110 kV Whanganui–Waverley–Hawera–Stratford corridor

Issue

The single 110 kV Whanganui–Waverley–Hawera–Stratford circuit is rated 153/165 MVA summer/winter. The Waipipi wind farm (130 MW) connects at Waverley, and the Patea hydro power station (32 MW) and Whareroa co-generation (64 MW) connect at Hawera.

There is limited capacity to host additional generation at 110 kV along this corridor.

To minimise generation constraints in the region, a special protection scheme is used to automatically reduce generation at Waipipi following an outage of a Marton–Whanganui–Bunnythorpe circuit (in the Central North Island region).

Solar generation proposals at Marton (in the Central North Island region) will also use some of the 110 kV capacity of the Whanganui–Stratford circuit to host generation.

What next?

Further significant generation development between Bunnythorpe and Stratford will need to connect at 220 kV. The loading on the three 220 kV Brunswick–Stratford circuits is approximately equal, which maximises their transfer capacity. In order to maintain approximately equal loading so that existing transfer capacity can be maintained, large new generation station(s) may need to connect to all three circuits. Alternately, the capacity of one or more of the circuits would need to be increased.

We expect significant maintenance expenditure will be required on the 220 kV lines between Brunswick and Stratford in the next ten years. This provides the opportunity to increase the 220 kV transmission capacity (see section 12.7.1).

13 Hawke's Bay Regional Plan

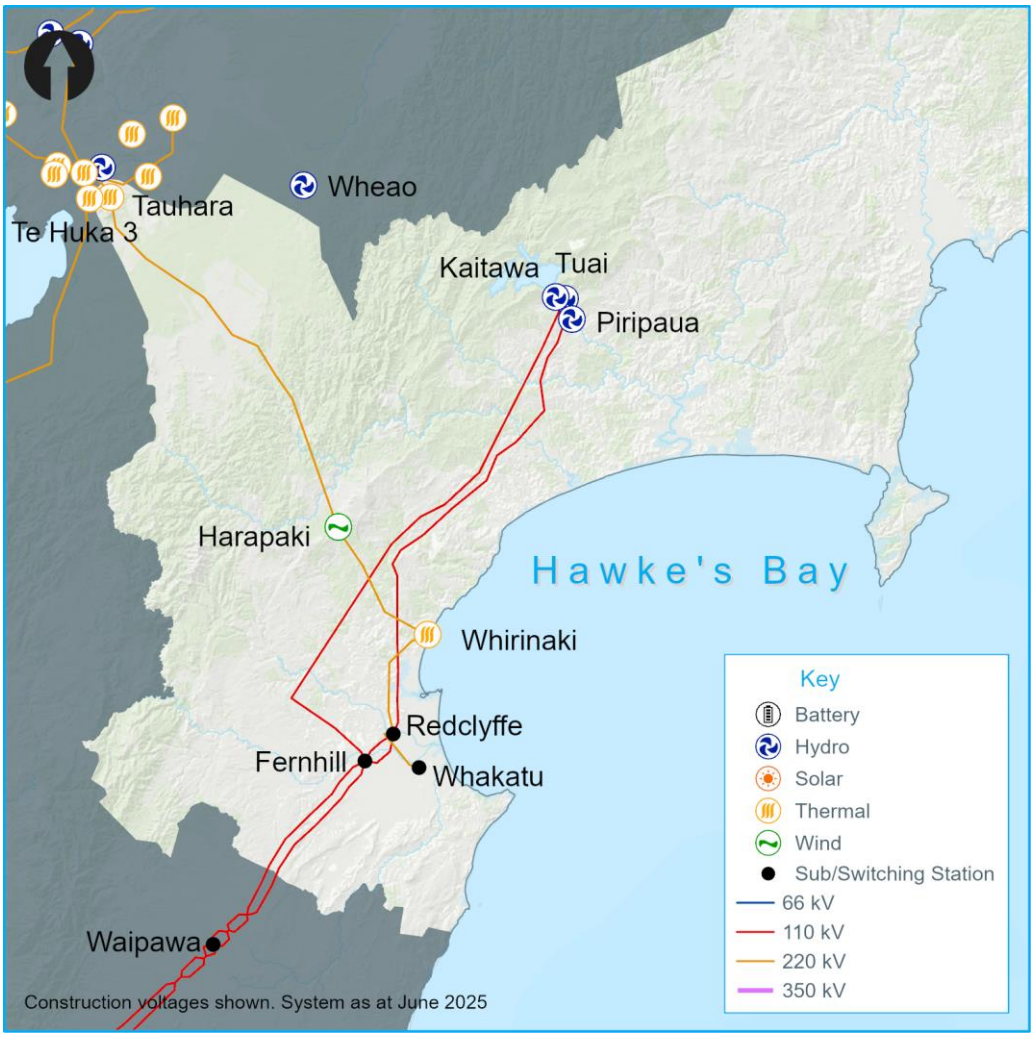
13.1	Regional overview and transmission system
13.2	Hawke's Bay load and generation forecasts
13.3	Grid enhancement approach and inputs
13.4	Grid asset capability and management within the wider region
13.5	Grid asset capability and management by grid exit point
13.6	Hawke's Bay bus security
13.7	Other items of interest
13.8	Hawke's Bay generation opportunities and proposals

13.1 Regional overview and transmission system

The Hawke's Bay transmission system supplies a mix of significant provincial cities (Napier, Hastings and Gisborne), heavy industry (Pan Pac Mill), and smaller towns (Havelock North and Wairoa).

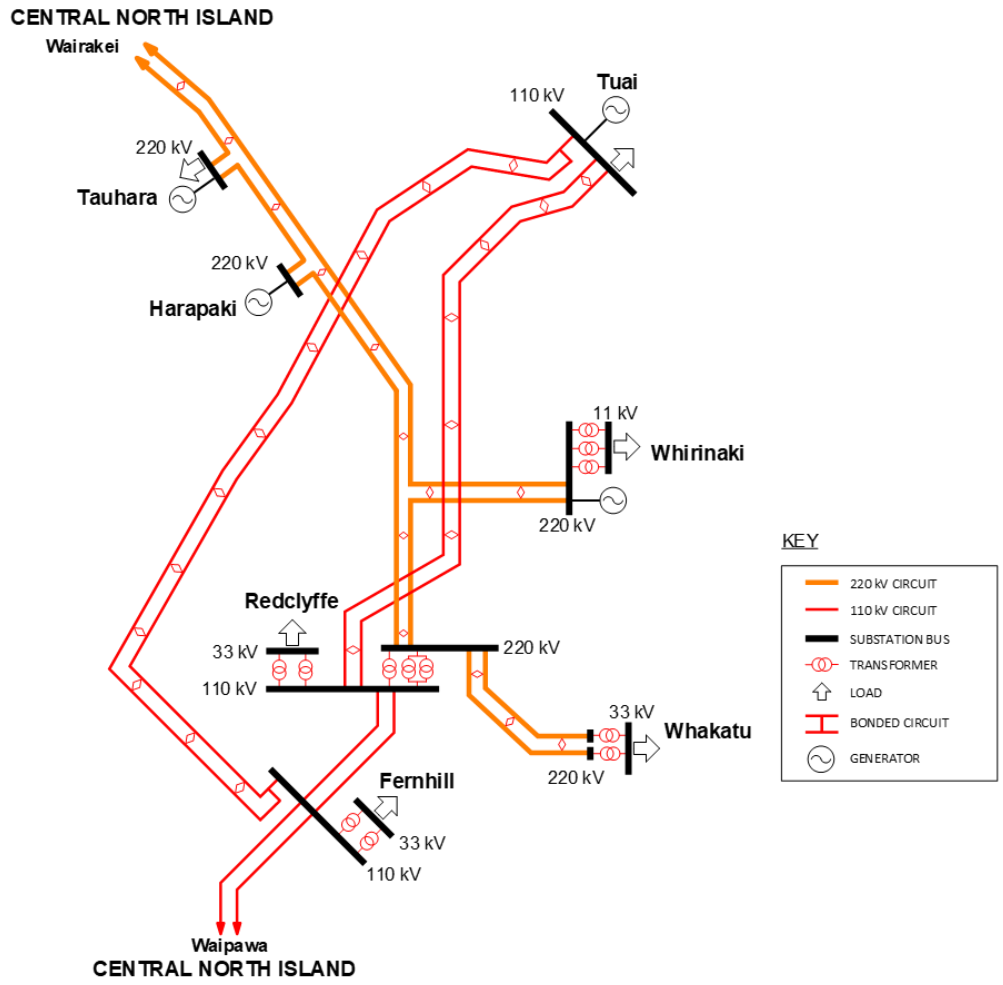
The existing transmission network for the Hawke's Bay region is set out geographically in Figure 13-1 and schematically in Figure 13-2.

Figure 13-1: Hawke's Bay region transmission network map



2025 Annual Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 13-2: Hawke's Bay region transmission schematic



13.1.1 Transmission into the region

Transmission into the Hawke's Bay region is via two 220 kV circuits from Wairakei that directly supply the Whirinaki and Whakatu loads, and two 220/110 kV interconnecting transformers at Redclyffe.

Two 110 kV circuits also connect the Hawke's Bay 110 kV system at Fernhill from Waipawa in the south. These are normally open at Waipawa.

13.1.2 Transmission within the region

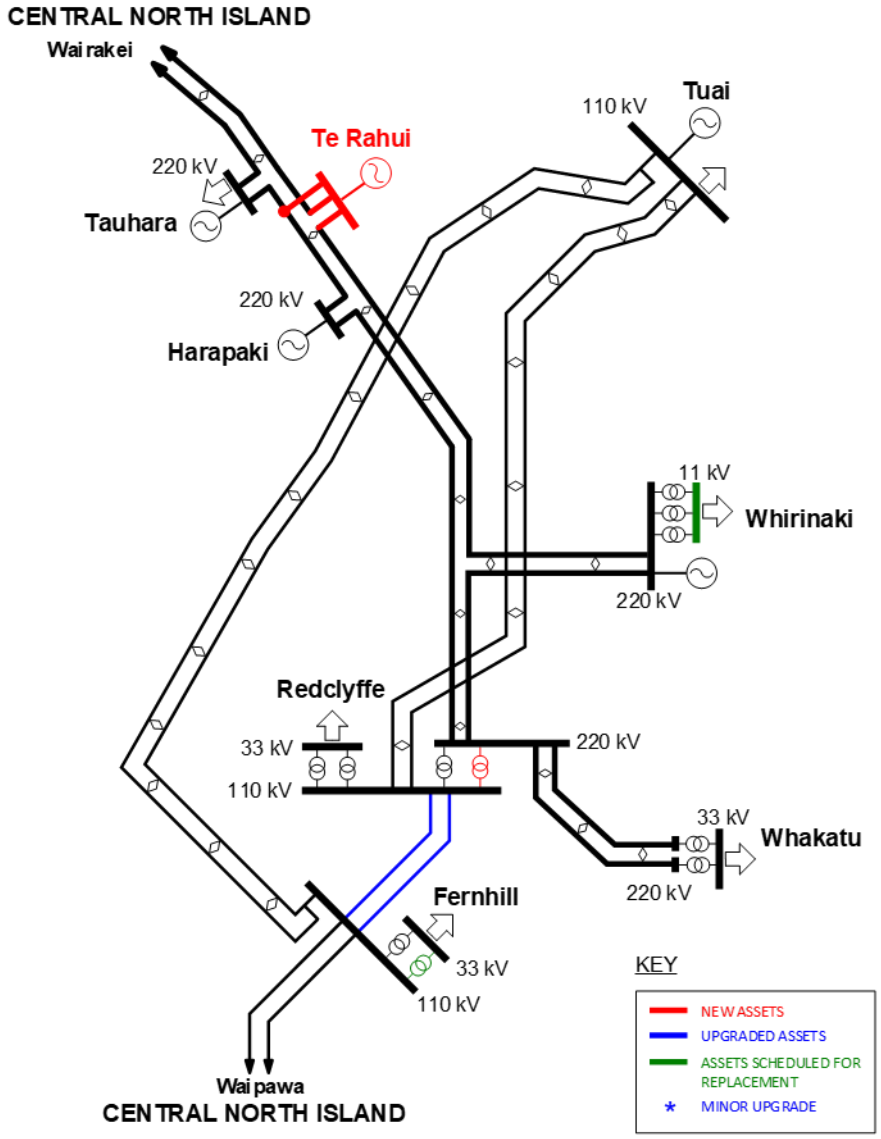
Within the Hawke's Bay region, the transmission network comprises 220 kV and 110 kV transmission circuits. The majority of the region's load is supplied via the 220/110 kV interconnecting transformers at Redclyffe. Transmission within the region is predominantly at 110 kV.

13.1.3 Possible Hawke's Bay transmission configuration

Figure 13-3 shows the possible configuration of Hawke's Bay transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 13-3: Possible Hawke's Bay transmission configuration in 2040



13.2 Hawke's Bay load and generation forecasts

13.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Hawkes Bay regional peak demand is forecast to grow by an average 1.7 per cent per annum over the next 15 years, from 357 MW in 2025 to 462 MW by 2040. This is lower than the national average growth rate of 2.6 per cent per annum.

Table 13-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

[1] Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 13-1: Forecast prudent annual peak demand (MW) at Hawke's Bay grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Fernhill	0.99	77	79	81	84	86	88	89	90	91	92	92	92
Redclyffe[2]	1.00	102	106	111	116	120	123	127	129	132	135	137	144
Tuai	1.00	70	77	79	80	82	84	86	87	89	90	91	95
Tauhara[1]	0.99	15	26	32	36	38	41	43	46	46	47	49	52
Whakatu[2]	0.99	103	106	108	109	110	111	111	111	112	112	112	108
Whirinaki	1.00	80	80	80	80	80	80	80	80	80	80	80	80

1. Tauhara load is a gross demand value. It excludes embedded generation.
2. Unison advised a 16 MW load shift from Whakatu to Redclyffe in 2025.

13.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing coal users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the Hawke's Bay region that are not included in the prudent demand forecast.

13.2.3 Existing and committed generation

The Hawke's Bay region's generation capacity is approximately currently 732 MW in 2025. This excludes any embedded solar (PV) generation, which was approximately 30 MW[2] in Hawke's Bay at the time of publication.

Table 13-2 lists the generation forecast for each grid injection point in the Hawke's Bay region for the forecast period. This includes all known and committed generation stations including those embedded within local lines company networks (Unison Networks or Firstlight Network)[3].

Further generation may be developed during the period. Refer to section 13.8 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 13-2: Existing and committed generation capacity at Hawke's Bay grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2039	2040
Harapaki	176	176	176	176	176	176	176	176	176	176	176	176
Kaitawa[1]	36	36	36	36	36	36	36	36	36	36	36	36
Piripaua[1]	42	42	42	42	42	42	42	42	42	42	42	42
Redclyffe (Esk River)	4	4	4	4	4	4	4	4	4	4	4	4
Tauhara	174	174	174	174	174	174	174	174	174	174	174	174
Tauhara (Te Huka 3)	51	51	51	51	51	51	51	51	51	51	51	51
Tuai[1]	68	68	68	68	68	68	68	68	68	68	68	68
Tuai (Gisborne)	5	5	5	5	5	5	5	5	5	5	5	5
(Matawai)	2	2	2	2	2	2	2	2	2	2	2	2
(Waihi)	5	5	5	5	5	5	5	5	5	5	5	5

2 Electricity Market Information (EMI): Installed distributed solar generation trends

3 Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2039	2040
Whirinaki	156	156	156	156	156	156	156	156	156	156	156	156
Whirinaki (Pan Pac)	13	13	13	13	13	13	13	13	13	13	13	13
Te Rahui	0	0	200	200	200	200	200	200	200	200	200	200

1. Kaitawa, Piripaua and Tuai are collectively known as the Waikaremoana scheme and connect to the Tuai 110 kV bus.

13.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Hawke's Bay region.

13.3 Grid enhancement approach and inputs

13.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Hawke's Bay region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancements to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 13.4 and 13.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

13.3.2 Hawke's Bay significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 13-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Hawke's Bay region for the next 15 years that may significantly impact related system issues or connected parties.

Table 13-3: Proposed significant upcoming replacement and refurbishment work for the Hawke's Bay region

Description	Tentative year	E&D issue
Fernhill–T2 transformer replacement	2037-2039	13.5.1
Tuai 110 kV feeder protection replacement	2028-2030	None
Whakatu–T3/T4 transformers' bushing replacement	2023-2025	None
Whirinaki–T3 transformer's bushing replacement	2023-2025	13.5.6
Whirinaki 11 kV switchboard replacement	2026-2028	13.5.6

13.3.3 Hawke's Bay asset feedback

The Asset Feedback Register includes the following E&D-related entry specific to the Hawke's Bay region:

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- Bus coupler and bus zone protection at Fernhill, see section 13.6.

13.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Hawke's Bay region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 13-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 13-4: Changes within the wider region since the 2023 TPR

Issues	Change
Hawke's Bay voltage quality	Removed. Addressed by Redclyffe 220/110 kV capacity upgrade.

The overview of transmission capability within the wider Hawke's Bay region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
13.4.1	Redclyffe 220/110 kV transformer capacity
13.4.2	Fernhill–Redclyffe transmission capacity
13.4.3	Hawke's Bay rebuild following Cyclone Gabrielle

13.4.1 Redclyffe 220/110 kV transformer capacity

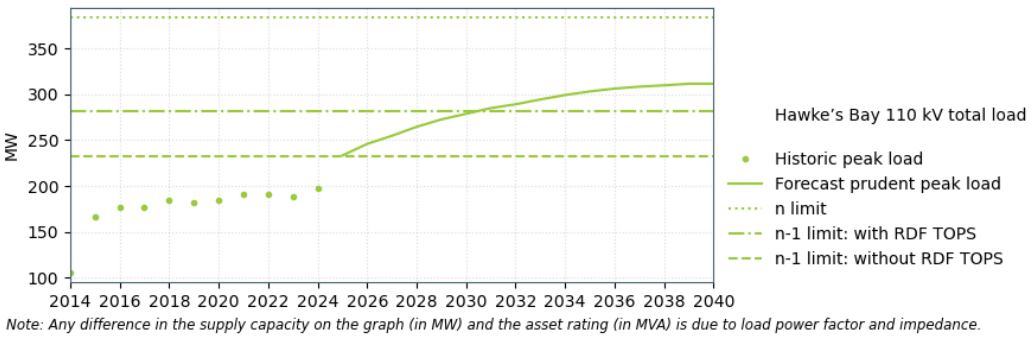
Issue

The Hawke's Bay 110 kV system supplies over half of the regional load at Fernhill, Redclyffe and Tuai. The 110 kV system, in turn, is supplied through two 220/110 kV interconnecting transformers at Redclyffe and from the Waikaremoana hydro generation scheme connected at Tuai.

In 2025 we upgraded the 220/110 kV interconnection capacity at Redclyffe by installing a new 250 MVA, 220/110 kV transformer (T5) and banking together the two existing 85 MVA 220/110 kV transformers (T4A/T4B[4]). As a result, the two 220/110 kV interconnecting transformers at Redclyffe now provide a nominal installed capacity of 420 MVA.

While this capacity upgrade has improved the situation, an outage of the new larger interconnecting transformer (T5) will still overload the remaining transformer (T4A/T4B) during periods of high load and low Waikaremoana generation from winter 2025 (see Figure 13-4).

Figure 13-4: Redclyffe interconnecting transformer capacity (with 25 MW Waikaremoana generation)



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

There is usually a minimum of 25 MW of generation from Waikaremoana during regional peaks. However, there have been prolonged periods of low inflows into the Lake Waikaremoana scheme resulting in low lake levels and very low generation, with the "natural" generation close to 7 MW. Even with the capacity increase from installing T5 and the transformer overload

[4] The T4A/T4B bank is a renaming of T3 and T4 after they were banked together following installation of T5.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

protection scheme (TOPS), the load may exceed the capacity of the upgraded transformers plus 7 MW of generation in the next few years. Generation at Waikaremoana would need to be constrained-on above 7 MW, risking insufficient water storage to supply the regional load later in the year.

What next?

We will investigate adapting the existing Redclyffe transformer overload protection scheme to the new transformer configuration, or alternate measures, to allow the transformers to operate above their n-1 limit pre-contingency. However, the range of action of this special protection scheme is limited, because the post-contingent loading on the T4A/T4B bank needs to remain below 260 MVA to avoid irreversible damage to it.

A longer-term solution to fully remove the interconnecting transformer constraint is replacing the 170 MVA T3-T4 bank with a second 250 MVA transformer.

Base E&D capex investments

Project name:	Redclyffe 220/110 kV transformer overload protection scheme
Project description:	Adapting existing transformer overload protection scheme to the new 220/110 kV configuration
Project's state of completion:	Possible
Grid need date:	2025
Indicative cost [$ million]:	0.2
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Redclyffe interconnecting capacity
Project description:	Replace T4A/T4B bank with a single 220/110 kV 250 MVA transformer
Project's state of completion:	Possible
Grid need date:	2031
Indicative cost [$ million]:	16
Reliability or Economic investment?	Reliability (Grid Reliability Report)

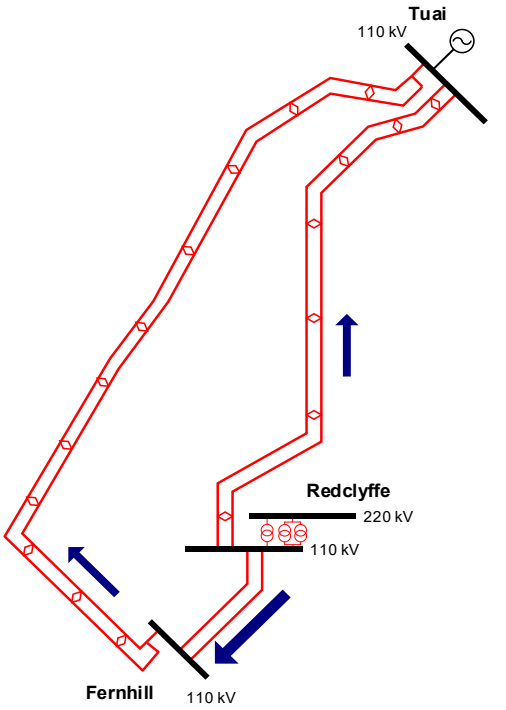
13.4.2 Fernhill–Redclyffe transmission capacity

Issue

The two 110 kV Fernhill–Redclyffe circuits are each rated at 51/62 MVA (summer/winter). During periods of high load and low Waikaremoana generation, power flows from Redclyffe to Tuai on the 110 kV circuits, as shown on Figure 13-5. In this situation, an outage of one Fernhill–Redclyffe circuit can overload the other circuit.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 13-5: Power flow from Redclyffe to Tuai during high load and low generation at Tuai (with 25 MW Waikaremoana generation)



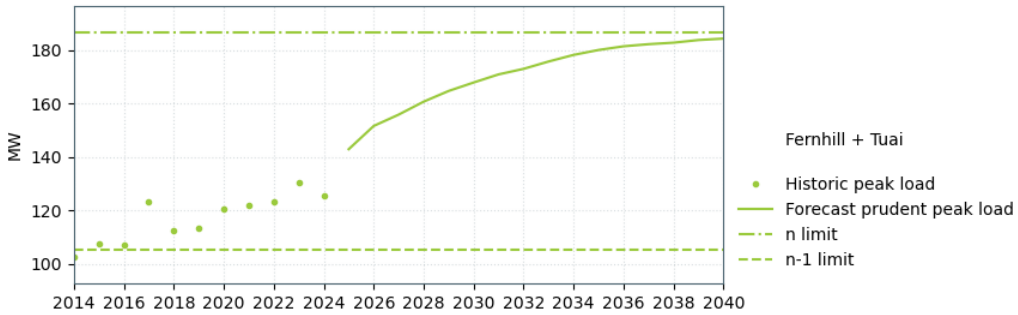
We currently manage the circuit constraint operationally by constraining-on Waikaremoana hydro generation or requesting a load transfer within Unison's network from Fernhill to Redclyffe or Whakatu, to avoid exceeding the n-1 capacity of the circuits.

The minimum Waikaremoana generation level to avoid Fernhill–Redclyffe n-1 overloads is expected to be approximately 59/79 MW for the 2025 summer/winter peaks[5]. Towards the end of the forecast period, the Waikaremoana generation requirement is expected to increase to 108/140 MW (summer/winter). While this is still within the rated capacity of the Waikaremoana hydro scheme (146 MW), there may not always be enough hydro inflow to sustainably remove the transmission constraint. Historically there have been prolonged periods of low inflows into the Lake Waikaremoana scheme resulting in low lake levels and very low generation. During these times, the "natural" generation was close to 7 MW.

Figure 13-6 shows the forecast overload for a Fernhill–Redclyffe circuit with 25 MW Waikaremoana generation and no load shifted from Fernhill.

Historically the need to constrain-on Waikaremoana generation to manage loading on the Redclyffe 220/110 kV interconnecting transformers (see section 13.4.1) has usually occurred before the need to constrain-on generation to manage the loading on the Fernhill–Redclyffe circuits. With the new Redclyffe–T5 interconnecting transformer, the Fernhill–Redclyffe constraint will occur before the Redclyffe interconnector constraint.

Figure 13-6: Fernhill–Redclyffe transmission capacity (with 25 MW Waikaremoana generation)



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[5] This analysis assumes that no load has been shifted away from Fernhill pre-contingency to reduce the magnitude of the transmission capacity issue.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

New generation hosted at Fernhill or along the Fernhill–Waipawa circuits may also overload the 110 kV Fernhill–Redclyffe circuits, for power flow from Fernhill to Redclyffe. See section 13.8.3.

What next?

A possible short-term investment to address the Fernhill–Redclyffe transmission capacity issue is a special protection scheme for automatic post-contingency load transfer from Fernhill to Whakatu. However, post-contingency load transfer may result in the n-1 capacity of the Whakatu supply transformers being exceeded, which may limit the amount of load that can be transferred (see section 13.5.5 for further details).

Note this occurs after the n-1 contingency in the Hawke's Bay 110 kV system, so the risk at Whakatu is similar to an "n-2 security risk".

In the longer-term it may be economic to reconductor the Fernhill–Redclyffe circuits to increase their capacity.

Base E&D capex investments

Project name:	Fernhill–Redclyffe–A and B line capacity
Project description:	Install an overload protection scheme
Project's state of completion:	Possible
Grid need date:	2025
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project name:	Fernhill–Redclyffe–A and B line reconductoring
Project description:	Reconductor to increase rating
Project's state of completion:	Possible
Grid need date:	2025
Indicative cost [$ million]:	17
Reliability or Economic investment?	Reliability (Grid Reliability Report)

13.4.3 Hawke's Bay rebuild following Cyclone Gabrielle

Redclyffe and Whirinaki substations were flooded and parts were severely damaged as a result of Cyclone Gabrielle in 2023. Whakatu and Fernhill substations were also flooded but to a lesser extent.

The recovery phase following the cyclone, restoring the regional grid to its pre-cyclone configuration and capacity, is now complete. We are now in the investigation and build phase to harden the regional grid against weather events like Cyclone Gabrielle.

Redclyffe

Transpower has worked with local distribution companies Unison Networks and Firstlight Network to investigate options to mitigate the risk of transmission network outages from similar weather events in the future. The investigation identified that the fastest and most economic way of providing increased resilience to the community is to strengthen and improve the Redclyffe substation at its current location.

This "rebuild' option involves rebuilding the Redclyffe 220 kV switchyard with raised structures to provide "wet feet" protection for all critical equipment. We estimate this will cost about $47 million and expect it will be completed by the end of 2027. It will make the Redclyffe substation flood resilient to a one-in-450-year flooding event and significantly enhance its earthquake resilience. We have submitted a Major Capex Proposal to the Commerce Commission to seek funding for this rebuild.

Further investment by Transpower and Unison will be required to meet future demand driven by population growth and increased electrification.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Major capex investments

Project name:	Redclyffe 220 kV Switchyard Resilience Project
Project description:	Rebuild the Redclyffe 220 kV switchyard with raised structures to provide "wet feet" protection for all critical equipment.
Project's state of completion:	Proposed
Grid need date:	2027
Indicative cost [$ million]:	47
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Whirinaki

The Whirinaki substation connects the Pan Pac industrial load and Contact Energy's gas turbine generators, which were equally or more affected by flooding than our equipment. We expect flood resilience will be achieved by working with Pan Pac, Contact and councils to keep water out of the combined sites rather than raising equipment above flood levels.

13.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 13-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 13-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Tauhara supply security	Added. New GXP commissioned in 2024.
Whakatu supply capacity	Removed. Reduced load forecast.
Redclyffe supply capacity	Added. Increased load forecast.

The overview of transmission capability for each grid exit point within the Hawke's Bay region is listed below. Where an issue is identified we list options to address it.

Section number	Description
13.5.1	Fernhill supply capacity
13.5.2	Redclyffe supply capacity
13.5.3	Tauhara supply capacity
13.5.4	Tuai supply capacity
13.5.5	Whakatu supply capacity
13.5.6	Whirinaki supply capacity and security

13.5.1 Fernhill supply capacity

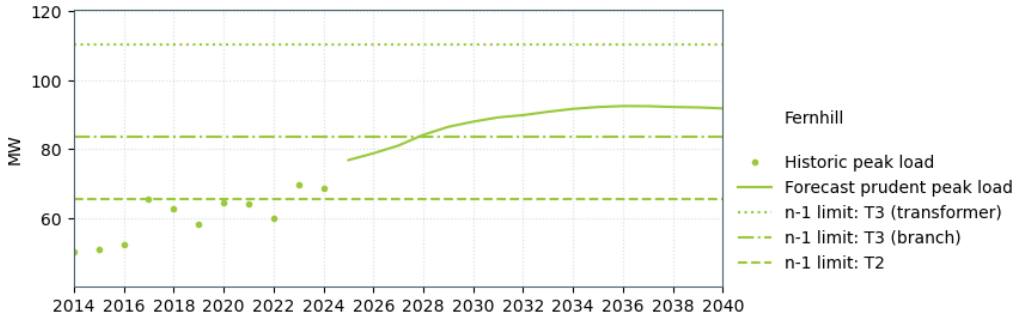
Issue

Two 110/33 kV transformers (rated at 80 MVA and 50 MVA) supply Fernhill's load, providing a total nominal installed capacity of 130 MVA.

Peak load at Fernhill has exceeded the n-1 capacity of the smaller transformer (T2) since 2023 (see Figure 13-7). The branch n-1 capacity limit on the larger transformer (T3) is forecast to be exceeded in 2028. The n-1 capacity on T3 is limited by protection equipment and 33 kV cables.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 13-7: Fernhill supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The short-term operational solution involves load shifting within Unison's network following a transformer outage.

Options in the longer-term include:

- Installing a transformer overload special protection scheme on both supply transformers. The scheme would automatically reduce the Redclyffe load if a supply transformer is overloaded post-contingency.
- Bringing forward the risk-based condition replacement of T2 (currently scheduled for 2039) to install a higher rated unit and removing the branch limits on T3.

Future investment will be customer driven.

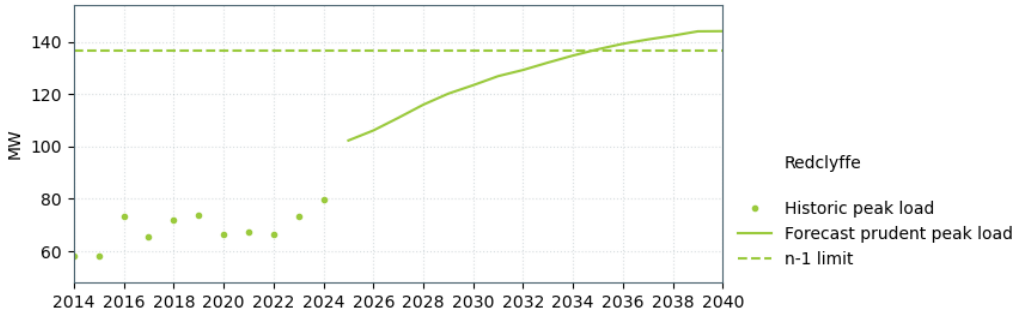
13.5.2 Redclyffe supply capacity

Issue

Two 110/33 kV transformers supply Redclyffe's load, providing total nominal installed capacity of 240 MVA. The transformers' capacity is limited by the 33 kV circuit breakers.

Peak load at Redclyffe is forecast to exceed the n-1 capacity of the supply transformers from 2035 (see Figure 13-8).

Figure 13-8: Redclyffe supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will continue to monitor this risk and investigate investment options as part of our regional planning work with Unison. Options include shifting load post-contingency, upgrading the Redclyffe supply transformers or installing a third supply transformer at Redclyffe. The Redclyffe supply transformer overload issue will be more significant if Unison shifts load to manage transmission constraints at Fernhill during peak loads.

13.5.3 Tauhara supply capacity and security

Issue

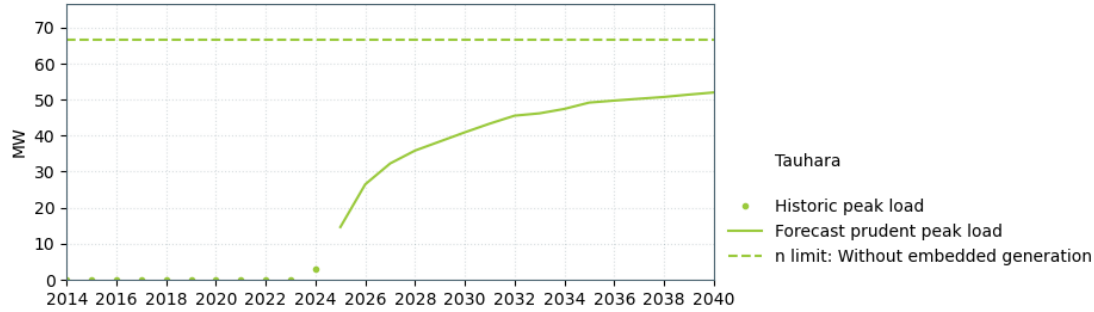
Tauhara is a new GXP commissioned in 2024. A single 220/33 kV, 70 MVA transformer supplies the Unison load at Tauhara, resulting in n security.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The Te Huka Unit 3 geothermal generator is connected within the distribution network supplied from the Tauhara 33 kV bus.

Peak load at Tauhara is forecast to stay within the n capacity of the supply transformer for the forecast period, even without generation at Te Huka Unit 3 (see Figure 13-9).

Figure 13-9: Tauhara supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

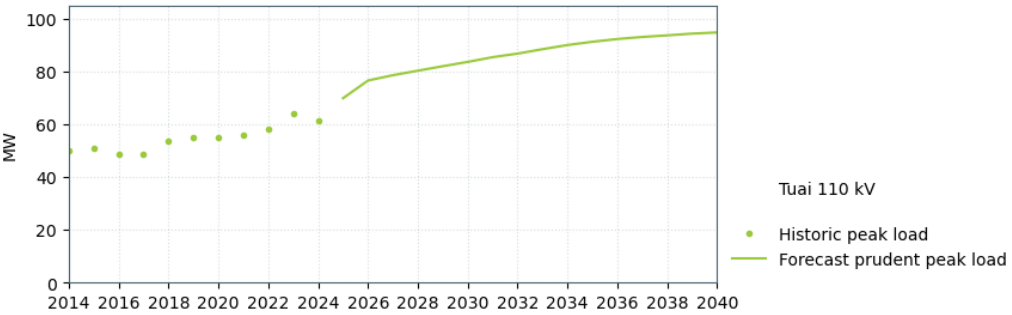
What next?

Some load can be backfed from the Wairakei GXP (In the Central North Island region) through Unison's distribution system. Unison considers the lack of n-1 security is operationally manageable for the forecast period. We have not planned any investments to increase security at Tauhara. Future investment will be customer driven.

13.5.4 Tuai supply capacity

Eastland Network has 110 kV feeders connected directly to the Tuai 110 kV bus; their capacity is not reported in the TPR. See Figure 13-10 for the peak load forecast.

Figure 13-10: Tuai 110 kV load forecast



13.5.5 Whakatu supply capacity

Issue

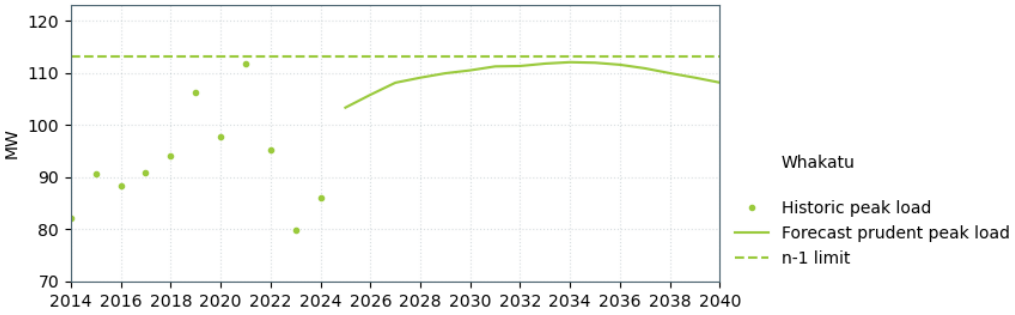
Two 220/33 kV transformers supply Whakatu's load, providing nominal installed capacity of 200 MVA. There is no 220 kV bus at Whakatu, so a Redclyffe–Whakatu circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[6], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Whakatu is within the n-1 capacity of the supply transformers for the forecast period (see Figure 13-11). However, this does not account for possible post-contingency load shifting from Fernhill to Whakatu (see section 13.4.2).

[6] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 13-11: Whakatu supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

If post-contingency load transfer from Fernhill is implemented, a special protection scheme may be required at Whakatu to allow the pre-contingency load to exceed the transformers' n-1 capacity.

Customer investments

Project name:	Whakatu supply capacity
Project description:	Install overload protection scheme on the Whakatu supply transformers
Project's state of completion:	Possible
Grid need date:	2025
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

13.5.6 Whirinaki supply capacity and security

Issue

Three 220/11 kV transformers supply Pan Pac Forest's load, providing nominal installed capacity of 180 MVA.

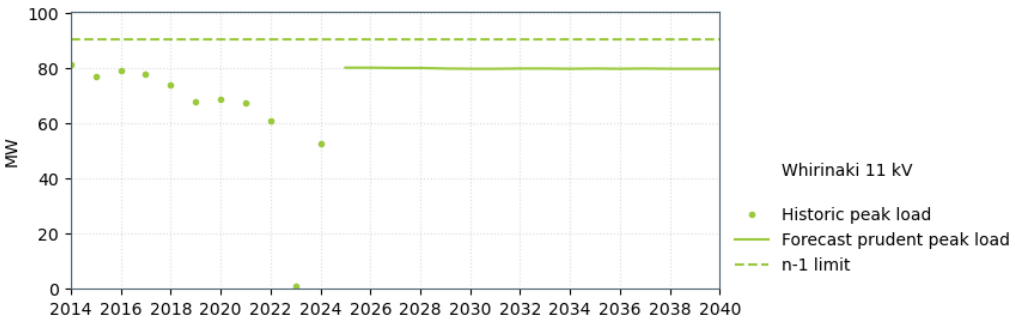
The three 220/11 kV supply transformers at Whirinaki are a dedicated supply to the Pan Pac Mill, where each transformer is connected to a 11 kV bus. The 11 kV bus is normally operated split to manage the fault level within the customer's 11 kV network.

Part of the load is supplied with switched n-1 security through a single supply transformer (T1). The load can be supplied through the other two transformers if T1 is out of service.

The remaining load is supplied at n-1 security through parallel transformers T2 and T3.

The total load is within the n-1 capacity of the supply transformers (see Figure 13-12).

Figure 13-12: Whirinaki supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss the configuration of the 11 kV connection with Pan Pac as part of the planned risk-based condition replacement of the 11 kV switchboard at Whirinaki (see Table 13-3).

Any change in the security level will be customer driven.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

13.6 Hawke's Bay bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 13-6 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 13-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Fernhill 110 kV	Fernhill	-	-	Note 1
Redclyffe 110 kV			Redclyffe 220/110 kV transformer overloading Fernhill–Redclyffe 110 kV transmission capacity	13.4.1 13.4.2
Redclyffe 220 kV	-	-	Redclyffe 220/110 kV transformer overloading	13.4.1
Tuai 110 kV	-	-	Fernhill–Redclyffe 110 kV transmission capacity	13.4.2
Tauhara 220 kV	Tauhara	- Tauhara	- -	13.5.3 Note 1
Whirinaki 220 kV	Whirinaki	Whirinaki	- -	Note 1 Note 1

1. There are single bus sections at Fernhill, Tauhara and Whirinaki. Therefore, a bus fault will cause loss of connection and/or loss of supply.

The customers at these grid exit and injection points (Genesis, Contact Energy, Unison, Firstlight Network and Pan Pac) have not requested higher bus security levels. Unless otherwise noted, we do not propose increasing bus security and further investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

13.7 Other items of interest

13.7.1 Hawke's Bay supply security for double 220 kV circuit outages

Issue

Transmission into the Hawke's Bay region is via two 220 kV circuits from Wairakei to Whirinaki and Redclyffe. Both circuits are strung on a single 220 kV line known as the Wairakei–Whirinaki–A line. The line traverses some very harsh terrain and sections of the line are particularly exposed to the elements making the line susceptible to double circuit outages caused by:

- conductor clashing from snow unloading
- lightning, compounded by high tower footing resistance and lack of earth wire on the line.

An outage of both 220 kV circuits causes loss of supply to the Hawke's Bay region.

What next?

We have invested to minimise the two major causes listed above. Inter-phase spacers[7] were installed to reduce the risk of double 220 kV circuit outages into Hawke's Bay and a semi-automated switching scheme reduces restoration time following a double-circuit outage. If it becomes economic to further improve reliability of the 220 kV transmission system, we will invest accordingly.

7 Interphase spacers are insulators installed between the three conductor phases to hold them apart. They are installed part way along the line between towers.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

13.8 Hawke's Bay generation opportunities and proposals

This section provides a high-level description of the Hawke's Bay region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The Hawke's Bay region has some long-established generation, and new generation connected to the 220 kV lines supplying Hawke's Bay. Developers are also investigating additional generation, principally solar but also some wind, that would inject into the 110 kV and 220 kV Hawke's Bay systems.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal, and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
13.8.1	Generation opportunities by substation
13.8.2	Generation investigations and proposals
13.8.3	Fernhill–Redclyffe circuit capacity
13.8.4	220 kV transmission capacity

13.8.1 Generation opportunities by substation

Envision Opportunities[8] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities uses a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[9]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy.
- winter evening peak – wet/windy
- winter midday high – wet/calm

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

13.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[10]. Generation proposals transfer from the

[8] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

[9] "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

[10] Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

The following are generation and grid-scale battery projects in the Hawke's Bay region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 13-2 instead.

Table 13-7 Generation investigation and proposals

Connection point	Technology	Status	Capacity (MW)
Wairakei–Whirinaki	Solar	Delivery[1]	200[2]
Waipawa (North)	Solar + BESS[3]	Investigation	100

1. "Delivery" is a stage in the Transpower generation queue process, it does not denote a final commitment by the developer to build the generation.
2. This is a 200 MW extension of the committed Te Rahui solar farm.
3. BESS refers to Battery Energy Storage System

13.8.3 Fernhill–Redclyffe circuit capacity

The ability of the 110 kV system to host new generation at or near Fernhill may be constrained by the rating of the 110 kV Fernhill–Redclyffe circuits for exporting power from Fernhill to Redclyffe during periods of high generation and low load.

Pre-contingency generation constraints could be managed with a special protection scheme to automatically and quickly reduce generation following a circuit outage.

The possible upgrade of the Fernhill–Redclyffe circuits to manage periods of high load and low Waikaremoana generation (see section 13.4.2) will also enable additional generation during periods of low load.

13.8.4 220 kV transmission capacity

Development of additional generation anywhere in the Hawke's Bay region may be constrained during periods of low load due to the low capacity of the Atiamuri–Whakamaru 220 kV circuit, part of the Wairakei Ring (see Chapter 6).

The potential for new generation in the Hawke's Bay and along the 220 kV circuits from Wairakei is such that it may exceed the n-1 capacity of the 220 kV Tauhara–Wairakei and Wairakei–Whirinaki circuits.

If the capacity of the circuits becomes an issue in future, one option is to bus the Wairakei–Whirinaki circuit into Tauhara (creating Tauhara–Wairakei–1 and 2) and thermally upgrade the 8 km of line from Tauhara to Wairakei. An increase in capacity in the order of 200-270 MW is expected to be possible with this approach.

No investments are proposed at present.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

14 Wellington Regional Plan

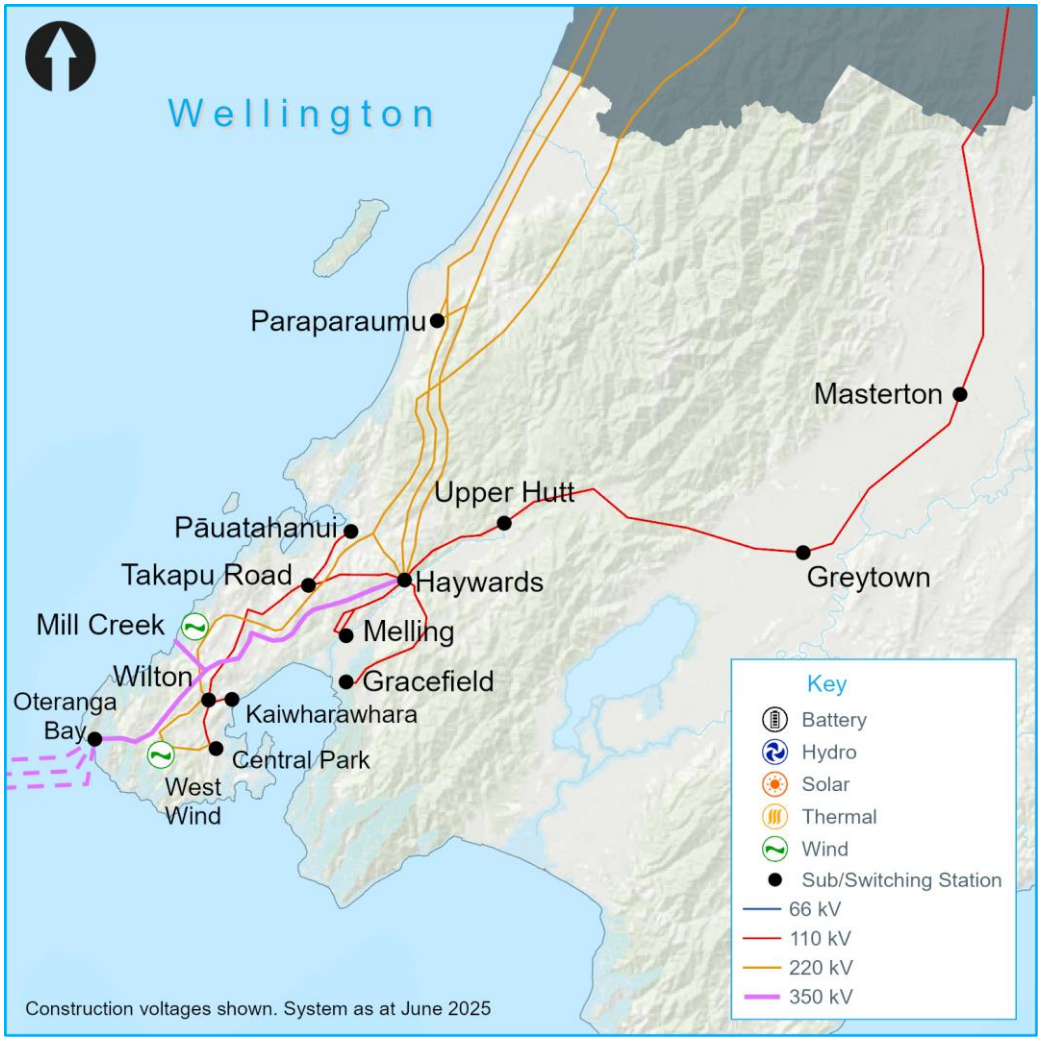
14.1	Regional overview and transmission system
14.2	Wellington load and generation forecasts
14.3	Grid enhancement approach and inputs
14.4	Grid asset capability and management within the wider region
14.5	Grid asset capability and management by grid exit point
14.6	Wellington bus security
14.7	Other items of interest
14.8	Wellington generation opportunities and proposals

14.1 Regional overview and transmission system

The Wellington region is the major load centre of the southern North Island, comprising both residential loads and a major city Central Business District (CBD). The region includes the large load centre of Wellington City, together with provincial towns and smaller rural localities.

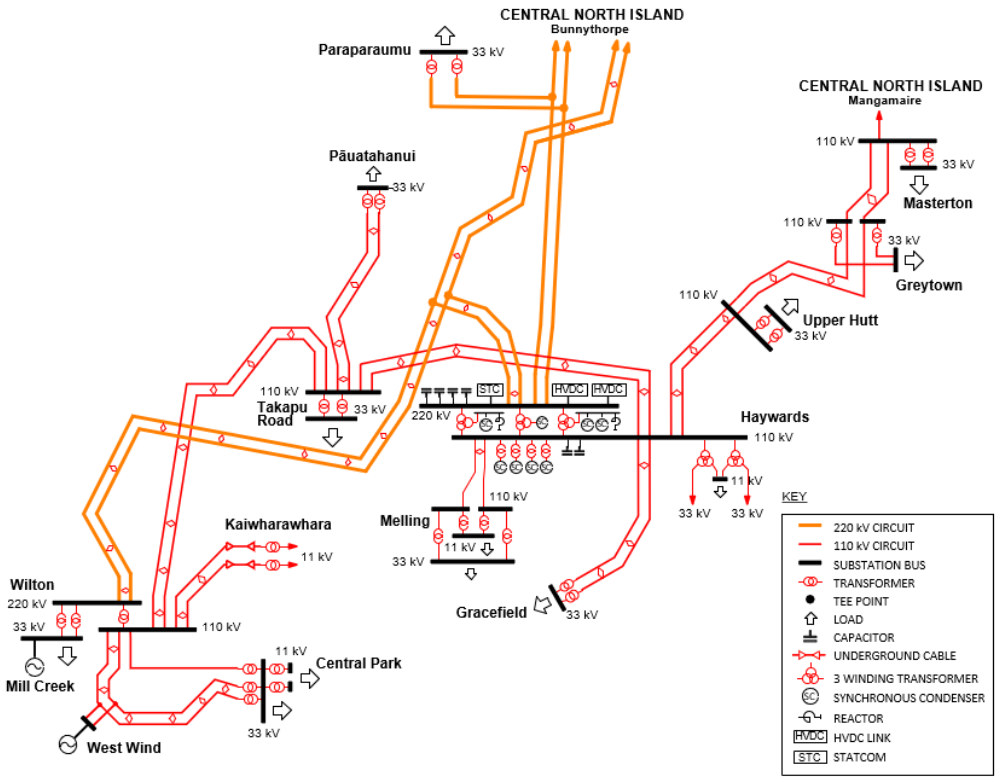
The existing transmission network for the Wellington region is set out geographically in Figure 14-1 and schematically in Figure 14-2.

Figure 14-1: Wellington region transmission network map



2025 Annual Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 14-2: Wellington region transmission schematic



14.1.1 Transmission into the region

The Wellington region is connected to the rest of the National Grid through 220 kV circuits from Bunnythorpe and the HVDC inter-island link. It is a main corridor for through-transmission between the North and South Islands. The loading of these circuits is primarily driven by HVDC power flow and Central North Island generation.

The HVDC link's North Island terminal is at Haywards. The HVDC link can transfer up to 850 MW to the South Island (depending on the load and generation in the Wellington region), and up to 1,200 MW from the South Island (see Chapter 6).

As generation capacity in the region is much lower than local load, power is normally imported, either via the HVDC link (from the South Island) or from the Central North Island.

14.1.2 Transmission within the region

The region has some of the higher load densities in the North Island. Transmission within the Wellington region comprises:

- 220 kV circuits entering the region from Bunnythorpe
- a 110 kV circuit entering the region from Mangamaire
- interconnecting transformers located at Haywards and Wilton.

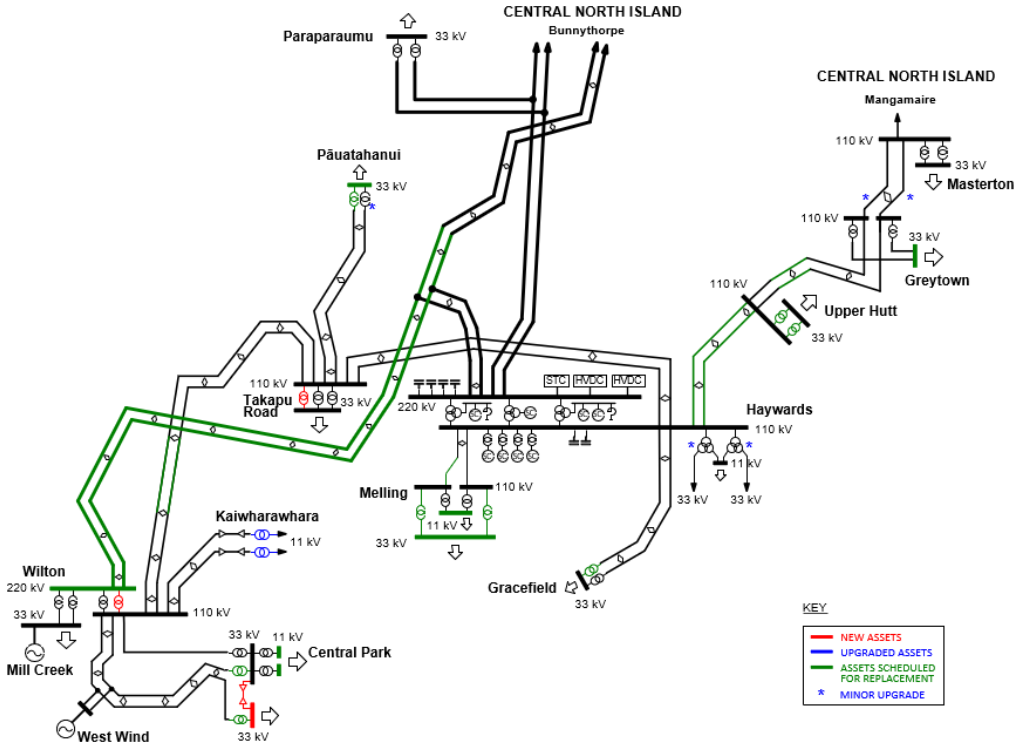
Reactive support in the region is mainly provided from the Haywards substation, with some contribution from the West Wind and Mill Creek wind generation stations.

14.1.3 Possible future Wellington transmission configuration

Figure 14-3 shows the possible configuration of Wellington transmission in 2040. New assets, upgraded assets, and assets scheduled for replacement within the forecast period are shown.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 14-3: Possible Wellington transmission configuration in 2040



14.2 Wellington load and generation forecasts

14.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Wellington regional peak demand is forecast to grow by an average 1.5 per cent per annum over the next 15 years, from 706 MW in 2025 to 889 MW by 2040. This is lower than the national average growth rate of 2.6 per cent per annum.

Table 14-1 lists the peak demand forecast (prudent growth) for each grid exit point for the forecast period.

Table 14-1: Forecast annual prudent peak demand (MW) for Wellington grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Central Park 11 kV	1.00	24	24	24	24	25	26	26	27	27	27	27	28
Central Park 33 kV[1]	1.00	143	149	158	160	161	163	164	165	166	167	168	168
Gracefield[2,3]	1.00	68	73	70	71	72	76	77	78	79	81	81	84
Greytown	1.00	17	18	18	18	18	19	19	19	19	19	19	19
Haywards 11 kV[4]	1.00	18	22	22	23	23	23	23	23	23	23	24	23
Haywards 33 kV[4]	0.99	21	32	33	37	37	38	38	38	38	38	38	38
Kaiwharawhara[5]	1.00	29	34	34	57	57	58	58	59	59	59	60	61
Masterton	1.00	56	59	61	63	64	65	66	66	67	68	68	67
Melling 11 kV	1.00	32	32	32	33	33	33	33	33	34	34	34	33
Melling 33 kV[3,4]	1.00	35	38	51	51	52	52	53	53	53	53	54	53

1 Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Paraparaumu	1.00	72	73	74	76	77	78	80	81	82	83	84	85
Pāuatahanui[6]	1.00	21	25	26	34	34	34	35	35	36	36	36	37
Takapu Road[6]	1.00	106	113	119	120	122	124	126	127	128	130	131	133
Upper Hutt	1.00	32	32	33	34	34	34	35	35	35	35	35	34
Wilton	1.00	52	53	53	54	54	55	55	56	56	56	57	56

1. Central Park 33 kV has multiple step loads from expected public transport electrification upgrades and several new buildings planned.
2. Gracefield has multiple step loads due to public transport electrification and industrial development.
3. In 2027, there is a 9 MW load shift from Gracefield to Melling.
4. Haywards, Melling – public transport electrification, industrial developments and residential developments in Manor Park, Naenae, Waterloo and Wainuiomata.
5. Kaiwharawhara growth from expected industrial development, public transport electrification and port upgrades.
6. Takapu Road and Pāuatahanui growth from public transport electrification and significant industrial and residential developments.

14.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing fossil fuel users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the Wellington region that are not included in the prudent demand forecast.

14.2.3 Existing and committed generation

The Wellington region's generation capacity is currently 225 MW, which is significantly lower than the local load. This excludes any embedded solar (PV) generation, which was approximately 42 MW in the Wellington region at the time of publication[2]. Most of the generation capacity is from wind generation stations, the largest being West Wind at 143 MW.

Table 14-2 lists the generation forecast for each grid injection point in the Wellington region for the forecast period. This includes all known and committed generation stations, including those embedded within the local lines company networks (Wellington Electricity, Powerco, and Electra)[3].

Further generation may be developed during the period. Refer to Table 14-7 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 14-2: Existing and committed generation capacity at Wellington grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Central Park (Southern Landfill) (Wellington Hospital[1])	1 8	1 8	1 8	1 8	1 8	1 8	1 8	1 8	1 8	1 8	1 8	1 8
Greytown (Hau Nui)	9	9	9	9	9	9	9	9	9	9	9	9
Haywards (Silverstream)	3	3	3	3	3	3	3	3	3	3	3	3
Masterton (Kourarau A and B)	1	1	1	1	1	1	1	1	1	1	1	1
West Wind	143	143	143	143	143	143	143	143	143	143	143	143

2 Electricity Market Information (EMI): Electricity Authority - EMI (market statistics and tools)

3 Only generators with capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Wilton (Mill Creek)	60	60	60	60	60	60	60	60	60	60	60	60

1. The Wellington Hospital generation is standby only.

14.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Wellington region.

14.3 Grid enhancement approach and inputs

14.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Wellington region into the future. We assessed transmission capacity requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancements to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 14.4 and 14.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

14.3.2 Wellington significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 14-3 lists the significant upcoming risk-based replacement and refurbishment work proposed for the Wellington region during the next 15 years that may significantly impact related system issues or connected parties.

Table 14-3: Proposed significant upcoming replacement and refurbishment work for the Wellington region

Description	Tentative year	E&D issue
Haywards–Wilton–Linton–1 and 2 circuits:		
reconductor Judgeford to Wilton section	2019-2025	None
reconductor 19 km north from Judgeford towards Linton	2028-2030	None
Central Park–T4 transformer replacement	2026-2028	None
Central Park–T3 transformer replacement	2032-2034	None
Central Park seismic upgrade	2026-2028	None
Central Park transformer overload protection scheme replacement	2026-2028	None
Gracefield–T6 transformer replacement	2035-2037	None
Haywards–Upper Hutt–A line reconductoring	2027-2029	14.4.1
Haywards–Melling–B line partial reconductoring	2033-2035	None
Greytown 33 kV outdoor to indoor conversion	2024-2026	None
Masterton–Upper Hutt–A line partial reconductoring	2027-2027	None
Masterton–Greytown–Upper Hutt line protection upgrade	2025-2028	None
Melling–T3 and T4 transformers replacement	2027-2029	14.5.7
Melling 33 kV switchboard replacement	2037-2039	None
Melling 11 kV switchboard replacement	2037-2039	None

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Description	Tentative year	E&D issue
Pāuatahanui 33 kV outdoor to indoor conversion	2033-2035	None
Pāuatahanui–T1 transformer replacement	2030-2032	14.5.9
Takapu Road special protection scheme decommissioning	2026-2028	None
Takapu Road–Wilton–A line partial reconductoring	2033-2035	None
Upper Hutt supply transformers replacement	2030-2032	None
Wilton 220 kV gas insulated substation life extension	2032-2034	None
Wilton 220 kV oil-filled cables replacement	2032-2034	None

14.3.3 Wellington asset feedback

The Asset Feedback Register includes the following E&D-related entries specific to the Wellington region:

- High impact low probability (HILP) events that result in the total disconnection of the substation:
  - Central Park – see section 14.7.1.
  - Wilton – This may result in a loss of supply at Wilton, Central Park and Kaiwharawhara. We are developing contingency plans to manage this event.

14.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Wellington region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 14-4 lists specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 14-4: Changes within the wider region since the 2023 TPR

Issues	Change
Greytown–Upper Hutt 110 kV transmission capacity	Removed. Reduced load forecast.

The overview of transmission capability within the wider Wellington region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
14.4.1	Haywards–Upper Hutt 110 kV transmission capacity
14.4.2	Haywards and Wilton interconnecting transformer capacity
14.4.3	Pāuatahanui and Takapu Road supply capacity

14.4.1 Haywards–Upper Hutt 110 kV transmission capacity

Issue

The transmission network between Haywards and Upper Hutt consists of two 110 kV circuits rated at 104/109 MVA (summer/winter), limited by a short section of 110 kV cable at Haywards.

With high HVDC north transfer, an outage on either of the Haywards–Upper Hutt circuits may cause the loading on the remaining Haywards–Upper Hutt circuit to exceed its capacity.

What next?

At present we expect the issue can be managed operationally. If the issue becomes significant, we will investigate using the cyclic rating of the 110 kV cable at Haywards to address the issue. The reconductoring of this circuit, scheduled for late RCP4, will not impact this issue.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

14.4.2 Haywards and Wilton interconnecting transformer capacity

Issue

Four 220/110 kV interconnecting transformers, three at Haywards (rated at 200 MVA) and one at Wilton (rated at 250 MVA), supply the majority of the Wellington 110 kV transmission network. The loading of these interconnecting transformers depends on the Wellington regional load, wind generation in the region, and the HVDC transfer level and direction (north or south power flow).

During periods of high Wellington load, low HVDC north transfer and low wind generation in the region, the interconnecting transformer at Wilton can overload pre-contingency.

During periods of high Wellington load, high HVDC north transfer and low wind generation in the region, the interconnecting transformers at Haywards can overload for the outage of either the Wilton interconnecting transformer or one Haywards interconnecting transformer, from winter 2030 onwards. An operational split at Mangamaire (section 14.7.2) brings forward the overload to winter 2028.

What next?

We will monitor the interconnecting transformer capacity issue and investigate options closer to the need date. A longer-term solution is to install a second 220/110 kV interconnecting transformer at Wilton.

Base E&D capex investments

Project Name	Wellington interconnecting transformer capacity
Project description:	Install new 220/110 kV transformer at Wilton
Project's state of completion	Possible
Grid need date:	2030
Indicative cost [$ million]:	12
Reliability or Economic investment?	Reliability (Grid Reliability Report)

14.4.3 Pāuatahanui and Takapu Road supply capacity

Issue

The north-western section of Wellington Electricity's network is supplied from the Pāuatahanui and Takapu Road grid exit points. Wellington Electricity can transfer load between Takapu Road and Pāuatahanui via its distribution network, so we compare their combined load with the total supply transformer capacity at both grid exit points.

The Takapu Road grid exit point is forecast to exceed the n-1 capacity of its transformers from winter 2027 (see section 14.5.10 for more information). The Pāuatahanui grid exit point is forecast to exceed the n-1 capacity of its transformers from winter 2026. Because Pāuatahanui has no 110 kV bus, a circuit outage will also cause a transformer outage at Pāuatahanui, which we manage by limiting the Pāuatahanui load to its n-1 capacity pre-contingency (see section 14.5.9 for more information).

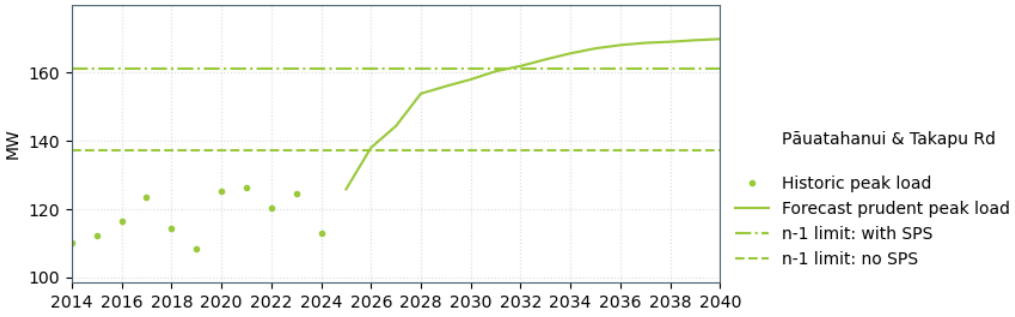
Therefore, for a Takapu Road transformer outage, the total load that can be supplied is the combined rating of one Takapu Road and one Pāuatahanui transformer.

The four 110/33 kV transformers at Takapu Road and Pāuatahanui supply the total Takapu Road and Pāuatahanui load, providing a total nominated installed capacity of 220 MVA.

The combined load is forecast to exceed the combined n-1 capacity of the transformers from winter 2026 (see Figure 14-4).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 14-4: Combined Pāuatahanui and Takapu Road supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Managing the loading on the Pāuatahanui or Takapu Road supply transformers operationally following load transfers may address the issue in the short term.

Installing a special protection scheme at Pāuatahanui to allow both transformers to be fully loaded (n limit) defers the need to upgrade the supply transformer capacity until winter 2032.

We will discuss longer term options with Wellington Electricity. These include:

- upgrading the Pāuatahanui or Takapu Road supply transformers, or
- installing a third supply transformer at Takapu Road.

In addition, Pāuatahanui–T1 is due for risk-based replacement around 2030. An appropriate rating for the replacement transformer will be discussed with Wellington Electricity closer to the replacement date.

Customer investments

Project Name	Takapu Road and Pāuatahanui supply transformers capacity
Project description:	Install a transformer overload protection scheme at Pāuatahanui
Project's state of completion	Possible
Grid need date:	2026
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	Takapu Road supply transformer capacity
Project description:	Install a third 110/33 kV transformer at Takapu Road
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	10
Reliability or Economic investment?	Reliability (Grid Reliability Report)

14.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 14-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 14-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Central Park 33 kV supply capacity	Removed. Reduced load forecast.
Greytown supply capacity	Removed. Reduced load forecast.
Haywards 11 kV supply capacity	Removed. Reduced load forecast.
Haywards supply capacity	Added. Increased load forecast.
Melling 33 kV supply capacity	Removed. Reduced load forecast.

The overview of transmission capability for each grid exit point within the Wellington region is listed below. Where an issue is identified we list options to address it.

Section number	Description
14.5.1	Central Park supply capacity
14.5.2	Gracefield supply capacity
14.5.3	Greytown supply capacity
14.5.4	Haywards supply capacity
14.5.5	Kaiwharawhara supply capacity and security
14.5.6	Masterton supply capacity
14.5.7	Melling supply capacity
14.5.8	Paraparaumu supply capacity
14.5.9	Pāuatahanui supply capacity
14.5.10	Takapu Road supply capacity
14.5.11	Upper Hutt supply capacity
14.5.12	Wilton supply capacity

14.5.1 Central Park supply capacity

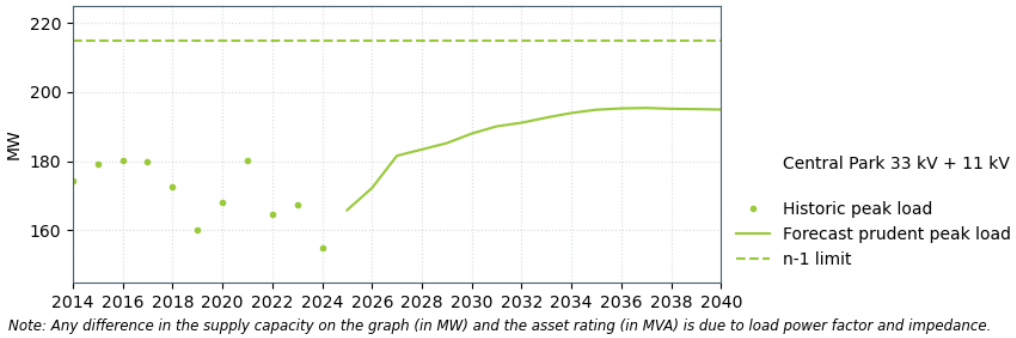
At Central Park, Wellington Electricity is supplied at two voltage levels: 33 kV and 11 kV (via 33/11 kV supply transformers).

Three 110/33 kV transformers (one rated 120 MVA and two rated at 100 MVA) supply Central Park's 33 kV and 11 kV loads, providing a total nominal installed capacity of 320 MVA.

There is no 110 kV bus at Central Park, so any outage on a 110 kV circuit supplying Central Park from Wilton also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[4], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Central Park for the combined 33 kV and 11 kV load is within the n-1 capacity of the supply transformers for the forecast period (see Figure 14-5).

Figure 14-5: Central Park 110/33 kV supply capacity (combined 11 kV and 33 kV load)



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

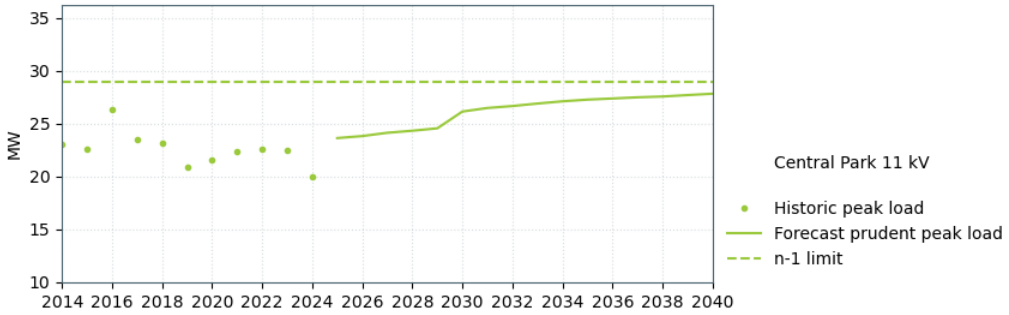
[4] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Two 33/11 kV transformers supply Central Park's 11 kV load, providing a total nominal installed capacity of 50 MVA.

The Central Park 11 kV bus is operated split. Peak load at Central Park 11 kV is within the n-1 capacity of the supply transformers for the forecast period (see Figure 14-6).

Figure 14-6: Central Park 11 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

We are also working with Wellington Electricity to investigate possible upgrades to mitigate high impact low probability events at Central Park, as discussed in section 14.7.1.

14.5.2 Gracefield supply capacity

Issue

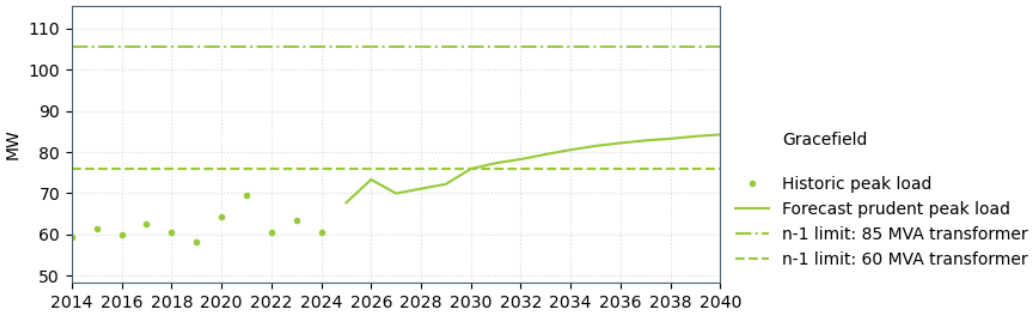
The Gracefield load is supplied by:

- two 110 kV circuits from Haywards, each rated at 108/112 MVA (summer/winter)
- two 110/33 kV supply transformers (one 60 MVA and the other 85 MVA), providing a total nominal installed capacity of 145 MVA. The n-1 capacity is limited by the 60 MVA (T5) transformer.

There is no 110 kV bus at Gracefield, so a Gracefield–Haywards circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[5], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Gracefield is forecast to exceed the n-1 capacity of the supply transformers from winter 2030 (see Figure 14-7).

Figure 14-7: Gracefield supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will monitor the load growth at Gracefield. Options to manage the n-1 capacity issue include pre-contingency load management, post-contingency load shedding, or replacing the T5 transformer with a higher rated unit. Any upgrade will be customer-initiated.

[5] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

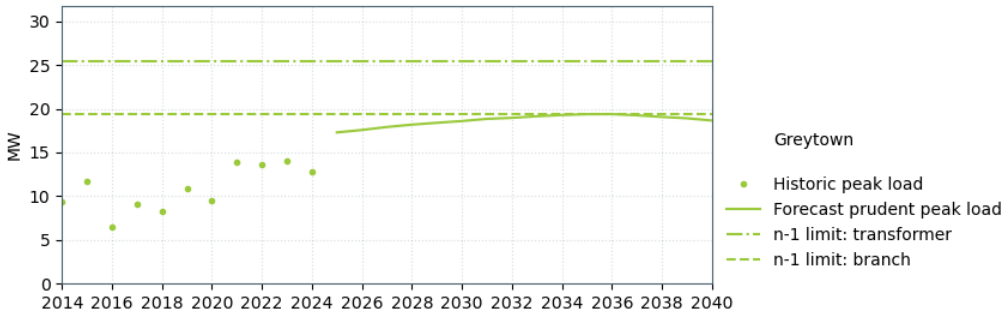
14.5.3 Greytown supply capacity

Two 110/33 kV transformers supply Greytown's load, providing a total nominal installed capacity of 40 MVA. The transformers' capacity is limited by a metering limit.

There are no line circuit breakers at Greytown, so a Masterton–Greytown–Upper Hutt circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[6], which is done restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Greytown is within the n-1 capacity of the supply transformers for the forecast period (see Figure 14-8).

Figure 14-8: Greytown supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will take advantage of the next recalibration of the revenue metering unit to remove the branch limit.

14.5.4 Haywards supply capacity

Issue

At Haywards, Wellington Electricity is supplied at 33 kV and 11 kV.

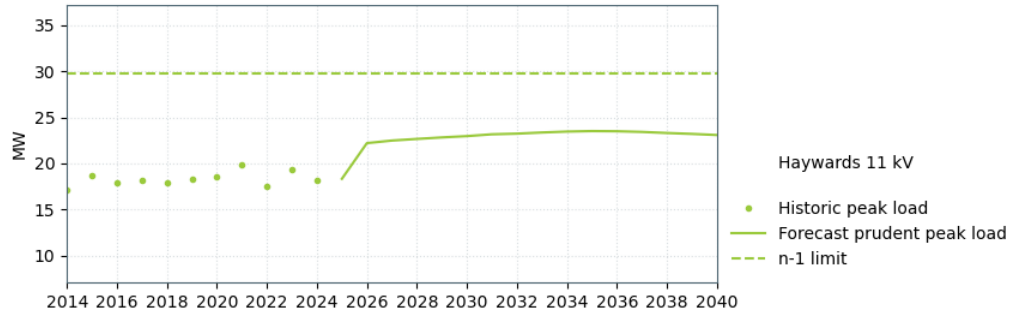
Two 110/33/11 kV transformers (each rated at 60 MVA) supply Haywards 33 kV and 11 kV loads, providing a total nominal installed capacity of 30 MVA at 33 kV and 30 MVA on the 11 kV bus. The transformers' 33 kV capacity is limited by a protection limit.

Peak load at Haywards 11 kV is within the n-1 capacity of the supply transformers for the forecast period. Peak load at Haywards 33 kV is forecast to exceed the n-1 capacity of the supply transformers from winter 2026 (see Figure 14-9).

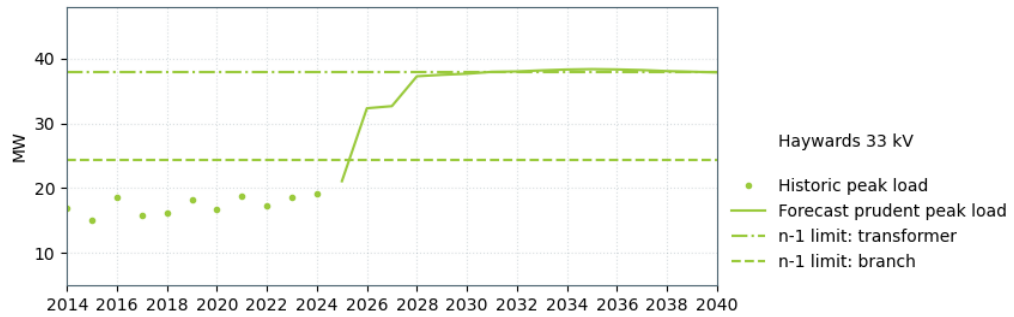
[6] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 14-9: Haywards 11 kV and 33 kV supply capacity



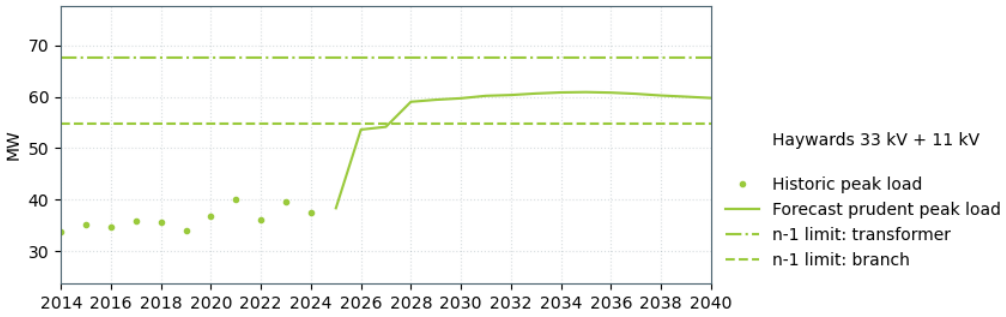
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The combined peak load at Haywards 33 kV and 11 kV is forecast to exceed the n-1 capacity of the supply transformers from winter 2028 (see Figure 14-10).

Figure 14-10: Haywards supply capacity (combined 33 kV and 11 kV load)



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The protection limit at Haywards 33 kV will be removed by mid-2026. This will address the supply capacity issue at Haywards for the forecast period.

Base E&D capex investments

Project Name	Haywards supply transformer capacity
Project description:	Remove supply transformer protection limit
Project's state of completion	Delivery
Grid need date:	2026
Indicative cost [$ million]:	0.2
Reliability or Economic investment?	Reliability (Grid Reliability Report)

14.5.5 Kaiwharawhara supply capacity and security

Issue

The Kaiwharawhara load is supplied by:

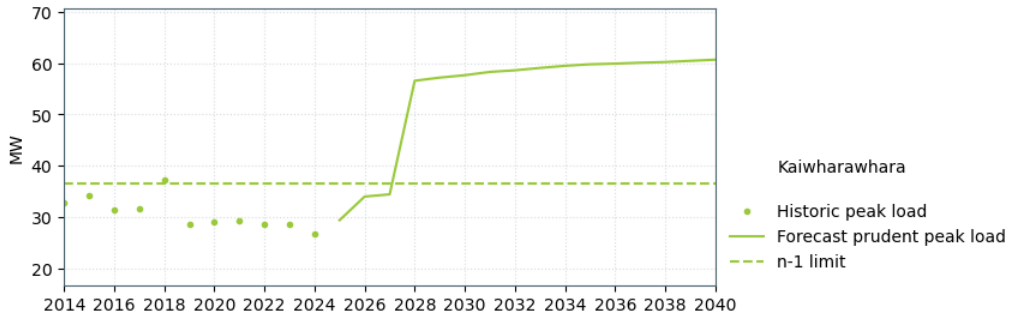
2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- two 110/11 kV supply transformers, providing a total nominal installed capacity of 60 MVA. The transformers' capacity is limited by the 11 kV circuit breaker owned by the local distribution company.
- two 110 kV circuits from Wilton, each rated at 57/66 MVA (summer/winter). The circuits' winter capacity is limited by a cable section.

The Kaiwharawhara substation is configured with no 110 kV bus (each transformer is connected to one 110 kV circuit) and the 11 kV bus is operated split (to limit fault levels within the distribution network). Tripping either one of the transformer feeders will result in a loss of supply to half the load.

Assuming this load would be transferred to the remaining transformer feeder, the total Kaiwharawhara peak load is forecast to exceed the n-1 capacity of the supply transformers from winter 2028 (see Figure 14-11).

Figure 14-11: Kaiwharawhara supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss longer term options to address the forecast supply transformer constraint with Wellington Electricity. Options include replacing the transformers with higher capacity units.

Customer investments

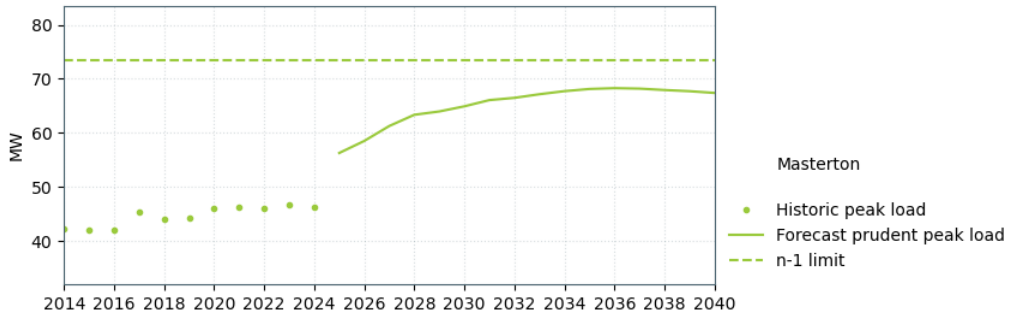
Project Name	Kaiwharawhara supply capacity
Project description:	Replace Kaiwharawhara supply transformers with higher capacity units
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

14.5.6 Masterton supply capacity

Two 110/33 kV transformers supply Masterton's load, providing a total nominal installed capacity of 120 MVA.

Peak load at Masterton is within the n-1 capacity of the supply transformers for the forecast period (see Figure 14-12).

Figure 14-12: Masterton supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

14.5.7 Melling supply capacity

Issue

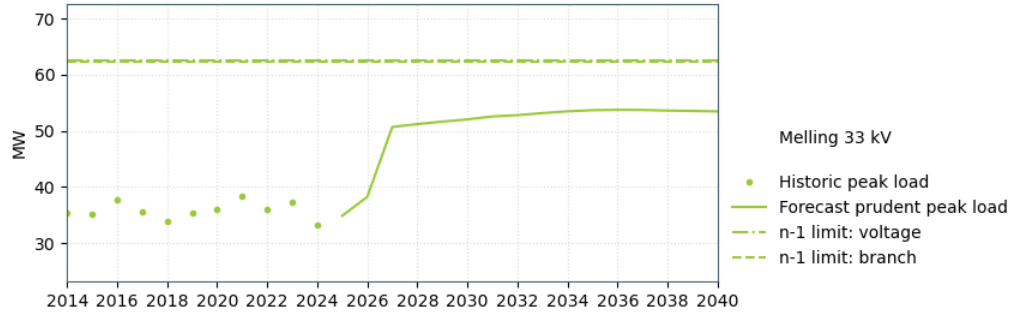
The Melling load is supplied by:

- two 110/33 kV transformers supplying Melling's 33 kV load, providing a total nominal installed capacity of 100 MVA. The transformers' winter capacity is limited by the 33 kV current transformers.
- two 110/11 kV transformers supplying Melling's 11 kV load, providing a total nominal installed capacity of 50 MVA.
- two 110 kV circuits from Haywards, each rated at 95/101 MVA (summer/winter). The circuits' winter capacity is limited by a cable section.

There is no 110 kV bus at Melling, so a Haywards–Melling circuit outage also disconnects a 110/33 kV transformer and a 110/11 kV transformer. We are required to avoid overloading a transformer for a circuit outage[7], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at 33 kV is within the n-1 capacity of the supply transformers and the n-1 low 33 kV bus voltage limit for the forecast period (see Figure 14-13). This low voltage limit is due to off-load tap changers on the 110/33 kV transformers.

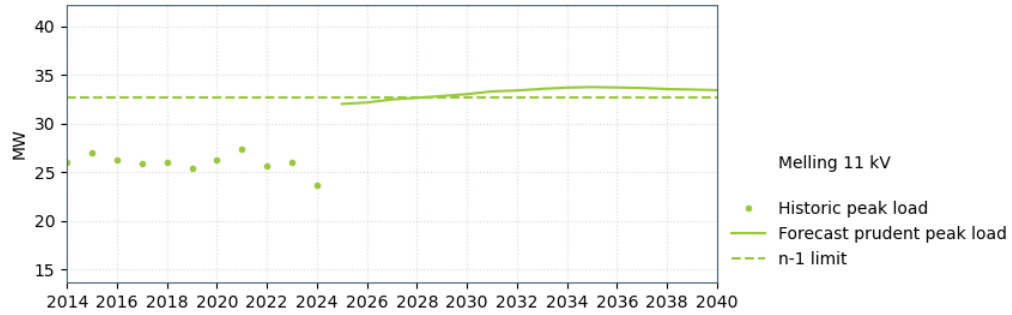
Figure 14-13: Melling 110/33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The 11 kV peak load is forecast to exceed the n-1 capacity of the supply transformers from winter 2029 (see Figure 14-14).

Figure 14-14: Melling 110/11 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss options to address the forecast supply transformer constraint with Wellington Electricity closer to the need date. There is a scheduled risk-based replacement of the Melling–T3 and T4 110/33 kV supply transformers in 2027-2029. Installing higher rated 110/33 kV units would provide capacity headroom for shifting load off Melling 11 kV to address the 110/11 kV supply capacity issue.

[7] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

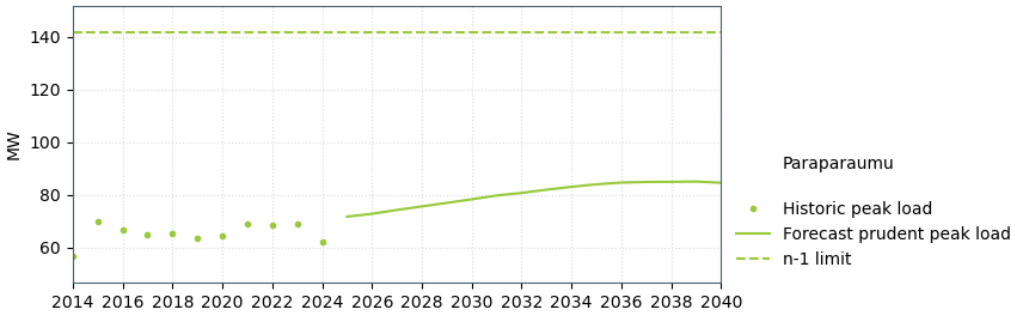
14.5.8 Paraparaumu supply capacity

Two 220/33 kV transformers supply Paraparaumu's load, providing a total nominal installed capacity of 240 MVA. The transformers' capacity is limited by the 33 kV circuit breaker.

The transformers are tee-connected on the Bunnythorpe–Paraparaumu–Haywards 220 kV circuits, so a circuit outage also disconnects a supply transformer.

Peak load at Paraparaumu is within the n-1 capacity of the supply transformers for the forecast period (see Figure 14-15).

Figure 14-15: Paraparaumu supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

14.5.9 Pāuatahanui supply capacity

Issue

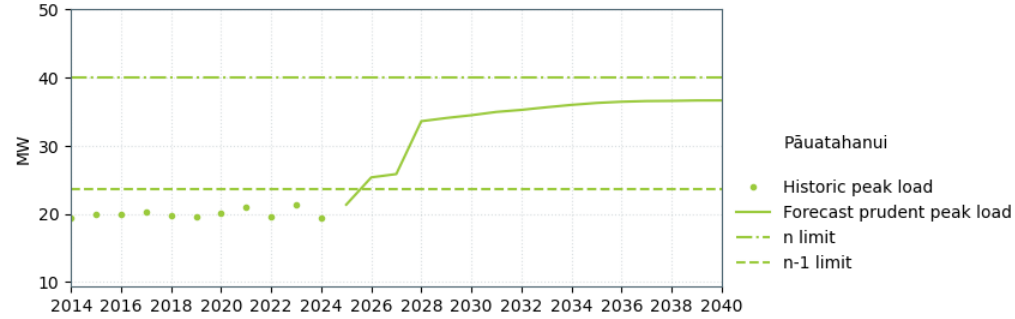
The Pāuatahanui load is supplied by:

- two 110/33 kV transformers, providing a total nominal installed capacity of 40 MVA.
- two 110 kV circuits from Takapu Road, each rated at 78/78 MVA (summer/winter). The circuits' capacity is limited by a bus section rating.

There is no 110 kV bus at Pāuatahanui, so a Takapu Road–Pāuatahanui circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[8], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

Peak load at Pāuatahanui is forecast to exceed the n-1 capacity of the supply transformers from winter 2026 (see Figure 14-16).

Figure 14-16: Pāuatahanui supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss options to address the forecast supply transformer constraint with Wellington Electricity. Refer also to section 14.4.3 for discussion on maintaining adequate capacity to supply Wellington Electricity's north-western network.

[8] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

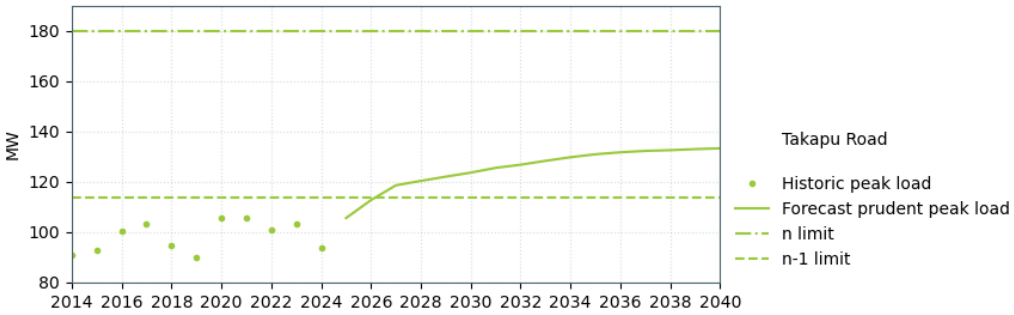
14.5.10 Takapu Road supply capacity

Issue

Two 110/33 kV transformers supply Takapu Road's load, providing a total nominal installed capacity of 180 MVA.

Peak load at Takapu Road is forecast to exceed the n-1 capacity of the supply transformers from winter 2027 (see Figure 14-17).

Figure 14-17: Takapu Road supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

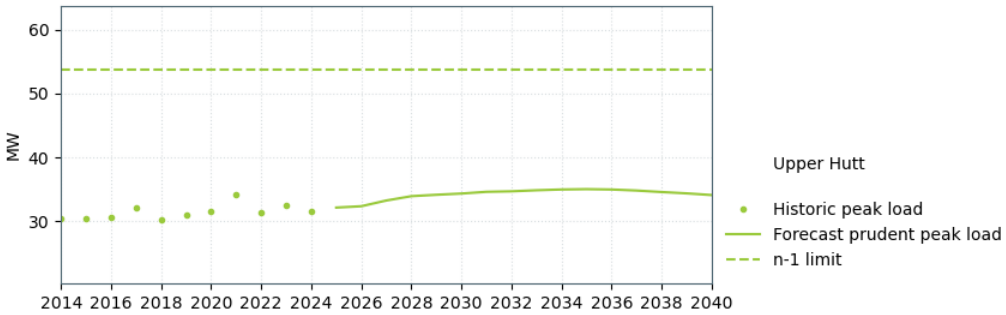
Wellington Electricity can transfer load between Takapu Road and Pāuatahanui. Operationally, managing the loading on the Pāuatahanui or Takapu Road supply transformers following load transfers may address the issue in the shorter term. Refer also to section 14.4.314.4.3 for discussion on maintaining adequate capacity to supply Wellington Electricity's north-western network.

14.5.11 Upper Hutt supply capacity

Two 110/33 kV transformers supply Upper Hutt's load, providing a total nominal installed capacity of 80 MVA.

Peak load at Upper Hutt is within the n-1 capacity of the supply transformers for the forecast period (see Figure 14-18).

Figure 14-18: Upper Hutt supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

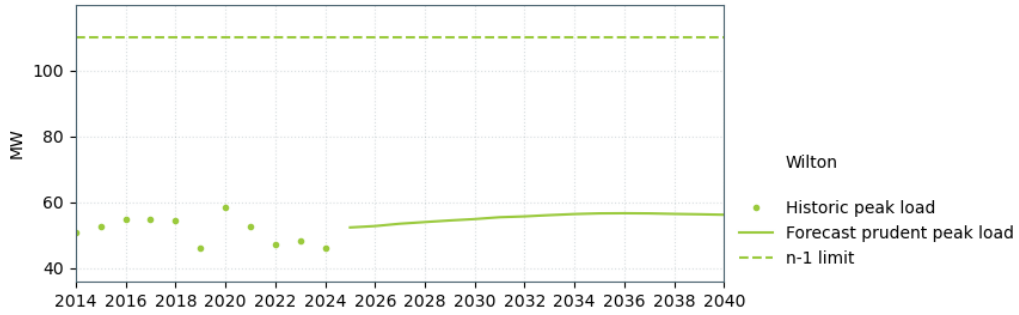
14.5.12 Wilton supply capacity

Two 220/33 kV transformers supply Wilton's load, providing a total nominal installed capacity of 200 MVA. The transformers' capacity is limited by the 33 kV cables.

Peak load at Wilton is within the n-1 capacity of the supply transformers for the forecast period (see Figure 14-19).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 14-19: Wilton supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

14.6 Wellington bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generators). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 14-6 lists bus outages that cause voltage issues or a total loss of supply. Generators are included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 14-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Haywards 110 kV	-	-	Wellington interconnecting transformer capacity	14.6.1
Haywards 220 kV	-	-	Wellington interconnecting transformer capacity	14.6.1
Masterton 110 kV	Masterton	-	-	Note 1
Takapu Road 110 kV	-	-	Pāuatahanui and Takapu Road supply capacity	Note 2
Upper Hutt 110 kV	Upper Hutt	-	- Wairarapa low voltage	Note 1 14.6.2
Wilton 110 kV	Kaiwharawhara	- West Wind	- - Wellington interconnecting transformer capacity	Note 3 Note 4 14.6.1
Wilton 220 kV	-	-	Wellington interconnecting transformer capacity	14.6.1

1. Masterton and Upper Hutt 110 kV do not have bus section circuit breakers, so a bus fault will trip the whole bus in either case and cause a total loss of supply.
2. An outage of a Takapu Road bus section may disconnect a supply transformer at Takapu Road, a Takapu Road–Haywards circuit, a Takapu Road–Wilton circuit, a Takapu Road–Pāuatahanui circuit and the associated supply transformer at Pāuatahanui (there is no 110 kV bus at Pāuatahanui). See section 14.4.314.4.3 for more information on supply capacity at Takapu Road and Pāuatahanui.
3. An outage of a Wilton bus section may disconnect one of the two Kaiwharawhara circuits. As Kaiwharawhara has no 110 kV bus and a split 11 kV bus, this will cause a partial interruption to the load at Kaiwharawhara (see section 14.5.5).
4. An outage of a Wilton bus section may disconnect Central Park–West Wind–Wilton–2 or 3. Because West Wind has no 110 kV bus, this will also disconnect half of the wind farm.

The customers at these grid exit and injection points (Wellington Electricity, Powerco, Electra, and Meridian Energy) have not requested a higher security level. Unless otherwise noted, we do not propose increasing bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

14.6.1 Wellington interconnecting transformer capacity

Issue

The Wellington 110 kV transmission network is predominantly supplied by 220/110 kV interconnecting transformers, with three transformers at Haywards and one at Wilton. The loading of these interconnecting transformers depends on the Wellington regional load, wind generation in the region, and the HVDC transfer level and direction (north or south power flow).

An outage of a Haywards 220 kV or 110 kV bus section or Wilton 220 kV or 110 kV bus section may cause the remaining interconnecting transformers to exceed their n-1 capacity from winter 2025.

The worst contingency affecting the Wellington interconnecting transformer loading is an outage of the 110 kV middle bus section (B) at Haywards, disconnecting several components:

- one of the three 220/110 kV interconnecting transformers
- one of the two 110/33/11 kV supply transformers
- four 110 kV circuits
- three synchronous condensers and a shunt filter.

This contingency would also separate the two outer bus sections, causing an imbalance in interconnecting transformer loading.

What next?

We expect that this issue can be managed operationally. We will continue to monitor the need to enhance the bus configuration.

14.6.2 Wairarapa low voltage and Bunnythorpe–Woodville 110 kV transmission capacity

Issue

Depending on the availability of wind generation at Te Apiti, an outage of the Upper Hutt 110 kV bus:

- will normally cause transmission bus voltages at Greytown and Masterton to fall below 0.90 pu, depending on the combined load at Greytown and Masterton. The situation is worse without Te Apiti generation. This issue exists now.
- will normally cause a voltage step of more than 10 per cent at the 33 kV supply buses at Greytown and Masterton.
- may overload the Bunnythorpe–Woodville 110 kV circuits (in the Central North Island region).

What next?

Our high-level investigation indicates no economic investment options are available to address the voltage issues. We will continue to monitor the issue and will install a bus section circuit breaker at Upper Hutt 110 kV when economically justified.

The Bunnythorpe–Woodville overloading issue will be addressed as part of replacing the existing special protection scheme. See Section 11.4.3 in the Central North Island region chapter for more information.

14.7 Other items of interest

14.7.1 Central Park resiliency

Issue

Central Park (via Wellington Electricity's distribution network) supplies a large portion of Wellington's CBD as well as the eastern and southern suburbs where the hospital and airport are located. Wellington Electricity takes supply at 33 kV and 11 kV, and the combined peak load is forecast to be 166 MW in 2025, increasing to about 195 MW in 2040.

Central Park is a relatively compact substation and is exposed to a range of potential single points of failure within the substation. In addition, all three Central Park–Wilton circuits are strung on three triple circuit towers entering the substation.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

A high impact low probability (HILP) incident at Central Park substation, such as a triple circuit tower failure or cable fire, would result in a loss of supply to a large load, potentially for an extended period. Wellington Electricity has limited capacity to shift CBD load to its other grid exit points at Wilton and Kaiwharawhara and there is presently no alternative to supply the remaining load.

Options considered

We have contingency plans for returning supply to the site quickly following a tower failure.

Options to address the other risks include:

- increasing substation resiliency by building a new 33 kV substation, near but physically separated from the existing site.
- increasing the capacity of Wellington Electricity's network to reduce the impact of a HILP incident at Central Park by enabling load to be transferred to other grid exit points.

What next?

We are working with Wellington Electricity to diversify supply from Central Park. A new 33 kV substation near Central Park would operate in parallel with Central Park. The new substation would include one 110/33 kV supply transformer, 33 kV switchgear and associated protection. For a major failure at Central Park, this option avoids a total loss of supply and provides operational flexibility to restore as much load as possible.

The number of 110/33 kV supply transformers at Central Park would reduce from three to two, with the "third" transformer at the new site. This work would be coordinated with the risk-based condition replacement of the Central Park–T3 transformer (see section 14.3.2).

Customer investments

Project name	Central Park resiliency
Project description:	New substation
Project's state of completion	Proposed
Grid need date:	Customer initiated
Indicative cost [$ million]:	27
Reliability or Economic investment?	Reliability (Grid Reliability Report)

14.7.2 Mangamaire operational split

Issue

The Wellington region is connected to the Central North Island region via a Mangamaire–Masterton 110 kV circuit. The loading and power flow direction on this circuit depend on the HVDC flow, wind generation in the Wellington region and the Wairarapa 110 kV load. Under certain system conditions, an operational split at Mangamaire (on the Masterton side) may be used to manage loading on the Bunnythorpe–Woodville 110 kV circuits caused by a 220 kV circuit outage between Bunnythorpe and Haywards (see section 11.4.3 in the Central North Island region chapter for more information).

The operational split may worsen transmission issues in the Wellington region. During periods of high load at Upper Hutt, Greytown and Masterton, an outage of a:

- Haywards–Upper Hutt circuit may cause the loading on the remaining Haywards–Upper Hutt circuit to exceed its winter capacity from 2027 (see section 14.4.114.4.1).
- Masterton–Greytown–Upper Hutt circuit may cause the loading on the Greytown–Upper Hutt section on the other Haywards–Greytown–Upper Hutt circuit to exceed its winter capacity from 2025.

What next?

At present we expect the issue can be managed operationally. We will continue to monitor the transmission capacity issue and investigate further options if the issue becomes significant.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

14.8 Wellington generation opportunities and proposals

This section provides a high-level description of the Wellington region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

Generation in the Wellington region, mainly wind, is much less than the regional load. Developers are investigating additional generation, principally solar along the 110 kV Masterton–Greytown–Upper Hutt corridor.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to make their own assessment of the possible constraints that may apply to their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
14.8.1	Generation opportunities by substation
14.8.2	Generation investigations and proposals
14.8.3	Masterton–Greytown–Upper Hutt corridor
14.8.4	Haywards–Upper Hutt circuit capacity

14.8.1 Generation opportunities by substation

Envision Opportunities[9] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[10]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy
- winter evening peak – wet/windy
- winter midday high – wet/calm.

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

14.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[11]. Generation proposals transfer from the

9 Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

10 "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

11 Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 14-7 shows generation and grid-scale battery projects in the Wellington region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 14-2 instead.

Table 14-7: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Masterton	Solar + BESS[1]	Delivery[2]	91
Greytown	Solar	Delivery[2]	158
Mangamaire–Masterton	Wind	Investigation	90
Masterton	Solar + BESS[1]	Investigation	100
Mangamaire	Solar	Application	40

1. BESS refers to Battery Energy Storage System
2. "Delivery" is a stage in the Transpower generation queue process, it does not denote a final commitment by the developer to build the generation.

We also have other preliminary requests for generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of select parts of the Wellington region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

14.8.3 Masterton–Greytown–Upper Hutt corridor

Issue

Hosting generation along the Masterton–Greytown–Upper Hutt corridor may overload the circuits.

The double circuit line between Masterton and Upper Hutt is strung with the same conductor, but has different ratings for each section:

- Upper Hutt–Greytown section is rated at 63/71/77 MVA (summer/shoulder/winter)
- Greytown–Masterton section is rated at 88/93/98 MVA (summer/shoulder/winter).

The capacity of the Upper Hutt–Greytown circuit is lower due to its lower thermal rating.

What next?

We are undertaking a Major Capital Proposal (MCP) investigation for the Tararua and Wairarapa regions. This will determine an economic level of investment to enable the connection of new generation. As a part of this investigation, we will assess whether a thermal upgrade of the Upper Hutt–Greytown section, to match or slightly exceed the rating of the Greytown–Masterton section, can be justified. It will also consider the Bunnythorpe-Woodville line capacity (section **Error! Reference source not found.**) and the Bunnythorpe interconnection capacity (section 11.8.6).

A thermal upgrade of the Greytown–Masterton section is also possible but is not expected to be economic because only a small increase in rating is likely to be possible.

A special protection scheme to automatically reduce generation if a circuit section overloads may also be possible to reduce pre-contingency generation constraints.

Customer investments

Project Name	Masterton–Greytown–Upper Hutt capacity
Project description:	Circuit overload protection scheme
Project's state of completion	Committed
Grid need date:	2027
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Major capex investments

Project Name	Greytown–Upper Hutt capacity
Project description:	Thermally upgrade the Greytown–Upper Hutt circuits
Project's state of completion	Possible
Grid need date:	Generation dependent
Indicative cost [$ million]:	8.5
Reliability or Economic investment?	Economic (Grid Economic Investment Report)

14.8.4 Haywards–Upper Hutt circuit capacity

Issue

Hosting generation along the Masterton–Greytown–Upper Hutt corridor may overload a Haywards–Upper Hutt circuit for an outage of the parallel circuit, for power flow into Haywards. However, the Greytown–Upper Hutt circuit section would overload first.

What next?

The Haywards–Upper Hutt circuit capacity is limited by a short section of cable at Haywards. We will investigate using the cyclic rating of the 110 kV cable at Haywards to address the issue if enough new generation connects along the Masterton–Greytown–Upper Hutt corridor.

See also section 14.4.1 for information on cable overloading for power flow out of Haywards.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

15 Nelson-Marlborough Regional Plan

15.1	Regional overview and transmission system
15.2	Nelson-Marlborough load and generation forecasts
15.3	Grid enhancement approach and inputs
15.4	Grid asset capability and management within the wider region
15.5	Grid asset capability and management by grid exit point
15.6	Nelson-Marlborough bus security
815.7	Nelson-Marlborough generation opportunities and proposals

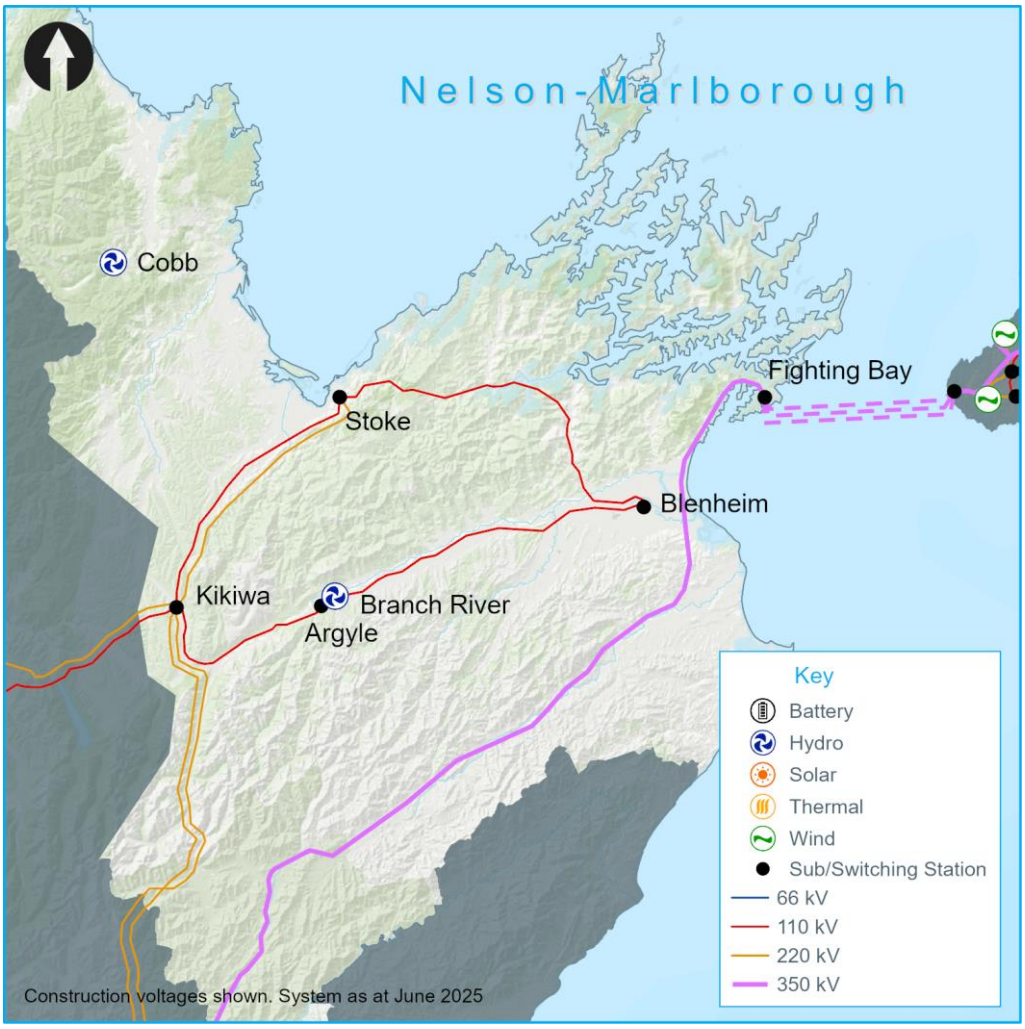
15.1 Regional overview and transmission system

The Nelson-Marlborough region includes a mix of significant and growing provincial cities and towns (Nelson, Blenheim and Richmond) together with smaller rural localities (Picton, Seddon, Tasman Bay and Golden Bay area).

Local generation at Cobb, embedded behind the Stoke 66 kV grid exit point, provides important voltage and load support to the region.

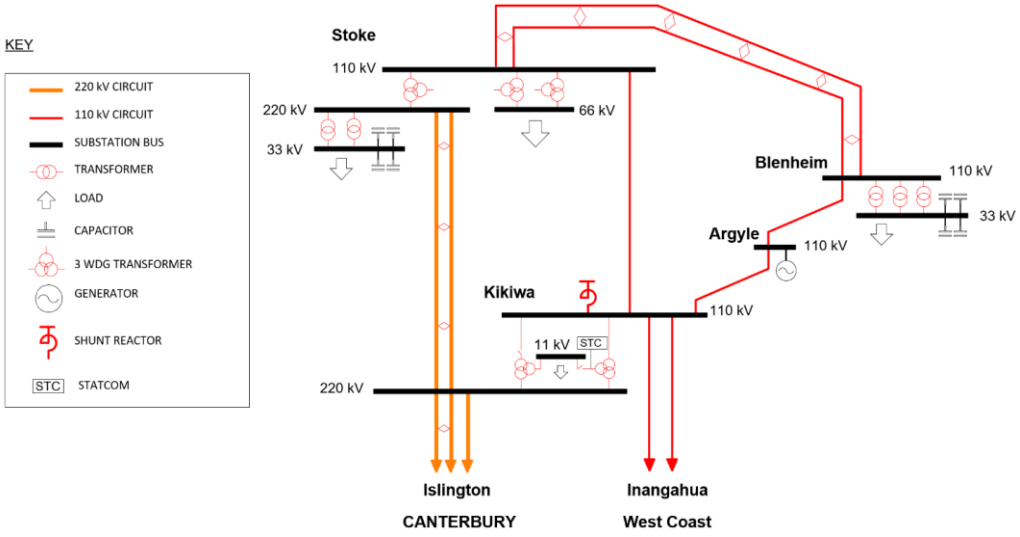
The existing transmission network for the Nelson-Marlborough region is set out geographically in Figure 15-1 and schematically in Figure 15-2.

Figure 15-1: Nelson-Marlborough region transmission network map



2025 Annual Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 15-2: Nelson-Marlborough region transmission schematic



15.1.1 Transmission into the region

The Nelson-Marlborough region, together with the West Coast region, is connected to the National Grid at Kikiwa via three 220 kV circuits from Islington.

The load of the two regions far exceeds generation so most of the load is supplied via 220 kV circuits from the Waitaki Valley, which also supply significant load in the South Canterbury and Canterbury regions. This shared capacity from the Waitaki Valley is important for supply security to all four regions.

15.1.2 Transmission within the region

Within the Nelson-Marlborough region, transmission comprises 220 kV circuits from Kikiwa to Stoke, and parallel 110 kV circuits forming a 'triangle' between Kikiwa, Stoke and Blenheim. Interconnection between the 220 kV and 110 kV networks within the region is provided by a single transformer at Stoke, and a second transformer at Kikiwa, which together provide n-1 security to the 110 kV transmission network.

The reactive power support in this region is provided by:

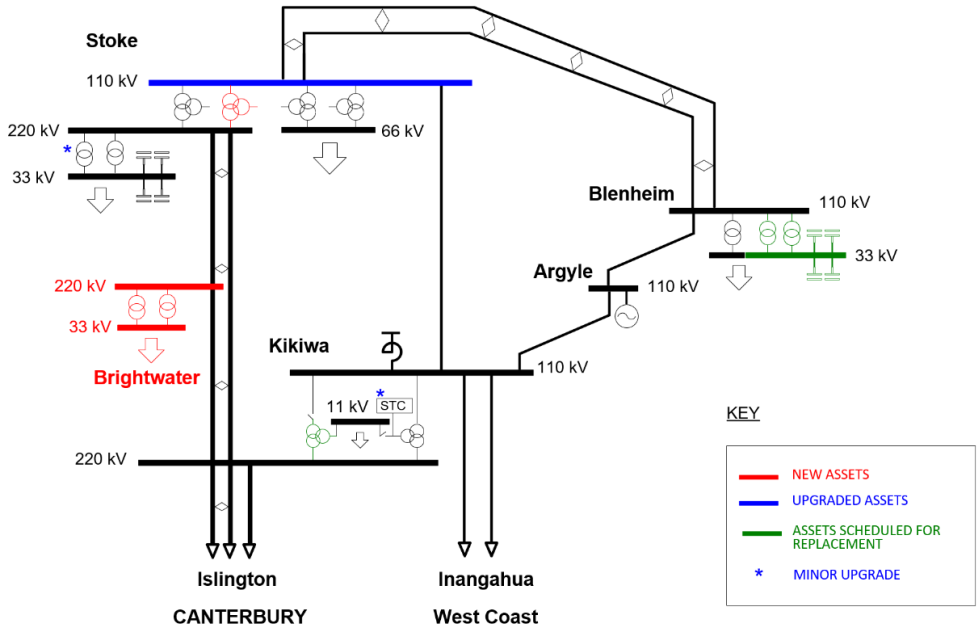
- 40 Mvar of capacitors at Stoke
- 20 Mvar of capacitors at Blenheim
- 50 Mvar shunt reactor at Kikiwa
- two 40 Mvar STATCOMs at Kikiwa.

15.1.3 Possible future Nelson-Marlborough transmission configuration

Figure 15-3 shows the possible configuration of Nelson-Marlborough transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investment are shown.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 15-3: Possible Nelson-Marlborough transmission configuration in 2040



15.2 Nelson-Marlborough load and generation forecasts

15.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Nelson-Marlborough regional peak demand is forecast to grow by an average 1.4 per cent per annum over the next 15 years, from 224 MW in 2025 to 277 MW by 2040. This is lower than the national average growth rate of 2.6 per cent per annum. Table 15-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

Table 15-1: Forecast prudent annual peak demand (MW) at Nelson-Marlborough grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Blenheim[1]	1.00	79	81	87	89	91	93	95	96	96	97	98	98
Kikiwa[2]	0.98	4	4	4	5	5	5	5	5	5	5	5	5
Stoke 33 kV[3]	0.99	142	145	148	150	152	155	157	160	162	167	168	168
Stoke 66 kV[4]	0.97	28	29	29	30	34	35	35	36	36	36	37	36

1. Marlborough Lines advised of about 10 MW of industrial load increase between 2025 and 2029.
2. This is leading power factor.
3. Stoke 33 kV load includes supply to the Network Tasman and Nelson Electricity networks.
4. Stoke 66 kV load is a gross value. It includes demand that will be supplied from embedded generation at Cobb (distribution network connected).

15.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

[1] Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing coal users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the Nelson-Marlborough region that are not included in the prudent demand forecast.

15.2.3 Existing and committed generation

The Nelson-Marlborough region's generation capacity is currently 50 MW. This excludes any embedded solar (PV) generation, which was approximately 36.3 MW[2] in the Nelson-Marlborough region at the time of publication. This is significantly lower than local demand, requiring power to be imported through the National Grid.

Table 15-2 lists the generation forecast for each grid injection point in the Nelson-Marlborough region for the forecast period. This includes all known and committed generation stations, including those embedded within the relevant local lines company's network (Network Tasman or Marlborough Lines)[3].

Further generation may be developed during the period. Refer to Table 15-7 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 15-2: Existing and committed generation capacity at Nelson-Marlborough grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Argyle – Branch River Scheme	11	11	11	11	11	11	11	11	11	11	11	11
Blenheim												
(Ra Nui Solar)[1]	0	13	13	13	13	13	13	13	13	13	13	13
(Lulworth Wind)	1	1	1	1	1	1	1	1	1	1	1	1
(Waihopai hydro)	3	3	3	3	3	3	3	3	3	3	3	3
(Wairau Valley Solar)	2	2	2	2	2	2	2	2	2	2	2	2
Stoke												
(Cobb)	32	32	32	32	32	32	32	32	32	32	32	32
(Onekaka hydro)	1	1	1	1	1	1	1	1	1	1	1	1

1. Ra Nui Solar Farm is expected to begin commissioning late 2025.

15.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Nelson-Marlborough region.

15.3 Grid enhancement approach and inputs

15.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Nelson-Marlborough region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancement to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation

2 The capacity of existing embedded solar farms mentioned in Table 15-2 has been subtracted off the total embedded solar generation reported on the Electricity Market Information (EMI) website: Installed distributed generation trends.

3 Only generators with capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 15.4 and 15.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

15.3.2 Nelson-Marlborough significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 15-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Nelson-Marlborough region for the next 15 years that may significantly impact related system issues or connected parties.

Table 15-3: Proposed significant upcoming replacement and refurbishment work for the Nelson-Marlborough region

Description	Tentative year	E&D issue
Blenheim 33 kV switchboard partial replacement	2030-2032	None
Blenheim 33 kV C1-C4 capacitor replacement	2026-2029	15.4.1
Blenheim–T1/T2 transformer replacement	2038-2040	None
Kikiwa–T1 220/110/11 kV replacement	2032-2034	None
Kikiwa STATCOM midlife refurbishment	2027-2030	None

15.3.3 Nelson-Marlborough asset feedback

The Asset Feedback Register does not contain any E&D-related entries specific to the Nelson-Marlborough region.

15.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Nelson-Marlborough region can reasonably be expected to meet n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

As the Nelson-Marlborough region relies on generation from several hundred kilometres away, there will be an ongoing need for investment in reactive support equipment (such as the STATCOM at Kikiwa and additional capacitors) to support regional voltage. Any future investment in reactive support equipment in the region (such as replacement of the Blenheim and Stoke capacitor banks), would consider location and sizing in terms of voltage issues faced by the wider Upper South Island. Our approach to maintaining voltage stability in the region is discussed in Chapter 6, Grid Backbone (South Island section).

Table 15-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 15-4: Changes within the wider region since the 2023 TPR

Issues	Change
No changes to report.	

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The overview of transmission capability within the wider Nelson-Marlborough region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
15.4.1	Kikiwa–Stoke 110 kV transmission capacity and regional low voltages

15.4.1 Kikiwa–Stoke 110 kV transmission capacity and regional low voltages

Issue

The 220/110 kV interconnecting transformers at Kikiwa and Stoke effectively operate in parallel through the two 110 kV circuits:

- Kikiwa–Stoke–3 circuit rated at 56/68 MVA (summer/winter)
- Kikiwa–Argyle–Blenheim–1 circuit rated at 56/68 MVA (summer/winter).

The 110 kV Kikiwa–Stoke–3[4] circuit may overload for an outage of:

- the Stoke–T7 220/110 kV interconnecting transformer from summer 2027. The overload is for power flow from Kikiwa to Stoke.
- the Kikiwa–T2 220/110 kV interconnecting transformer when West Coast load is high coupled with low generation in the West Coast region and at Coleridge. The overload is for power flow from Stoke to Kikiwa.

An outage of the Stoke–T7 interconnecting transformer, when the Nelson-Marlborough regional load is high, will also cause low voltages and voltage steps greater than 5% at the Blenheim 110 kV and 33 kV buses, and Stoke 110 kV and 66 kV buses.

What next?

Issues caused by a 220/110 kV transformer outage can be managed operationally post-contingency by:

- constraining-on Cobb generation and/or using load management in the Nelson-Marlborough region for a Stoke–T7 transformer outage. The minimum Cobb generation required is approximately 8 MW for the 2027 peak, increasing to approximately 23 MW later in the forecast period. This is within the maximum capacity of Cobb generation.
- Constraining-on Coleridge generation and/or using load management in the West Coast region for a Kikiwa–T2.

In the longer term:

- The Kikiwa–T1 220/110/11 kV transformer is due for risk-based policy replacement in 2034 (see Table 15-3). Replacing this transformer with a new higher capacity and higher impedance transformer allows both 220/110 kV transformers to operate in parallel. This would avoid Kikiwa–Stoke–3 overloads for a Kikiwa 220/110 kV transformer outage.
- We will continue to monitor Stoke–T7 transformer outages causing the Kikiwa–Stoke–3 circuit to overload, using the 15-minute rating for the circuit. Further options will be investigated closer to the need date. A possible upgrade option is to install a second 220/110 kV transformer at Stoke. See also section 15.6.1 for a related investment.

Replacing the capacitors at Blenheim with higher rated units (see Table 15-3) will reduce the low voltage issue at Blenheim. After the planned risk-based policy replacement of transformers T1 and T2 at Blenheim, all three Blenheim supply transformers will be equipped with on-load tap changer to bring the 33 kV bus voltage back within the required range after a contingency of Stoke–T7.

[4] This is the first issue to occur, followed by low voltages across the region. Towards the end of the forecast period, loss of either of the Kikiwa or Stoke interconnectors may cause an overload on the other interconnector.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Base E&D capex investments

Project Name	Stoke second 220/110 kV transformer
Project description:	Install a second 220/110 kV transformer at Stoke
Project's state of completion	Possible
Grid need date	2035
Indicative cost [$ million]:	18
Reliability or Economic investment?	Reliability (Grid Reliability Report)

15.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 15-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 15-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Kikiwa supply capacity and security	Moved from West Coast to Nelson-Marlborough chapter

The overview of transmission capability for each grid exit point within the Nelson-Marlborough region is listed below. Where an issue is identified we list options to address it.

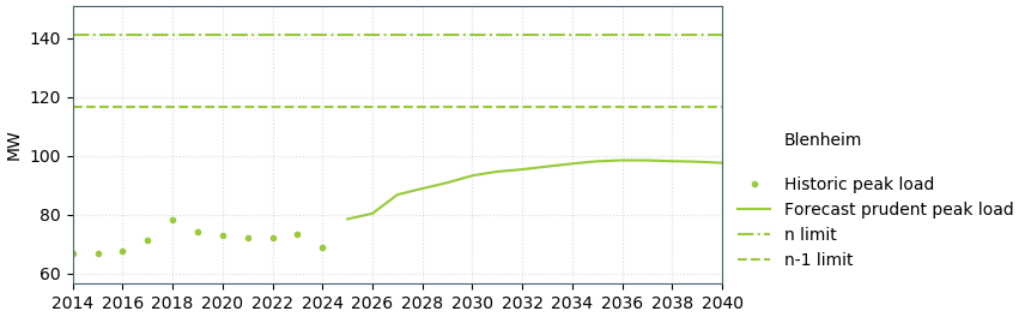
Section number	Description
15.5.1	Blenheim supply capacity
15.5.2	Kikiwa supply capacity and security
15.5.3	Stoke supply capacity

15.5.1 Blenheim supply capacity

Three 110/33 kV transformers supply Blenheim's load, providing a total installed capacity of 160 MVA. The transformers' capacity is limited by the 33 kV incomer cables.

Peak load at Blenheim is within the n-1 capacity of the supply transformers for the forecast period (see Figure 15-4).

Figure 15-4: Blenheim supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

15.5.2 Kikiwa supply capacity and security

Issue

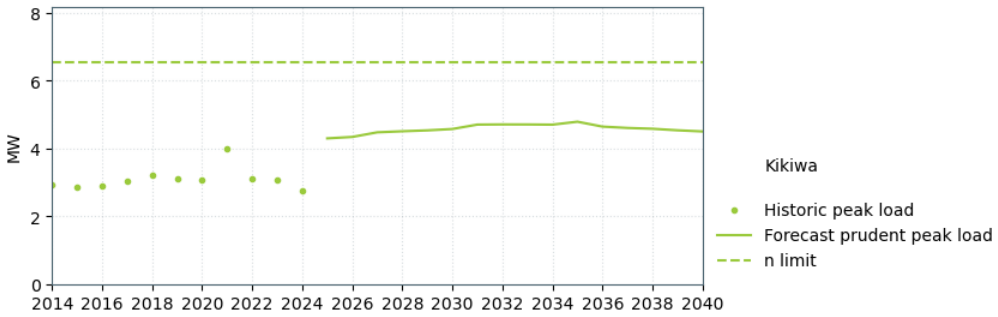
The Kikiwa load is normally supplied from the 11 kV tertiary winding of the Kikiwa–T1 interconnecting transformer, normally energised from the 220 kV side only and with the 110 kV side open. There is a backup supply from the T2 interconnecting transformer. Transferring the load between T1 and T2 requires a short interruption to the load.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

An outage of the 11 kV switchgear, fault limiting reactor or voltage regulator results in a total loss of supply, as these assets have n security.

The 20 MVA voltage regulator is limited to 7 MVA[5]. The peak load is within the capacity of the voltage regulator for the forecast period (see Figure 15-5).

Figure 15-5: Kikiwa supply security and capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Network Tasman has not requested a higher level of security for the Kikiwa 11 kV load, so no investments are planned.

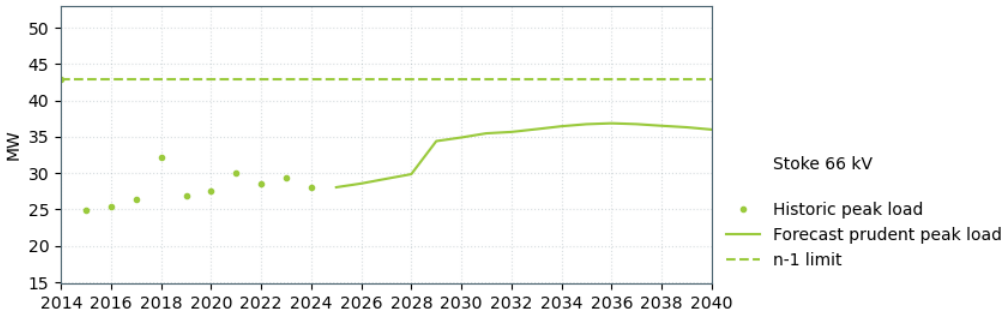
15.5.3 Stoke supply capacity

The Stoke load is supplied at two voltage levels: 66 kV and 33 kV.

Two 110/66 kV transformers supply Network Tasman's 66 kV load, providing a total nominal installed capacity of 80 MVA. The transformers' capacity is limited by 66 kV cables.

Peak load at Stoke 66 kV is within the n-1 capacity of the supply transformers for the forecast period (see Figure 15-6), even with no generation from Cobb.

Figure 15-6: Stoke 66 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Issue

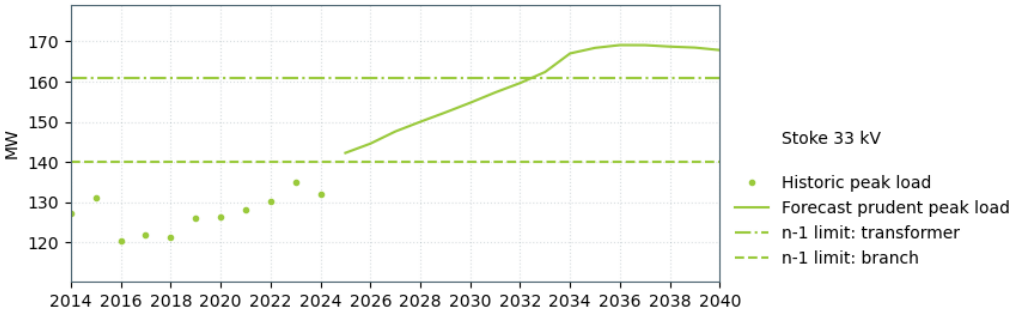
Two 220/33 kV transformers supply Stoke's 33 kV load, providing a total nominal installed capacity of 240 MVA. The transformers' capacity is limited by 33 kV protection, switchgear and cable limits.

Peak load at Stoke 33 kV is forecast to exceed the n-1 capacity of the supply transformers from winter 2025 (see Figure 15-7).

[5] The voltage regulator's capacity is limited by LV metering and protection limit of 7 MVA followed by transformer cable limit of 8 MVA; with these limits resolved the continuous capacity will be 20/20 MVA (summer/winter).

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 15-7: Stoke 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

In the short-term, operational measures will be used to manage constraints.

Network Tasman intends to develop a new 220/33 kV grid exit point at Brightwater, connected to one of the 220 kV Kikiwa–Stoke circuits. This investment will be customer funded. Network Tasman owns land for the new grid exit point and will decide on the timing for it. Load will be shifted from the Stoke 33 kV grid exit point to Brightwater to ensure the load at Stoke 33 kV remains within the n-1 capacity of the Stoke 33 kV supply transformers. A new grid exit point would also provide diversity for Nelson's electricity supply.

Customer investments

Project Name	Stoke 33 kV supply capacity
Project description:	Develop new 220/33 kV grid exit point (Brightwater GXP)
Project's state of completion	Possible
Grid need date	2025, customer initiated
Indicative cost [$ million]:	41.9
Reliability or Economic investment?	Reliability (Grid Reliability Report)

15.6 Nelson-Marlborough bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 15-6 lists the bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 15-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Argyle 110 kV		Argyle	-	-
Blenheim 110 kV	Blenheim	-	-	Note 1
Kikiwa 110 kV			West Coast overload and voltage issue	See 16.6.1
Kikiwa 220 kV	Kikiwa	-	- Possible overload of Kikiwa–Stoke–3 West Coast overload and voltage issue	Note 2 Note 3 Note 3
Stoke 66 kV	Stoke 66 kV	- Cobb	- -	Note 4 Note 4
Stoke 110 kV	Blenheim Stoke 66 kV	- - Cobb	- - - Overload of Blenheim–Argyle–Kikiwa Voltage collapse	15.6.1 Note 4 Note 4 15.6.1 15.6.1
Stoke 220 kV	Stoke 33 kV	-	- Possible overload of Kikiwa–Stoke 3	Note 5 15.6.1

1. Blenheim has a single zone of bus protection, so a bus fault disconnects all circuits from service causing a loss of supply.
2. An outage of the Kikiwa 220 kV bus-section that disconnects Kikiwa–T1 causes a loss of supply to Kikiwa.
3. An outage of the Kikiwa 220 kV bus section that disconnects the Kikiwa 220/110 kV T2 transformer means power flow to the West Coast comes from Stoke through the 110 kV Kikiwa–Stoke–3 circuit. Depending on the load and generation within the West Coast and wider grid (including generation at Coleridge) this may overload the 110 kV Kikiwa–Stoke–3 circuit and/or cause overload and voltage issues in the West Coast region (See 16.6.1).
4. An outage of the Stoke 110 kV or 66 kV bus will disconnect the Stoke 66 kV bus, including Cobb generation which is connected within the 66 kV distribution network. This may or may not cause a loss of supply, depending on the balance of load and generation in the area.
5. An outage of a Stoke 220 kV bus-section disconnects a supply transformer feeding the Stoke 33 kV bus, potentially causing the remaining transformer to overload (see 15.5.3).

The customers at these grid exit and injection points (Network Tasman, Marlborough Lines and Manawa Energy) have not requested higher bus security levels. Unless otherwise noted, we do not propose increasing bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

15.6.1 Regional 110 kV overloads and voltage issues

Issue

The Stoke 110 kV bus has a single bus zone, therefore, a fault on the Stoke 110 kV bus will disconnect both Blenheim–Stoke circuits and the Stoke 220/110 kV transformer. This may overload the Blenheim–Argyle–Kikiwa circuit which will also cause a low voltage issue at Blenheim. Towards the end of the forecast period the low voltage could lead to voltage collapse if load at Blenheim is high.

An outage of Stoke 220 kV bus-section A1 will also disconnect the 220/110 kV interconnecting transformer (but leave the Stoke 110 kV circuits and 110/66 kV transformers in service). Depending on levels of generation and load in the region, this may cause overloading of the 110 kV Kikiwa–Stoke–3 circuit, and low voltage at Stoke and Blenheim (see 15.4.1).

The Blenheim–Kikiwa 110 kV overload protection scheme is normally enabled. If the loading on the Blenheim–Argyle–Kikiwa circuit exceeds its rating, the scheme will trip selected feeders in stages to reduce the Blenheim load. This will normally address the overload and low voltage issues, but if the loading still exceeds the circuit rating the scheme will trip the circuit, causing a total loss of supply at Blenheim. The scheme may not act fast enough to prevent voltage collapse towards the end of the forecast period when the Blenheim load is high.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

What next?

A second 220/110 kV transformer at Stoke will partially address the issue (see 15.4.1) for a Stoke 220 kV bus outage.

Installing a bus section circuit breaker on the Stoke 110 kV bus in addition to the second 220/110 kV transformer will address the issues relating to a Stoke 110 kV bus outage for the forecast period.

Base E&D capex investments

Project Name	Stoke 110 kV bus section circuit breaker
Project description:	Install a section circuit breaker on the Stoke 110 kV bus
Project's state of completion	Possible
Grid need date	2026
Indicative cost [$ million]:	10
Reliability or Economic investment?	Reliability (Grid Reliability Report)

15.7 Nelson-Marlborough generation opportunities and proposals

This section provides a high-level description of the Nelson-Marlborough region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Section number	Description
15.7.1	Generation opportunities by substation
□	summer midday average – wet/calm • summer midday low – dry/windy • summer midday low – wet/windy • summer midday high – wet/windy • winter evening peak – wet/windy • winter midday high – wet/calm. Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.
	Generation investigations and proposals

15.7.1 Generation opportunities by substation

Envision Opportunities[6] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[7]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy
- winter evening peak – wet/windy
- winter midday high – wet/calm.

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

15.7.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation investigation queue[8]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 15-7 shows generation and grid-scale battery projects in the Nelson-Marlborough region that are in the generation investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 15-2 instead.

6 Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

7 "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

8 Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 15-7: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Argyle	Solar	Investigation	75
Kikiwa	Solar	Investigation	100

We have received further preliminary requests for generation connections that are at a Concept Assessment level and are not included in the investigation queue.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

16 West Coast Regional Plan

16.1	Regional overview and transmission system
16.2	West Coast load and generation forecasts
16.3	Grid enhancement approach and inputs
16.4	Grid asset capability and management within the wider region
16.5	Grid asset capability and management by grid exit point
16.6	West Coast bus security
16.7	Other items of interest
16.8	West Coast generation opportunities and proposals

16.1 Regional overview and transmission system

The West Coast region includes a mix of significant provincial towns (Westport, Greymouth, and Hokitika) and smaller, lower-growth rural localities.

The existing transmission network for the West Coast region is set out geographically in Figure 16-1 and schematically in Figure 16-2.

Figure 16-1: West Coast region transmission network map

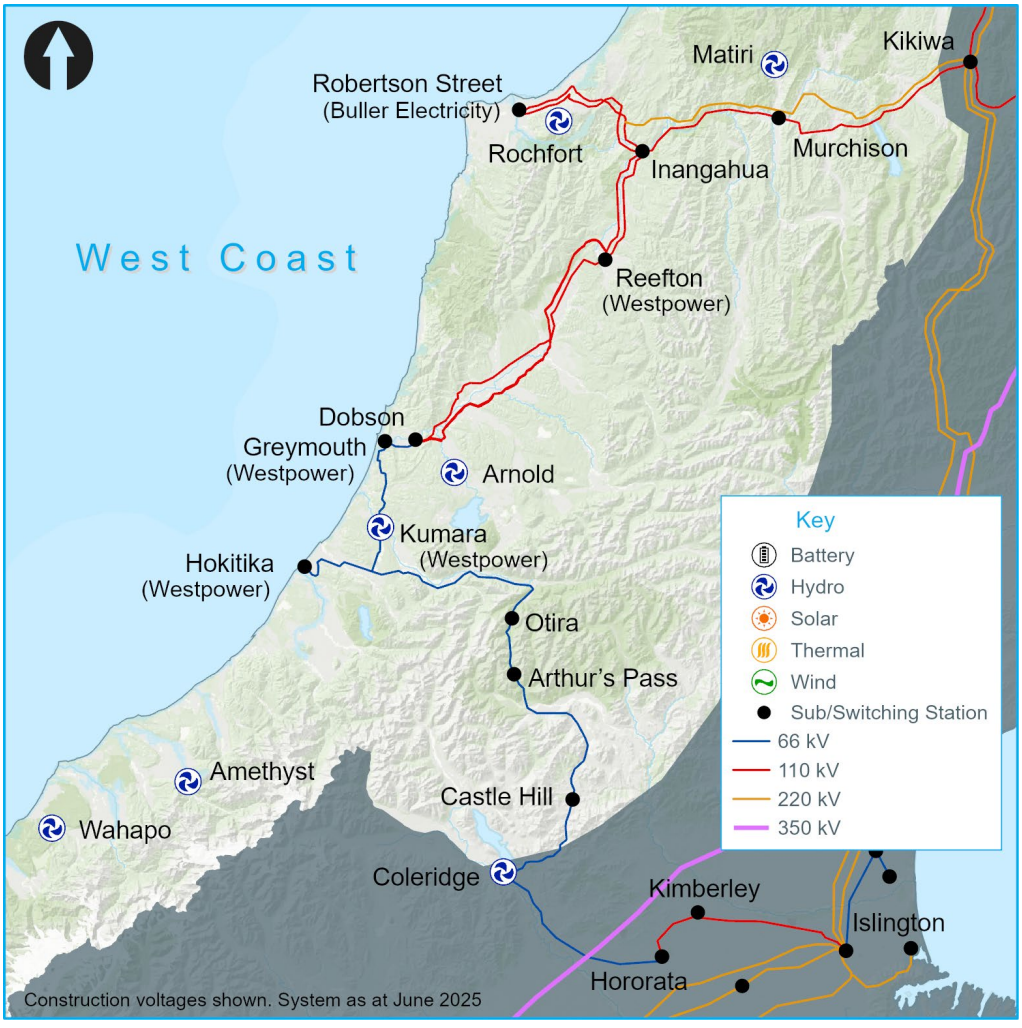
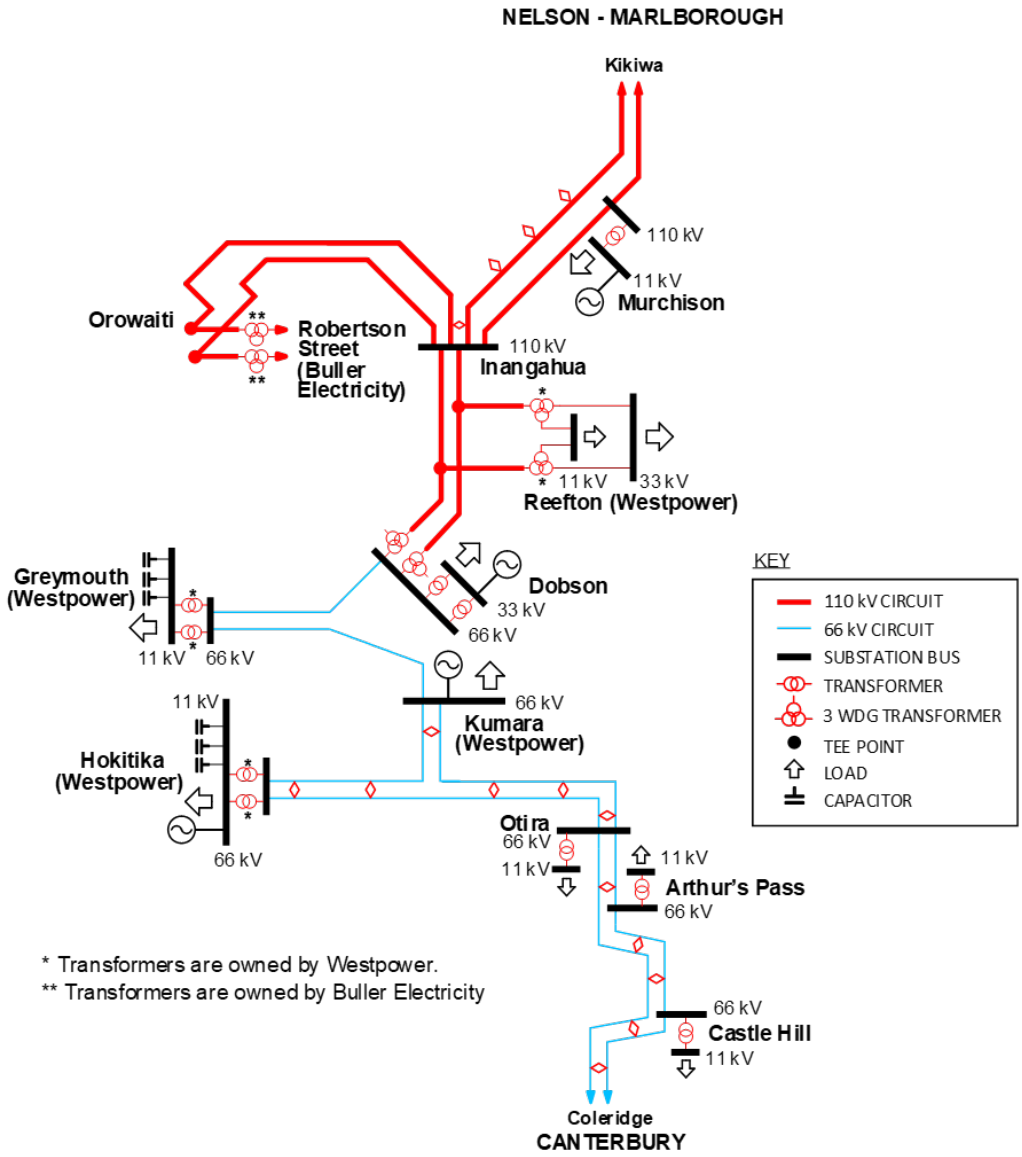


Figure 16-2: West Coast transmission schematic



16.1.1 Transmission into the region

The West Coast region is connected to the National Grid via two 110 kV circuits from Kikiwa and two 66 kV circuits from Coleridge. The amount of generation in the West Coast and Nelson-Marlborough regions, combined, is much less than their combined demand. Significant imports are required, most of which is supplied from remote generation in the Waitaki Valley, with significant load off take in the South Canterbury and Canterbury regions.

16.1.2 Transmission within the region

Within the West Coast region, the transmission network comprises 110 kV and 66 kV transmission circuits, with two 110/66 kV interconnecting transformers at Dobson.

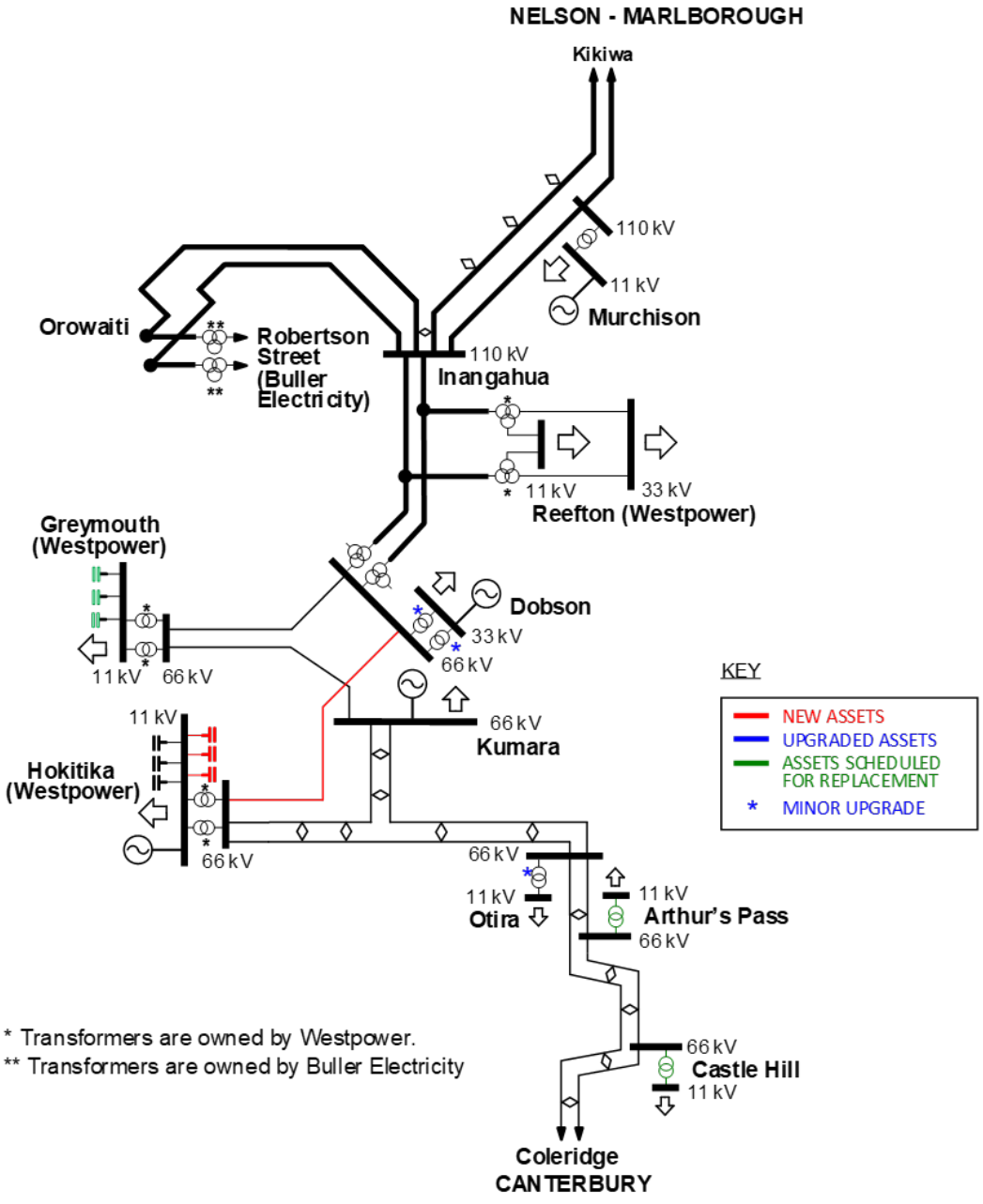
Most of the West Coast load is supplied through the northern transmission circuits, with power flowing through the region on the 110 kV circuits from Kikiwa to Dobson via Inangahua, and the 110 kV spur from Inangahua to Robertson Street. Some load is fed from the south via low capacity 66 kV circuits from Coleridge, which also provide significant voltage support to the region. Reactive support inside the region is provided by capacitor banks at Greymouth and Hokitika.

Most of the assets at Robertson Street, Reefton, Greymouth, Kumara and Hokitika are owned by the local lines companies (Westpower and Buller Electricity).

16.1.3 Possible West Coast transmission configuration

Figure 16-3 shows the possible configuration of West Coast transmission in 2040. New assets, upgraded assets, dismantled assets and assets scheduled for replacement within the forecast period, and possible investment are shown.

Figure 16-3: Possible West Coast transmission configuration in 2040



16.2 West Coast load and generation forecasts

16.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand

for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The West Coast regional peak demand is forecast to grow by an average 3.9 per cent per annum over the next 15 years, from 39 MW in 2025 to 69 MW by 2040. This is higher than the national average growth rate of 2.6 per cent per annum.

Table 16-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

Table 16-1: Forecast prudent annual peak demand (MW) at West Coast grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Arthur's Pass	1.00	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Castle Hill[1]	0.98	0.7	0.7	0.8	0.8	0.8	0.9	0.9	1	1	1	1	1
Dobson	0.99	9	10	14	15	15	15	15	15	15	16	16	16
Greymouth	1.00	15	16	16	17	17	17	18	18	18	19	19	20
Hokitika[2]	0.97	22	22	23	24	24	25	25	26	26	27	27	29
Kumara[1]	0.95	3	3	3	3	3	3	3	3	3	3	3	3
Murchison[1]	0.95	3	3	3	3	3	3	3	3	3	3	3	3
Otira	0.96	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7
Reefton[4]	1.00	6	15	15	15	15	15	16	16	16	16	16	17
Robertson Street[3]	1.00	12	12	13	13	14	14	14	14	14	15	15	15

1. These are leading power factors.
2. This is the gross load assuming no embedded generation contribution at Hokitika.
3. Robertson Street (owned by Westpower) is connected to the grid at Orowaiti.
4. Westpower advised 8 MW load increase from heavy industry at Reefton in 2026.

16.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing coal users to electricity (or electricity and biofuels), and generators seeking new low carbon industries. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the West Coast region that are not included in the prudent demand forecast.

16.2.3 Existing and committed generation

The West Coast region's generation capacity is currently 36 MW. This excludes any embedded solar (PV) generation, which was approximately 2 MW in the West Coast region at the time of publication[2]. This is significantly less than the demand in the region.

Table 16-2 lists the generation forecast for each grid injection point in the West Coast region for the forecast period. This includes all known and committed generation stations including those embedded in local lines company networks (Westpower, Buller Electricity, Network Tasman, or Orion)[3].

Further generation may be developed during the period. Refer to Table 16-7 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

1 Refer to Chapter 3 for further information on demand forecasting

2 Electricity Market Information (EMI): Installed distributed solar generation trends

3 Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

Table 16-2: Existing and committed generation capacity at West Coast grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Dobson												
(Arnold)	3	3	3	3	3	3	3	3	3	3	3	3
(Inchbonnie)	2	2	2	2	2	2	2	2	2	2	2	2
Hokitika												
(Amethyst)	7	7	7	7	7	7	7	7	7	7	7	7
(McKays Creek and Kaniere Forks)	1	1	1	1	1	1	1	1	1	1	1	1
(Wahapo)	3	3	3	3	3	3	3	3	3	3	3	3
Kumara												
(Kumara and Dillmans[1])	10	10	10	10	10	10	10	10	10	10	10	10
Murchison												
(Matiri)	5	5	5	5	5	5	5	5	5	5	5	5
Robertson Street												
(Rochfort)	5	5	5	5	5	5	5	5	5	5	5	5

1. The Dillmans hydro power scheme does not have significant water storage but is expected to supply an average of 5 MW during summer peaks.

16.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the West Coast region.

16.3 Grid enhancement approach and inputs

16.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the West Coast region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancement to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 16.4 and 16.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

16.3.2 West Coast significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 16-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the West Coast region for the next 15 years that may significantly impact related system issues or connected parties.

Table 16-3: Proposed significant upcoming replacement and refurbishment work for the West Coast region

Description	Tentative year	E&D issue
Arthur's Pass transformer replacement	2030-2032	None
Castle Hill transformer replacement	2030-2032	16.5.2
Dobson–T1 and T2 replacement	2027-2029	16.5.3
Greymouth capacitor bank replacement Greymouth reactive power controller replacement	2030-2031 2026-2028	None None
Hokitika reactive power controller replacement	2026-2027	None
Otira–T6 transformer protection replacement	2026-2028	None

16.3.3 West Coast asset feedback

The Asset Feedback Register does not contain any E&D-related entries specific to the West Coast region.

16.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider West Coast region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 16-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 16-4: Changes within the wider region since the 2023 TPR

Issues	Change
Kikiwa and Stoke interconnecting transformer capacity	Moved to the Nelson-Marlborough chapter.

The overview of transmission capability within the wider West Coast region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
16.4.1	Coleridge–Otira 66 kV transmission capacity
16.4.2	Dobson–Greymouth–Kumara 66 kV transmission capacity and low voltage

16.4.1 Coleridge–Otira 66 kV transmission capacity

Issue

Two 66 kV circuits connect the West Coast to the Canterbury region:

- Coleridge–Castle Hill–Arthur's Pass–Otira–1 rated at 27/32 MVA (summer/winter)
- Coleridge–Otira–2 rated at 27/32 MVA (summer/winter).

An outage of one of these circuits may cause the remaining circuit to overload towards the end of the forecast period.

What's next?

We will continue to monitor the transmission capacity issue and investigate further options if the issue becomes significant.

16.4.2 Dobson–Greymouth–Kumara 66 kV transmission capacity and low voltage

Issue

A single-circuit 66 kV line Dobson–Greymouth–Kumara rated at 30/36 MVA (summer/winter) connects the West Coast 110 kV and 66 kV networks.

An outage of either Dobson–Greymouth or Greymouth–Kumara will split the West Coast network. From 2033, this will cause low voltage issues at 66 kV buses, or voltage collapse when the West Coast load is high.

What's next?

Options to resolve transmission capacity and low voltage at Hokitika could resolve the West Coast low voltage issues (see section 16.5.5).

16.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 16-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 16-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Atarau supply capacity	Removed. Substation decommissioned in 2024.
Dobson supply capacity	Removed. Lower load forecast

The overview of transmission capability for each grid exit point within the West Coast region is listed below. Where an issue is identified we list options to address it.

Section number	Description
16.5.1	Arthur's Pass supply capacity and security
16.5.2	Castle Hill supply capacity and security
16.5.3	Dobson supply capacity
16.5.4	Greymouth supply capacity
16.5.5	Hokitika supply capacity and low voltage
16.5.6	Kumara supply capacity and security
16.5.7	Murchison supply capacity and security
16.5.8	Otira supply capacity and security
16.5.9	Reefton supply capacity
16.5.10	Robertson Street supply capacity

16.5.1 Arthur's Pass supply capacity and security

Issue

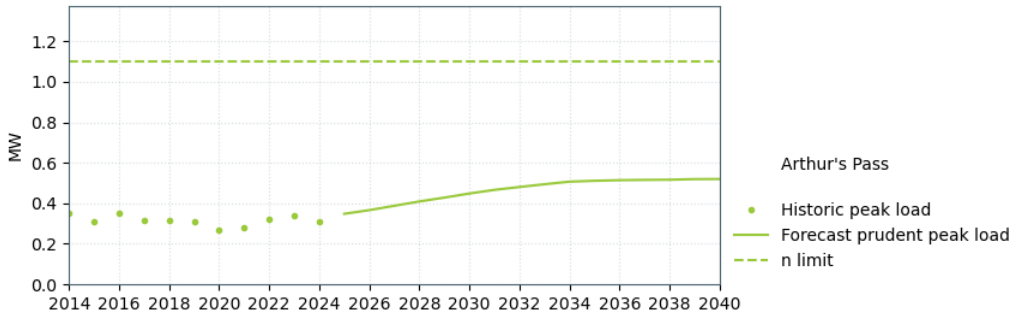
The two circuits supplying Arthur's Pass only have line circuit breakers and protection at Coleridge and Otira. A fault on any section of the Coleridge–Castle Hill–Arthur's Pass–Otira circuits will result in a loss of supply to the Arthur's Pass load.

A single 66/11 kV, 3 MVA transformer supplies load at Arthur's Pass, resulting in n security. The transformer's capacity is limited by a metering limit.

Peak load at Arthur's Pass is within the capacity of the supply transformer for the forecast period (see Figure 16-4).

There is a non-contracted single-phase spare transformer unit on site.

Figure 16-4: Arthur's Pass supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We have strategic spare transformers[4] to cover for failure of the Arthur's Pass, Castle Hill, Otira and Coleridge supply transformers. Orion has not requested a higher level of security for this site, so no investments are planned to increase supply security.

16.5.2 Castle Hill supply capacity and security

Issue

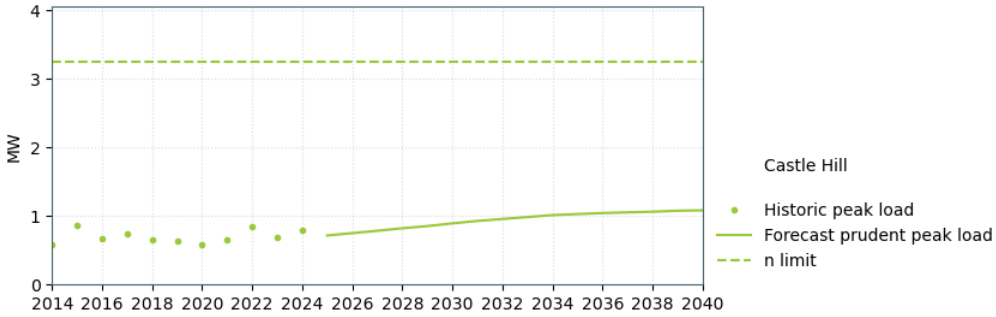
The two circuits supplying Castle Hill only have line circuit breakers and protection at Coleridge and Otira. A fault on any section of the Coleridge–Castle Hill–Arthur's Pass–Otira circuits will result in a loss of supply to the Castle Hill load.

A single 66/11 kV, 3.8 MVA transformer supplies load at Castle Hill, resulting in n security. The transformer's capacity is limited by a metering limit.

Peak load at Castle Hill is within the capacity of the supply transformer for the forecast period (see Figure 16-5).

There is a non-contracted spare transformer on site, allowing possible replacement within 8-14 hours following a unit failure (if the spare unit is available).

Figure 16-5: Castle Hill supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We have strategic spare transformers to cover for failure of the Arthur's Pass, Castle Hill, Otira and Coleridge supply transformers. The customers have not requested a higher level of security for these sites.

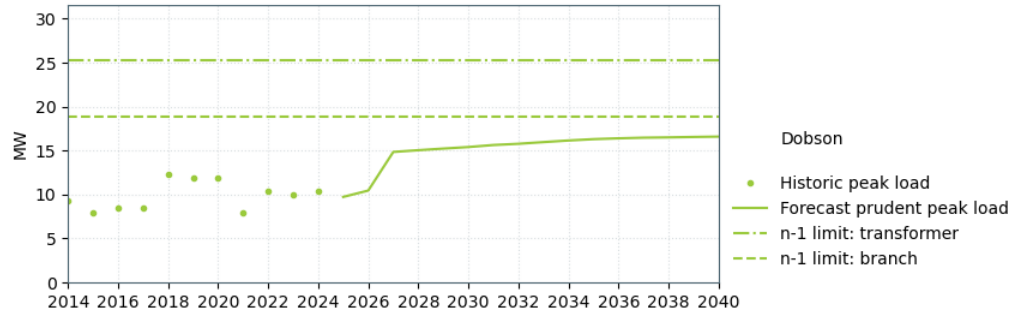
16.5.3 Dobson supply capacity

Two 66/33 kV, 20 MVA transformers supply Dobson's load, providing a total nominal installed capacity of 40 MVA. The transformers' capacity is limited by the LV protection limit.

Peak load at Dobson is within the capacity of the supply transformers for the forecast period (see Figure 16-6).

[4] We own a large strategic spare transformer and have access to a smaller, easier-to-transport strategic spare transformer.

Figure 16-6: Dobson supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will remove the transformer protection limits in conjunction with the planned transformer protection replacement work, by 2029 (see Table 16-3). Resolving the transformer protection limits will increase the n-1 supply capacity. Future investment to supply the forecast increase at Dobson will be customer driven.

16.5.4 Greymouth transmission capacity and low voltage.

Issue

Two 66 kV circuits connect Greymouth to the 110 kV network:

- Greymouth–Kumara–1 rated at 29/34 MVA (summer/winter)
- Dobson–Greymouth–1 rated at 30/36 MVA (summer/winter)

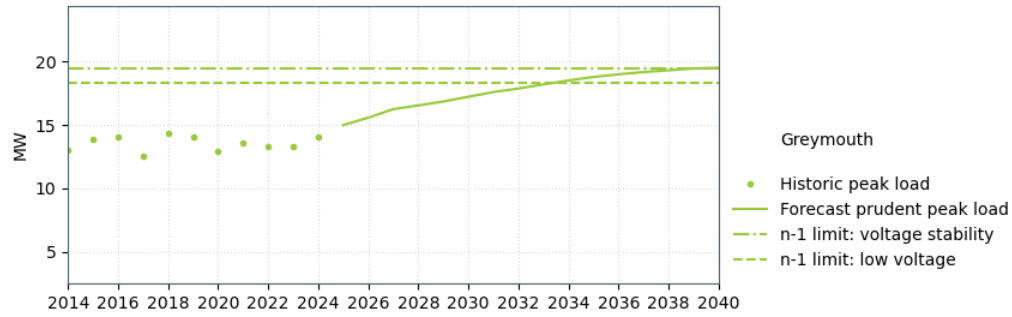
A wider voltage agreement at the Greymouth 66 kV bus allows a post contingency operating voltage band between 0.9 p.u. and 1.10 p.u.

With high load at Greymouth, and without any contribution from Kumara embedded generation, an outage of Dobson–Greymouth–1 will cause:

- Greymouth 66 kV bus voltage to drop below 0.9 p.u. from 2034
- the Greymouth load to exceed the voltage stability limit from 2039.

The supply transformers at Greymouth are owned by Westpower and are not reported in the TPR. See Figure 16-7 for the peak load forecast.

Figure 16-7: Greymouth transmission capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What's next?

The voltage stability issue is mainly due to the high load in Hokitika (see 16.5.5). By resolving the voltage issue in Hokitika, we can also address the voltage stability problem in Greymouth. We will monitor the situation and raise an investment need if necessary.

16.5.5 Hokitika transmission capacity and low voltage

Issue

Two circuits supply the Hokitika grid exit point:

- Hokitika–Kumara rated at 27/32 MVA (summer/winter)
- Hokitika–Otira rated at 27/32 MVA (summer/winter).

A wider voltage agreement at the Hokitika 66 kV bus allows a post contingent operating voltage band between 0.9 p.u. and 1.10 p.u.

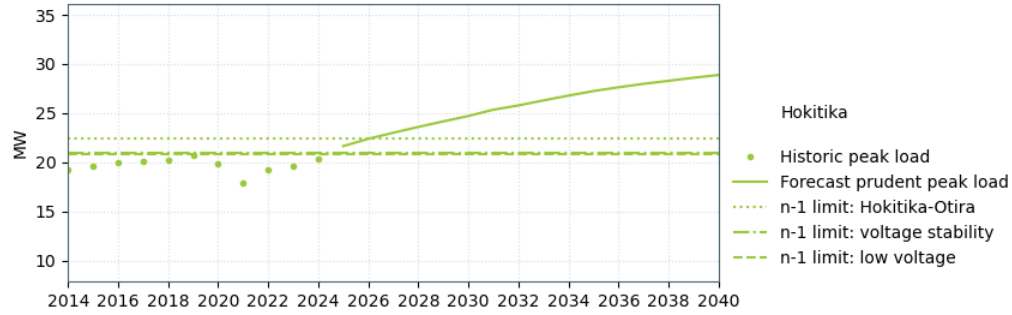
The supply transformers at Hokitika are owned by Westpower and are not reported in the TPR.

The Hokitika peak load occurs during the dairy season when the major dairy processing and storage plant is in full operation. With high load at Hokitika and without any contribution from the Amethyst embedded generator, a Hokitika–Kumara outage may cause (see Figure 16-8):

- the Hokitika 66 kV bus voltage to drop below 0.9 p.u. from 2025
- the Hokitika load to exceed the voltage stability limit from 2025
- the Hokitika–Otira circuit to exceed its n-1 capacity from 2028.

The 66 kV line from Coleridge to Kumara is predominantly strung with a copper conductor, so it cannot be thermally upgraded.

Figure 16-8: Hokitika–Otira transmission capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Options to improve supply security into Hokitika include:

- additional reactive support at Hokitika to resolve the voltage issues
- a special protection scheme to reduce load at Hokitika if either circuit connecting Hokitika is beyond its thermal limit.

This is a medium-term solution. In the long-term we will discuss options with Westpower, such as an additional line from Dobson to Hokitika, to address these issues when load eventuates.

Customer investments

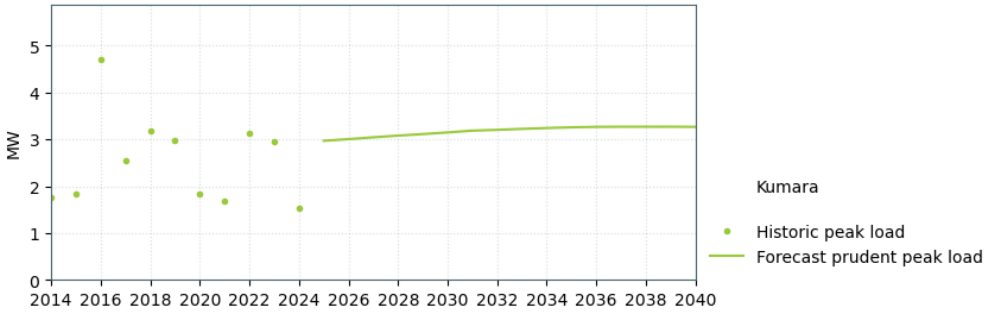
Project Name	Hokitika low voltage and voltage stability
Project description:	Install additional binary capacitors at Hokitika
Project's state of completion	Possible
Grid need date:	2025
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	Hokitika transmission capacity
Project description:	Install circuit overload protection schemes on Hokitika–Otira and Hokitika–Kumara circuits.
Project's state of completion	Possible
Grid need date:	2028
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

16.5.6 Kumara supply capacity and security

Kumara load is supplied via a single 66/11 kV supply transformer, resulting in n security. The supply transformer is owned by Westpower and is not reported in the TPR. See Figure 16-9 for the peak load forecast.

Figure 16-9: Kumara load forecast



16.5.7 Murchison supply capacity and security

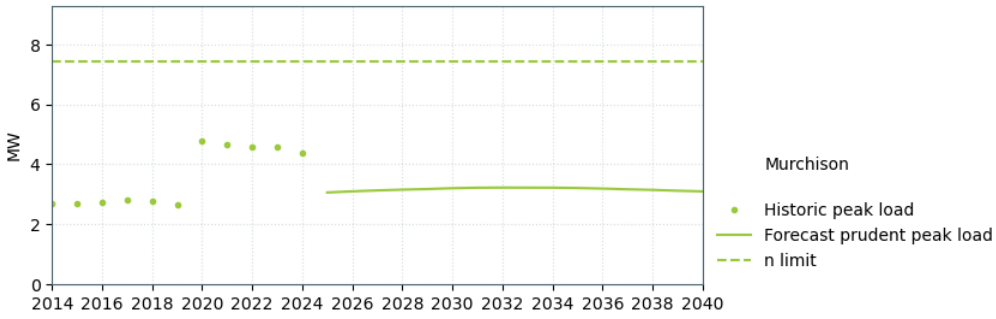
Issue

The load at Murchison is supplied by:

- two circuits, which do not have line protection at Murchison
- a single 110/11 kV, 10 MVA supply transformer.

A fault on either circuit or the supply transformer will cause a loss of supply to Murchison as it is on n security. Peak load at Murchison is within the capacity of the supply transformer for the forecast period (see Figure 16-10).

Figure 16-10: Murchison supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

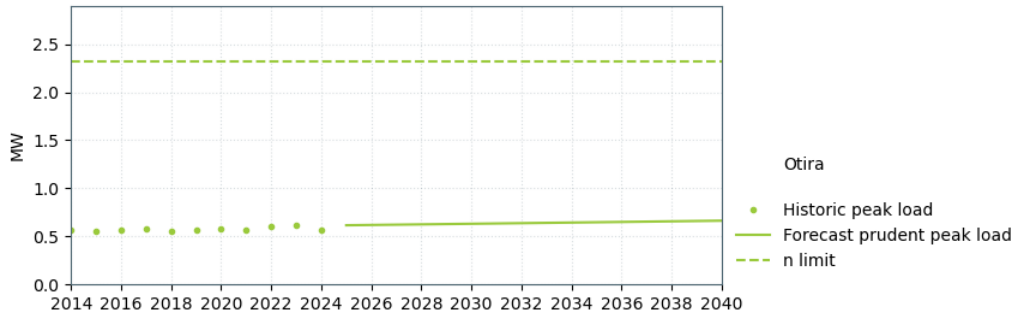
Network Tasman has not requested a higher level of security, so no investments are planned.

16.5.8 Otira supply capacity and security

Issue

Otira is supplied by a single 66/11 kV, 2.5 MVA transformer, resulting in n security. Peak load at Otira is within the capacity of the supply transformer for the forecast period (see Figure 16-11).

Figure 16-11: Otira supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

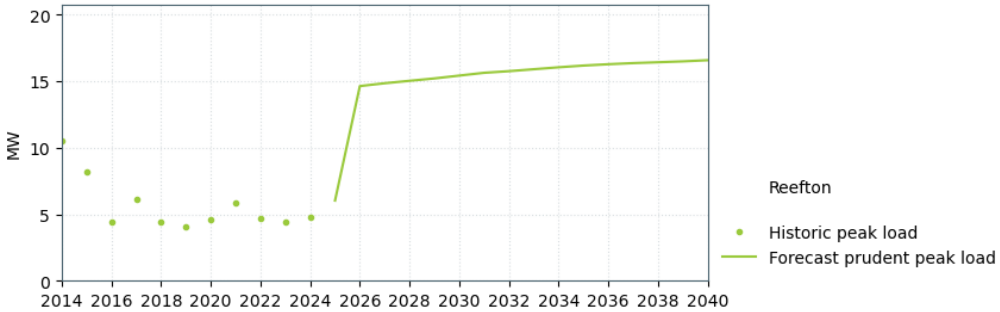
What next?

Westpower has not requested a higher level of security. Therefore, we have not planned any investments to increase supply security at Otira.

16.5.9 Reefton supply capacity

The supply transformers at Reefton are owned by Westpower and are not reported in the TPR. See Figure 16-12 for the peak load forecast.

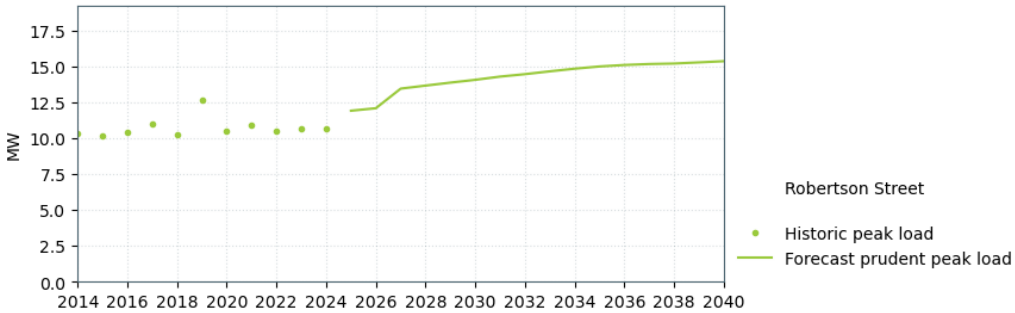
Figure 16-12: Reefton load forecast



16.5.10 Robertson Street supply capacity

The supply transformers at Robertson Street are owned by Buller Electricity and are not reported in the TPR. See Figure 16-13 for the peak load forecast.

Figure 16-13: Robertson Street load forecast



16.6 West Coast bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 16-6 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 16-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Arthur's Pass 66 kV	Arthur's Pass Castle Hill	- -	- -	Note 1 Note 1
Castle Hill 66 kV	Arthur's Pass Castle Hill	- -	- -	Note 1 Note 1
Coleridge 66 kV (Canterbury region)	Arthur's Pass Castle Hill Coleridge	- - - Coleridge	- - - - Hororata low voltage Dobson–Greymouth circuit overload and West Coast low voltages	16.6.2 16.6.2 Note 2 Note 2 Note 3 16.6.2
Dobson 66 kV	Dobson	-	- 66 kV transmission circuits overload and West Coast low voltages	Note 2 16.6.3
Greymouth 66 kV	Greymouth	-	- 66 kV transmission circuits overload and West Coast low voltages	Note 2 16.6.3
Hokitika 66 kV	Hokitika	-	-	Note 2
Kikiwa 110 kV (Nelson-Marlborough region)	-	-	66 kV transmission circuits overload and West Coast low voltages	16.6.1
Kumara 66 kV	Kumara -	- -	- Hokitika transmission capacity	Note 2 16.5.5
Inangahua 110 kV	Robertson Street	-	- 66 kV transmission circuits overload and West Coast low voltages	Note 4 16.6.1
Murchison 110 kV	Murchison	-	-	-
Otira 66 kV	Arthur's Pass Castle Hill Otira	- - -	- - - Dobson–Greymouth circuit overload	16.6.2 16.6.2 Note 2 16.6.2

1. There is no 66 kV circuit protection at Arthur's Pass or Castle Hill. Therefore, a bus fault at either grid exit point will trip the Coleridge–Castle Hill–Arthur's Pass–Otira circuit, causing a loss of supply at both Arthur's Pass and Castle Hill.
2. There is a single 66 kV solid bus (with no bus protection) at each of Dobson, Greymouth, Hokitika, Kumara, Otira and Coleridge (in the Canterbury region). A bus fault at any of these sites will cause a loss of supply (and embedded generation) at that site.
3. A Coleridge 66 kV bus outage may also cause low voltage at Hororata (Canterbury region), which will cause the Hororata Automatic Under Voltage Load Shedding (AUVLS) to operate.
4. Inangahua has a single bus, so a bus fault disconnects supply to Robertson Street. Robertson Street substation is owned by Buller Electricity; its point of connection to the grid is at Orowaiti, a point along the 110 kV Waimangaroa–Westport–A and Inangahua–Westport–B lines.

The customers in this region (Buller Electricity, Network Tasman, Orion and Westpower) have not requested higher bus security levels. Unless otherwise noted we do not propose increasing bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

16.6.1 Kikiwa 110 kV and Inangahua 110 kV bus security

Issue

The West Coast 110 kV load is mainly supplied from the National Grid via two 110 kV Inangahua–Kikiwa circuits, with lower capacity 66 kV backup circuits from Coleridge. There are single 110 kV bus sections at Kikiwa and Inangahua, so a bus outage will disconnect both circuits. This will cause:

- low voltage issues at all 66 kV buses[5] or voltage collapse when West Coast load is high
- 66 kV transmission circuit capacity issues in the West Coast region.

An outage of a Kikiwa 110 kV or Inangahua 110 kV bus section will cause low post-contingency voltage at the 110 kV and 66 kV buses or voltage collapse when West Coast load is high.

The effect of the low voltages and circuit overloading is difficult to predict, as this will be heavily influenced by the local generation and load composition at the time of the outage. The low voltages may cause enough motor load to trip that the transmission system stays intact and continues to supply the remaining load. Otherwise, one or more circuits will trip, causing a total loss of supply to some or all the grid exit points in the region.

What next?

The customers (Westpower, Buller Electricity, Network Tasman, and Orion) have not requested a higher security level. Therefore, we have not planned any investments to increase bus security at Inangahua or Kikiwa.

16.6.2 Coleridge 66 kV and Otira 66 kV bus security

Issue

There is no bus protection at Coleridge and Otira, so bus faults will be cleared by the connected circuits' far end line protection. In particular, the two circuits between Coleridge and Otira (including the connection to Arthur's Pass and Castle Hill) will trip, causing:

- loss of supply at Arthur's Pass and Castle Hill
- peak load to exceed the summer capacity of the 66 kV Dobson–Greymouth circuit from 2025.

What next?

Options to address this issue include thermally upgrading the Dobson–Greymouth circuit or transferring load from Greymouth to Dobson.

Orion and Westpower have not requested a higher security level. Therefore, we have not planned any investments to increase bus security at Coleridge or Otira.

16.6.3 Greymouth 66 kV and Dobson 66 kV bus security

Issue

The West Coast 66 kV load is mainly supplied from the low capacity 66 kV circuits from Coleridge and the interconnecting transformers at Dobson. There are single 66 kV bus sections at Greymouth and Dobson so a bus outage will disconnect both circuits and split the West Coast 66 kV network. This will cause:

- 66 kV transmission circuit capacity issues in the West Coast region
- low voltage issues at all 66 kV buses or voltage collapse when West Coast load is high.

What next?

The customers (Westpower, Buller Electricity, Network Tasman, and Orion) have not requested a higher security level. Therefore, we have not planned any investments to increase bus security at Dobson or Greymouth.

[5] There are Wider Voltage Agreements (WVAs) in place in Arthur's Pass, Coleridge, Castle Hill, Dobson, Greymouth, Hokitika, Kumara and Otira that allow the 66 kV voltage to be between 0.9 p.u. and 1.1 p.u. The WVA for Dobson is between 0.875 p.u. and 1.1 p.u.

16.7 Other items of interest

16.7.1 West Coast high voltage

Issue

High voltage will occur on the 110 kV transmission system under light load conditions where there is also high generation from the local embedded and grid connected generators.

In addition, an outage of the Kikiwa–T2 interconnecting transformer will also disconnect the Kikiwa STATCOM (which is connected to the transformer's tertiary winding) from the network resulting in a reduced amount of available reactive power support. This may cause transmission bus voltages in the region to rise above 1.1 p.u.

What next?

This issue can be managed operationally at present by switching out selected circuits. Increased levels of embedded generation (from new generation investment) or a further reduction in load, will cause this issue to become more significant, potentially requiring more intensive operational control of the generating units' voltage set-points.

We installed a 50 Mvar shunt reactor at Kikiwa which has helped to relieve the high voltage issue on the West Coast. We will continue to monitor the situation. Any further investments to resolve the Upper South Island high voltage issue will further relieve the high voltage issue on the West Coast (see section 6.9.2).

16.8 West Coast generation opportunities and proposals

This section provides a high-level description of the West Coast region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The West Coast has a number of existing small scale hydro generators connected within the distribution network, with potential for more. There is also a low level of interest in grid-scale solar generation.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
16.8.1	Generation opportunities by substation
16.8.2	Generation investigations and proposals
16.8.3	Transmission capacity to host generation

16.8.1 Generation opportunities by substation

Envision Opportunities[6] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

[6] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[7]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy.
- winter evening peak – wet/windy
- winter midday high – wet/calm

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

16.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[8]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 16-7 shows generation and grid-scale battery projects in the West Coast region that are in the generation connection investigation queue (as at the time of writing); there are none at present.

Table 16-7: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity
-	-	-	-

The following sections discuss the capacity of selected parts of West Coast region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

16.8.3 Transmission capacity to host generation

The 66 kV transmission system has the capacity to host moderate amounts of additional generation, especially generation connected within the distribution networks. This is particularly true for additional generation connected at Hokitika, which would assist in managing transmission issues.

The 110 kV transmission system has enough capacity to host generation well in excess of the regional load. Excess generation would particularly support the Nelson-Marlborough region, which is a net load region, and then Canterbury which has very little generation compared with the load off-take.

[7] "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

[8] Link to the Generation Investigation Queue: Connection enquiry information | Transpower

17 Canterbury Regional Plan

17.1	Regional overview and transmission system
17.2	Canterbury load and generation forecasts
17.3	Grid enhancement approach and inputs
17.4	Grid asset capability and management within the wider region
17.5	Grid asset capability and management by grid exit point
17.6	Canterbury bus security
17.7	Other items of interest
17.8	Canterbury generation opportunities and proposals

17.1 Regional overview and transmission system

The Canterbury region is the South Island's major load centre. It includes the city of Christchurch together with smaller rural localities.

The existing transmission network for the Canterbury region is set out geographically in Figure 17-1 and schematically in Figure 17-2.

Figure 17-1: Canterbury region transmission network map

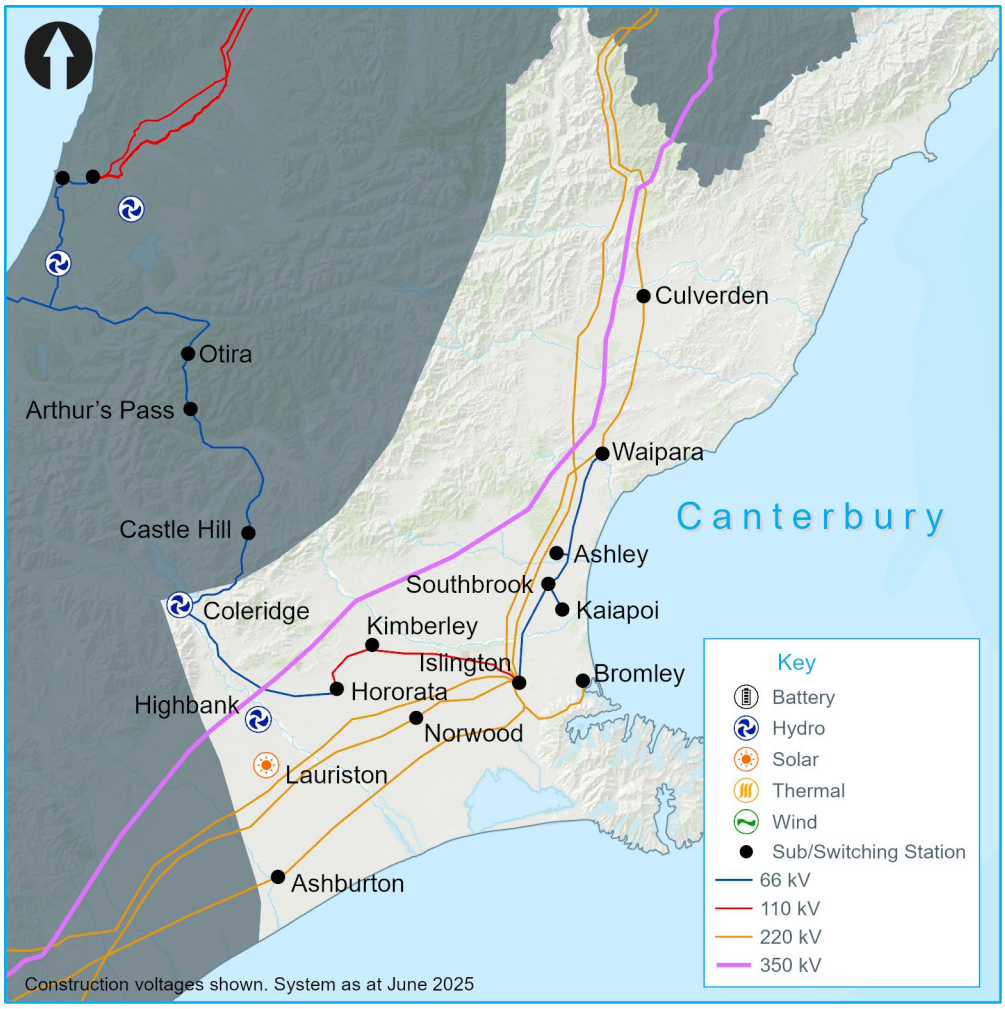
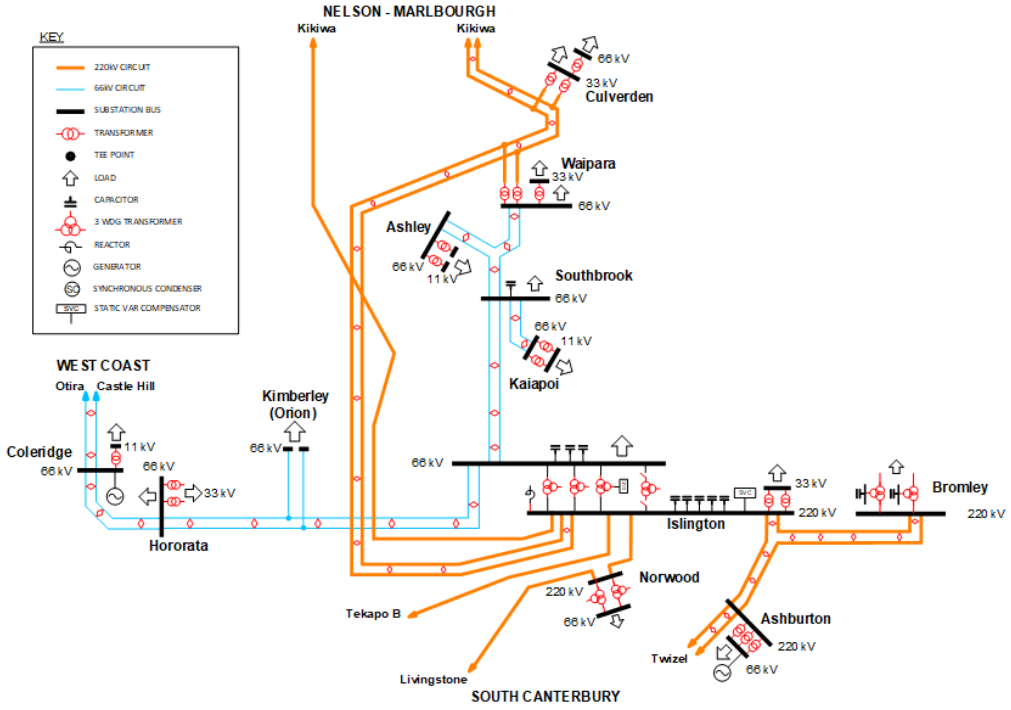


Figure 17-2: Canterbury region transmission schematic



17.1.1 Transmission into the region

The Canterbury region has some of the South Island's highest load densities, but relatively low levels of local generation. As a result, most of Canterbury's electricity demand is supplied by generation located in the South Canterbury region, via four 220 kV transmission circuits – three from Twizel and one from Livingstone. This transmission is essential for power flow into Canterbury and onwards to the Nelson-Marlborough and West Coast regions of the South Island.

17.1.2 Transmission within the region

Within the Canterbury region, the transmission network comprises 220 kV and 66 kV transmission circuits, with six 220/66 kV interconnecting transformers – four at Islington (one on cold standby) and two at Waipara.

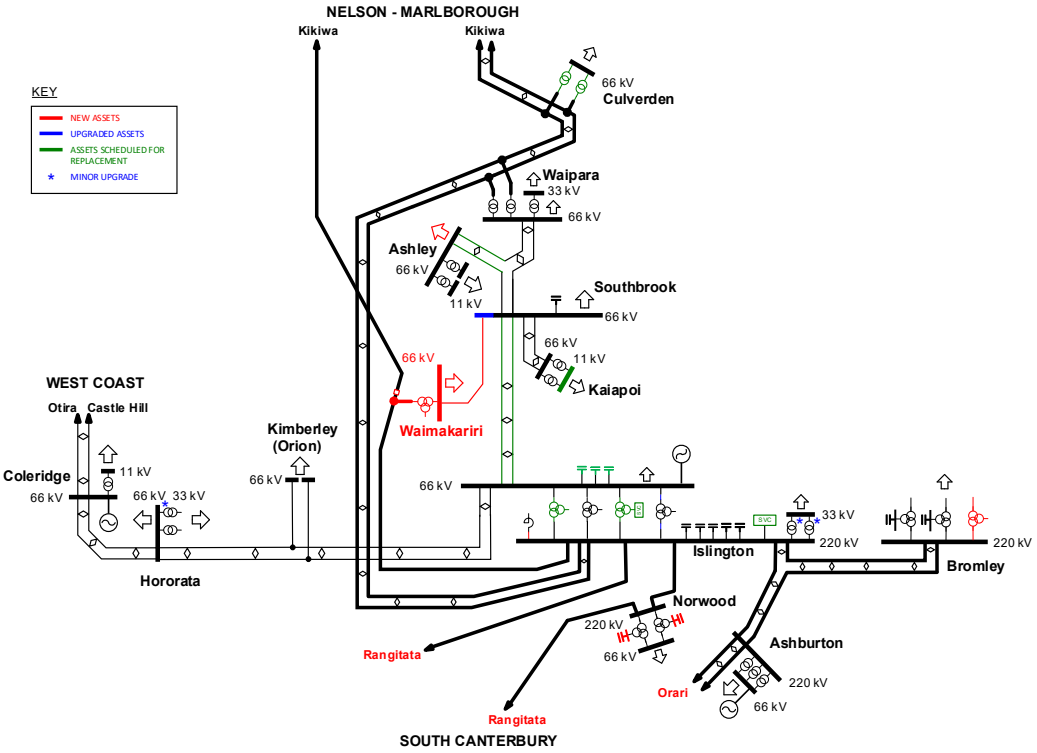
Reactive support for the region (and grid backbone) is provided by:

- static var compensators at Islington
- capacitor banks at Islington, Bromley and Southbrook
- a reactor at Islington.

17.1.3 Possible future Canterbury transmission configuration

Figure 17-3 shows the possible configuration of Canterbury transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

Figure 17-3: Possible Canterbury transmission configuration in 2040



17.2 Canterbury load and generation forecasts

17.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify potential issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Canterbury regional peak demand is forecast to grow by an average 2.6 per cent per annum over the next 15 years, from 861 MW in 2025 to 1,258 MW by 2040. This is equal to the national average growth rate. Table 17-1 sets out forecast peak demand (prudent growth) at each grid exit point over the forecast period.

Table 17-1: Forecast prudent annual peak demand (MW) at Canterbury grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Ashburton 66 kV	0.97	211	213	216	219	222	225	229	232	235	243	246	256
Ashley 11 kV (MainPower)[2,7,8]	1.00	13	13	13	10	10	10	11	11	11	11	11	12
Ashley 11 kV (Daiken)	0.84	9	9	9	9	9	9	9	9	9	9	9	9
Ashley 66 kV [2,7,8]	1.00	0	0	0.2	16	18	22	23	27	28	30	31	36
Bromley 66 kV [1,3,6]	0.99	165	169	173	235	240	248	207	210	276	280	282	289
Coleridge[1]	0.94	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.4
Culverden 33 kV	0.98	22	22	23	23	24	24	25	25	25	26	26	28
Culverden 66 kV	1.00	7	7	8	8	9	9	10	10	10	11	11	12
Hororata 33 kV[4]	0.97	20	21	22	23	23	24	25	26	19	22	22	24
Hororata 66 kV[5]	0.97	17	18	18	19	20	21	22	23	1	1	2	3
Islington 33 kV	1.00	73	76	79	82	84	92	94	97	99	106	108	112

[1] Refer to Chapter 3 for further information on demand forecasting.

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Islington 66 kV [3,6]	1.00	473	489	505	470	488	484	550	565	541	554	562	583
Kaiapoi [7]	1.00	31	33	34	32	33	34	35	36	38	39	40	44
Kimberley	0.97	17	17	18	19	20	21	22	23	23	24	24	27
Norwood [4,5,6]	0.96	40	43	44	47	49	73	76	78	108	108	109	112
Southbrook 66 kV[8]	1.00	60	63	58	60	62	61	62	61	62	68	69	72
Waipara 33 kV	1.00	9	9	9	10	10	10	11	11	12	12	13	14
Waipara 66 kV	0.96	9	9	9	9	10	10	10	10	11	11	11	12

1. These are leading power factors.
2. Planned load shifts as advised by MainPower from Ashley 11 kV (MainPower): 3 MW to Ashley 66 kV in 2028.
3. Planned load shifts as advised by Orion from Bromley 66 kV: 50 MW to Islington 66 kV in 2031.
4. Planned load shifts as advised by Orion from Hororata 33 kV: 7 MW to Norwood in 2033.
5. Planned load shifts as advised by Orion from Hororata 66 kV: 20 MW to Norwood in 2033.
6. Planned load shifts as advised by Orion from Islington 66 kV: 48 MW and 36 MW to Bromley 66 kV in 2028 and 2033 respectively; 23 MW to Norwood in 2030.
7. Planned load shifts as advised by MainPower from Kaiapoi 11 kV: 2 MW to Ashley 11 kV (MainPower) in 2025 and 4 MW to Ashley 66 kV in 2028.
8. Planned load shifts as advised by MainPower from Southbrook 66 kV: 1 MW to Ashley 11 kV (MainPower) in 2025; 7 MW, 3 MW and 3 MW to Ashley 66 kV in 2027, 2030 and 2032, respectively.

17.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing fossil fuel users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

We are not aware of any reasonably advanced proposals for additional demand in the Canterbury region that are not included in the prudent demand forecast.

17.2.3 Existing and committed generation

The Canterbury region's generation capacity is currently 115 MW. This excludes any embedded solar (PV) generation, which was approximately 73 MW in the Canterbury region at the time of publication[2]. Generation in this region represents a small portion of total South Island generation. Additional generation is imported via the National Grid, primarily from the lower South Island.

Table 17-2 lists the generation forecast for each grid injection point in the Canterbury region for the forecast period. This includes all known and committed generation stations, including those embedded in local lines company networks (EA Networks, Orion or MainPower)[3].

Further generation may be developed during the period. Refer to section 17.8 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

2 The capacity of existing embedded solar farms listed in Table 17-2 have been subtracted off the total embedded solar generation reported on the Electricity Market Information (EMI) website: Installed distributed generation trends.

3 Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

Table 17-2: Existing and committed generation capacity at Canterbury grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Ashburton												
(Highbank)	25	25	25	25	25	25	25	25	25	25	25	25
(Lauriston)	47	47	47	47	47	47	47	47	47	47	47	47
(Montalto)	2	2	2	2	2	2	2	2	2	2	2	2
Coleridge	41	42	42	44	44	44	44	44	44	44	44	44
Islington												
(Kowhai Park)	0	150	150	150	150	150	150	150	150	150	150	150

17.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Canterbury region.

17.3 Grid enhancement approach and inputs

17.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Canterbury region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancements to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 17.4 and 17.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

17.3.2 Canterbury significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 17-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Canterbury region for the next 15 years that may significantly impact related system issues or connected parties.

Table 17-3: Proposed significant upcoming replacement and refurbishment work for the Canterbury region

Description	Tentative year	E&D issue
Ashley deviation reconductoring	2025-2026	None
Culverden 220/33 kV T22/T23 transformer replacement	2037-2039	17.5.5
Culverden–T1 bushing replacement	2028-2030	None
Islington SVC9 refurbishment Islington C14, C15, C16 capacitor replacement	2028-2029 2031-2035	Upper South Island Voltage (see Chapter 6)
Islington–T6 bushing replacement Islington 220/66 kV T3/T7 transformer replacement	2026-2028 2028-2030	17.4.1 17.4.1
Islington–Southbrook–A line reconductoring	2025-2028	17.7.1
Kaiapoi 11 kV switchboard replacement	2025	17.5.8

17.3.3 Canterbury asset feedback

The Asset Feedback Register includes the following E&D-related entry specific to the Canterbury region:

- Southbrook 66 kV bus disconnectors outage unavailability (section 17.7.1).

17.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Canterbury region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 17-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 17-4: Changes within the wider region since the 2023 TPR

Issues	Change
Hororata and Kimberley low voltage	Added. Increased load forecast

The overview of transmission capability within the wider Canterbury region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

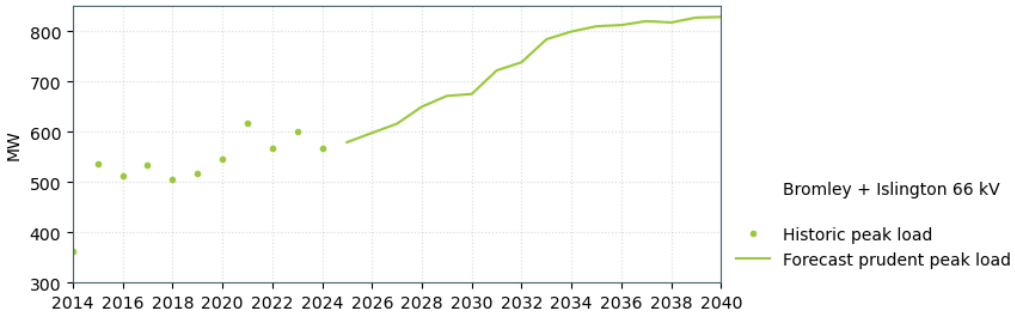
Section number	Description
17.4.1	Christchurch supply capacity
17.4.2	Hororata and Kimberley low voltage and transmission capacity
17.4.3	North Canterbury 66 kV area transmission capacity

17.4.1 Christchurch supply capacity

Issue

Most of the Christchurch 66 kV load is supplied from the Bromley and Islington grid exit points. The customer, Orion, can transfer significant load between the Bromley and Islington 66 kV buses. This forecast includes plans for multiple load shifts between the two substations during the forecast period. Therefore, Bromley and Islington are considered together when considering security of supply for 220/66 kV transformer contingencies at either substation. See Figure 17-4.

Figure 17-4: Bromley and Islington combined 66 kV load



Three 220/66 kV interconnecting transformers supply Islington 66 kV load, providing a total nominal installed capacity of 657 MVA. Two 220/66 kV supply transformers supply Bromley 66 kV load, providing a total nominal installed capacity of 360 MVA.

A system spare 220/66 kV interconnecting transformer (T8) is operated on cold standby at Islington (i.e., normally not on load). It can be switched in whenever required when a “main” transformer is out of service. This provides switched n-1 security.

A contingency of Islington–T6 may overload the remaining “main” Islington transformers from 2025 which can be mitigated by either switching in the “spare” transformer, or by shifting load from Islington to Bromley. At regional peak loads, load shifting from Islington to Bromley will cause the Bromley supply transformers to exceed their n-1 capacity from 2031.

Orion has indicated further load shifts from Islington 66 kV to Norwood in 2030, alleviating some of these transformer constraints. These constraints will be alleviated further as more load is shifted to Norwood.

A contingency of a Bromley 220/66 kV transformer may overload the remaining Bromley transformer from 2028. In this event, Orion can shift load to Islington to remove the overload at Bromley. The load at Islington will remain within the switched n-1 capacity of the transformers.

What next?

We anticipate the transformer n-1 overloading issues at Bromley will initially be resolved by shifting load between Bromley and Islington via Orion's network. See section 17.5.3 for a possible longer-term option.

Two Islington 220/66 kV transformers (T3 and T7) are currently scheduled for risk-based condition replacement in 2028-2030. While the new transformers will have higher ratings, post-contingency load shifts to Bromley and switching in Islington–T8 will still be required to address the Islington 220/66 kV capacity issue.

Transpower will investigate options to permanently switch in Islington–T8 as part of the Islington T3 and T7 replacement project.

17.4.2 Hororata and Kimberley low voltage and transmission capacity

Issue

Hororata and Kimberley substations are supplied from:

- Islington, by two 66 kV Hororata–Kimberley–Islington circuits, each rated at 59/62 MVA (summer/winter)
- Coleridge and the West Coast, by two 66 kV Coleridge–Hororata circuits, each rated at 30/37 MVA (summer/winter).

A wider voltage agreement with Orion for the Hororata and Kimberley 66 kV buses allows a post contingent operating voltage band of between 0.9 and 1.05 p.u.

With low Coleridge generation (three of the five units in service), and high load at Hororata and Kimberley, a Hororata–Kimberley–Islington circuit outage may cause:

- the remaining Hororata–Kimberley–Islington circuit to exceed the n-1 thermal capacity from 2029
- voltages on the Hororata and Kimberley 66 kV buses to drop below 0.9 p.u. from 2030.

The expected load increase on the West Coast 66 kV network also contributes to higher power flows through the 66 kV circuits supplying the region from Islington, exacerbating the voltage and loading issues at Hororata and Kimberley.

What next?

Orion has indicated a large load shift from Hororata 66 kV to the new Norwood GXP in 2033. This is expected to relieve the thermal and voltage issues for the long term.

There is an automatic under voltage load shedding scheme at Hororata to manage the voltage quality (post-contingency) at Hororata and Kimberley in the short-term. Because the thermal limit is reached prior to the voltage limit, the special protection scheme may need to be updated to include thermal overload considerations.

Alternate short-term options include constraining-on Coleridge generation at peak load to prevent both thermal and voltage issues.

Projects to resolve the West Coast regional constraints may improve the loading issues experienced in the Canterbury region. See Chapter 16 for details on the West Coast region.

17.4.3 North Canterbury 66 kV area transmission capacity

Issue

The North Canterbury 66 kV area is supplied from:

- Islington via two Islington–Southbrook circuits, each rated at 60/65 MVA (summer/winter)
- Waipara via two Southbrook–Waipara circuits (one via Ashley) rated at 38/46 MVA (summer/winter).

A wider voltage agreement with MainPower for the Ashley, Culverden, Kaiapoi, Southbrook, and Waipara 66 kV buses allows for an operating voltage band of between 0.9 and 1.1 p.u. at all times.

From 2028, MainPower plans to shift load from Ashley 11 kV, Southbrook, and Kaiapoi to its new Coldstream zone substation, supplied from Ashley 66 kV. This exacerbates transmission capacity constraints in the area, by increasing loading on the lower rated Ashley–Waipara and Ashley–Southbrook circuits.

During periods of high load in the North Canterbury 66 kV area, an outage of:

- the Southbrook–Waipara circuit may cause the Ashley–Waipara circuit to exceed its winter capacity from 2031.
- the Ashley–Waipara circuit may cause the Ashley–Southbrook and Southbrook–Waipara circuits to exceed their winter capacity from 2033 and 2034 respectively.
- the Ashley–Southbrook circuit may cause the Ashley–Waipara circuit to exceed its winter capacity from 2032.
- the Islington–Southbrook circuit may cause:
  - the Ashley–Waipara circuit to exceed its winter capacity from 2034,
  - the parallel circuit to exceed its summer capacity from 2038.
- an Islington 220/66 kV transformer may cause the Ashley–Waipara circuit to exceed its winter capacity from 2034.

What next?

From the early 2030s, MainPower plans to further develop its 66 kV network, allowing Coldstream zone substation to be potentially supplied from Southbrook instead of Ashley 66 kV. If MainPower's Coldstream zone substation is normally supplied from Southbrook from the early 2030s, the transmission capacity constraints will be deferred by several years, to the mid-2030s.

Short to medium-term options include upgrading the upcoming North Canterbury 66 kV Regional Overload Protection Scheme (see section 17.7.1), to be normally enabled and to reduce load at Southbrook GXP post-contingency.

A joint investigation with MainPower concluded that building a new 220/66 kV substation with a single 180 MVA transformer, connected to Islington–Kikiwa–1, is the most economic option in the long term. This option also provides increased security of supply for the North Canterbury area and includes solutions for the Southbrook 66 kV bus security (see section 17.6.2).

Major capex investment

Project Name	North Canterbury 66 kV area transmission capacity
Project description:	Build a single transformer 220/66 kV substation, connected to Islington–Kikiwa–1. Minor reconfiguration on Southbrook bus
Project's state of completion	Possible
Grid need date:	2032
Indicative cost [$ million]:	34
Reliability or Economic investment?	Reliability (Grid Reliability Report)

17.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 17-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 17-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Ashley supply capacity	Added. New 66 kV Ashley load
Islington 33 kV supply capacity	Added. Increased load forecast.
Waipara supply capacity	Removed. Decreased load forecast

The overview of transmission capability for each grid exit point within the Canterbury region is listed below. Where an issue is identified we list options to address it.

Section number	Description
17.5.1	Ashburton supply capacity
17.5.2	Ashley supply capacity and security
17.5.3	Bromley supply capacity
17.5.4	Coleridge supply capacity and security
17.5.5	Culverden supply capacity and security
17.5.6	Hororata supply capacity
17.5.7	Islington supply capacity
17.5.8	Kaiapoi supply capacity
17.5.9	Kimberley supply capacity
17.5.10	Norwood supply capacity
17.5.11	Southbrook supply capacity
17.5.12	Waipara supply capacity and security

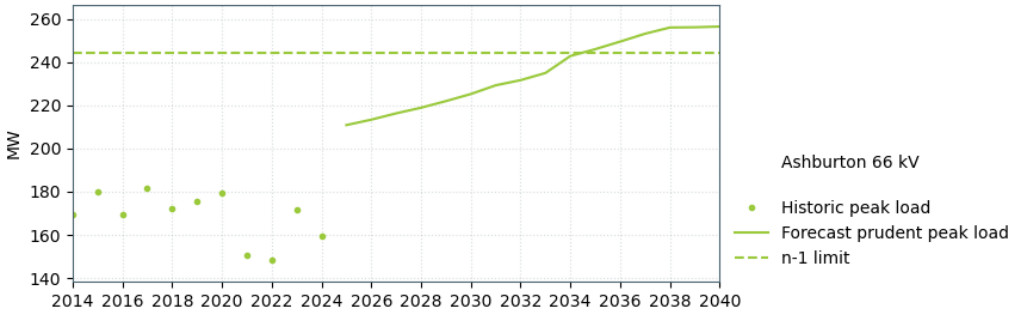
17.5.1 Ashburton supply capacity

Issue

Three 220/66 kV transformers supply Ashburton 66 kV load, providing a nominal installed capacity of 340 MVA.

Peak load at Ashburton is forecast to exceed the n-1 capacity of the supply transformers from summer 2035 (see Figure 17-5).

Figure 17-5: Ashburton supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will work with EA networks to identify options to resolve the n-1 capacity issue closer to the need date.

17.5.2 Ashley supply capacity and security

Issue

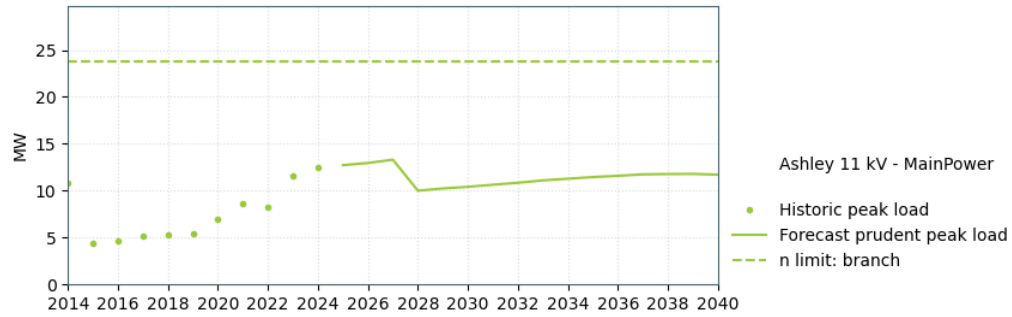
Two 66/11 kV transformers supply Ashley's 11 kV load, providing a total nominal installed capacity of 80 MVA. From 2027, Ashley will also supply load at 66 kV.

Ashley has two 11 kV buses, one supplying the Daiken load and the other supplying MainPower's local distribution network. Each bus is normally supplied by one transformer, providing n security to each load. The Daiken transformer capacity is limited by the metering limit and the MainPower transformer capacity is limited by the 11 kV incomer.

Both buses can be supplied from one transformer if the other transformer is out of service.

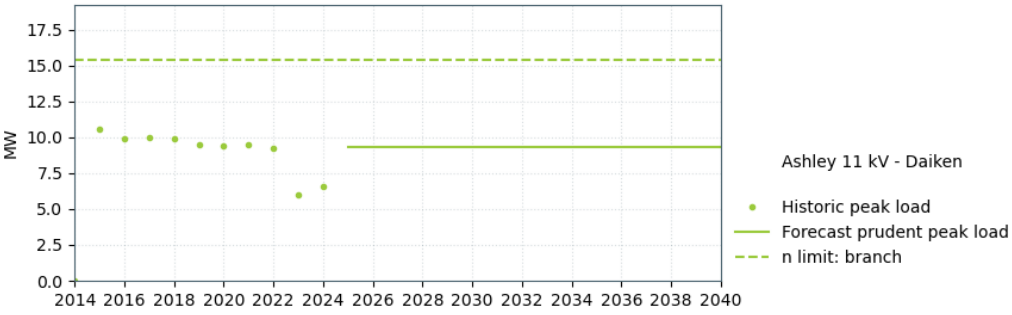
The individual peak loads of MainPower and Daiken are within the continuous capacity of their respective supply transformers for the forecast period (see Figure 17-6 and Figure 17-7 respectively).

Figure 17-6: Ashley 11 kV supply capacity - MainPower



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

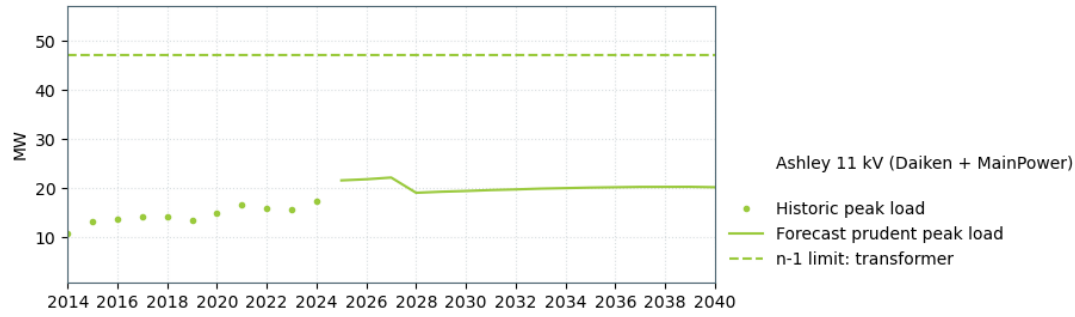
Figure 17-7: Ashley 11 kV supply capacity - Daiken



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The combined peak load (Daiken + MainPower) at Ashley is within the switched n-1 capacity of the supply transformers for the forecast period (see Figure 17-8).

Figure 17-8: Ashley 11 kV supply capacity

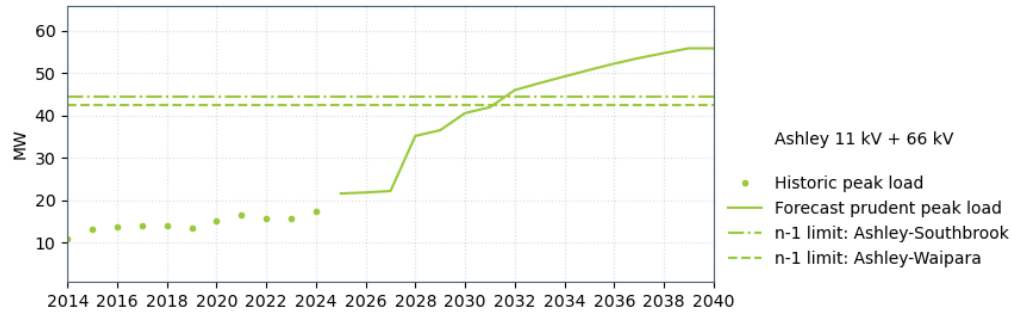


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Issue

The combined 11 kV and 66 kV peak load at Ashley is forecast to exceed the n-1 capacity of the Ashley–Waipara and Ashley–Southbrook circuits from winter 2032 (see Figure 17-9).

Figure 17-9: Ashley 11 kV and 66 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Longer term options were investigated in collaboration with MainPower (see section 17.4.3). A new 220/66 kV substation in the North Canterbury area is proposed and is expected to offload Ashley 66 kV load, resolving future transmission capacity constraints.

For short-term solutions, MainPower will develop its 66 kV network and shift the Ashley 66 kV load to Southbrook in the early 2030s, deferring transmission constraints by several years.

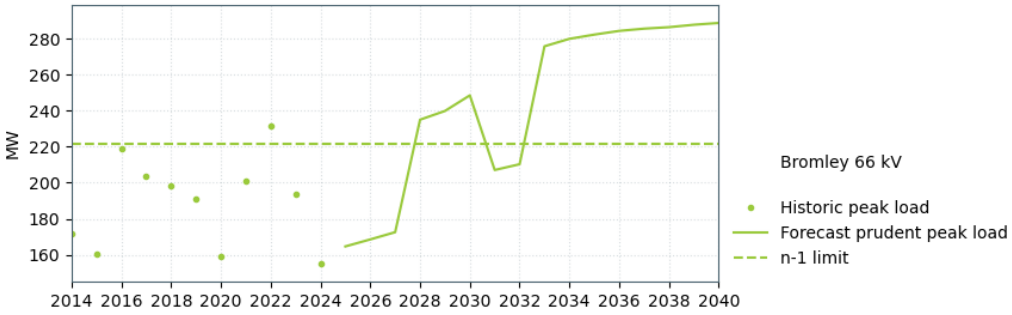
17.5.3 Bromley supply capacity

Issue

Two 220/66 kV transformers supply Bromley 66 kV load, providing a total nominal installed capacity of 360 MVA.

Peak load at Bromley is forecast to exceed the n-1 capacity of the supply transformers from winter 2028 (see Figure 17-10).

Figure 17-10: Bromley supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We anticipate this issue will initially be managed post-contingency by shifting load from Bromley to Islington (refer to section 17.4.1). A longer-term option is to install a third 220/66 kV transformer at Bromley.

Customer investments

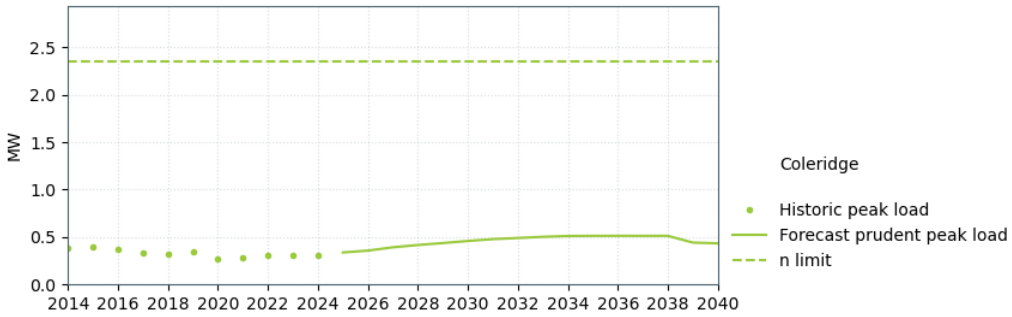
Project Name	Bromley 220/66 kV supply transformer capacity
Project description:	Install a third 220/66 kV supply transformer at Bromley
Project's state of completion	Possible
Grid need date:	2028 (Customer initiated)
Indicative cost [$ million]:	12
Reliability or Economic investment?	Reliability (Grid Reliability Report)

17.5.4 Coleridge supply capacity and security

Issue

A single 66/11 kV, 2.5 MVA transformer supplies the load at Coleridge, resulting in n security. Peak load at Coleridge is within the capacity of the single supply transformer for the forecast period (see Figure 17-11).

Figure 17-11: Coleridge supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

There is an off-site spare transformer available. In the event it is required, transportation to site and installation is likely to take several days during which time supply will be unavailable. Orion has not requested a higher level of security, so no investment is planned to address this.

17.5.5 Culverden supply capacity and security

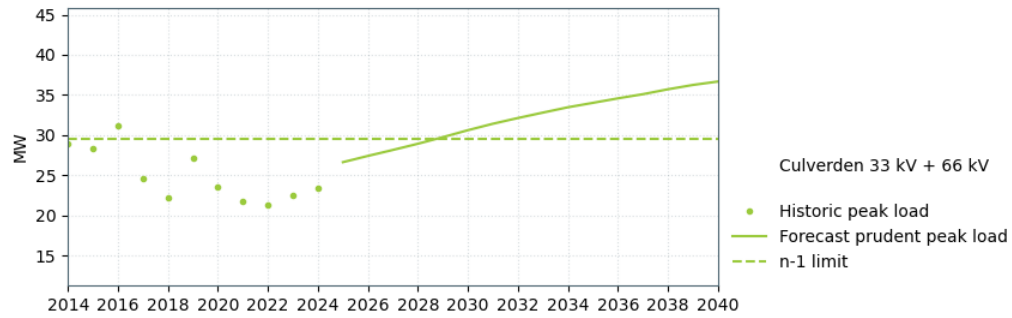
Issue

At Culverden, MainPower's load is supplied at two voltage levels: 33 kV and 66 kV.

Two 220/33 kV transformers supply Culverden 33 kV and 66 kV loads, providing a nominal installed capacity of 60 MVA. The two transformers are tee-connected to the Islington–Waipara–Culverden–Kikiwa circuits, so a circuit outage also disconnects a transformer. We are required to avoid overloading a transformer for a circuit outage[4], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers.

The combined 33 kV and 66 kV peak load at Culverden is forecast to exceed the n-1 capacity of the supply transformers from summer 2029 (see Figure 17-12).

Figure 17-12: Culverden 220/33 kV supply capacity (combined 33 kV and 66 kV load)

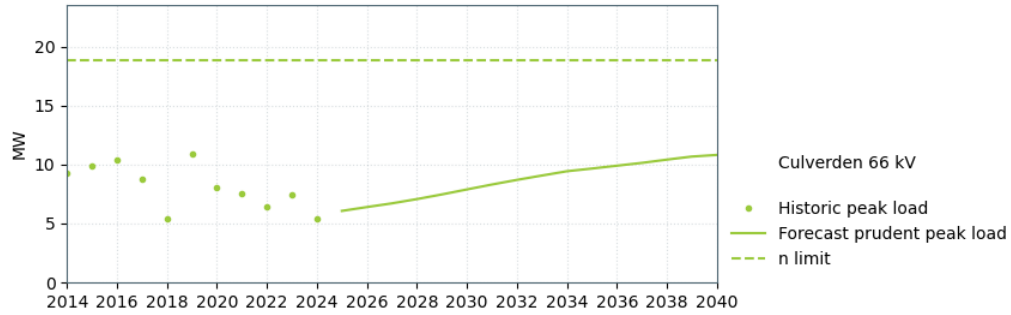


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

A single 33/66 kV, 20 MVA transformer supplies the 66 kV load, resulting in n security. The peak load at Culverden 66 kV is expected to remain within the continuous capacity of the supply transformer for the forecast period (see Figure 17-13).

[4] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

Figure 17-13: Culverden 33/66 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Options to manage the 220/33 kV supply transformer capacity issue include using the transformer's short-term rating, shifting load to another GXP pre-contingency or installing a special protection scheme to quickly trip load post-contingency. Future investment will be customer driven.

The issue of having only n security for 66 kV load can be managed operationally. MainPower has not requested a higher level of security, so no investment is planned to address this.

Development of the distribution network may require the 220/33 kV transformers to be replaced with two 220/66 kV transformers in the future. This investment would be customer driven.

Customer investments

Project Name	Culverden supply transformer capacity
Project description:	Install overload protection scheme on the Culverden supply transformers
Project's state of completion	Possible
Grid need date:	2029 (Customer initiated)
Indicative cost [$ million]:	0.4
Reliability or Economic investment?	Reliability (Grid Reliability Report)

17.5.6 Hororata supply capacity

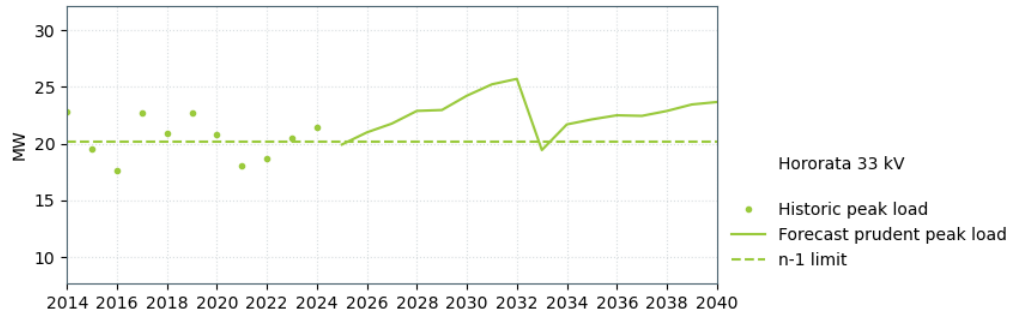
Issue

At Hororata, Orion's load is supplied at two voltage levels: 33 kV and 66 kV.

Two 66/33 kV transformers supply Hororata's 33 kV load providing a total nominal installed capacity of 34 MVA. The transformers' winter capacity is limited by a bus section rating.

Peak load on the Hororata 33 kV bus is forecast to exceed the n-1 capacity of the supply transformers from summer 2026 (see Figure 17-14).

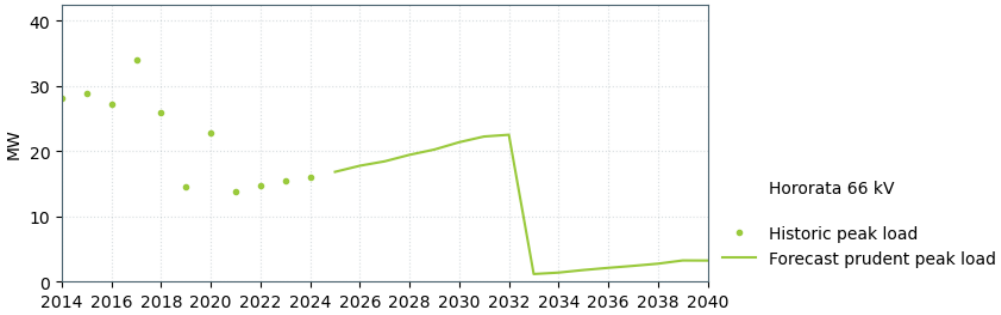
Figure 17-14: Hororata 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Orion has feeders connected directly to the Hororata 66 kV bus; their capacity is not reported in the TPR. See Figure 17-15 for the peak load forecast at Hororata 66 kV.

Figure 17-15: Hororata 66 kV load forecast



What next?

The supply transformer capacity issue can be managed operationally. Future investment will be customer driven. In the long term, Orion may transfer some or all the Hororata load to its new Norwood grid exit point.

17.5.7 Islington supply capacity

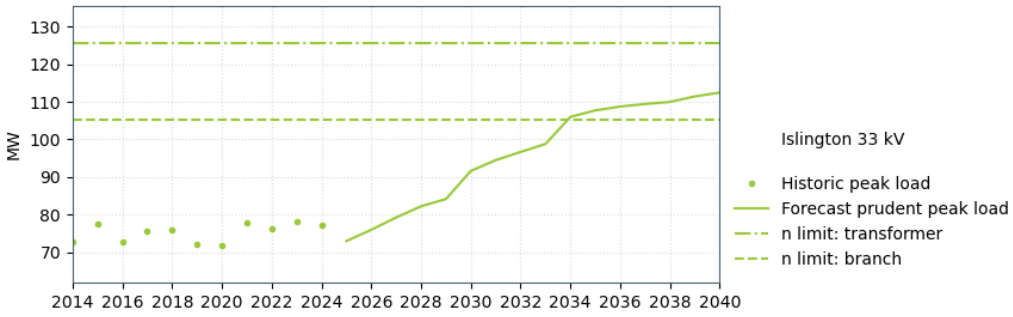
Issue

At Islington, Orion's load is supplied at two voltage levels: 33 kV and 66 kV.

Two Islington 220/33 kV transformers supply Islington's 33 kV load, providing a total nominal installed capacity of 200 MVA. The transformers' capacity is limited by LV cable limits.

Peak load at Islington 33 kV is forecast to exceed the n-1 capacity of the supply transformers from winter 2034 (see Figure 17-16).

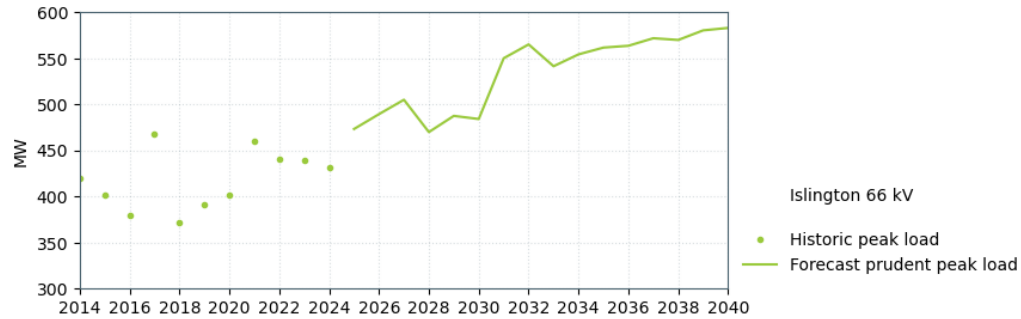
Figure 17-16: Islington 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Orion has feeders connected directly to the Islington 66 kV bus; their capacity is not reported in the TPR. See Figure 17-17 for the peak load forecast at Islington 66 kV.

Figure 17-17: Islington 66 kV load forecast



What next?

For the 220/33 kV supply transformers, resolving the LV cable limit will address the transformer capacity issue for the forecast period. We will discuss options to address the forecast supply transformer constraint with Orion closer to the need date.

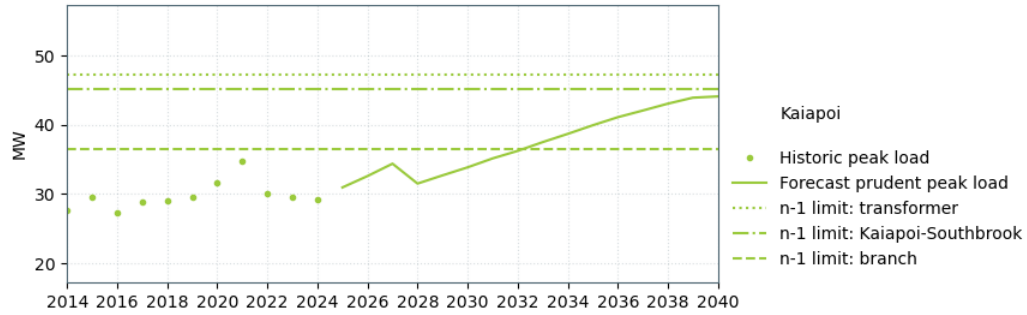
17.5.8 Kaiapoi supply capacity

Issue

Two 66/11 kV transformers supply Kaiapoi's load, providing a total nominal installed capacity of 80 MVA. The transformers' capacity is limited by 11 kV equipment.

Peak load at Kaiapoi is forecast to exceed the n-1 capacity of the supply transformers from winter 2033 (see Figure 17-18).

Figure 17-18: Kaiapoi supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

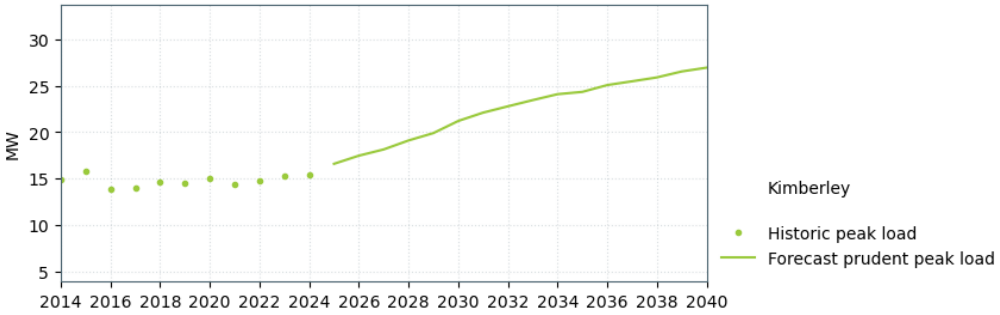
What next?

A new 11 kV switchboard is planned to be commissioned in late 2025. This will remove the branch limit on the supply transformers and resolve the overload for the forecast period.

17.5.9 Kimberley supply capacity

The supply transformers at Kimberley are owned by Orion and are not reported in the TPR. See Figure 17-19 for the peak load forecast.

Figure 17-19: Kimberley load forecast

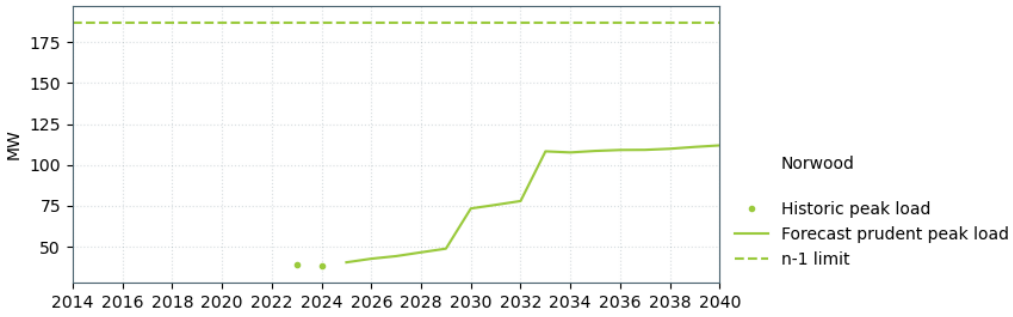


17.5.10 Norwood supply capacity

Two 220/66 kV transformers supply the Norwood 66 kV load, providing a total nominal installed capacity of 360 MVA.

Peak load at Norwood is expected to remain within the n-1 capacity of the supply transformers for the forecast period (see Figure 17-20).

Figure 17-20: Norwood load forecast

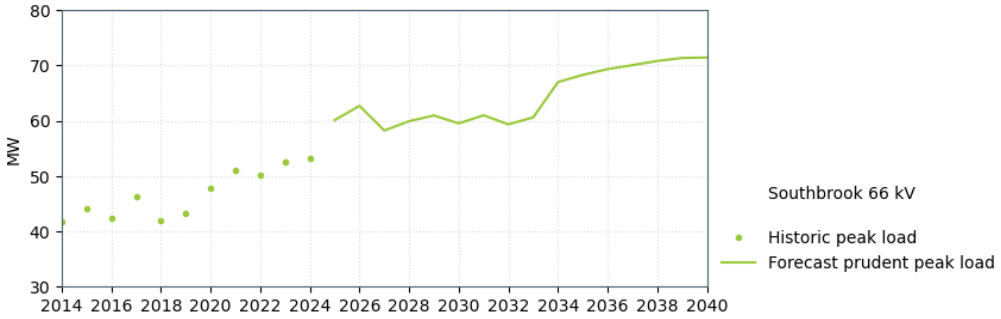


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

17.5.11 Southbrook supply capacity

MainPower has feeders connected directly to the Southbrook 66 kV bus; their capacity is not reported in the TPR. See Figure 17-21 for the peak load forecast.

Figure 17-21: Southbrook 66 kV load forecast



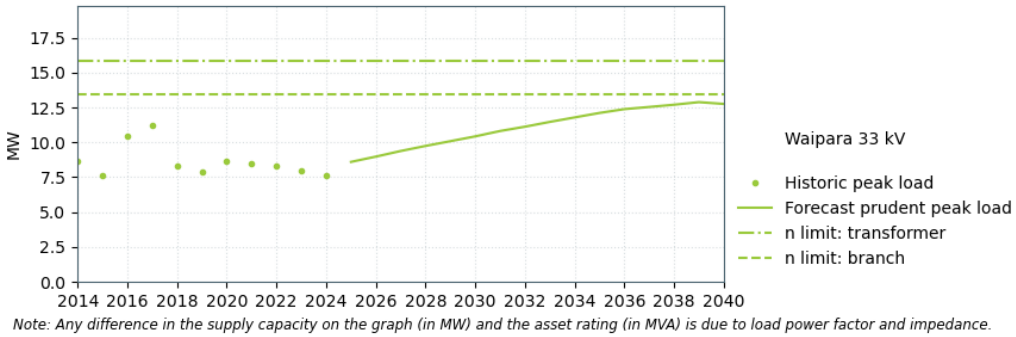
17.5.12 Waipara supply capacity and security

Issue

At Waipara, MainPower's load is supplied at two voltage levels: 33 kV and 66 kV.

A single 66/33 kV, 16 MVA transformer supplies 33 kV load at Waipara resulting in n security. The transformer capacity is limited by a metering limit. Peak load at Waipara 33 kV is expected to remain within the n-1 capacity of the supply transformers for the forecast period (see Figure 17-22).

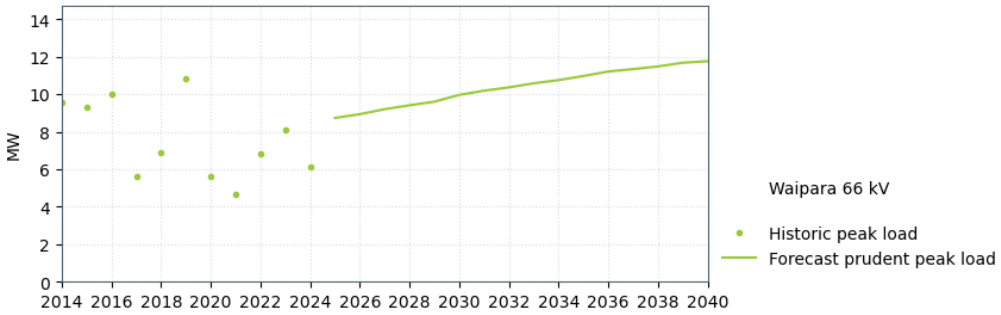
Figure 17-22: Waipara 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

MainPower has feeders connected directly to the Waipara 66 kV bus; their capacity is not reported in the TPR. See Figure 17-23 for the peak load forecast.

Figure 17-23: Waipara 66 kV load forecast



What next?

For the 33 kV Waipara load, MainPower has indicated that it plans to continue with the present level of security. No investment is planned to increase security.

17.6 Canterbury bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 17-6 lists bus outages that cause voltage issues or total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 17-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Ashburton 220 kV	-	-	Upper South Island voltage stability	Chapter 6
Ashley 66 kV	Ashley	-	-	Note 1
Coleridge 66 kV	Coleridge	- Coleridge	- -	Note 1 Note 1
Hororata 66 kV	Hororata	-	-	Note 2
Islington 220 kV	-	-	Upper South Island voltage stability	Chapter 6
Islington 66 kV	-	-	North Canterbury 66 kV line capacity	17.6.1
Kaiapoi 66 kV	Kaiapoi	-	-	Note 1
Southbrook 66 kV	-	-	North Canterbury 66 kV line capacity	17.6.2
Waipara 66 kV	Waipara -	- -	- North Canterbury 66 kV line capacity	Note 1 17.6.3

1. Ashley, Coleridge, Kaiapoi and Waipara have no 66 kV bus zone protection, hence bus faults will be cleared by the connected circuits' far end line protection, causing a loss of supply.
2. Hororata has a single bus section with bus zone protection, so a bus fault will cause a loss of supply.

Note that the customers at these grid exit and injection points (Orion, EA Networks, MainPower, and Manawa Energy) have not requested a higher security level. Unless otherwise noted, we do not propose increasing bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

17.6.1 Islington 66 kV bus security

Issue

The North Canterbury 66 kV network is supplied via 220/66 kV interconnectors at Waipara and two 66 kV Islington–Southbrook circuits. An outage of one of the Islington 66 kV bus sections will disconnect one of the Islington–Southbrook circuits and one of the shunt capacitors on the Islington 66 kV bus. At peak load, this will overload the:

- Ashley–Waipara circuit from winter 2031
- Southbrook–Waipara circuit from 2035

What next?

The preferred option identified by the North Canterbury 66 kV area transmission capacity investigation (see section 17.4.3) will resolve the circuit overloading issues.

17.6.2 Southbrook 66 kV bus security

Issue

Southbrook is supplied via four 66 kV circuits:

- Islington–Southbrook–1 and 2, each rated at 60/65 MVA (summer/winter)
- Southbrook–Waipara, rated at 38/46 MVA (summer/winter)
- Ashley–Southbrook, rated at 38/46 MVA (summer/winter).

An outage of Southbrook Bus A will disconnect the Islington–Southbrook–2 and Southbrook–Waipara circuits, leading to an overload of:

- the Ashley–Waipara circuit from winter 2025
- the Islington–Southbrook–1 circuit from winter 2026
- the Kaiapoi–Southbrook–2 circuit from winter 2039.

This bus outage will cause voltage to drop below 0.9 p.u at:

- Kaiapoi 66 kV from winter 2029
- Ashley 66 kV and Southbrook 66 kV from winter 2033.

An outage of Southbrook Bus B will disconnect the Islington–Southbrook–1 and Ashley–Southbrook circuits, leading to an overload of:

- the Islington–Southbrook–2 circuit from summer 2035
- the Ashley–Waipara circuit from winter 2032.

This bus outage will also cause voltage to drop below 0.9 p.u. at Ashley 66 kV from winter 2037.

What next?

The near-term issues will be managed operationally. A North Canterbury 66 kV Regional Overload Protection Scheme (COPS) will be commissioned in late 2025 (see section 17.7.1).

Longer term issues will be resolved with the preferred solution of the North Canterbury 66 kV area transmission capacity investigation (see section 17.4.3).

17.6.3 Waipara 66 kV bus security

Issue

The North Canterbury 66 kV network is supplied via 220/66 kV interconnectors at Waipara and Islington. An outage of the Waipara 66 kV bus will disconnect Waipara from the wider region so all load must be supplied from Islington. At peak loads:

- from winter 2032 onwards, this will overload both Islington–Southbrook circuits.
- from winter 2033 onwards, this will overload the Ashley–Southbrook circuit.

What next?

The preferred option identified by the North Canterbury 66 kV area transmission capacity investigation (see section 17.4.3) will resolve the circuit overloading issues.

17.7 Other items of interest

17.7.1 North Canterbury 66 kV maintenance outages

Issue

It is increasingly difficult to obtain an outage window to perform maintenance work on the Islington–Southbrook 66 kV circuits and Southbrook 66 kV bus. This is primarily due to increased load growth in the area.

What next?

A North Canterbury 66 kV Regional Overload Protection Scheme (COPS) will be commissioned in late 2025. The scheme manages post-contingency circuit overloads and reduces the need for pre-contingency load restrictions during maintenance outages on the North Canterbury 66 kV network.

Base E&D capex investment

Project Name	North Canterbury 66 kV regional COPS
Project description:	Post-contingent demand management scheme
Project's state of completion	Committed
Grid need date:	2025
Indicative cost [$ million]:	0.2
Reliability or Economic investment?	Reliability (Grid Reliability Report)

17.7.2 Ashburton–Timaru–Twizel maintenance security

Issue

Outage windows to perform maintenance on the 220 kV Ashburton–Timaru–Twizel circuits are becoming increasingly difficult to find; large irrigation loads in the Upper South Island are causing load increase in this region during summer months, when circuit maintenance is normally carried out.

What next?

The increasing solar generation in the Upper South Island should partly offset the peaks of the irrigation load, as high solar generation output should be correlated with high irrigation needs. This may increase the availability of suitable outage windows in summer.

We will investigate options to increase maintenance outage windows for these circuits. Options include installing a post-contingent demand management scheme in the Upper South Island to raise voltage stability limits in the area.

This issue is closely linked to the Timaru 110 kV voltage stability issue. See Chapter 18 for details and the proposed enhancement approach.

Base E&D capex investment

Project name:	Ashburton–Timaru–Twizel outage windows
Project description:	Upper South Island post-contingent demand management scheme
Project's state of completion:	Possible
Grid need date:	2027
Indicative cost ($ million):	0.8
Reliability or economic investment?	Reliability (Grid Reliability Report)

17.8 Canterbury generation opportunities and proposals

High load density areas coupled with relatively low levels of local generation in Canterbury mean there is no practical limit to the amount of generation that can be connected within the region. However, there will be limits to the generation that can be connected at a particular substation or along an existing line due to the rating of existing circuits.

This section provides a high-level description of the Canterbury region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints affecting their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
17.8.1	Generation opportunities by substation
17.8.2	Generation investigations and proposals

17.8.1 Generation opportunities by substation

Envision Opportunities[5] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities uses a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[6]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy.
- winter evening peak – wet/windy
- winter midday high – wet/calm

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

17.8.2 Generation investigations and proposals

There is a range of possible new generation developments that affect the Canterbury region, particularly grid-scale solar connected to Transpower's grid.

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[7]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 17-7 shows generation and grid-scale battery projects in the Canterbury region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 17-2 instead.

5 Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

6 "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

7 Link to the Generation Investigation Queue: Connection enquiry information | Transpower

Table 17-7: Generation investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Waipara (Mount Cass)	Wind	Delivery[1]	93
Hororata–Islington	Solar + BESS[2]	Investigation	100
Roxburgh–Islington A	Solar + BESS[2]	Investigation	450
Islington–Kikiwa	Solar	Investigation	200
Waipara	Solar	Investigation	120
Islington–Kikiwa	Solar + BESS[2]	Application	600
Islington–Kikiwa	Solar + BESS[2]	Application	200
Islington–Kikiwa	Solar + BESS[2]	Application	310

1. "Delivery" is a stage in the Transpower generation queue process, it does not denote a final commitment by the developer to build the generation.
2. BESS refers to Battery Energy Storage System

We have received further preliminary requests for generation connections that are at a Concept Assessment level and are not included in the investigation queue.

18 South Canterbury Regional Plan

18.1	Regional overview and transmission system
18.2	South Canterbury load and generation forecasts
18.3	Grid enhancement approach and inputs
18.4	Grid asset capability and management within the wider region
18.5	Grid asset capability and management by grid exit point
18.6	South Canterbury bus security
18.7	Other items of interest
18.8	South Canterbury generation opportunities and proposals

18.1 Regional overview and transmission system

The South Canterbury region includes a mix of significant provincial towns (Timaru and Oamaru) and smaller rural localities. The region supports a diverse range of primary-based industries and significant electricity demand growth is expected from initiatives to decarbonise these industries.

The region also hosts the bulk of the Island's hydro generation and the southern end of the HVDC inter-island link.

The existing transmission network for the South Canterbury region is set out geographically in Figure 18-1 and schematically in Figure 18-2.

Figure 18-1: South Canterbury region transmission map

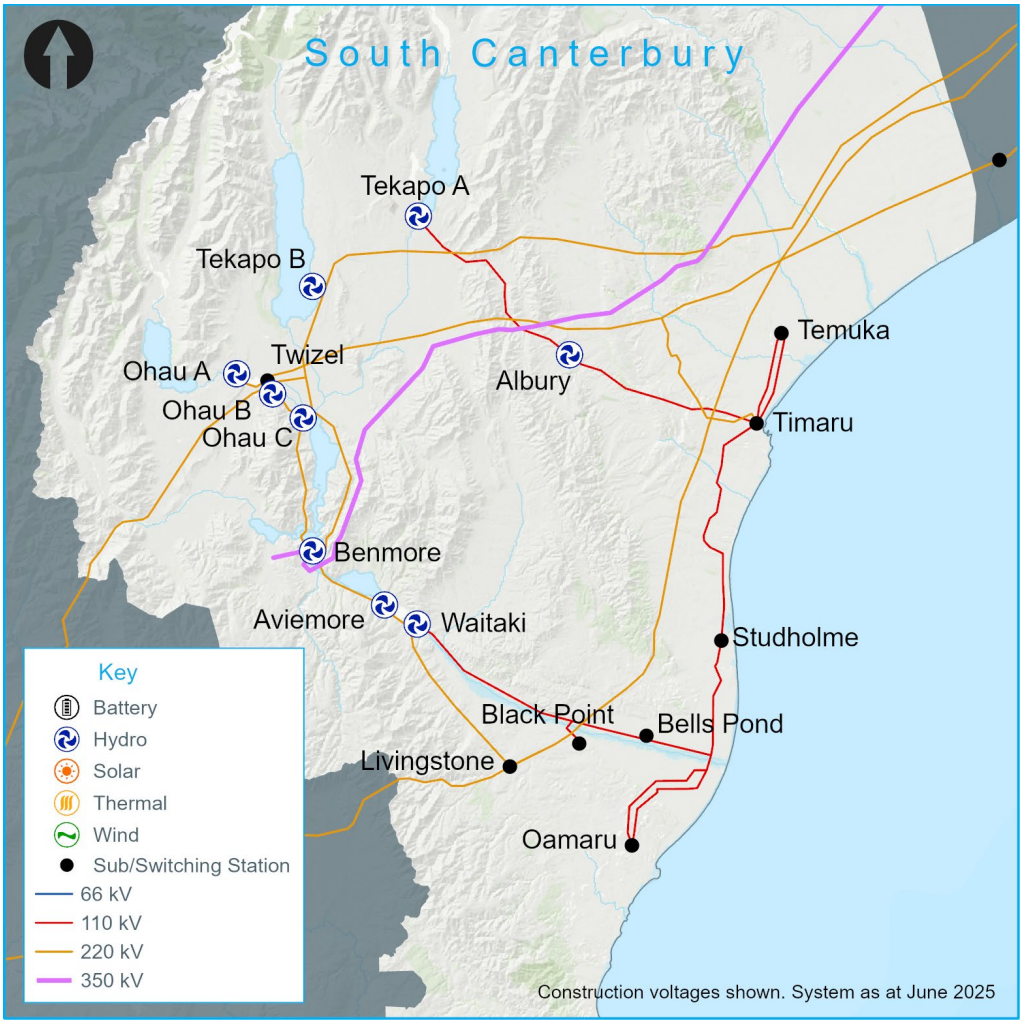
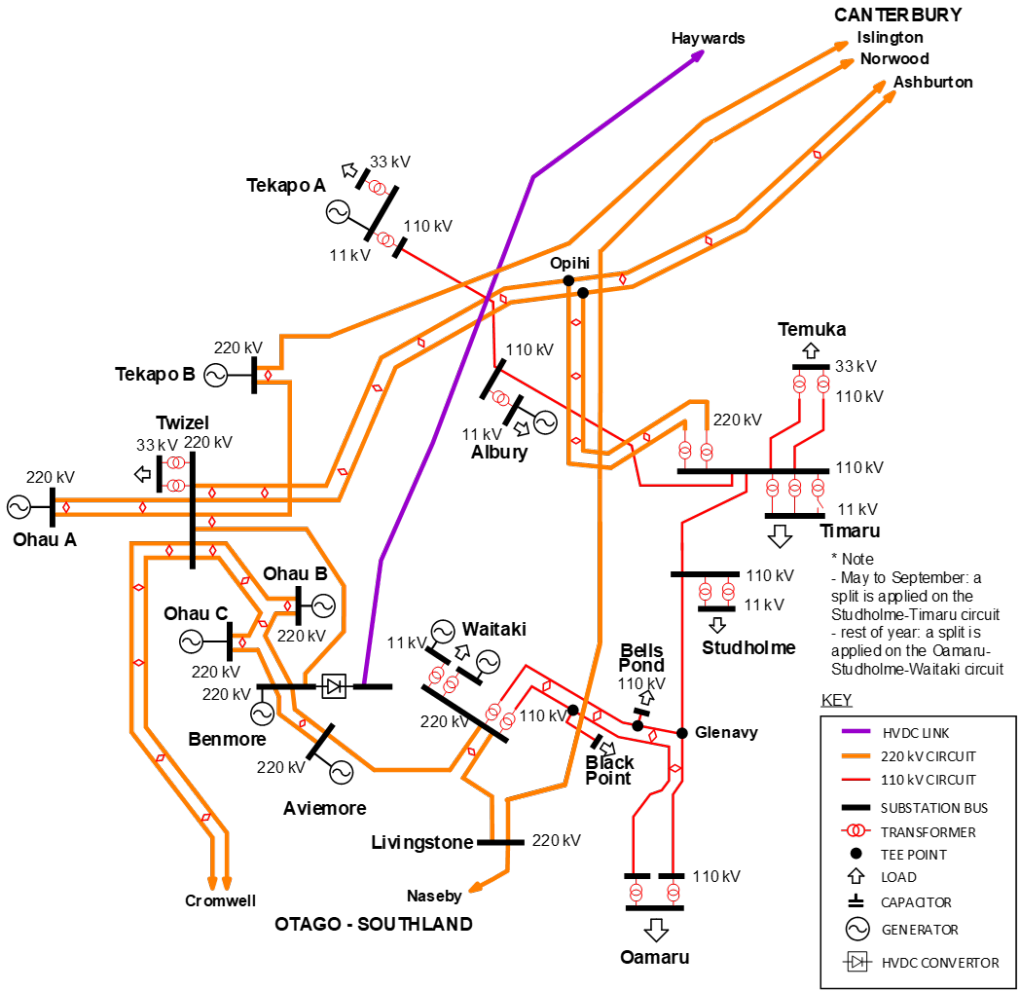


Figure 18-2: South Canterbury region transmission schematic



18.1.1 Transmission into the region

Several major 220 kV lines serve the South Canterbury region, connecting it to Christchurch and the upper South Island to the north, and the Otago-Southland region to the south.

This region contributes a major portion of the generation in the South Island, feeding the 220 kV transmission network from the Tekapo, Ohau, and Waitaki Valley generation stations. Transmission capacity requirements are driven by generation capacity (as generation in the region far exceeds local demand) and the need to transfer power the length of the South Island and into the North Island. In dry periods with low generation south of Clyde, there may also be a need to transfer power southwards to the Otago-Southland region (see Chapter 6 for transmission issues on the 220 kV grid backbone).

18.1.2 Transmission within the region

The South Canterbury regional transmission network comprises 220 kV and 110 kV transmission circuits, with interconnecting transformers at Timaru and Waitaki. Almost all loads in the South Canterbury region are supplied via the 110 kV transmission network, which runs up the east coast from Oamaru to Temuka.

The 220 kV transmission circuits form part of the grid backbone. A special protection scheme on the Aviemore–Benmore circuits enables higher pre-contingency power flow[1]. Historically, the special protection scheme was enabled only for power flow from Aviemore to Benmore (north flow). However, the scheme is now enabled for south flow as well.

[1] The special protection scheme will operate if: (i) an Aviemore–Benmore circuit is open, (ii) the in-service circuit is overloaded. The control action opens the 220 kV Aviemore–Waitaki circuit.

The 110 kV transmission network is split at Studholme. The split creates two radial feeds:

- During summer, the Timaru 220/110 kV interconnecting transformers supply Timaru, Albury, Tekapo A, Temuka, and Studholme
- During winter, the Waitaki 220/110 kV interconnecting transformers supply Bells Pond, Black Point, Oamaru, and Studholme.

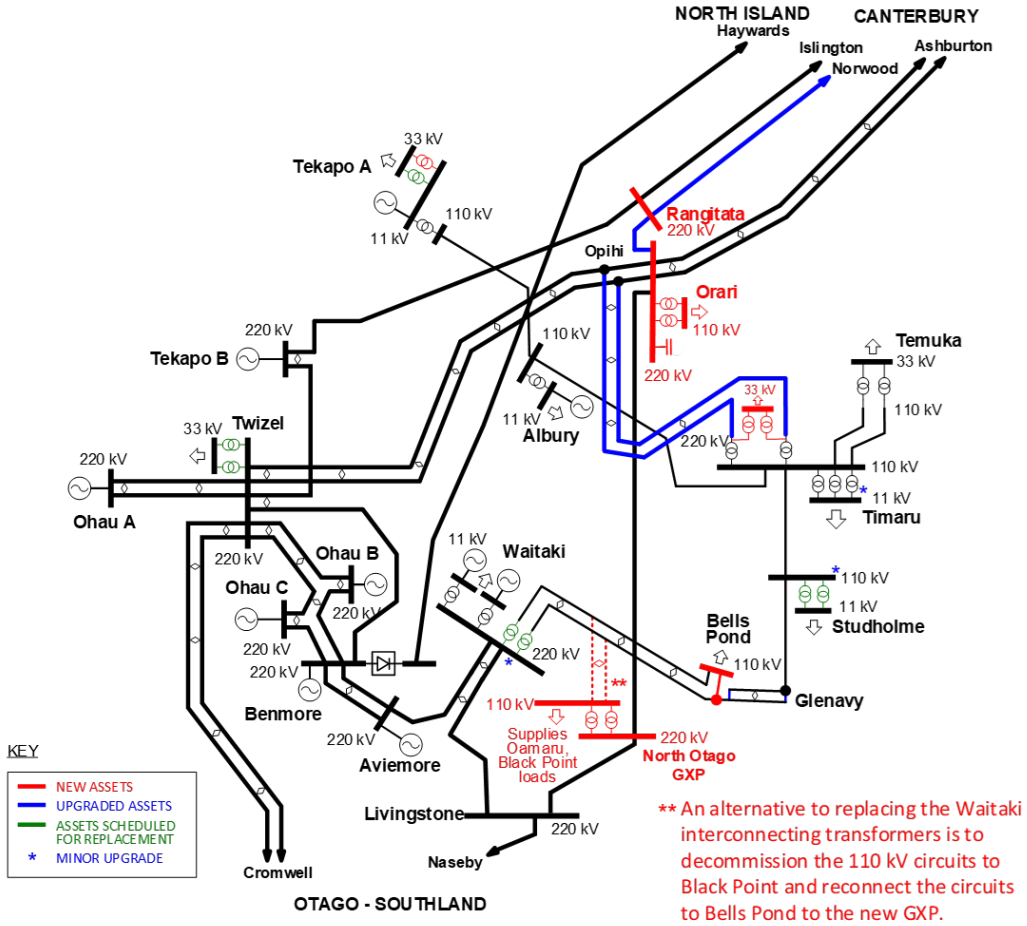
Much of the 110 kV transmission network is at capacity. This is mainly due to load associated with the dairy industry, including dairy processing and irrigation. Supplying existing and committed new load via the 110 kV network is currently achievable but will become increasingly difficult to manage if potential load in the area is developed.

Multiple special protection schemes are utilised on the 110 kV transmission system to protect assets from overloading post-contingency. These include both automatic grid reconfiguration and load shedding schemes.

18.1.3 Possible South Canterbury transmission configuration

Figure 18-3 shows the possible configuration of South Canterbury transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown. Changes to the grid backbone shown below are discussed in Chapter 6.

Figure 18-3: Possible South Canterbury transmission configuration in 2040



18.2 South Canterbury load and generation forecasts

18.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, to identify issues we use a prudent load forecast. This uses a 10 per cent probability of exceedance forecast of underlying demand

for the first seven years of the forecast period, and for following years an expected (or mean) rate of underlying growth[2].

The South Canterbury regional peak demand is forecast to grow by an average 3.4 per cent per annum over the next 15 years, from 237 MW in 2025 to 391 MW by 2040. This is higher than the national average growth rate of 2.6 per cent per annum.

Table 18-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

Table 18-1: Forecast prudent annual peak demand (MW) at South Canterbury grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Albury	1.00	6	6	6	6	6	6	6	6	7	7	7	7
Bells Pond	0.95	18	18	19	20	21	22	22	23	24	24	25	28
Black Point	0.92	17	17	18	18	18	18	18	18	18	18	18	18
North Otago	1.00	0	0	9	20	20	20	27	27	27	27	27	27
Oamaru[1]	0.97	48	50	61	42	44	45	41	42	43	43	43	44
Studholme	0.98	17	17	18	18	18	19	19	19	19	19	19	20
Tekapo A[2]	1.00	6	6	6	7	7	8	9	10	11	12	13	30
Temuka	0.97	63	65	68	70	75	76	113	114	115	116	116	116
Timaru	1.00	80	94	106	108	112	114	115	116	118	119	121	124
Twizel	1.00	7	7	8	8	8	9	9	10	10	10	10	10
Waitaki[3]	0.92	13	14	14	9	9	9	9	10	10	10	10	10

1. Advised by Network Waitaki: 8 MW, 5 MW, 5 MW load shift from Oamaru to North Otago GXP in 2027, 2028 and 2031, respectively. The North Otago grid exit point is not committed at the time of publication.
2. Includes several commercial developments around Tekapo (from customer information).
3. Advised by Network Waitaki: 5 MW load shift from Waitaki to North Otago grid exit point in 2028.

18.2.2 Other demand

The South Canterbury region has many industries with considerable potential for decarbonising their businesses by converting directly to electric heating or converting to biomass, which is often also paired with partially electrifying processes (such as heat pumps for low temperature heat). Our prudent load forecast includes an estimate for electrification (or other step load increases), but there is still considerable potential for additional load increases due to electrification. Our longer term prudent peak load forecast follows the assumptions included in our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*.

In the 2023 Mid-South Canterbury Regional Energy Transition Accelerator (RETA) report, EECA[3] provides detail and insight into options to decarbonise process heat emissions in South Canterbury as much as possible. A total of 33 sites – spanning the dairy, meat and food processing, manufacturing and commercial sectors are identified.

Despite the insights provided in the report, the timing and magnitude of any additional electricity demand at GXP level is still very uncertain. We know that any additional demand will occur at GXPs already expected to be constrained under the prudent load forecast. Also, upgrades to relieve these constraints will also create capacity to support additional electricity demand beyond what is included in our prudent forecast.

However, none of these upgrades are committed and all are customer-led. The upgrades that would assist the GXPs identified as having considerable potential for additional load growth are summarised below.

New Orari GXP

The new Orari GXP would address constraint issues at Temuka by transferring load from Temuka to Orari (section 18.5.8 and Chapter 6). It would also allow additional load to be supplied from Orari, and the load transfer from Temuka may allow additional load to be supplied

2 Refer to Chapter 3 for further information on demand forecasting.

3 Mid-South Canterbury Regional Energy Transition Accelerator https://www.eeca.govt.nz/co-funding/regional-decarbonisation/mid-south-canterbury-regional-energy-transition-accelerator/

from Temuka. The load transfer from Temuka would also assist in reducing 220 kV transmission constraints into Timaru (section 18.4.2 and section 18.5.9).

New 220/33 kV supply at Timaru

A new 220/33 kV supply at Timaru could provide for additional demand at Timaru, beyond our prudent forecast (see section 18.5.9).

New North Otago 220/110 kV GXP

The new North Otago GXP could allow load to be transferred from the 110 kV Waitaki–Black Point–Bells Pond–Oamaru transmission corridor (see section 18.4.1.6). This would provide capacity for additional load growth at Oamaru. It would also make the existing 110 kV transmission capacity available for additional load growth at Bells Pond and Studholme.

18.2.3 Existing and committed generation

The South Canterbury region's generation capacity is currently 1,741 MW. This excludes any embedded solar (PV) generation, which was approximately 8 MW in the South Canterbury region at the time of publication[4]. Generation in this region represents a major portion of total South Island generation and significantly exceeds local demand. Surplus generation is exported via the National Grid to other demand centres in the South Island, and via the HVDC link to the North Island. Up to 30 MW of generation is also injected directly into the 110 kV transmission network from Tekapo A.

Table 18-2 lists the generation forecast for each grid injection point in the South Canterbury region for the forecast period. This includes all known and committed generation stations including those embedded within local lines company networks (Network Waitaki and Alpine Energy)[5].

Further generation may be developed during the period. Refer to Table 18-7 for more information on potential new generation that is not sufficiently advanced to include in our forecasts.

Table 18-2: Existing and committed generation capacity at South Canterbury grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Albury (Opuha)	7	7	7	7	7	7	7	7	7	7	7	7
Aviemore	232	232	232	232	232	232	232	232	232	232	232	232
Benmore	540	540	540	540	540	540	540	540	540	540	540	540
Ohau A	264	264	264	264	264	264	264	264	264	264	264	264
Ohau B	212	212	212	212	212	212	212	212	212	212	212	212
Ohau C	212	212	212	212	212	212	212	212	212	212	212	212
Tekapo A	30	30	30	30	30	30	30	30	30	30	30	30
Tekapo B	154	154	154	154	154	154	154	154	154	154	154	154
Temuka (Clandeboye Solar Farm)	0	28	28	28	28	28	28	28	28	28	28	28
Waitaki	90	90	90	90	90	90	90	90	90	90	90	90

18.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the South Canterbury region.

[4] See embedded solar generation reported on the Electricity Market Information (EMI) website: Installed distributed solar generation trends

[5] Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

18.3 Grid enhancement approach and inputs

18.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the South Canterbury region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancement to address identified issues we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 18.4 and 18.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

18.3.2 South Canterbury significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 18-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the South Canterbury region for the next 15 years that may significantly impact related system issues or connected parties.

Table 18-3: Proposed significant upcoming replacement and refurbishment work for the South Canterbury region

Description	Tentative year	E&D issue
Bells Pond special protection scheme replacement	2026-2028	18.4.1
Black Point special protection scheme replacement	2026-2028	18.4.1
Studholme supply transformers replacement Studholme special protection scheme replacement	2025-2027 2026-2028	18.5.6 18.4.1
Tekapo A–T1 supply transformer replacement	2028-2030	18.5.7
Timaru special protection scheme replacement	2032-2034	18.5.9
Twizel supply transformers replacement	2030-2032	None
Waitaki interconnecting transformer condition replacement Waitaki special protection scheme replacement	2031-2033 2026-2028	18.4.1.6 18.4.1

18.3.3 South Canterbury asset feedback

The Asset Feedback Register includes the following E&D-related entries specific to the South Canterbury region:

- When Waitaki–T23 is out of service, Bells Pond loses supply. However, Alpine Energy has the capability to supply Bells Pond load from Studholme. See section 18.5.3.
- When Waitaki–T24 is out of service, Black Point loses supply. No grid exit point ties exist for Network Waitaki's Black Point load. See section 18.5.4.
- Due to the voltage security constraints in the upper South Island, limited work can be done on the Ashburton–Timaru–Twizel 220 kV circuits other than during the weekend and in the shoulder season (March-May). Also, outages longer than a weekend are difficult to facilitate. See Chapter 17, section 17.7.2 for further information.

- Currently at Studholme there are no dedicated 110 kV transformer circuit breakers. Therefore, a fault on either supply transformer zone results in a complete loss of supply at Studholme. When the 110/33 kV transformers are replaced (see Table 18-3) additional equipment will be installed at Studholme so a transformer fault will remove only one transformer from service. See section 18.5.6 for more information.

18.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider South Canterbury region can reasonably be expected to meet an n-1 level of security over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 18-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 18-4: Changes within the wider region since the 2023 TPR

Issues	Change
No changes to report	

The overview of transmission capability within the wider South Canterbury region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
18.4.1	Oamaru–Waitaki transmission capacity, security and low voltage
18.4.2	Timaru area capacity

18.4.1 Oamaru–Waitaki transmission capacity, security and low voltage

Background

The Oamaru, Black Point, Bells Pond, and Studholme grid exit points are collectively referred to as the lower Waitaki Valley area. These loads are supplied mainly via two 110 kV circuits from Waitaki:

- Oamaru–Black Point–Waitaki–1 circuit (supplies Black Point via a tee connection)
- Oamaru–Studholme–Bells Pond–Waitaki–2 circuit (supplies Bells Pond via a tee connection).

There is also a connection into the area via the Studholme–Timaru circuit.

Issues with grid asset capability and management at Bells Pond (section 18.5.3), Black Point (section 18.5.4), Oamaru (section 18.5.5) and Studholme (section 18.5.6) also consider the area transmission issues.

The Oamaru, Black Point, Bells Pond, and Studholme grid exit points all peak in summer, when circuit ratings are lower. We have implemented several upgrades and operational measures to allow increased load to be supplied in this area, including:

- a wider voltage agreement with Network Waitaki, which extends the lower voltage range at the Oamaru 110 kV bus to 0.875 pu
- the Oamaru–Waitaki circuit overload protection scheme, which manages the n-1 constraints on both the 110 kV Black Point–Waitaki and Bells Pond–Waitaki circuits
- variable line ratings on the 110 kV Glenavy–Oamaru and Black Point Tee–Oamaru circuits, which maximise thermal capacity by changing circuit ratings every two hours based on historical temperature records for the area
- the Oamaru circuit overload protection scheme, which manages the n-1 constraints on both the 110 kV Black Point–Oamaru and Glenavy–Oamaru circuits.

However, the lower Waitaki Valley area still has constraints and must be carefully managed to accommodate load growth, as described further in this section.

Summary

There are several inter-related issues within the lower Waitaki area. In summary:

- The Studholme 110 kV will be normally split, putting Studholme on n security, although supply can be restored after switching. There is an auto-changeover scheme that improves security of supply at Studholme, see section 18.4.1.1 for more information.
- In the short to medium term the Oamaru–Waitaki circuit overload protection scheme will be used to manage circuit loading, although increasing amounts of load will need to be tripped.
- In the short term, load restrictions may be required to prevent voltage collapse. In the medium term a new 220 kV grid exit point (see section 18.5.5 for details) is proposed which will reduce load at Oamaru sufficient to prevent voltage collapse.
- There are two possible solutions to address all issues in the medium- to long-term. One is for Network Waitaki to exit Black Point and Oamaru, transferring load to the proposed new 220 kV grid exit point (see section 18.5.5 for details). The other is to upgrade the 110 kV circuits between Waitaki and Bells Pond.

18.4.1.1 Supply to Studholme

Issue

Two 110 kV circuits supply Studholme but are split at Studholme to prevent overloading the 110 kV circuits from Waitaki, putting Studholme on n security:

- In summer, Studholme is supplied from Timaru (to reduce loading on the 110 kV circuits from Waitaki).
- In winter, Studholme is supplied from Waitaki (to reduce system losses).

In summer, if the Studholme–Timaru circuit has a permanent fault, it is possible to transfer Studholme to be supplied from Waitaki, but this requires an operator to be on-site for the switching. It also worsens the 110 kV transmission constraints discussed later in this section.

In winter, if the Oamaru–Studholme–Bells Pond–Waitaki–2 circuit trips, the Studholme auto-changeover scheme[6] switches to the Studholme–Timaru circuit so Studholme is supplied from Timaru.

What next?

In the medium term, replacement of the Studholme supply transformers will provide an opportunity to also install an auto-changeover scheme for the tripping of a Studholme–Timaru circuit; this will automatically switch Studholme to be supplied from Waitaki. See section 18.5.6 and section 18.4.1.6 for more information.

18.4.1.2 Waitaki to Bells Pond and Black Point transmission constraints

Issue

Two 110 kV circuits from Waitaki supply the load at Bells Pond, Black Point, Oamaru, and Studholme (if Studholme is not supplied from Timaru). Thermal overloading issues that exist on the two 110 kV circuits from Waitaki to Bells Pond and Black Point during summer periods are:

- the Bells Pond–Waitaki circuit may overload following an outage of the Oamaru–Black Point–Waitaki–1 circuit from around 2025.
- the Black Point–Waitaki circuit section may overload following an outage of the Oamaru–Studholme–Bells Pond–Waitaki–2 circuit from around 2025.

[6] The Studholme auto-changeover scheme is an automatic control scheme enabled when the system is split on the Studholme–Timaru circuit. Following an outage of the Oamaru–Studholme–Bells Pond–Waitaki–2 circuit it reconfigures the grid to have Studholme connected to Timaru. During the changeover, there will be approximately 25 seconds of loss of supply to Studholme.

What next?

In the short term, the Oamaru–Waitaki circuit overload protection scheme[7] will manage overloading on the two 110 kV circuits from Waitaki. This allows the circuits to be loaded above their n-1 limit.

If Studholme needs to be supplied from these circuits in summer (due to an outage of the Studholme–Timaru circuit), the circuit overload protection scheme will trip more load than if Studholme were not connected, in the worst case causing a total loss of supply to the lower Waitaki Valley.

The two circuits from Waitaki to Bells Pond and Black Point cannot overload from Oamaru load by itself. High Oamaru load is likely to overload the Black Point Tee–Oamaru and Glenavy–Oamaru circuits first, and this is managed by the Oamaru special protection scheme which in turn reduces loading on the Bells Pond–Waitaki and Black Point Tee–Waitaki circuits.

In the medium term we expect all options to extract more from the existing grid assets will be exhausted. For further information, refer to section 18.4.1.6 for a discussion of longer-term options.

18.4.1.3 Oamaru to Bells Pond and Black Point transmission constraints

Issue

The Oamaru load may exceed the n-1 thermal capacity of the two 110 kV Glenavy–Oamaru circuit sections. The load limit is approximately 43-51 MW depending on the time of day[8], the Oamaru load power factor, other loads in the region and (to a lesser extent) the Waitaki voltage set point.

There is a special protection scheme at Oamaru, which allows the load to exceed the n-1 capacity of the circuits. If one circuit trips during a high load period, the scheme will reduce the Oamaru load until it is within the rating of the remaining circuit.

What next?

For the Oamaru constraints, we are working with Network Waitaki to develop a new 220/110 kV grid exit point (see section 18.5.5 for details).

18.4.1.4 Waitaki 220/110 kV transformer outages

Issue

The loss of the Waitaki 220/110 kV transformer, T24, results in the 110 kV Oamaru–Black Point–Waitaki circuit being supplied via reverse power flow through the Oamaru supply transformer, T1 (as there is no 110 kV bus at Waitaki or Oamaru). Reverse power flow protection will normally disconnect Oamaru–T1 and result in a loss of supply at Black Point. If Oamaru–T1 does not trip, it may cause voltage collapse at Black Point and Oamaru, and low voltages at Bells Pond (and Studholme, if supplied from Waitaki), unless the lower Waitaki Valley load is low.

Similarly, the loss of the Waitaki 220/110 kV transformer, T23, results in the Oamaru–Studholme–Bells Pond–Waitaki circuit being supplied via reverse power through Oamaru–T2. This may result in a loss of supply at Bells Pond and Studholme (in winter) or voltage collapse at Bells Pond and Oamaru, and low voltages at Black Point.

Besides disconnecting a 220/110 kV transformer, a Waitaki 220 kV bus section outage will also cause a voltage drop on the other Waitaki 220 kV bus section, thereby exacerbating the 110 kV issues.

What next?

The voltage collapse caused by a Waitaki 220/110 kV transformer outage can be managed operationally in the short term. Longer term options to address this issue are discussed in section 18.4.1.5.

[7] This scheme provides overload protection for the Bells Pond–Waitaki and Black Point–Waitaki circuits. When the circuits overload the scheme first initiates load shedding requests to our customers and, if the overload is not removed, trips appropriate circuit breakers to remove the overload.

[8] Due to the variable line ratings that have been applied, the Glenavy–Oamaru circuit ratings change every two hours.

18.4.1.5 Voltage quality and stability

Issue

An unplanned outage of either a 110 kV circuit from Waitaki, an Oamaru supply transformer, or a Waitaki interconnecting transformer can cause:

- voltage at the Oamaru 110 kV bus to fall below 0.875 pu[9,10]
- a large voltage step at Oamaru during peak load periods[11].

In the short term, voltage stability issues will also emerge. The limits are highly dependent on the location of load growth (Bells Pond, Black Point, Oamaru, and Studholme if supplied from Waitaki) and the load power factor.

The voltage issues occur after the thermal limit on the two 110 kV circuits from Waitaki. We expect the voltage stability issue to arise from 2026 until 2028 (with the timing depending on the lower Waitaki load and power factor). The forecast load goes below the voltage stability limit from 2028 – this is heavily influenced by the Oamaru load forecast. For more information, see section 18.5.5.

What next?

In the short term the voltage issues can be managed operationally. In the medium term the proposed new 220/110 kV grid exit point will alleviate the voltage issues (see section 18.5.5 for details). Longer term options to address the voltage issues are discussed in section 18.4.1.6.

18.4.1.6 Longer term options

A credible medium- to long-term option to supply increased load in the lower Waitaki Valley area is for Network Waitaki to exit the Oamaru and Black Point grid exit points, transfer the load to the proposed new grid exit point (see section 18.5.5) and reconfigure the 110 kV circuits between Waitaki, Bells Pond and Studholme. This addresses the thermal issues with the 110 kV circuits. Due to the reduced loading on the 110 kV circuits, it also addresses the voltage issues and enables a second tee-circuit to Bells Pond, should the customer require n-1 security.

Exiting Black Point and Oamaru will require developments within Network Waitaki's distribution network. However, based on its current demand forecast, Network Waitaki has indicated[12] that it is unlikely to invest in those developments.

The Waitaki 220/110 kV interconnecting transformers are due for risk-based condition replacement in approximately eight years. As a part of that investigation, we will work with Alpine Energy and Network Waitaki to investigate alternative long-term options to increase supply capacity in the lower Waitaki Valley. These may include:

- upgrading the 110 kV circuits between Waitaki and Bells Pond
- rationalising the Lower Waitaki Valley 110 kV network by:
- removing the Waitaki interconnecting transformers
- removing the 110 kV circuits between Black Point and Waitaki
- building a 110 kV double-circuit line from the new Network Waitaki 220/110 kV grid exit point to Black Point
- upgrading the 110 kV circuits between Black Point and Bells Pond.

As the new grid exit point will impact the upper South Island, the selection of a preferred long-term option will consider issues identified there (see Chapter 6 for details).

9 There is a wider voltage agreement for the Oamaru 110 kV bus: -12.5%/+10% (96.3 kV / 121 kV).

10 This depends on the Oamaru power factor and assumes the Black Point or Bells Pond loads are shed due to high circuit loading.

11 There are no steady state voltage issues at Oamaru 33 kV, due to the range of the supply transformer on-load tap changers.

12 Network Waitaki Asset Management Plan 2025.

Base E&D capex investments

Project name:	Studholme auto-changeover enhancement
Project description:	Upgrade 110 kV auto-changeover scheme
Project's state of completion:	Delivery
Grid need date:	2027
Indicative cost ($ million):	0.6
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Customer investments

Project name:	Oamaru and Black Point exit
Project description:	Connect Glenavy–Waitaki–1 into Bells Pond Bond Glenavy–Waitaki circuits between Bells Pond and Glenavy
Project's state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost ($ million):	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

18.4.2 Timaru area capacity

Issue

Two 220/110 kV interconnecting transformers supply the loads at Timaru, Temuka, Albury, Tekapo A, and Studholme[13] (collectively referred to as the Timaru area) providing total nominal installed capacity of 490 MVA. The Timaru–T8 interconnecting transformer was replaced in 2024 with a lower impedance transformer, which raised the load limits in the Timaru area. The transformers' capacity is limited by the rating of the 220 kV Opihi–Timaru circuit sections.

However, other limits apply before the thermal capacity of the Timaru 220/110 kV interconnecting transformers:

- low voltage limits on 110 kV buses of approximately 199 MW (without Tekapo A generation)
- a thermal limit set by the 220 kV Opihi–Timaru circuits of approximately 194 MW (without Tekapo A generation)
- static voltage stability limits of approximately 204 MW[14] (without Tekapo A generation).

If investment in new 220/33 kV transformers proceeds (refer to section 18.5.9), transferring some Timaru load from the 110/11 kV supply transformers may defer the need for other investments at Timaru. However, depending on the proportion of Timaru load transferred to the 33 kV bus, the Timaru area load may be limited by the thermal rating of the Opihi–Timaru circuits.

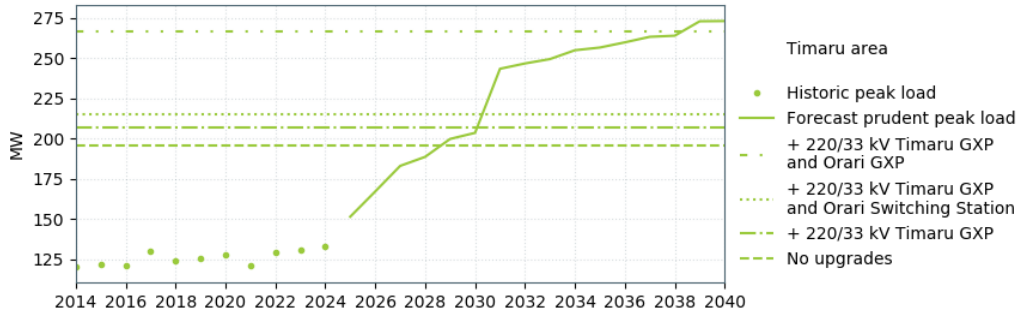
In addition, a new grid exit point at Orari (see section 18.5.8 and 18.7.2) may defer the need for investments at Timaru.

Figure 18-4 shows the impact of these possible upgrades on the limits on Timaru area load.

[13] Loads at Studholme are supplied from Timaru in summer, with Studholme–Timaru closed and the Glenavy–Studholme circuit open at Studholme.

[14] The Timaru area limits depend on a range of factors including the upper South Island load, and Waitaki valley voltage plane.

Figure 18-4: Timaru area capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

The load limits[15] in Figure 18-4 are caused by:

- low regional voltage limits at 110 kV and Timaru 220 kV with no other developments in the area
- the thermal limit on the 220 kV Opihi–Timaru circuits, closely followed by low voltages for the case with a Timaru 220/33 kV grid exit point
- the thermal limit on the 220 kV Opihi–Timaru circuits for all cases that include an Orari switching station.

What next?

With the possible upgrades in the wider region, viable combinations of investments are to install a 220/33 kV grid exit point at Timaru and:

- undertake a thermal upgrade to increase the capacity of the Opihi–Timaru circuits, plus a wider voltage agreement
- undertake a thermal upgrade to increase the capacity of the Opihi–Timaru circuits, plus a switching station at Orari, or
- construct a 220/110 kV grid exit point at Orari and transfer a significant portion of Temuka load to it.

We will continue to collaborate with Alpine Energy to coordinate the upgrades with a least regrets approach.

Base E&D capex investments

Project name:	Timaru deviation capacity
Project description:	Thermally upgrade the Opihi–Timaru 220 kV circuits
Project state of completion:	Possible
Grid need date:	TBC
Indicative Cost ($ million):	3.6
Reliability or Economic investment?	Reliability (Grid Reliability Report)

18.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 level of security at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 18-5 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

[15] The limits calculated with the new grid exit points are indicative and depend on how much load is moved to the new grid exit points. These limits will be refined if the new grid exit point projects become committed or are developed further with the customer.

Table 18-5: Changes at each grid exit point since the 2023 TPR

Issues	Change
Black Point capacity	Removed. Reduced load forecast.

The overview of transmission capability for each grid exit point within the South Canterbury region is listed below. Where an issue is identified we list options to address it.

Section number	Description
18.5.1	Albury supply capacity and security
18.5.2	Albury and Tekapo A transmission security
18.5.3	Bells Pond supply capacity and security
18.5.4	Black Point supply capacity and security
18.5.5	Oamaru supply capacity
18.5.6	Studholme supply capacity, supply security, and transmission security
18.5.7	Tekapo A supply capacity and security
18.5.8	Temuka supply capacity and security
18.5.9	Timaru supply capacity
18.5.10	Twizel supply capacity
18.5.11	Waitaki supply capacity and security

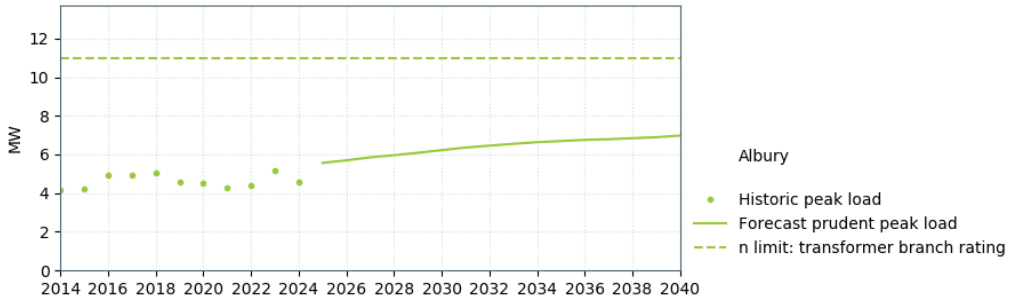
18.5.1 Albury supply capacity and security

Issue

A single 110/11 kV, 20 MVA transformer supplies the load at Albury resulting in n security. The transformer's capacity is limited by 11 kV metering limits.

Peak load at Albury is within the capacity of the supply transformer for the forecast period (see Figure 18-5).

Figure 18-5: Albury supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Albury has embedded generation at Opuha, which results in Albury injecting power into the National Grid during periods of low demand and/or high generation.

What next?

The n security issue can be managed operationally for the forecast period. The embedded Opuha generation can supply some of the local load during planned outages at Albury. Alpine Energy can also transfer some load to adjacent grid exit points. Our mobile substation can be used at Albury to cover a planned transformer outage. Therefore, we have no planned investments to increase the security of supply to Albury.

18.5.2 Albury and Tekapo A transmission security

Issue

A single 110 kV Tekapo A–Albury–Timaru circuit connects Tekapo A, Albury, and Opuha to the National Grid. If the circuit trips, Albury and Tekapo A will lose supply, and the Tekapo A and Opuha (embedded at Albury) generation will disconnect from the grid.

What next?

Albury and Tekapo A loads may be restored by operating Opuha and Tekapo A generation islanded (not connected to the grid). Alpine Energy considers the issue to be manageable operationally for the forecast period. Therefore, we have not planned any investment to increase transmission security to these sites.

18.5.3 Bells Pond supply capacity and security

Issue

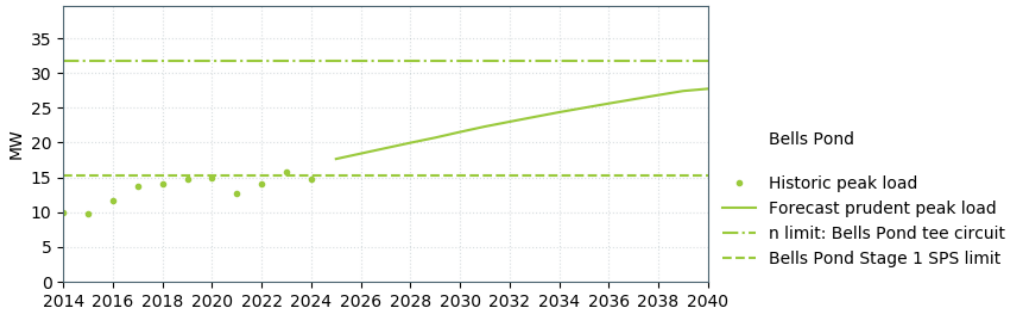
Bells Pond is connected via a single 110 kV tee connection to the Oamaru–Studholme–Bells Pond–Waitaki–2 circuit providing 34/34 MVA (summer/winter) capacity. The circuit's capacity is limited by a metering limit.

Alpine Energy owns the supply transformers at Bells Pond. An outage of the circuit or its associated Waitaki 220/110 kV interconnecting transformer (T23) results in a loss of supply to Bells Pond. Alpine Energy can restore some load by transferring it to Studholme.

Peak load at Bells Pond is within the capacity of the circuit for the forecast period (see Figure 18-6).

In addition, the Bells Pond–Waitaki circuit overload protection scheme presently includes a step which removes 4 MW of load at Bells Pond using ripple control (Stage 1). After that load is removed and if the Bells Pond–Waitaki circuit is still overloaded, the 110 kV incomers are opened at Bells Pond resulting in a complete loss of supply (Stage 2). As shown in Figure 18-6 the existing 4 MW load reduction may be insufficient to remove the overload if Bells Pond and Oamaru peak loads coincide from around 2025 and as a result the special protection scheme may trip the entire load (Stage 2).

Figure 18-6: Bells Pond supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Presently, Alpine Energy can supply some Bells Pond load from the Studholme grid exit point via its distribution network. The Bells Pond grid exit point can also be supplied from Timaru (after some switching) if Waitaki–T23 is out of service and the Oamaru–Studholme–Bells Pond–Waitaki circuit is in service.

What next?

We are discussing options with Alpine Energy to resolve capacity issues on the Bells Pond–Waitaki and parallel Black Point–Waitaki circuits (refer to section 18.4.1). In the medium term the existing Bells Pond–Waitaki circuit overload protection scheme is sufficient to prevent thermal limits being exceeded, although all load at Bells Pond may be placed at risk from 2025.

18.5.4 Black Point supply capacity and security

Issue

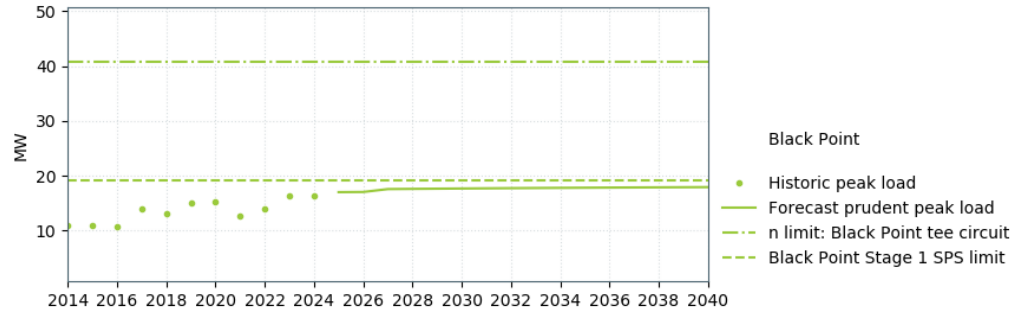
Black Point is connected via a single 110 kV tee connection to the Oamaru–Black Point–Waitaki–1 circuit providing 44/44 MVA (summer/winter) capacity. The capacity of the circuit section from Black Point to the tee point is limited by protection and metering limits. An outage of the circuit or its associated Waitaki 220/110 kV interconnecting transformer (T24) results in a loss of supply to Black Point.

Network Waitaki cannot supply the Black Point load from an alternative grid exit point. Therefore, there are constraints on maintenance outages during the irrigation season, which extends from September to May. The outage constraints are difficult to manage as some maintenance cannot be done during winter, leaving a narrow window for outages.

Peak load at Black Point is within the capacity of the circuit for the forecast period (see Figure 18-7).

In addition, the Black Point–Waitaki circuit overload protection scheme presently includes a step which removes 8 MW of load at Black Point (Stage 1). After that load has been removed, if the Black Point–Waitaki circuit is still overloaded, all load at Black Point is tripped (Stage 2). The existing 8 MW is sufficient to remove the overload if Black Point and Oamaru peak loads coincide.

Figure 18-7: Black Point supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

In the short to medium term the existing Black Point–Waitaki circuit overload protection scheme is sufficient to prevent thermal limits from being exceeded. For the long-term approach refer to section 18.4.1.

18.5.5 Oamaru supply capacity

Issue

The Oamaru load is supplied by:

- two 110/33 kV transformers, providing total nominal installed capacity of 120 MVA. The transformers' capacity is limited by the protection limit followed by the 33 kV circuit breaker rating.
- two 110 kV circuits, one each from:
  - Waitaki via Bells Pond and Glenavy rated at 53/57 MVA[16]
  - Waitaki via Black Point rated at 53/56 MVA[17]

Oamaru is configured with no 110 kV bus (each transformer is connected to only one 110 kV circuit). A circuit outage also disconnects the corresponding Oamaru transformer.

The peak load at Oamaru typically occurs for about two weeks at any time during the summer period (December to March). The peak load is driven by irrigation, which in turn is driven by the moisture deficit in soil, which varies within the summer season. The forecast includes load shifts between 2027 and 2031 from Oamaru to a potential new 220/110 kV North Otago grid exit point, which is uncommitted (see Table 18-1 and section 18.7.1 for more information).

The peak load is forecast to (see Figure 18-8):

- exceed the n-1 minimum variable line capacity of the Black Point–Oamaru and Glenavy–Oamaru circuits from summer 2025
- exceed the n-1 voltage stability limit from summer 2026 until summer 2028
- exceed the n-1 capacity of the Bells Pond–Waitaki and Black Point–Waitaki circuits from summer 2025.

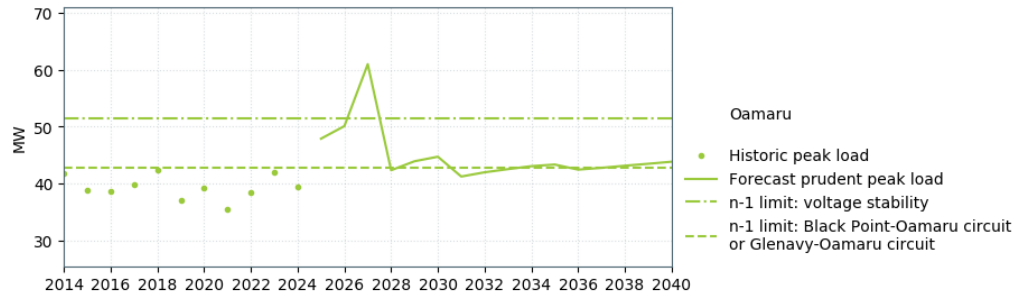
[16,17] The capacity of the circuits is set by variable line ratings. These limits represent the minimum rating for a season.

There is a special protection scheme at Oamaru, which allows the load to exceed the n-1 capacity of the Black Point–Oamaru and Glenavy–Oamaru circuits. If a circuit trips during high load periods, the scheme will reduce the Oamaru load until it is within the rating of the remaining circuit.

Similarly, separate special protection schemes manage n-1 loading on the Black Point–Waitaki and Bells Pond–Waitaki circuits, see sections 18.5.3 and 18.5.4.

The capacity of the supply transformers is reduced by low voltages at Oamaru when there is a 110 kV circuit outage. However, voltage stability (see Figure 18-8) is the limiting factor for Oamaru load.

Figure 18-8: Oamaru supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

In partnership with Network Waitaki, we are investigating a new 220/110 kV grid exit point connected to the Norwood–Livingstone circuit in the vicinity of the existing Black Point grid exit point. In the medium term this grid exit point would be used to reduce load at Oamaru by transferring rural zone substations close to Black Point to the new grid exit point. Network Waitaki have indicated its intention to maintain connection at Oamaru with similar summer peak loads (as shown in Figure 18-8).

Maintaining load at Oamaru also contributes to future overloads on the Bells Pond–Waitaki and Black Point–Waitaki circuits. For the long-term approach to address these issues, refer to section 18.7.1.

Customer investments

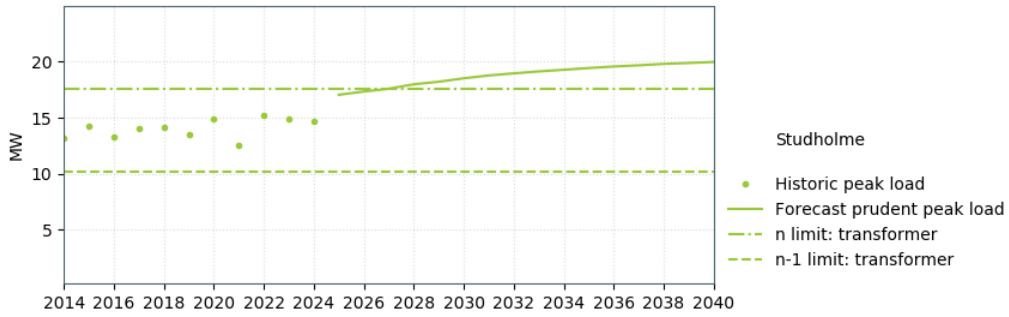
Project name:	Increase Oamaru supply capacity
Project description:	New North Otago 220/110 kV grid exit point
Project's state of completion:	Proposed
Grid need date:	Customer initiated
Indicative cost ($ million):	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

18.5.6 Studholme supply capacity, supply security, and transmission security

Issue

Two 110/11 kV transformers supply Studholme's load, providing a total nominal installed capacity of 20 MVA. The peak load at Studholme already exceeds the n-1 capacity of the supply transformers (see Figure 18-9). From summer 2027 the peak load at Studholme may exceed the continuous capacity of both transformers.

Figure 18-9: Studholme supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Currently the two 110/11 kV supply transformers at Studholme have no dedicated 110 kV circuit breakers. This means both supply transformers will trip for a transformer fault, causing a loss of supply. Supply can be restored after the faulted transformer is disconnected.

Studholme is normally supplied on the Studholme–Timaru circuit (summer) or the Oamaru–Studholme–Bells Pond–Waitaki circuit (winter). Currently this provides n security for transmission (circuit faults) in summer. In winter the Studholme Auto Changeover Scheme is enabled to increase security of supply, see section 18.4.1.1 for more detail.

What next?

The load cannot be allowed to exceed the continuous capacity of both transformers, so in the short term it may be necessary to use operational measures such as load shifting or load shedding to manage the transformer loading.

We have committed to replacing the transformers with two 30 MVA units by summer 2027. As part of this project, we will also install a 110 kV bus disconnecting circuit breaker to address the supply security issue. Following these upgrades Studholme will be within its n-1 limit for the forecast period. Alpine Energy has indicated it will manage the load at Studholme until the upgrades are completed.

Resolving n security for transmission first requires completion of possible future developments in the lower Waitaki Valley (see section 18.4.1.6).

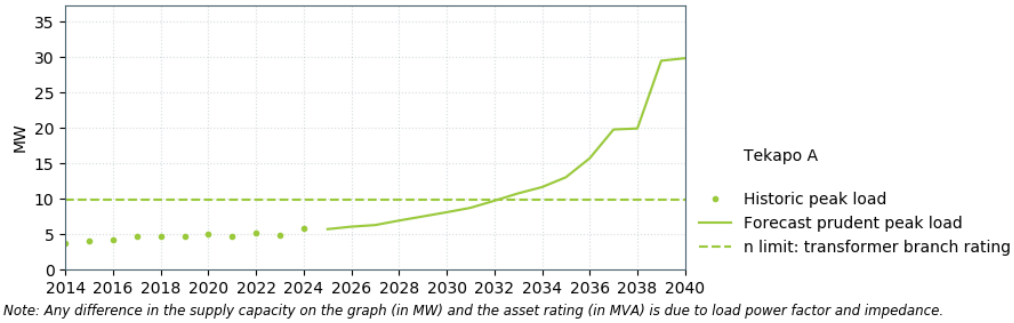
18.5.7 Tekapo A supply capacity and security

Issue

A single 110/11 kV, 35 MVA transformer (T6) in series with a single 33/11 kV, 10 MVA transformer (T1) supplies load at Tekapo, resulting in n security. The capacity of T1 is limited by protection and current transformer ratings.

Peak load at Tekapo A is forecast to exceed the continuous rating of T1 in 2032[18] (see Figure 18-10).

Figure 18-10: Tekapo A supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

[18] Assuming Tekapo A is not generating during peak load periods.

What next?

We have discussed the security and capacity issue at Tekapo A with Alpine Energy. It is considering options to increase the security by installing a second 33/11 kV supply transformer. The second transformer would also allow the existing transformer to have a post-contingency rating of 14.5 MVA (45% above its continuous rating). In the short term our mobile substation can be used at Tekapo A during planned outages.

The Tekapo A 33/11 kV supply transformer is also due for condition-based replacement in the next 5-10 years, allowing a higher-rated transformer to be installed.

Customer investments

Project name:	Tekapo A supply security and capacity
Project description:	Install second 33/11 kV transformer at Tekapo A
Project state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost ($ million):	2.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

18.5.8 Temuka supply capacity and security

Issue

The Temuka load is supplied by:

- two 110/33 kV transformers, providing a total nominal installed capacity of 108 MVA[19].
- two 110 kV circuits from Timaru, rated at 71/79 MVA and 73/80 MVA (summer/winter). The n-1 limit of the transformers is lower than that of the circuits.

There is no 110 kV bus at Temuka, so a Temuka–Timaru circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[20], which is done by restricting the pre-contingency peak load to the n-1 capacity of the transformers. A special protection scheme installed at Temuka allows the load to exceed the n-1 capacity of the transformers pre-contingency. If one circuit-transformer branch trips during a high load period, the scheme will reduce the Temuka load until it is within the rating of the remaining transformer.

The special protection scheme will be effective until Temuka load increases to 85 MW, at which point there is a risk that an outage of one transformer will cause the remaining transformer to trip on overload before the scheme acts.

The peak load at Temuka:

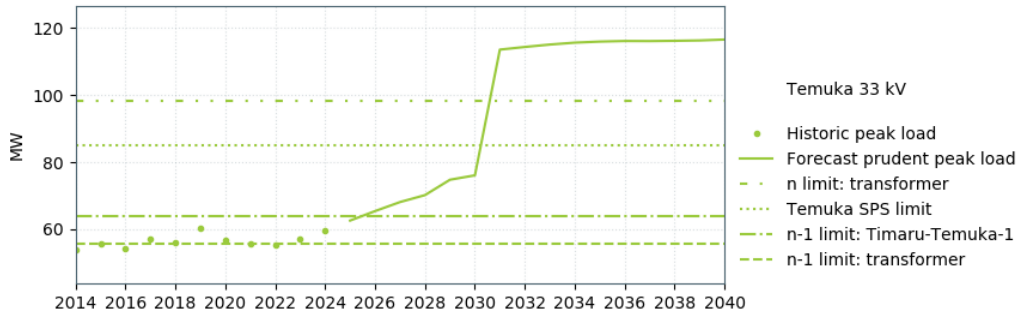
- already exceeds the n-1 capacity of the supply transformers in summer (see Figure 18-11)
- is forecast to exceed the continuous rating of the supply transformers from summer 2031 (see Figure 18-11)
- is forecast to exceed the n-1 capacity of the circuits from summer 2025 (see Figure 18-11)
- is forecast to exceed the special protection scheme limit from summer 2031 (see Figure 18-11)

The load at Temuka also contributes to the Timaru and upper South Island voltage stability limit (see section 18.4.2).

[19] The transformers' post contingency capacity is limited to 63 MVA. The 63 MVA summer rating is a 30-minute emergency rating. For an outage of one transformer, the loading on the other transformer must be reduced to 61/63 MVA (summer/winter) within 30 minutes.

[20] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

Figure 18-11: Temuka supply capacity: supply transformer



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

In partnership with Alpine Energy, we are considering options to increase capacity to connect additional load in the Temuka area. We are investigating the option of constructing a new 220/110 kV grid exit point at Orari switching station (see Chapter 6 for details on this substation). This new grid exit point will also require developments within Alpine Energy's distribution network.

Alternatively, we may increase the supply transformer capacity at Temuka by paralleling the existing transformers and installing one new 120 MVA supply transformer.

The Temuka 33 kV switchboard is being replaced in 2025 due to risk-based condition assessment.

Customer investments

Project name:	Temuka supply capacity constraints
Project description:	New Orari 220/110 kV grid exit point
Project state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost ($ million):	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

18.5.9 Timaru supply capacity

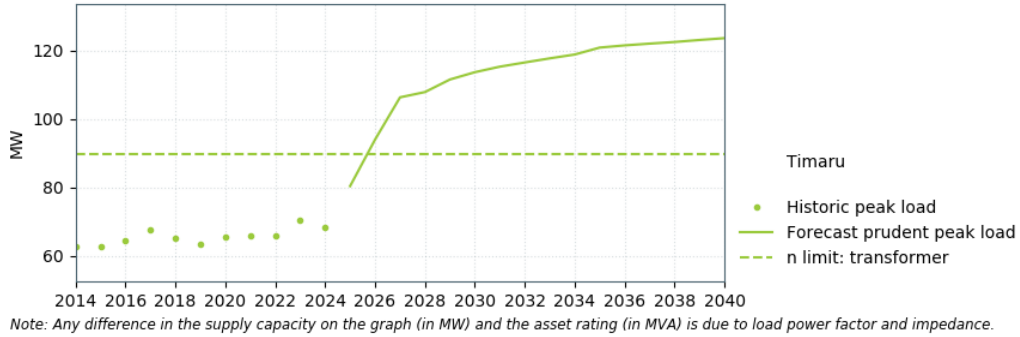
Issue

Three 110/11 kV transformers supply Timaru's load, providing total nominal installed capacity of 141 MVA. The transformers' capacity is limited by 11 kV circuit breaker and cable ratings.

The three Timaru supply transformers are operated with one unit on hot-standby, to ensure that 11 kV fault levels remain within the rating of Alpine Energy's distribution equipment. If one in-service transformer trips, the third transformer automatically switches into service, resulting in no loss of supply at Timaru. Because only two transformers can be in service at any time, the load cannot go above the n limit.

The peak load at Timaru is forecast to exceed the continuous capacity of two supply transformers in service from 2026 (see Figure 18-12).

Figure 18-12: Timaru supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We are investigating an upgrade at the request of Alpine Energy. The upgrade includes:

- installing two new 220/33 kV, 120 MVA supply transformers
- constructing a new 33 kV indoor switchboard.

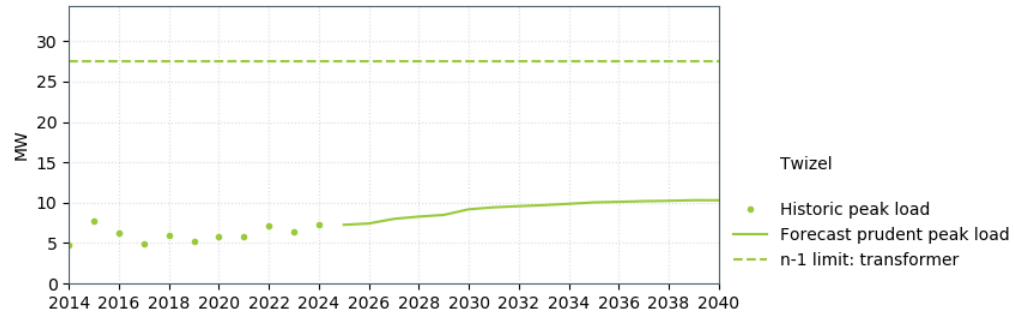
Customer investments

Project name:	Timaru grid exit point upgrade
Project description:	Install 2x 220/33 kV, 120 MVA transformers and 33 kV indoor switchroom
Project state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost ($ million):	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

18.5.10 Twizel supply capacity

Two 220/33 kV transformers supply Twizel's load, providing total nominal installed capacity of 40 MVA. Peak load at Twizel is within the n-1 capacity of the supply transformers for the forecast period (see Figure 18-13).

Figure 18-13: Twizel supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

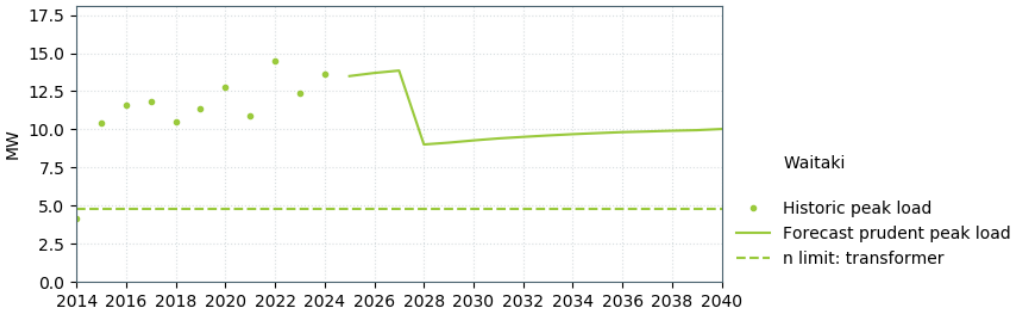
18.5.11 Waitaki supply capacity and security

Issue

Two 220/11 kV transformers connect the generators at Waitaki power station and supply the Waitaki load. The two transformers provide total nominal installed capacity of 140 MVA. The Waitaki 11 kV bus is split to manage fault current, and the transformers' capacity is limited by the 11 kV bus rating.

Network Waitaki is normally supplied through an 11/33 kV, 20 MVA step-up transformer owned by Network Waitaki. There is also a lower capacity alternate supply through an 11/33 kV, 5.5 MVA step-up transformer (T28) owned by Transpower that is too small to supply the peak load and normally has no load connected to it. These transformers are connected to different 11 kV bus sections. Figure 18-14 shows the Waitaki peak load forecast and T28 supply limit. Note, in the forecast approximately 4.6 MW of load is moved to a new 220/110 kV grid exit point in 2028 (see section 18.7.1).

Figure 18-14: Waitaki load forecast and n limit provided by Transpower step-up transformer



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

In partnership with Network Waitaki, we are investigating options to improve the Waitaki 11 kV capacity and supply security. Options include:

- removing our 5.5 MVA transformer and modifying the associated 11 kV cubicle and protection so that Network Waitaki can install higher capacity 11 kV cables and a 20 MVA transformer.
- relinquish the supply from Waitaki and transfer the load to a new 220/110 kV grid exit point (see section 18.7.1).

Customer investments

Project name:	Waitaki supply capacity and security
Project description:	Change protection to enable Network Waitaki to install a second 20 MVA transformer
Project state of completion:	Possible
Grid need date:	Customer initiated
Indicative cost ($ million):	0.1
Reliability or Economic investment?	Reliability (Grid Reliability Report)

18.6 South Canterbury bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 18-6 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

Table 18-6: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Albury 110 kV	Albury Tekapo A	Tekapo A Opuha	-	Note 1
Aviemore 220 kV		Aviemore	-	Note 2
Oamaru 110 kV-1	Black Point	-	-	Note 3
Oamaru 110 kV-2	Bells Pond Studholme	- -	- -	Note 4 Note 4, 5
Ohau A 220 kV		Ohau A	-	Note 2
Studholme 110 kV	Studholme	-	-	Note 2, 7
Tekapo B 220 kV		Tekapo B	-	Note 2
Timaru 110 kV A			Regional voltage and/or thermal issues	18.6.1
Timaru 110 kV B	Studholme	-	-	Note 6

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Timaru 110 kV C	Albury Tekapo A	Tekapo A	Regional voltage and/or thermal issues	18.6.1
Waitaki 220 kV A	Bells Pond Studholme	-	Regional 110 kV voltage and/or thermal issues	18.4.1, Note 5
Waitaki 220 kV B	Black Point Waitaki	-	Regional 110 kV voltage and/or thermal issues	18.4.1

1. An Albury 110 kV bus outage will disconnect the Albury load and embedded generator (Opuha) and the single circuit to Tekapo A, also disconnecting the generation and load at Tekapo A.
2. There is no bus section circuit breaker at Aviemore, Ohau A, Studholme, or Tekapo B. Therefore, a bus fault trips the whole bus, causing a total loss of supply or loss of connection.
3. Oamaru 110 kV-1 bus does not have a line circuit breaker, so a bus fault is the same as an Oamaru–Black Point–Waitaki circuit tripping.
4. Oamaru 110 kV-2 bus does not have a line circuit breaker, so a bus fault is the same as an Oamaru–Studholme–Bells Pond–Waitaki circuit tripping.
5. There is a loss of supply at Studholme only if the Studholme–Timaru circuit is open (normally in winter only).
6. There is a loss of supply at Studholme only if the Glenavy–Studholme circuit is open (summer configuration).
7. A disconnecting circuit breaker will be installed on the Studholme 110 kV bus (see section 18.5.6). However, there is no bus zone protection so a bus fault will still cause a loss of supply at Studholme.

The customers in this region (Alpine Energy, Network Waitaki, Genesis Energy and Meridian Energy) have not requested higher bus security levels. Unless otherwise noted, we do not propose increasing bus security and future investment is likely to be customer driven.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

18.6.1 Timaru 110 kV bus security

Issue

A fault on a Timaru 110 kV bus section will cause several issues to arise, the most onerous being a fault on bus section C. This will:

- disconnect Tekapo A and Albury
- overload the remaining Temuka supply transformer and Temuka–Timaru circuit if the Temuka load is high, triggering the Temuka special protection scheme to reduce load at Temuka
- potentially trigger a voltage collapse driven by low voltages at Temuka and/or Studholme.

What next?

Options to address the Timaru 110 kV bus security issue include:

- reconfiguring the Timaru 110 kV bus to connect the Albury circuit (which also connects Tekapo A) to bus section B
- a new 220/110 kV grid exit point at Orari (see section 18.5.8 and 18.4.2) which will eliminate the risk of voltage collapse.

We do not plan to investigate options to increase security to Albury and Tekapo A for a Timaru bus section outage as the customers connected to the single circuit line (Alpine Energy and Genesis Energy) have not requested a higher level of security.

18.7 Other items of interest

18.7.1 North Otago grid exit point

The lower Waitaki 110 kV transmission system has required automatic load shedding schemes, wider voltage operating ranges, system reconfiguration and circuit re-rating to meet load growth until now. However, this growth has increased the amount of load that cannot be supplied following an outage. Grid exit points on n security include Bells Pond, Black Point and

Studholme. Part of the Oamaru load is also on n security with the recent commissioning of the Oamaru circuit overload protection scheme. All options to extract more from the existing grid assets are exhausted.

The most credible option to address these issues in the lower Waitaki 110 kV system is a new 220/110 kV grid exit point connected to the Norwood–Livingstone 220 kV circuit (see 18.4.1.6 and 18.5.5).

Initially, Network Waitaki would transfer rural zone substations supplied from Oamaru to the new grid exit point, capping the load off-take at Oamaru. This maintains the existing level of security and capacity of the grid exit point in the lower Waitaki Valley but does not enhance security or supply capacity (see 18.4.1).

A longer-term option is to shift all Oamaru and Black Point load to the new grid exit point, which then releases the 110 kV circuit capacity to supply more load at Bells Pond and Studholme. It will also allow these grid exit points to be upgraded to n-1 security. However, this development will require considerable investment within the Network Waitaki distribution network. Network Waitaki has indicated that based on its current demand forecasts it is unlikely it would invest in this solution.

The new 220/110 kV grid exit point could also address issues at the Waitaki grid exit point (see 18.5.11).

18.7.2 Orari grid exit point

Demand in the Upper South Island is currently limited by voltage stability and thermal constraints. To address the voltage stability and thermal issues Transpower has proposed a package of upgrades as part of its Upper South Island Major Capex Proposal (MCP), see Chapter 6 for more information. The MCP has been submitted to the Commerce Commission for approval.

The proposal includes a new 220 kV switching station near Orari. If the Orari switching station is established, there is an opportunity to upgrade it to a grid exit point and transfer load from Temuka to Orari. This transfer would alleviate constraints on both the Temuka supply transformer capacity and the 110 kV Temuka–Timaru circuits (see section 18.5.8).

Moreover, a new grid exit point at Orari could also delay the need for some investments in the Timaru area (see section 18.4.2).

18.8 South Canterbury generation opportunities and proposals

This section provides a high-level description of the South Canterbury region: its capacity to host additional generation at an existing grid exit point, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

The South Canterbury region has a significant amount of existing hydro generation connected to the 220 kV grid backbone. There is interest in connecting new generation, particularly large-scale solar and some wind generation, to the 220 kV grid backbone.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
18.8.1	Generation opportunities by substation
18.8.2	Generation investigations and proposals
18.8.3	Tekapo A–Albury–Timaru corridor
18.8.4	Generation connecting at 220 kV

18.8.1 Generation opportunities by substation

Envision Opportunities[21] is our on-line tool that indicates the available capacity for connecting additional generation per grid exit point. Care should be taken that the assumptions used in Envision Opportunities to calculate the available capacity are understood before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[22]:

- summer midday average – wet/calm
- summer midday low – dry/windy
- summer midday low – wet/windy
- summer midday high – wet/windy.
- Winter evening peak – wet/windy
- Winter midday high – wet/calm.

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if new generation is also developed at other substations inside or outside the region. For transformer branches, we consider only the transformer and any associated cable ratings, not any other branch limits, such as protection, revenue metering and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading transformers or cables.

18.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[23]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 18-7 shows generation and grid-scale battery projects in the South Canterbury region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 18-2 instead.

Table 18-7: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Benmore–Islington 220 kV	Solar	Delivery[1]	300
Ohau A 220 kV	Solar	Investigation	222
Twizel 220 kV	Solar	Investigation	350
Twizel–Opihi 220 kV circuit section	Solar	Investigation	300
Waitaki / Livingstone area (110 kV or 220 kV)	Wind	Investigation	130
Benmore–Islington 220 kV	Solar + BESS[2]	Application	180
Islington–Tekapo–1, Tekapo B 220 kV	Solar	Application	250
Roxburgh–Twizel 220 kV	Solar + BESS[2]	Application	400

1. "Delivery" is a stage in the Transpower generation queue process, it does not denote a final commitment by the developer to build the generation.

21 Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

22 "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

23 Link to the Generation Investigation Queue: Connection enquiry information | Transpower

2. BESS refers to Battery Energy Storage System

We have received additional requests for assessment of generation connections that are at a Concept Assessment level and are not included in the investigation queue.

The following sections discuss the capacity of selected parts of the grid in the South Canterbury region to host additional generation. Please contact Transpower to discuss generation connection capacity for parts of the region that are not discussed.

18.8.3 Tekapo A–Albury–Timaru corridor

Issue

There are several constraints to connecting significant amounts of additional generation along the Tekapo A–Albury–Timaru transmission corridor, especially generation connected within the distribution network. We have received several initial enquiries for connecting solar generation along this corridor.

Tekapo A

At Tekapo A, the 33 kV distribution network is connected through a single 110/11 kV, 35 MVA transformer (T6) in series with a single 33/11 kV, 10 MVA transformer (T1). The 35 MVA transformer also connects the 30 MW Tekapo A generator. The 11/33 kV transformer capacity may be increased in future to meet load growth (see 18.5.7).

Generation will be constrained if the total hydro plus solar generation (netting off load) exceeds the capacity of the 35 MVA transformer. Every 1 MW of Tekapo A hydro generation that is constrained will (on average) constrain an additional 6 MW of generation at Tekapo B.

Also, Tekapo A and B power stations transfer water from Lake Tekapo, with relatively little storage, into Lake Pukaki, which is the largest intra-seasonal storage lake in New Zealand. Therefore, management of water flow from Lake Tekapo into Lake Pukaki has a significant effect on the electricity market.

Generation developers should make their own assessment of the likelihood of solar generation being constrained rather than hydro generation at Tekapo A.

Albury

At Albury, the distribution network is supplied with a single 110/11 kV, 20 MVA transformer. The Opuha hydro generation (7 MW), which is integrated with an irrigation scheme, is connected within the distribution network.

Generation will be constrained if the total hydro plus solar generation (netting off load) exceeds the 20 MVA rating of the transformer.

Tekapo A–Albury–Timaru circuit capacity

The Tekapo A–Albury–Timaru circuit is rated 51/57/62 MVA summer/shoulder/winter.

There is limited opportunity to connect new generation to the 110 kV Tekapo A–Albury–Timaru circuit without the risk of dispatch constraints. This is because the existing generation at Tekapo A and Opuha (embedded at Albury) generates up to 33 MW and the circuit capacity is 51 MVA (summer).

What next?

We have no plans to upgrade the transmission capacity along the Tekapo A–Albury–Timaru corridor. The circuit has copper conductor, which cannot be thermally upgraded. All future upgrades will be customer funded.

18.8.4 Generation connecting at 220 kV

There are no issues with connecting generation at 220 kV at existing substations within the Waitaki Valley.

The maximum generation that can be connected varies with the point of connection and the circuit. Connections close to the Waitaki Valley enable the most generation (approximately equal to the circuit rating). The best-case location and circuit will allow more than 400 MW of

generation. The worst-case location and circuit will not support the dispatch of any further generation.

Generation connected to one of the four circuits to Christchurch would need to avoid causing significant imbalance in circuit loading as this would reduce the maximum load that can be supplied across all four circuits.

19 Otago-Southland Regional Plan

19.1	Regional overview and transmission
19.2	Otago-Southland load and generation forecasts
19.3	Grid Enhancement approach and
19.4	Grid asset capability and management within the wider region
19.5	Grid asset capability and management by grid exit point
19.6	Otago-Southland bus security
19.7	Other items of interest
19.8	Otago-Southland generation opportunities and proposals

19.1 Regional overview and transmission

The Otago-Southland region includes a mix of provincial cities (Dunedin and Invercargill) together with the smaller but significant tourist and rural service centres of Queenstown, Wanaka, and Cromwell. New Zealand's largest electricity consumer is the New Zealand Aluminium Smelter at Tiwai Point, located in Otago-Southland.

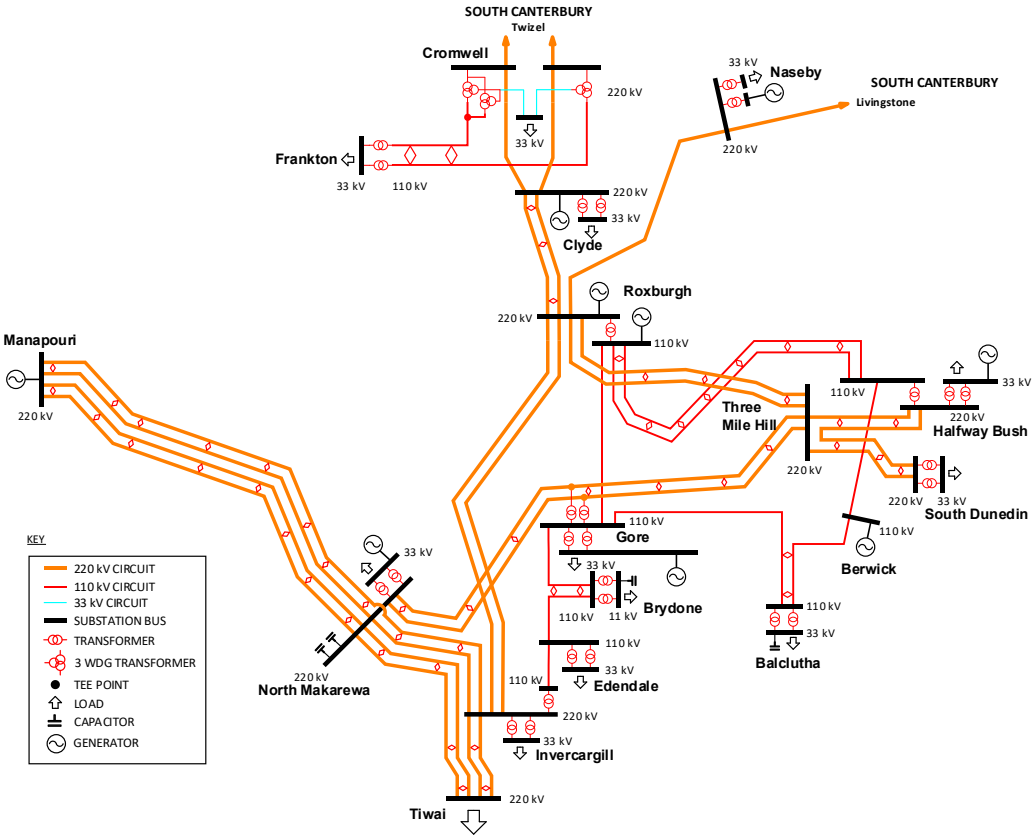
The existing transmission network for the Otago-Southland region is shown geographically in Figure 19-1 and schematically in Figure 19-2.

2025 Annual Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 19-1: Otago-Southland region transmission network

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 19-2: Otago-Southland region transmission schematic



19.1.1 Transmission into the region

Three 220 kV circuits connect the Otago-Southland region to the rest of the National Grid. The region has substantial hydro generation, much of which is consumed locally. Transmission capacity into the region is largely driven by the local hydrology. During wet periods, significant amounts of power are exported to the Waitaki Valley. During dry periods, power may be imported from the Waitaki Valley to Otago-Southland.

19.1.2 Transmission within the region

Transmission within the Otago-Southland region comprises 220 kV and 110 kV transmission circuits. Local transmission also includes interconnecting transformers located at Cromwell, Gore, Halfway Bush, Invercargill, and Roxburgh.

Capacitors at North Makarewa improve system voltage and voltage stability performance. There are also capacitors on the supply buses at Brydone and Balclutha for power factor correction and system voltage support.

The region can be divided into four load centres:

- The Southland 220 kV area, comprising Tiwai, Invercargill, and North Makarewa substations, is predominantly supplied from Manapouri or via the 220 kV Invercargill–Roxburgh circuits at times of low generation at Manapouri.
- The Dunedin area, comprising South Dunedin and Halfway Bush, is predominantly supplied via Three Mile Hill.
- The Southland 110 kV network is supplied via the five interconnecting transformers at Gore, Halfway Bush, Invercargill, and Roxburgh.
- Central Otago load is supplied from Cromwell and Frankton via the Cromwell 220/110/33 kV interconnecting transformers.

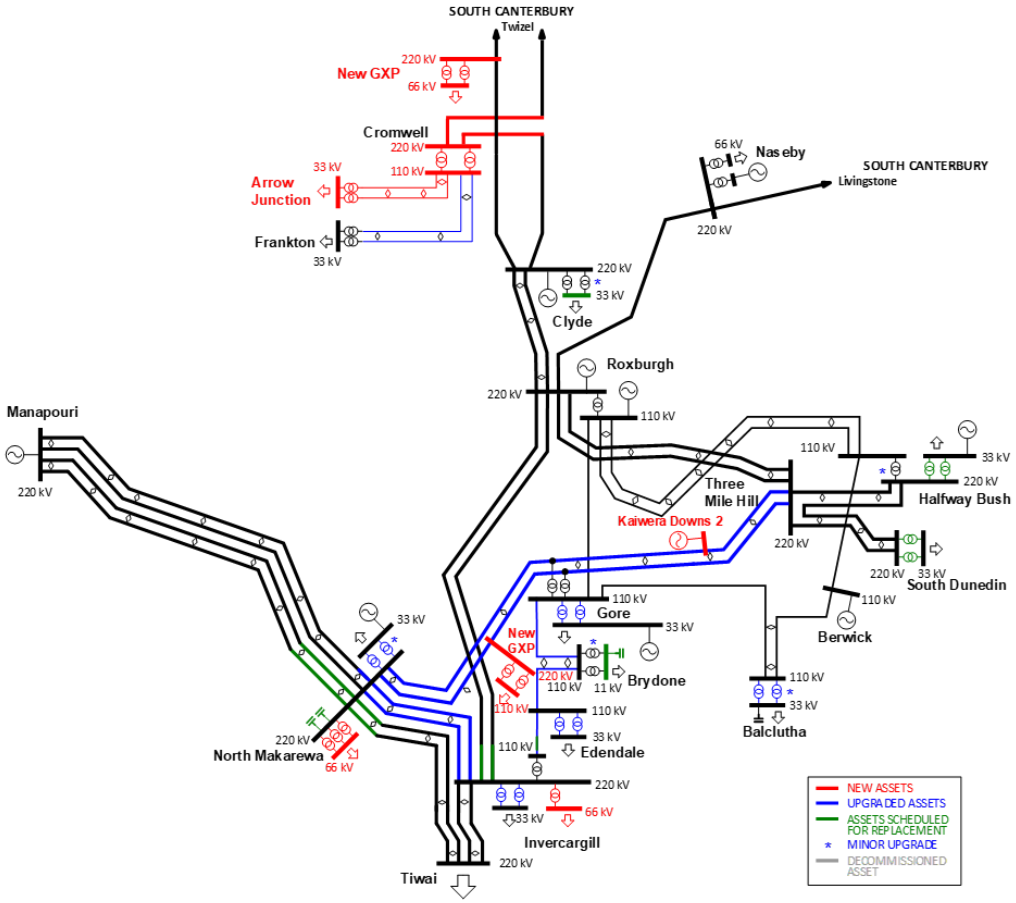
The 110 kV transmission network predominantly comprises low-capacity circuits supplying the smaller centres within the region. Both capacity and voltage issues can arise during outages, especially during the summer and shoulder seasons (agricultural loads).

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

19.1.3 Possible future Otago-Southland transmission configuration

Figure 19-3 shows the possible configuration of Otago-Southland transmission in 2040. New assets, upgraded assets, assets scheduled for replacement within the forecast period, and possible investments are shown.

Figure 19-3: Possible Otago-Southland transmission configuration in 2040



19.2 Otago-Southland load and generation forecasts

19.2.1 Prudent demand forecast

Forecasting peak load is inherently uncertain. Therefore, we use a prudent load forecast to identify issues. This uses a 10 per cent probability of exceedance forecast of underlying demand for the first seven years of the forecast period, and for following years, an expected (or mean) rate of underlying growth[1].

The Otago-Southland regional peak demand is forecast to grow by an average 1.4 per cent per annum over the next 15 years, from 1,185 MW in 2025 to 1,469 MW by 2040. This is lower than the national average growth rate of 2.6 per cent per annum. Table 19-1 sets out forecast peak demand (prudent growth) for each grid exit point for the forecast period.

Table 19-1: Forecast prudent annual peak demand (MW) at Otago-Southland grid exit points to 2040

Grid exit point	Power factor	Peak demand (MW)											
		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Balclutha	0.99	32	32	33	34	34	34	35	35	35	35	36	36
Brydone	0.81	11	11	11	11	11	11	11	11	11	11	11	11
Clyde	0.99	20	21	21	23	23	24	25	26	26	27	28	30

[1] Refer to Chapter 3 for further information on demand forecasting.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Cromwell[1]	1.00	60	73	79	81	86	87	99	100	102	103	104	106
Edendale 33 kV	0.96	54	54	54	33	37	38	38	38	38	39	39	40
Edendale 220 kV	0.96	0	0	0	20	20	20	20	20	20	20	20	20
Frankton	1.00	89	94	99	104	108	117	123	128	133	138	141	155
Gore	1.00	44	45	46	47	49	50	51	53	54	56	57	61
Halfway Bush	1.00	118	123	125	132	134	137	139	140	141	142	143	143
Invercargill 33 kV	0.99	122	125	128	137	142	145	149	151	154	157	159	167
Invercargill 66 kV	0.99	30	30	30	30	30	30	60	60	60	60	60	60
Naseby	0.98	30	30	31	32	36	37	38	38	38	38	39	41
North Makarewa[2]	0.99	62	63	66	69	86	90	93	104	106	108	110	114
South Dunedin	1.00	77	80	81	82	83	83	84	85	85	86	86	87
Tiwai	0.96	585	585	585	585	585	585	585	585	585	585	585	585

1. Load increase at Cromwell from 2026 contributed mainly by heavy industry.
2. PowerNet advised of a 5 MW step load at North Makarewa in 2032 from commercial sector.

19.2.2 Other demand

The prudent peak load forecast follows our accelerated electrification scenario in *Whakamana i Te Mauri Hiko*. This includes an estimate for each grid exit point where electrification assists in decarbonising New Zealand's economy.

Increased electrification is influenced by many factors, such as industrial loads switching away from fossil fuels, generators actively seeking to convert existing fossil fuel users to electricity (or electricity and biofuels), and generators seeking new low carbon industries to supply. Therefore, where increased electrification occurs at a grid exit point, the magnitude and timing of the peak load can be challenging to forecast.

In contrast to most regions, Otago-Southland has many industries with considerable potential for decarbonising their businesses[2]. Decarbonising industry can increase electricity demand, either by converting directly to electric heating or converting to biomass, which is often paired with partially electrifying processes (such as heat pumps for low temperature heat).

The 2023 TPR discussed the high level of uncertainty at grid exit points where there was potential for large increases in demand. We issued a consultation paper requesting feedback from stakeholders on their electrification investigations and plans to inform our studies and investments[3]. As a result, significant progress has been made in reducing this uncertainty, but large areas of uncertainty remain, as summarised below.

Balclutha

Large step load increases are no longer expected at Balclutha. This is partially due to developers not progressing projects. It is also less costly to upgrade the distribution network to supply the other possible step loads from Gore, than to undertake transmission upgrades at Balclutha.

Edendale

Fonterra has recently announced an investment in two additional electrode boilers. This load is not included in our load forecast (Table 19-1). These future load increases would be supplied from a new 220 kV Edendale grid exit point which is a committed project (see section 19.5.6).

Invercargill

There is considerable potential for load growth beyond the forecast reported in Table 19-1. A new 220/66 kV supply is being established at Invercargill which has sufficient capacity to supply this potential higher load.

2 See EECA report: https://www.eeca.govt.nz/insights/data-tools/regional-heat-demand-database/

3 Murihiku Southland Electrification Development Plan | Transpower

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Tiwai

New Zealand Aluminium Smelter (NZAS) has stated it is investigating the possibility of restarting production on reduction line 4 (the "fourth potline"). The Tiwai load forecast does not include the possible restarting of reduction line 4.

Data centres

The Otago-Southland region is attracting interest from new electricity-dependent enterprises such as large data centres. Otago-Southland is attractive due to access to renewable energy and a favourable climate (for cooling). This possible load is not included in Table 19-1. A large new data centre is expected to require a new, dedicated, 220 kV grid exit point.

19.2.3 Existing and committed generation

The Otago-Southland region's generation capacity is currently 1,912 MW. This excludes any embedded solar (PV) generation, which was approximately 33 MW in the Otago-Southland region at the time of publication[4].

Generation within the region contributes a major portion of total South Island generation and significantly exceeds local demand. Surplus generation is exported via the National Grid to other demand centres in the South Island, and via the HVDC link to the North Island.

Table 19-2 lists the generation forecast for each grid injection point in the Otago-Southland region for the forecast period. This includes all known and committed generation stations, including those embedded within the local lines company networks (such as PowerNet, OtagoNet and Aurora Energy)[5]. Further generation may be developed during the period. Refer to Table 19-6 for more information on potential new generation that is not sufficiently advanced to include in our forecasts[6].

Table 19-2: Existing and committed generation capacity at Otago-Southland grid injection points

Grid injection point (location/name if embedded)	Generation capacity (MW)											
	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2040
Balclutha												
(Mount Stuart)	8	8	8	8	8	8	8	8	8	8	8	8
Berwick												
(Waipori 2)	52	52	52	52	52	52	52	52	52	52	52	52
Clyde	464	464	464	464	464	464	464	464	464	464	464	464
Clyde												
(Horseshoe Bend hydro)	4	4	4	4	4	4	4	4	4	4	4	4
(Horseshoe Bend wind)	2	2	2	2	2	2	2	2	2	2	2	2
(Lower Fraser)	3	3	3	3	3	3	3	3	3	3	3	3
(Upper Fraser)	8	8	8	8	8	8	8	8	8	8	8	8
(Kowhai)	2	2	2	2	2	2	2	2	2	2	2	2
(Talla Burn)	2	2	2	2	2	2	2	2	2	2	2	2
(Teviot)	11	11	11	11	11	11	11	11	11	11	11	11
Cromwell												
(Roaring Meg)	6	6	6	6	6	6	6	6	6	6	6	6
Frankton												
(Wye Creek and Glenorchy)	2	2	2	2	2	2	2	2	2	2	2	2
Gore												
(Blue Mountain Lumber)	1	1	1	1	1	1	1	1	1	1	1	1
(Kaiwera Downs 1)	43	43	43	43	43	43	43	43	43	43	43	43
Halfway Bush												
(Deep Stream)	6	6	6	6	6	6	6	6	6	6	6	6
(Waipori 1)	38	38	38	38	38	38	38	38	38	38	38	38
(Mahinerangi)	36	36	36	36	36	36	36	36	36	36	36	36
Invercargill												
(Flat Hill)	7	7	7	7	7	7	7	7	7	7	7	7

[4] Electricity Market Information (EMI): Electricity Authority - EMI (market statistics and tools)

[5] Only generators with a capacity greater than 1 MW are listed. Generation capacity is rounded to the nearest megawatt.

[6] Potential generation that is not sufficiently advanced to be included in our forecasts includes the Clyde and Roxburgh generation station capacity increases for which resource consents have been sought. They do not yet meet the definition of 'committed'.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Kaiwera Downs 2	0	0	155	155	155	155	155	155	155	155	155	155
Manapouri	820	820	820	820	820	820	820	820	820	820	820	820
Naseby (Falls Dam) (Paerau) (Patearoa)	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2	 1 10 2
North Makarewa (Monowai) (White Hill)	 6 58	 6 58	 6 58	 6 58	 6 58	 6 58	 6 58	 6 58	 6 58	 6 58	 6 58	 6 58
Roxburgh	320	320	320	320	320	320	320	320	320	320	320	320

19.2.4 Batteries

We are not aware of any committed grid-scale battery projects in the Otago-Southland region.

19.3 Grid Enhancement approach and inputs

19.3.1 Our aim

We seek to ensure an economic level of secure transmission is available into and across the Otago-Southland region into the future. We assessed transmission capacity and reactive support requirements in the region over the next 15 years (while remaining cognisant of longer-term development opportunities). In developing grid enhancements to address identified issues, we take into account:

- transmission asset capability
- forecast demand and generation
- customer requests
- generation proposals and opportunities
- possible technological changes
- significant upcoming replacement and refurbishment work planned over the period
- asset feedback (information on assets or issues submitted through the asset feedback process).

Where an issue or opportunity exists, we examined initial options and actions that may be taken to address it (see sections 19.4 and 19.5).

While resilience benefits are considered in our optioneering, specific resilience investment needs are covered by our Asset Management Plan (AMP). Resilience investments are classed as E&D expenditure under our regulations.

19.3.2 Otago-Southland significant upcoming replacement and refurbishment work

We integrate our capital project and maintenance works to enable system issues to be resolved, if possible, when assets are replaced or refurbished. Table 19-3 lists the significant upcoming risk-based condition replacement and refurbishment work proposed for the Otago-Southland region for the next 15 years that may significantly impact related system issues or connected parties.

Table 19-3: Proposed significant upcoming replacement and refurbishment work for the Otago-Southland region

Description	Tentative year	E&D issue
Balclutha 110/33 kV LV transformer bushing replacement	2025-2027	19.5.1
Brydone 110/11 kV transformer bushing replacement Brydone 11 kV switchboard replacement	2030-2032 2033-2035	None None
Clyde 33 kV switchboard replacement	2026-2028	None
Cromwell 33 kV outdoor to indoor conversion Cromwell–T5A/T5B 110/33 kV transformer bushing	2026-2028 2027-2029	19.4.1 19.4.1

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

replacement Cromwell 110 kV CB/CVT replacement	2035-2037	19.4.1
Edendale 110/33 kV transformers replacement	2030-2032	19.5.6
Gore–Invercargill–A line conductor replacement (1 km, at Invercargill end)	2025-2027	0
Halfway Bush 220/110 kV transformer special protection scheme replacement Halfway Bush 220/33 kV transformer replacement Halfway Bush Bus Coupler Protection Replacement	2026-2028 2028-2030 2038-2040	None 19.5.9 None
Invercargill–Roxburgh–A line conductor replacements (7 km, at Invercargill end)	2025-2027	None
South Dunedin 220/33 kV T1 transformer replacement	2036-2038	None
Manapouri–Tiwai–A line conductor replacement (32 km)	2025-2027	None
North Makarewa 33 kV transformer cable replacement North Makarewa capacitor banks' tuning reactor replacement North Makarewa Reactive Power Controller replacement	2025-2027 2026-2027 2026-2028	19.5.12 6.9.3 None
Tiwai 220 kV bus zone, feeder and special protection scheme replacement Tiwai Under Frequency Load Shedding replacement	2025-2027 2035-2037	None None

19.3.3 Otago-Southland asset feedback

The Asset Feedback Register includes no E&D-related entries specific to Otago-Southland.

19.4 Grid asset capability and management within the wider region

This transmission capability section reports whether the Grid within the wider Otago-Southland region can reasonably be expected to meet an n-1 security level over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 19-4 lists the specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 19-4: Changes within the wider region since the 2023 TPR

Issues	Change
No changes to report	

The overview of transmission capability within the wider Otago-Southland region is listed below. In each case, we detected a condition that would constrain the network if action were not taken. Each issue is discussed in more detail below.

Section number	Description
19.4.1	Cromwell and Frankton supply capacity
0	
	Project Name — New Cromwell-Queenstown transmission line
	Project description: — New double-circuit 110 kV line between Cromwell and a new Arrow Junction grid exit point
	Project's state of completion — Possible
	Grid need date: — Customer initiated
	Indicative cost [$ million]: — 100
	Reliability or Economic investment? — Reliability (Grid Reliability Report)
	Gore–Brydone–Edendale–Invercargill 110 kV transmission capacity
19.4.3	Gore–Roxburgh 110 kV transmission capacity

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

19.4.1 Cromwell and Frankton supply capacity

Issue

Cromwell and Frankton are supplied via two 220/110/33 kV transformer banks at Cromwell that are tee-connected to the 220 kV Clyde–Cromwell–Twizel–1 and 2 circuits. The 33 kV winding of the transformers supplies the Cromwell 33 kV grid exit point. The 110 kV winding of the transformers supplies the Frankton grid exit point via a pair of 110 kV Cromwell–Frankton circuits and two 110/33 kV transformers at Frankton.

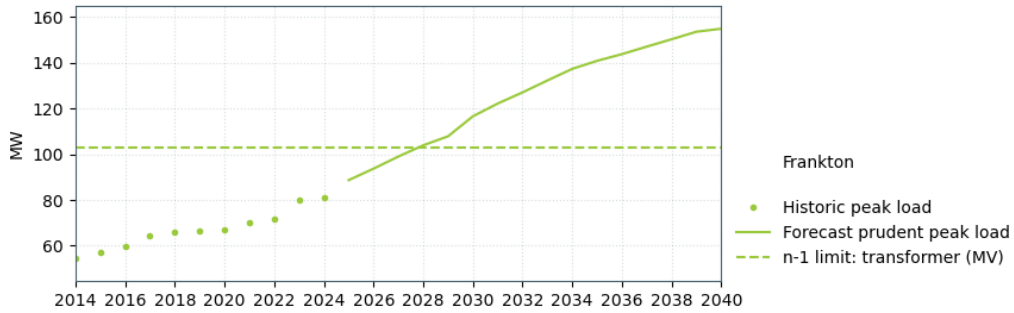
A Clyde–Cromwell–Twizel outage removes from service a Cromwell 220/110/33 kV transformer, the associated 110 kV Cromwell–Frankton circuit, and the associated Frankton transformer.

Issues impacting the supply capacity to Cromwell and Frankton are:

- The Cromwell 33 kV grid exit point n-1 capacity is limited by the 33 kV cables and transformer winding ratings (see section 19.5.5).
- The Frankton grid exit point n-1 capacity is limited by the 110 kV Cromwell–Frankton circuit ratings from winter 2025, followed by the ratings of the Cromwell 110 kV transformer windings from winter 2028.
- The 110/33 kV Frankton transformers are forecast to limit the n-1 capacity to the Frankton 33 kV grid exit point from winter 2032 (see section 19.5.7).
- The combined Cromwell and Frankton grid exit point n-1 capacity is limited by the ratings of the Cromwell 220 kV windings from 2027.
- The maximum combined load at Cromwell and Frankton may also be constrained pre-contingency to approximately 174 MW[7] by a voltage stability limit. This limit is above existing n-1 thermal constraints. However, after the completion of the proposed short-term upgrades to address thermal issues at Frankton and Cromwell, voltage stability will likely limit the maximum pre-contingency load allowable at Frankton and/or Cromwell during peak times.
- During periods of high load, a Clyde–Cromwell–Twizel circuit or Cromwell transformer outage causes voltage steps in excess of our grid planning guidelines of five per cent.

The 110 kV windings of the two Cromwell 220/110/33 kV transformers supply Frankton, providing a total nominal installed capacity of 247 MVA (one transformer 97 MVA and the other transformer 150 MVA). The peak load at Frankton is forecast to exceed the n-1 capacity of a Cromwell transformer 110 kV winding from winter 2028 (see Figure 19-4).

Figure 19-4: Cromwell (110 kV windings) supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

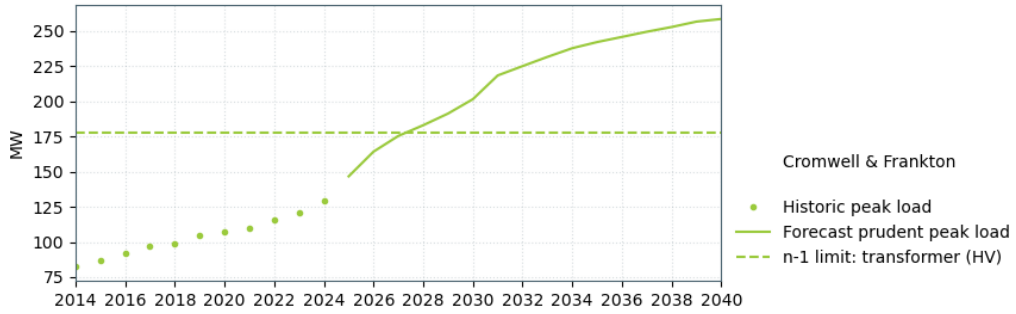
The 220 kV windings of the two Cromwell 220/110/33 kV transformers supply the combined load at Cromwell and Frankton. The transformers' 220 kV windings provide a total nominal installed capacity of 320 MVA (one transformer 170 MVA and the other transformer 150 MVA).

The combined peak load at Cromwell and Frankton is expected to exceed the n-1 capacity of the Cromwell transformers' 220 kV windings from winter 2028 (see Figure 19-5).

[7] A voltage stability limit occurs during periods of high load at Cromwell and Frankton, combined with periods of high generation export from the Otago-Southland region (towards the Waitaki Valley) for a Clyde–Cromwell–Twizel circuit or Cromwell transformer outage. The voltage stability limit is monitored by the System Operator, and varies slightly depending on the load distribution between Cromwell and Frankton and wider system conditions.

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Figure 19-5: Cromwell (220 kV windings) supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We are working with Aurora, PowerNet and other stakeholders on staged investigations and upgrades to address the capacity, stability, and resilience issues.

In the short term:

- There is a committed project to thermally upgrade the Cromwell–Frankton circuits from 63/77 MVA to 111/119 MVA summer/winter and apply variable line rating by winter 2026. This will improve, but not resolve, the n-1 transmission capacity issue to Frankton.
- The existing special protection scheme (see section 19.5.6) will continue to be used to manage the post-contingency load at Frankton to within the capacity of the Cromwell–Frankton circuits and 110 kV winding of the Cromwell transformers.
- The post-contingency loading on the 220 kV winding of the Cromwell transformers could be managed using a special protection scheme to reduce the Cromwell load post-contingency (see section 19.5.5).

Medium- to longer-term options include:

- Installing high-capacity, low-impedance 220/110 kV transformers at Cromwell to supply Frankton.
- Building a new 220/66 kV grid exit point north of Cromwell and relinquishing the 33 kV grid exit point at Cromwell, or upgrading the Cromwell grid exit point to have two 220/66 kV transformers.
- Building a new 110/33 kV grid exit point in the Queenstown area (Arrow Junction) supplied through a new 110 kV double-circuit line from Cromwell. This would likely also require the construction of a 110 kV bus at Cromwell.
- Installing a 110 kV bus at Frankton, if required to increase voltage stability before the new Arrow Junction grid exit point is commissioned.

The configuration of the 220 kV connection of Cromwell and a potential new 220/66 kV GXP on the Clyde–Cromwell–Twizel 220 kV line will need to minimise the impact of the growing load on through-transmission capacity between the Clutha area and the Waitaki Valley.

Customer investments

Project Name	Frankton supply capacity (medium term)
Project description:	Thermal upgrade of the Cromwell–Frankton circuits
Project's state of completion	Committed
Grid need date:	Customer initiated
Indicative cost [$ million]:	9.7
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	Cromwell 220 kV overload management (short term)
Project description:	Upgrade the Cromwell 33 kV special protection scheme to also manage the Cromwell transformer 220 kV winding
Project's state of completion	Possible
Grid need date:	Customer initiated

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	Frankton voltage stability and Cromwell 110 kV capacity
Project description:	New Cromwell 220/110 kV transformers
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	New 220/66 kV grid exit point north of Cromwell
Project description:	New 220/66 kV grid exit point for Aurora Energy
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	35
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	Frankton voltage stability
Project description:	New 110 kV bus at Frankton
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	Arrow Junction 110/33 kV grid exit point
Project description:	New 110/33 kV grid exit point
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	35
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	New Cromwell-Queenstown transmission line
Project description:	New double-circuit 110 kV line between Cromwell and a new Arrow Junction grid exit point
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	100
Reliability or Economic investment?	Reliability (Grid Reliability Report)

19.4.2 Gore–Brydone–Edendale–Invercargill 110 kV transmission capacity

Issue

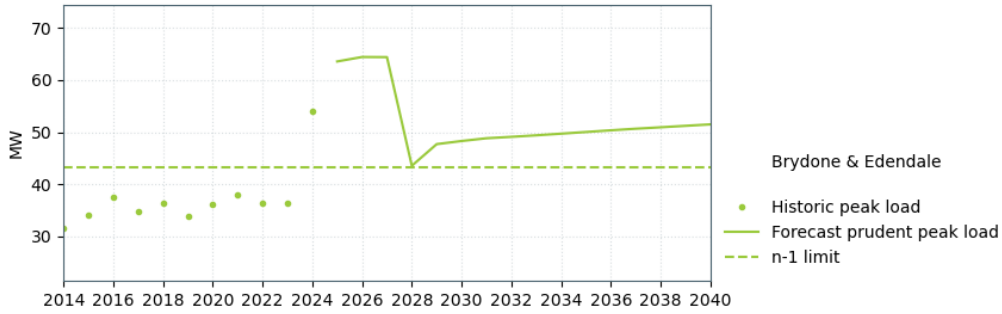
Brydone and Edendale are supplied via three 110 kV circuits:

- Edendale–Invercargill rated at 51/62 MVA (summer/winter)
- Brydone–Gore rated at 51/62 MVA (summer/winter)
- Brydone–Edendale rated at 51/62 MVA (summer/winter)

The combined peak load at Edendale and Brydone is forecast to exceed the n-1 capacity of the Brydone–Gore and Edendale–Invercargill circuits from summer 2025 (see Figure 19-6).

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Figure 19-6: Brydone–Gore–1 and Edendale–Invercargill–1 capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

We recently installed a special protection scheme at Edendale to manage the Brydone–Gore and Edendale–Invercargill thermal constraints.

During peak load periods, the voltage steps at the Brydone supply bus may exceed our grid planning guideline threshold of five per cent following a Brydone–Gore circuit outage.

What next?

The step load decrease in 2027 is due to load transfer from the Edendale 110 kV grid exit point to a new Edendale 220 kV grid exit point (see section 19.5.6).

Following the load transfer, we expect that the circuit overload will be managed operationally and that the existing special protection scheme will be decommissioned. If necessary, a replacement special protection scheme could be used to manage a post-contingency overload[8].

19.4.3 Gore–Roxburgh 110 kV transmission capacity

Issue

The 110 kV Gore–Roxburgh circuit is rated at 63/77 MVA (summer/winter) and operates in parallel with the 220 kV Invercargill–Roxburgh–1 and 2 circuits which are a part of the grid backbone (see Chapter 6).

With low generation in the Southland region (predominantly Manapouri and future wind), the 110 kV Gore–Roxburgh circuit may overload for several contingencies elsewhere in the grid. The first contingency to bind is usually a 220 kV Invercargill–Roxburgh outage, but other contingencies include outages of: the 110 kV Balclutha–Berwick–Halfway Bush circuit, the 110 kV Halfway Bush–Roxburgh circuit, a 220 kV Roxburgh–Three Mile Hill circuit, or a 220 kV Gore–North Makarewa–Three Mile Hill circuit.

The 110 kV Gore–Roxburgh circuit may also overload pre-contingency within the forecast period (see Chapter 6).

Presently, the capacity issue is managed operationally by constraining on generation in the Southland region. In 2022, an emergency grid reconfiguration was also used temporarily to manage exceptionally low hydro storage and inflows at Manapouri. The reconfiguration avoided overloading the Gore–Roxburgh circuit.

What next?

We are investigating installing a special protection scheme to automatically open Gore–Roxburgh if the circuit overloads. After the circuit is open, the Balclutha–Berwick circuit may also overload, which will be managed by a special protection scheme to open the Balclutha–Gore circuit. These schemes will reduce (but not eliminate) the need to constrain-on generation.

The need to constrain-on generation will increase with load growth in Southland. See Chapter 6 for other possible upgrades to further reduce the need to constrain-on generation.

Base E&D capex investments

Project Name	Gore–Roxburgh overload management

[8] The existing special protection schemes to manage overloading of Brydone–Gore and Edendale–Invercargill were installed at short notice to manage the step load increase in 2024. They are temporary schemes that are not suitable for long-term use.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Project description:	Install special protection schemes on Gore–Roxburgh and Balclutha–Berwick to manage overloads
Project's state of completion	Committed
Grid need date:	2025
Indicative cost [$ million]:	0.8
Reliability or Economic investment?	Reliability (Grid Reliability Report)

19.5 Grid asset capability and management by grid exit point

This transmission capability section reports whether the Grid can reasonably be expected to meet an n-1 security level at each grid exit point over the next 15 years. This section, together with the demand and generation sections, forms part of the Grid Reliability Report (GRR) and Grid Economic Investment Report (GEIR).

Table 19-4 lists specific new issues and those that are no longer relevant within the forecast period compared with the 2023 TPR.

Table 19-4: Changes at each grid exit point since the 2023 TPR

Issues	Change
Frankton transmission and supply capacity	Updated. New 110/33 kV supply transformers installed in 2025.

The overview of transmission capability for each grid exit point within the Otago-Southland region is listed below. Where an issue is identified, we list options to address it.

Section number	Description
19.5.1	Balclutha supply capacity
19.5.2	Berwick transmission security
19.5.3	Brydone supply capacity
19.5.4	Clyde supply capacity
19.5.5	Cromwell supply capacity
19.5.6	Edendale supply capacity
19.5.7	Frankton transmission and supply capacity
19.5.8	Gore supply capacity
19.5.9	Halfway Bush supply capacity
19.5.10	Invercargill supply capacity
19.5.11	Naseby supply capacity
19.5.12	North Makarewa supply capacity
19.5.13	South Dunedin supply capacity
19.5.14	Tiwai supply capacity

19.5.1 Balclutha supply capacity

Issue

The Balclutha load is supplied by:

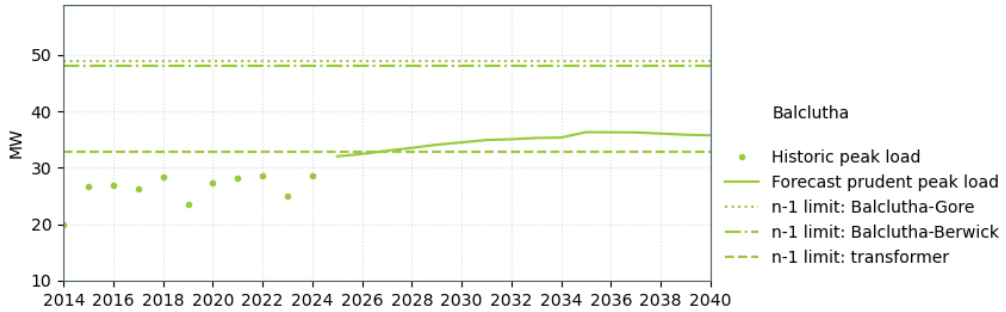
- the Balclutha–Gore 110 kV circuit rated at 51/62 MVA (summer/winter)
- the Balclutha–Berwick–Halfway Bush 110 kV circuit rated at 51/62 MVA (summer/winter)
- two 110/33 kV transformers which provide a total nominal installed capacity of 60 MVA.

The 110 kV Balclutha–Berwick and Berwick–Halfway Bush circuits have no line protection at Berwick. Both circuits will trip following a fault on either circuit (or on the Berwick 110 kV bus).

Peak load at Balclutha is forecast to exceed the n-1 capacity of the supply transformers from shoulder season 2027 (see Figure 19-7).

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Figure 19-7: Balclutha supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss future options (and timing) with OtagoNet and other stakeholders. Options include a special protection scheme to automatically shed load following a supply transformer outage. Longer term options include replacing the supply transformers with higher capacity units.

Customer investments

Project Name	Balclutha supply capacity (short term)
Project description:	Install a transformer overload protection scheme on Balclutha supply transformers
Project's state of completion	Possible
Grid need date:	2027
Indicative cost [$ million]:	0.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

Project Name	Balclutha supply capacity (long term)
Project description:	Replace Balclutha supply transformers with higher rated units
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

19.5.2 Berwick transmission security

Issue

A portion of the Waipori generation injects into the Berwick 110 kV bus. The 110 kV Balclutha–Berwick and Berwick–Halfway Bush circuits have no line protection at Berwick, so both circuits will trip following a fault on either circuit (or on the Berwick 110 kV bus). The portion of Waipori generation connected at 110 kV will disconnect from the National Grid. Therefore, the portion of Waipori generation connected to Berwick has n-connection security.

What next?

If n-1 connection security is required, line protection – together with the associated 110 kV current transformers and a voltage transformer – would need to be installed at Berwick. We have not planned for this investment as we have not received a request for a higher security level from Manawa Energy for its Berwick-connected generation.

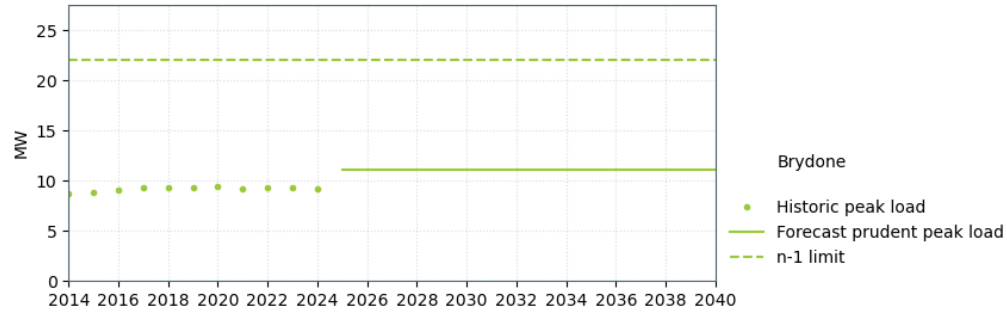
19.5.3 Brydone supply capacity

Two 110/11 kV transformers supply Brydone's load, providing a total nominal installed capacity of 50 MVA. The transformers' capacity is limited by protection and metering limits followed by 11 kV cable ratings.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Peak load at Brydone is within the n-1 capacity of the supply transformers for the forecast period (see Figure 19-8).

Figure 19-8: Brydone supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Security of supply to Brydone is also dependent on load growth at Edendale and the capacity of the 110 kV Gore–Brydone–Edendale–Invercargill circuits. See section 0 for details.

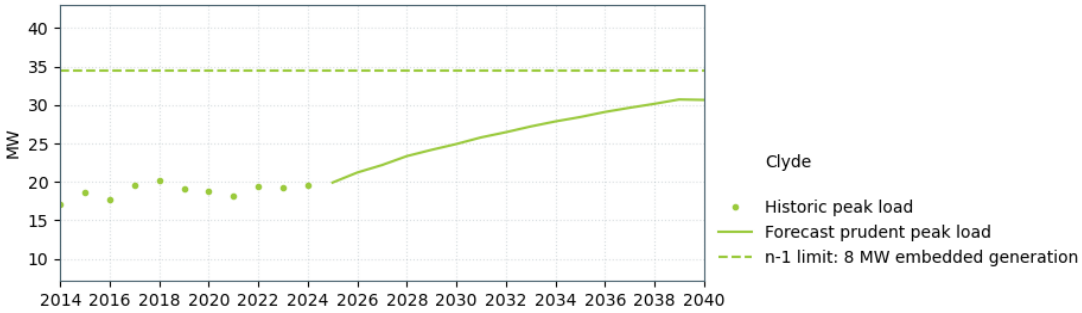
19.5.4 Clyde supply capacity

Two 220/33 kV transformers supply Clyde's load, providing a total nominal installed capacity of 120 MVA. The transformers' capacity is limited by a metering limit.

There is significant amount of generation connected within the distribution network at Clyde. The n-1 limit below assumes 8 MW contribution from embedded generation at Clyde.

Peak load at Clyde is within the n-1 capacity of the supply transformers for the forecast period (see Figure 19-9).

Figure 19-9: Clyde supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

19.5.5 Cromwell supply capacity

Two 220/110/33 kV transformers (rated at 73 MVA[9] and 50 MVA on their respective 33 kV windings) supply the Cromwell 33 kV load, providing a total branch capacity of 123 MVA. The transformers' 33 kV capacity is limited by the 33 kV cable rating.

There are no 220 kV line circuit breakers at Cromwell, so a Clyde–Cromwell–Twizel circuit outage also disconnects a supply transformer. We are required to avoid overloading a transformer for a circuit outage[10], which is done by restricting the pre-contingency peak load to the short-term rating of the 33 kV cables. Following a transformer outage, the operator must quickly reduce the transformer load to within the n-1 capacity of the cables (branch limit).

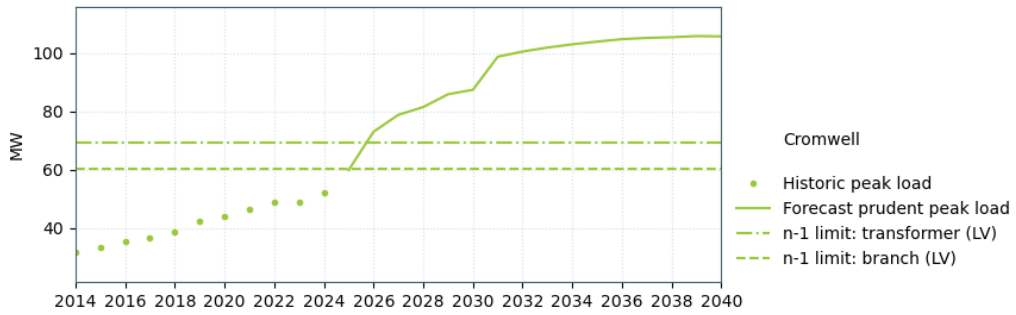
[9] This is a bank of two transformers connected in parallel and operated as a single unit, with the 33 kV transformer cables providing a combined nominal installed capacity of 73 MVA.

[10] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Peak load at Cromwell 33 kV is forecast to exceed the 33 kV cable rating and the n-1 capacity of the transformers' 33 kV winding from winter 2026 (see Figure 19-10).

Figure 19-10: Cromwell (33 kV windings) supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

To manage the issue in the short-term we are proposing to install a special protection scheme to reduce the load post-contingency to within the n-1 capacity of the 33 kV cables and 33 kV transformer windings.

We may need to extend the special protection scheme in the near future to manage the loading on the 220 kV windings of the Cromwell transformers, which supply both Cromwell and Frankton (see section 19.4.1).

Longer-term solutions include transferring the Cromwell 33 kV load to a new grid exit point, or replacing the two 220/110/33 kV transformers with dedicated higher rated 220/33 kV transformers (see section 19.4.1).

Customer investments

Project Name	Cromwell 33 kV overload management (short term)
Project description:	Deploy load management scheme / install special protection scheme to manage Cromwell 33 kV cable and transformer LV over loading
Project's state of completion	Possible
Grid need date:	2026 (Customer initiated)
Indicative cost [$ million]:	0.5
Reliability or Economic investment?	Reliability (Grid Reliability Report)

19.5.6 Edendale supply capacity

Issue

Two 110/33 kV transformers supply Edendale's load, providing a total nominal installed capacity of 60 MVA.

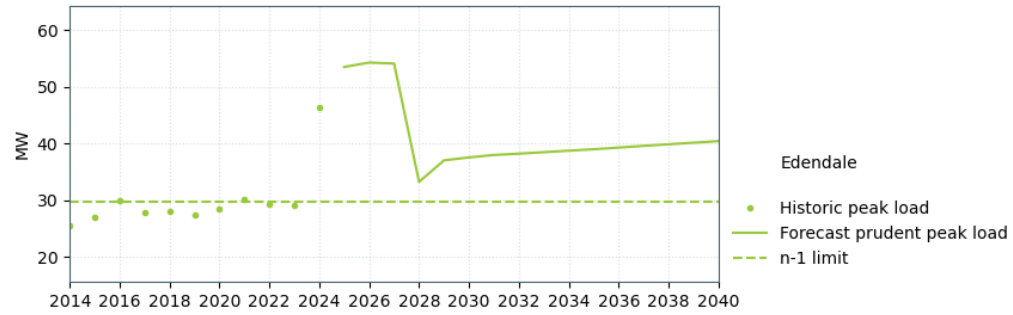
Peak load at Edendale is forecast to exceed the n-1 capacity from summer 2025 (see Figure 19-11). A transformer overload protection scheme resolves this issue temporarily.

Refer to section 0 for discussion on the transmission capacity issue with supplying Edendale's load.

The supply transformers are programmed for risk-based condition replacement towards the end of the forecast period.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 19-11: Edendale 33 kV supply capacity



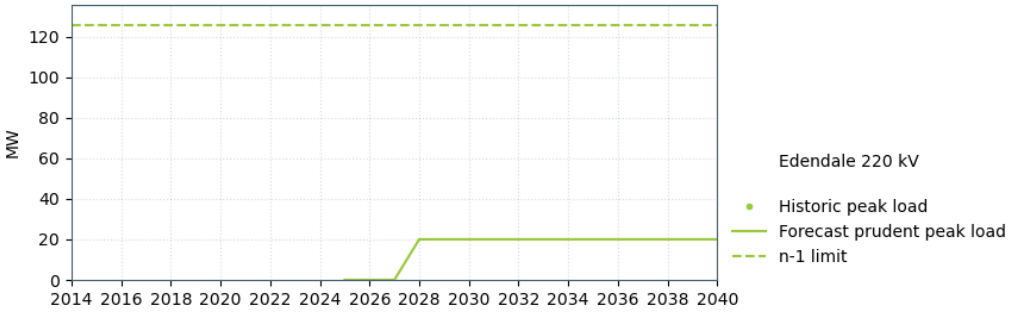
Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The step decrease in load is due to load transfer to a new 220 kV Edendale grid exit point, to be commissioned by 2027. We will work with PowerNet on options to manage the n-1 supply capacity issues.

Two 220/110 kV transformers will supply the new Edendale load, providing a total nominal installed capacity of 240 MVA. Peak load at the new Edendale GXP is within the n-1 capacity of the supply transformers for the forecast period (See Figure 19-12). There is considerable capacity to accommodate possible load growth that is not included in our load forecast (see section 19.2.2).

Figure 19-12: New Edendale 220 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Customer investments

Project Name:	Edendale new Grid Exit Point
Project description:	Construction of a new 220/33 kV GXP
Project's state of completion	Committed
Grid need date:	2025
Indicative cost [$ million]:	35
Reliability or Economic investment?	Reliability (Grid Reliability Report)

19.5.7 Frankton transmission and supply capacity

Issue

The Frankton load is supplied by:

- two 110/33 kV supply transformers providing a total nominal capacity of 240 MVA
- two 110 kV circuits from Cromwell, each rated at 63/77 MVA (summer/winter)
- the 110 kV windings of two 220/110/33 kV transformers at Cromwell, rated at 97 MVA and 150 MVA.

There is no 110 kV bus at Frankton, so a Cromwell–Frankton circuit outage also disconnects a supply transformer at Frankton. Furthermore, due to the absence of 110 kV bus and 220 kV line circuit breakers at Cromwell, a fault on either a Clyde–Cromwell–Twizel 220 kV circuit or a Cromwell 220/110/33 kV transformer also disconnects a Cromwell–Frankton circuit and a

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

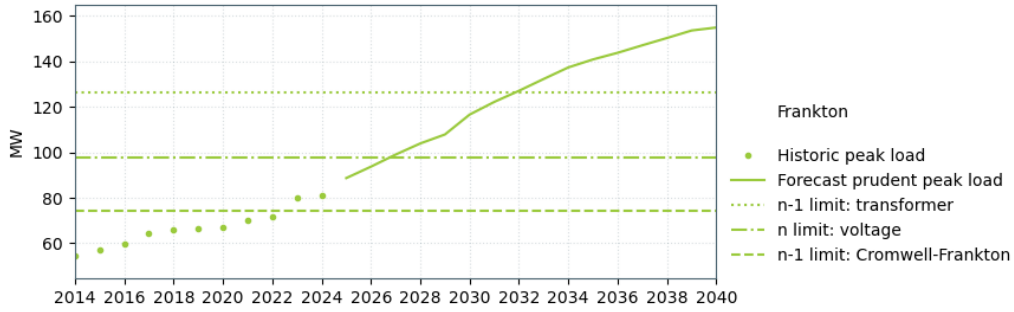
supply transformer. We are required to avoid overloading a transformer or a circuit for a circuit outage[11], which is done using a special protection scheme to reduce the Frankton load to within the n-1 capacity of the circuits post-contingency.

Peak load at Frankton is forecast to exceed the n-1 thermal capacity of the 110 kV Cromwell–Frankton circuits from winter 2025 and the n-1 capacity of the supply transformers from winter 2032 (see Figure 19-13). At high loads the voltage step following an outage will exceed our five per cent guideline.

The Frankton supply capacity is also limited by the voltage stability limit for an outage of a 220 kV Clyde–Cromwell–Twizel circuit or a Cromwell transformer (see section 19.4.1). The voltage stability limit varies depending on the system conditions and is managed operationally by the System Operator.

The Frankton supply capacity will also be limited in future by the Cromwell transformers' 110 kV and 220 kV winding capacities from about winter 2028. Refer to section 19.4.1 for a discussion on this issue, and how developments at Frankton and Cromwell may affect each other.

Figure 19-13: Frankton supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

The first limit is the capacity of the Cromwell–Frankton circuits. There is a committed project to thermally upgrade the circuits to 111/119 MVA summer/winter (see section 19.4.1).

In the short-term, the special protection scheme can manage post-contingency overloading of the circuits (after the thermal upgrade), the Cromwell 110 kV transformer winding and the Frankton supply transformers. However, the Frankton and/or Cromwell load may still need to be constrained pre-contingency to prevent voltage collapse following a Clyde–Cromwell–Twizel circuit outage.

We will discuss future options (and timing) with Aurora, PowerNet and other stakeholders.

Refer to section 19.4.1 for a discussion on the investigation approach and upgrade options for addressing the thermal and voltage issues at Frankton and Cromwell.

19.5.8 Gore supply capacity

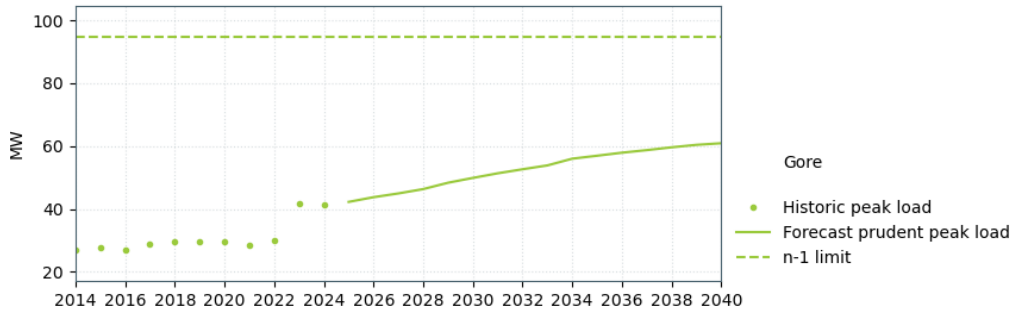
Two 110/33 kV transformers supply Gore's 33 kV load, providing a total nominal installed capacity of 160 MVA. Peak load at Gore is within the n-1 capacity of the supply transformers for the forecast period (see Figure 19-14).

The Kaiwera Downs stage 1 wind generation is connected to the Gore 33 kV bus; the forecast conservatively assumes that the wind farm is not generating during peak load periods.

[11] The System Operator's Principal Performance Objectives require that it anticipate and be prepared to manage Credible Events (CEs) in real time. CEs are events, such as a circuit outage, that are reasonably foreseeable and that require certain types of control to manage their effects on the power system.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure 19-14: Gore supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

Increased electrification

Our load forecast includes an estimate of load growth due to increased electrification. Gore has scope for additional load growth due to electrification beyond that included in the load forecast.

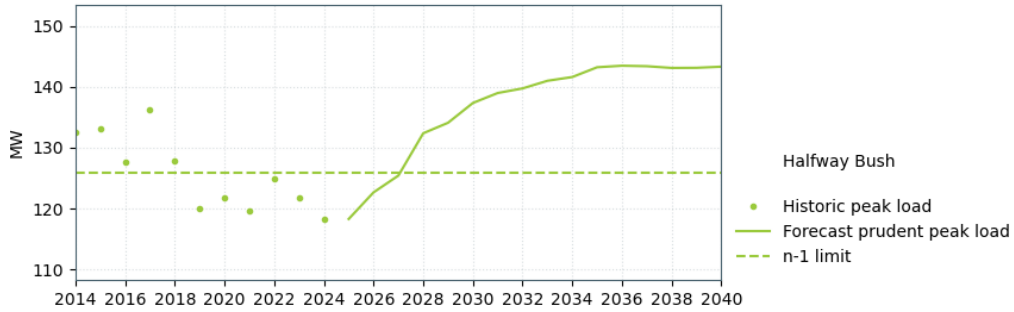
19.5.9 Halfway Bush supply capacity

Issue

Two 220/33 kV transformers rated at 100 MVA and 120 MVA supply Halfway Bush's 33 kV load, providing a total nominal installed capacity of 220 MVA.

There is significant embedded generation (44 MW of hydro and 36 MW of wind) connected behind the Halfway Bush 33 kV grid exit point. Assuming no contribution from the embedded generators, the peak load at Halfway Bush is forecast to exceed the n-1 capacity of the supply transformers from winter 2027 (see Figure 19-15).

Figure 19-15: Halfway Bush supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We (and our customers) expect the embedded generation at Halfway Bush 33 kV will be available and sufficient to provide security to the load for the forecast period. We have no plans to upgrade the supply capacity at Halfway Bush.

19.5.10 Invercargill supply capacity

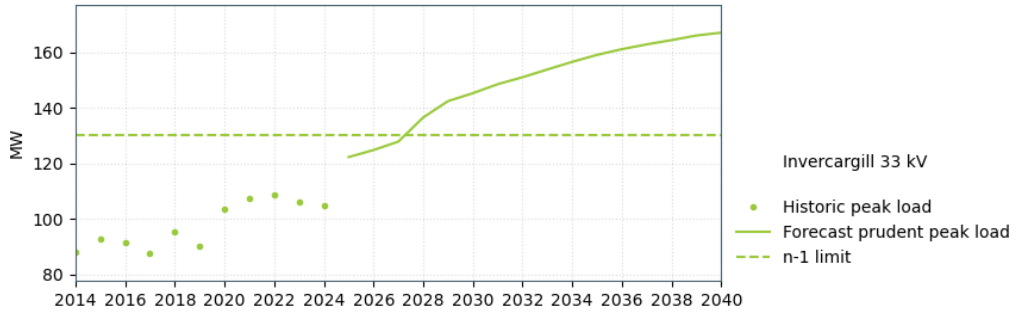
Issue

Two 220/33 kV transformers supply Invercargill's load, providing total nominal installed capacity of 240 MVA. The transformers' capacity is limited by 33 kV circuit breakers.

Peak load at Invercargill is forecast to exceed the n-1 capacity of the supply transformers from winter 2028 (see Figure 19-16).

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Figure 19-16: Invercargill 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

We will discuss future options with PowerNet to accommodate future load growth at the Invercargill 33 kV grid exit point.

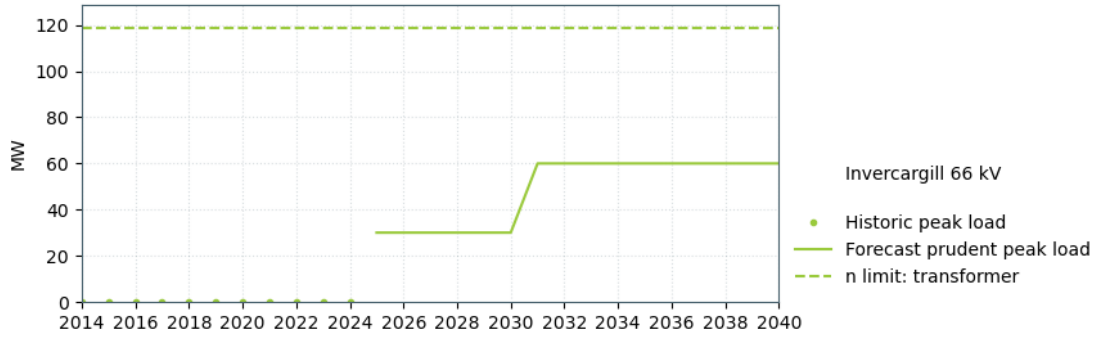
Future options include:

- Transferring more load from the 33 kV grid exit point to the new 66 kV grid exit point (see below)
- Upgrading the capacity of the 33 kV grid exit point.

PowerNet has committed to a new Invercargill 66 kV grid exit point to supply new electrification load, with an expected commissioning date in winter 2025.

One 220/66 kV transformer will supply the Invercargill 66 kV load, providing a nominal installed capacity of 120 MVA. The forecast peak load is within the n capacity of the supply transformer for the forecast period (see Figure 19-17).

Figure 19-17: Invercargill 66 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

PowerNet's distribution network allows post-contingent load shifting from the 66 kV to the 33 kV GXP. When the 66 kV load exceeds the capacity of the distribution network to allow load transfer from the 66 kV to the 33 kV, a second 220/66 kV transformer will be required.

Customer investments

Project Name	Invercargill 66 kV GXP
Project description:	Construction of a new 220/66 kV GXP
Project's state of completion	Committed
Grid need date:	Customer initiated
Indicative cost [$ million]:	35
Reliability or Economic investment?	Reliability (Grid Reliability Report)

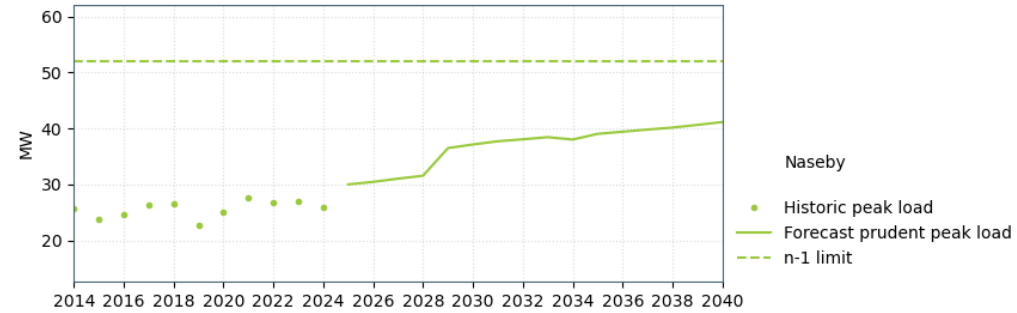
19.5.11 Naseby supply capacity

Two 110/33 kV transformers supply Naseby's load, providing a total nominal installed capacity of 80 MVA.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Peak load at Naseby is within the n-1 capacity of the supply transformers for the forecast period (see Figure 19-18).

Figure 19-1819: Naseby supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

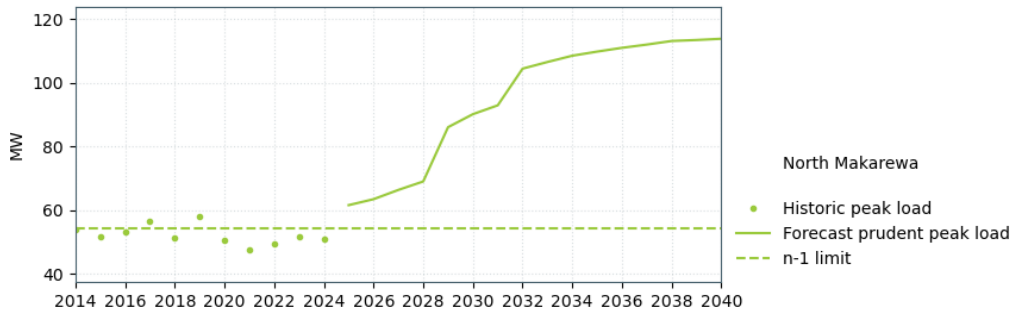
Developments within the distribution network mean that the Naseby 220/33 kV transformers can be converted to 220/66 kV, when required.

19.5.12 North Makarewa supply capacity

Two 220/33 kV transformers supply North Makarewa's load, providing a total nominal installed capacity of 120 MVA. The transformers' capacity is limited by 33 kV incomer cables, circuit breakers, and disconnectors.

Assuming no local generation at White Hill wind farm, peak load at North Makarewa is forecast to exceed the n-1 capacity of the supply transformers from summer 2025 (see Figure 19-20).

Figure 19-20: North Makarewa 33 kV supply capacity



Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

What next?

Removing the branch limits will not significantly address the n-1 capacity issue. Short-term options include a special protection scheme to trip load post-contingency and/or transfer load to the Invercargill 66 kV GXP (see section 19.5.10).

A longer-term option is to replace the transformers with higher-rated 220/66 kV transformers.

Customer investment

Project Name	North Makarewa supply capacity (short-term)
Project description:	Install a special protection scheme to manage transformer overloading
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

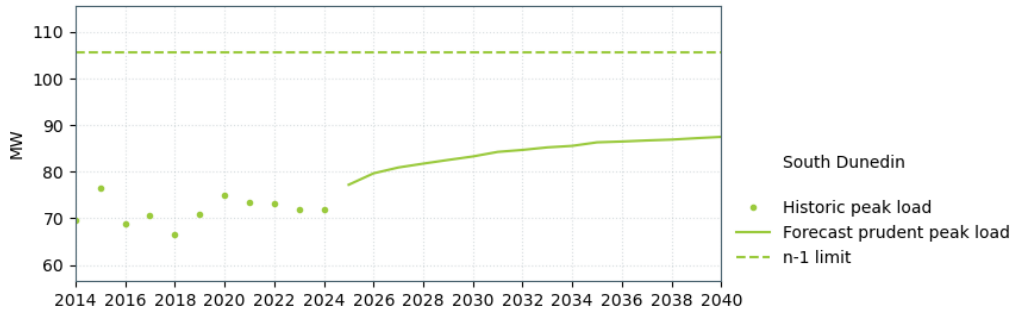
Project Name	North Makarewa supply capacity (long-term)
Project description:	Replace North Makarewa supply transformers with two 220/66 kV transformers
Project's state of completion	Possible
Grid need date:	Customer initiated
Indicative cost [$ million]:	TBC
Reliability or Economic investment?	Reliability (Grid Reliability Report)

19.5.13 South Dunedin supply capacity

Two 220/33 kV transformers supply South Dunedin's load, providing a total nominal capacity of 200 MVA.

Peak load at South Dunedin is within the n-1 capacity of the supply transformers for the forecast period (see Figure 19-21).

Figure 19-21: South Dunedin supply capacity

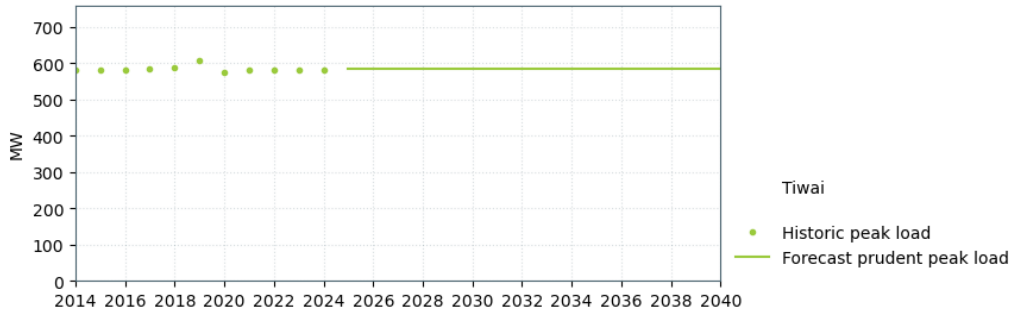


Note: Any difference in the supply capacity on the graph (in MW) and the asset rating (in MVA) is due to load power factor and impedance.

19.5.14 Tiwai supply capacity

NZAS owns the 220 kV feeders connected directly to the Tiwai 220 kV bus and their capacity is not reported in the TPR. NZAS confirmed the smelter will remain active for the forecast period. See Figure 19-22 for the peak load forecasts. This forecast does not include the possible restart of reduction line 4 (see section 19.2.2).

Figure 19-22: Tiwai 220 kV load forecast



19.6 Otago-Southland bus security

Bus outages disconnect more than one power system component (for example, other circuits, transformers, reactive support, or generating units). Therefore, bus outages may cause greater issues than a single circuit or transformer outage (although the risk of a bus fault is low, being less common than a circuit or transformer outage).

Table 19-5 lists bus outages that cause voltage issues or a total loss of supply. Generation is included only if a bus outage disconnects the whole generation station or causes a widespread system impact. Supply bus outages, typically 11 kV and 33 kV, are not listed.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table 19-5: Transmission bus outages

Transmission bus outage	Loss of supply	Generation disconnection	Transmission issue	Further information
Balclutha 110 kV	Balclutha	-	Brydone–Gore and Brydone–Edendale overloading Gore–Roxburgh overloading	Note 1 0 19.4.3
Berwick 110 kV		Waipori (110 kV)	Gore–Roxburgh overloading	19.5.2 19.4.3
Brydone 110 kV	Brydone	-	Edendale–Invercargill overloading Gore–Roxburgh overloading	Note 1 19.4.2 19.4.3
Clyde 220 kV			Gore–Roxburgh overloading	19.4.3
Edendale 110 kV	Edendale	-	-	Note 1
Gore 110 kV	Gore	-	- Edendale–Invercargill overloading	Note 1 0
Halfway Bush 110 kV			Gore–Roxburgh overloading	19.4.3 Note 2
Halfway Bush 220 kV			Gore–Roxburgh overloading	19.4.3
Invercargill 110 kV			Brydone–Gore and Brydone–Edendale overloading	Note 1 19.4.2
Invercargill 220 kV	Invercargill		Brydone–Gore and Brydone–Edendale overloading	Note 3 19.4.2 19.5.10
Manapouri 220 kV			Gore–Roxburgh overloading	19.4.3
Naseby 220 kV			Gore–Roxburgh overloading	19.4.3
North Makarewa 220 kV			Gore–Roxburgh overloading	19.4.3
South Dunedin 220 kV			Gore–Roxburgh overloading	19.4.3
Three Mile Hill 220 kV			Gore–Roxburgh overloading	19.4.3
Tiwai 220 kV			Gore–Roxburgh overloading	19.4.3
Roxburgh 110 kV		Roxburgh (110 kV)	-	Note 4
Roxburgh 220 kV			Gore–Roxburgh overloading	19.4.3

1. There are no bus section circuit breakers at Balclutha, Brydone, Edendale, Gore and Invercargill so bus faults cause a loss of supply.
2. A 110 kV bus contingency at Halfway Bush disconnects the Halfway Bush–Roxburgh–1 and 2, Berwick–Halfway Bush and the T6 220/110 kV transformer. This may cause an overload of Gore–Roxburgh. Balclutha–Gore may also overload during high Balclutha load and low Waipori generation.
3. The 110 kV Edendale–Invercargill circuit is supplied via a single 220/110 kV transformer at Invercargill. Therefore, a loss of a 220 kV bus section will disconnect Edendale–Invercargill, so Brydone and Edendale will be supplied from Gore.
4. There are no bus section circuit breakers on the Roxburgh 110 kV bus. Therefore, a bus fault will disconnect all generation connected to the Roxburgh 110 kV bus.

Our customers in the Otago-Southland region (Aurora Energy, PowerNet, OtagoNet, Solid Energy, and Dongwha Patinna) have not requested a higher security level. Unless otherwise noted, we do not propose increasing bus security.

If increased bus security is required, the options typically include bus reconfiguration and/or additional bus circuit breakers.

19.7 Other items of interest

19.7.1 Cromwell and Frankton security during maintenance

Issue

Cromwell and Frankton are connected to the National Grid via double tee connections onto the 220 kV Clyde–Twizel circuits. Two 220/110/33 kV transformers connect onto the 220 kV tee connections without a bus on the 220 kV or 110 kV sides.

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

An outage on a Clyde–Twizel circuit or a 220/110/33 kV transformer places all the Cromwell and Frankton loads on n security.

What next?

Aurora and PowerNet (local lines companies) have expressed interest in increasing the security of supply to Cromwell and Frankton for an outage of a Clyde–Twizel circuit or a Cromwell transformer, in the longer term. These outages place both grid exit points on n security. A preliminary investigation indicates the solution will require a connection or bus at Cromwell 220 kV and/or 110 kV. We will study this option further as a part of an investigation into the long-term options for Cromwell and Frankton. We currently have no investments planned to address this issue.

19.7.2 Lower South Island voltage stability

Issue

Towards the end of the forecast period, we expect voltage stability issues on the 220 kV network in Otago-Southland. The voltage issues arise during periods of low generation in Southland (predominantly Manapouri) and high generation import into Otago-Southland. This issue is relevant to the South Island grid backbone (see Chapter 6). This issue will be brought forward if there is load growth in excess of our forecast (see section 19.2.2).

What next?

Low generation at Manapouri and high generation import into Otago-Southland are currently managed operationally. There are longer term solutions for the South Island grid backbone which will address this issue (see Chapter 6).

19.8 Otago-Southland generation opportunities and proposals

This section provides a high-level description of the Otago-Southland region: its capacity to host additional generation at an existing GXP, the amount of new generation being investigated, and possible transmission upgrades to enable further generation.

Southland has a high potential for significant levels of additional wind generation.

The capacity of the transmission system to host additional generation, either connected directly to the Grid or indirectly connected to the Grid when installed within a distribution network, depends on several factors. It may vary significantly with small changes in assumptions, such as variations in the local load, how existing generators are dispatched, where other proposed new generators are connected and dispatched, and planned and possible system upgrades.

Therefore, generation developers are strongly encouraged to both make their own assessment of the possible constraints for their generation proposal and consult with us at an early stage of their investigations to discuss capacity and connection issues.

Some known existing and potential generation constraints due to transmission capacity are discussed below. Generation developers should contact us if they require information on potential generation constraints for parts of the transmission system that are not covered.

Section number	Description
19.8.1	Generation opportunities by substation
19.8.2	Generation investigations and proposals
19.8.3	Invercargill–North Makarewa transmission capacity
19.8.4	Invercargill–Manapouri–2 bussing at North Makarewa
19.8.5	North Makarewa–Three Mile Hill capacity increase

19.8.1 Generation opportunities by substation

Envision Opportunities[12] is our online tool that indicates the available thermal capacity for injecting additional generation into the Grid at each substation. Care should be taken to

[12] Link to Envision Opportunities: https://experience.arcgis.com/experience/007dcdef2909420ba7420377a22799d0/page/ENVISION-OPPORTUNITIES

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

understand the assumptions used in Envision Opportunities to calculate the available capacity before acting on the information.

Envision Opportunities is based on a small number of representative system snapshots that have occurred within the last five years to estimate the capacity of the Grid to host additional generation. These system snapshots are[13]:

- summer midday average – wet/windy
- summer midday maximum – dry/calm
- summer midday minimum – wet/calm
- summer morning peak – dry/calm
- winter evening peak – wet/windy
- winter midday maximum – dry/windy.

Estimates of the n and n-1 transmission capacity to host generation are provided. Note that the estimates are per substation and do not consider additional constraints that may occur if generation is also connected at other substations in the region. For transformer branches, we consider only the transformer rating and not any other branch limits, such as protection, revenue metering, cables and switchgear. The cost to address the other branch limits is usually much lower than the cost of upgrading the transformer.

19.8.2 Generation investigations and proposals

Transpower receives so many requests to investigate generation proposals that we need to operate a generation connection investigation queue[14]. Generation proposals transfer from the queue to investigation as resourcing becomes available. Experience shows not all generation proposals in the investigation queue will result in generation build.

Table 19-6 shows generation and grid-scale battery projects in the Otago-Southland region that are in the generation connection investigation queue (as at the time of writing). Note that committed projects are excluded from this table and included in Table 19-2 instead.

Table 19-6: Generation and grid-scale battery investigations and proposals

Connection point	Technology	Status	Capacity (MW)
Naseby	Solar + BESS[1]	Investigation	300
North Makarewa–Three Mile Hill	Wind	Investigation	300
North Makarewa–Three Mile Hill	Wind	Investigation	330
Halfway Bush–Roxburgh	Wind	Application	165
Edendale	Wind	Application	150
Naseby–Roxburgh	Solar + BESS[1]	Application	220
Roxburgh–Islington	Solar + BESS[1]	Application	310

1. BESS refers to Battery Energy Storage System.

We have received additional requests for assessment of generation connections that are at a Concept Assessment level and are not included in the investigation queue. We have issued a consultation paper requesting feedback from stakeholders on their generation investigations and plans, to inform our studies and investments[15].

19.8.3 Invercargill–North Makarewa transmission capacity

Issue

Load growth in Southland and new generation connected along 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).

13 "Wet" and "dry" indicate high and low hydro generation. "Windy" and "calm" indicate high and low wind generation.

14 Link to the Generation Investigation Queue: Connection enquiry information | Transpower

15 Murihiku Southland Electrification Development Plan | Transpower

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

What next?

The Invercargill–North Makarewa circuit can be thermally upgraded to 666/717 MVA (summer/winter).

Base E&D capex investments

Project Name:	Invercargill–North Makarewa circuit thermal upgrade
Project description:	Thermal upgrade of the Invercargill–North Makarewa 220 kV circuits
Project's state of completion	Possible
Grid need date:	2027
Indicative cost [$ million]:	9
Reliability or Economic investment?	Economic

19.8.4 Invercargill–Manapouri–2 bussing at North Makarewa

Issue

High load growth at Invercargill and very high levels of new generation along the 220 kV North Makarewa–Three Mile Hill circuits may overload the 220 kV Invercargill–North Makarewa circuit beyond the capacity increase available from a thermal upgrade (see section 19.8.3).

What next?

The 220 kV Invercargill–Manapouri–2 circuit can be bussed at North Makarewa to form a second Invercargill–North Makarewa circuit (and a fourth Manapouri–North Makarewa circuit). This upgrade would be done after a thermal upgrade of the Invercargill–North Makarewa circuit (see section 19.8.3), not as an alternative.

Base E&D capex investments

Project Name:	Bussing Manapouri–Invercargill–2 circuit
Project description:	Bus the Manapouri–Invercargill–2 circuit at North Makarewa to form a second Invercargill–North Makarewa circuit
Project's state of completion	Possible
Grid need date:	Generation and load dependent
Indicative cost [$ million]:	7
Reliability or Economic investment?	Economic

19.8.5 North Makarewa–Three Mile Hill capacity increase

Issue

The investigation queue lists three large wind farms that would connect to the North Makarewa–Three Mile Hill circuits. There is potential for other wind farms, not yet in the connection queue, to also connect to these circuits.

It is expected the 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 require generation constraints be imposed to prevent overloading of the circuits.

Increased load in Southland during periods of very low Southland generation (low Manapouri hydro conditions and little or no wind) may also require the North Makarewa–Three Mile Hill circuits to be upgraded.

What next?

Increasing the capacity of the North Makarewa–Three Mile Hill circuits to host more than two wind farms is expected to require the existing simplex conductor be replaced with duplex conductor. A detailed investigation is required to assess if only a portion of the line or the whole line would need to be duplexed.

A thermal upgrade will increase the capacity of the North Makarewa–Three Mile Hill circuits, but the capacity increase will be less than the capacity of the prospective wind farms. Therefore, a thermal upgrade is not expected to be an economic option.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Base E&D capex investments

Project Name:	Duplexing North Makarewa–Three Mile Hill–A line
Project description:	Duplex the North Makarewa–Three Mile Hill–A line
Project's state of completion	Possible
Grid need date:	Generation dependent
Indicative cost [$ million]:	140
Reliability or Economic investment?	Economic

2024 Transmission Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Appendix A: Enhancement and Development Planning Process

The System Planning function ensures that we have a system view of the problems and opportunities across the grid. This system view is important for all grid problems and opportunities, including across asset portfolios, but is particularly relevant to those that enhance or reduce the capability of the grid.

The Enhancement and Development Planning (E&D) process is the primary mechanism for addressing these problems and opportunities.

This Appendix describes at a high level how the E&D process operates, utilising existing Transpower processes, including our Decision Framework.

A.1 E&D process overview

The E&D process consists of four inter-related processes:

- Annual Transmission Planning
- Customer Technical Requests (CTR) including Concept Assessments (CAs)
- Asset Feedback
- Asset Planning Decision Framework (Decision Framework).

The first three processes provide information on the capability of the grid to provide the system capacity, reliability and security required to meet future customer and grid needs. Where the capability of the grid is insufficient, or changes in load or generation require a reassessment of system requirements, a problem or opportunity is passed to the Decision Framework for further investigation. This becomes an E&D System Need (System Need).

The Decision Framework provides a mechanism for grouping System and Asset Needs (needs identified in the asset portfolios) to prioritise and collectively consider them.

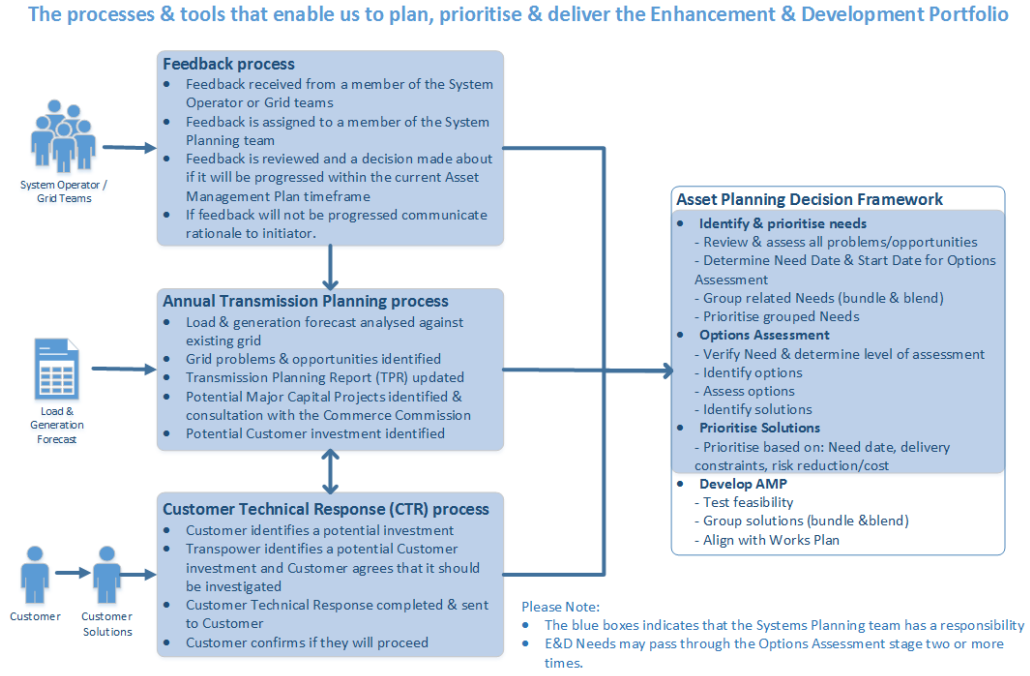
The Decision Framework incorporates the Options Assessment Approach (OAA), which specifies how Needs are investigated, the level of analysis being commensurate with the complexity of the issue, likely level of expenditure and timing of the Need. The outcome of the delivery-level OAA is selection of a preferred solution.

The Grid Enhancement Approach (GEA) as detailed in this TPR comprises both current System Planning knowledge relating to System Needs, and the progress of System Needs through the Decision Framework. The GEA discusses investment drivers, investment uncertainties, collective Needs, options for resolution and indicative investment costs. The accuracy of information in the GEA is commensurate with level of certainty of investment, timing of the System Need and level of OAA investigation completed.

Figure A-1 presents a high-level overview of the inter-related processes and information flows that comprise the E&D process.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Figure A-1 Overview of the Enhancement and Development Process



A.2 E&D process inputs: grid and asset capability

The inputs to the E&D process come from three processes that inform us about the existing capability of the grid both now and in the future (the three boxes on the left hand side of Figure A-1). Each process is described in more detail in the section below, with a specific focus on problems and opportunities within the E&D portfolio.

A.2.1 Annual Transmission Planning Process

The Annual Transmission Planning Process assesses the existing grid for potential capacity and service level problems and opportunities over a 15 year planning period, in accordance with the Grid Reliability Standards[1] and our Transmission System Planning Criteria.

This process uses load forecasts, generation forecasts and the current power system configuration (modelled in DIgSILENT Powerfactory) to identify the problems and opportunities relating to grid capability over the forecast period. Other environmental information that can impact the need for changes in grid capability is considered, such as customer development plans and step increases or decreases in load or generation connections.

There are several outputs from the Annual Transmission Planning Process:

- Regulatory reporting through the Grid Reliability Report (GRR), Grid Economic Investment Report (GEIR) and publication of 10 year forecast fault levels.
- The publication of current and forecast grid capability through the TPR.
- Identification of problems and opportunities that may result in Major Capital Projects (MCPs). This information is shared with the Commerce Commission.
- Where problems or opportunities impact connection assets that are paid for by customers, we share the information with those customers.
- Information relating to the problem or opportunity is passed to the Decision Framework. The System Need is confirmed, collected with other relevant System and Asset Needs and prioritised for investigation. The Asset Management Planning System (AMPS) will record and track the progress of all System Needs through the Decision Framework.

1 https://www.ea.govt.nz/documents/986/Code-Part-12-Transport-25-July-20221366027.3.pdf

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

The Annual Transmission Planning Process is repeated on an annual basis with updated inputs and provides the main input to the Decision Framework for E&D System Needs.

A.2.2 Customer Investment Process

Customer-initiated investments are identified through three broad areas:

- Customers requesting connection or changes to existing connections (changes to their connection assets, grid configuration, protection settings or metering). Customers raise problems and opportunities with us through Customer Technical Requests (CTRs) also known as Concept Assessments. These projects progress to the Decision Framework when there is a high level of certainty they will proceed.
- The Annual Transmission Planning Process may identify problems or opportunities associated with connection assets. If the customer elects to invest, it initiates this process using a CTR. If the customer chooses not to progress an investment we ensure the customer understands the risks associated with this course of action.
- When System Needs involving interconnection assets are being investigated through the OAA, options for resolving the problem or opportunity may include customer-funded, or partially customer-funded investment options. If a preferred solution is a customer funded investment, and the customer agrees to invest, a contract is signed by the customer and the investment is prioritised for delivery in the Decision Framework.

Information on customer-initiated investments is passed to the Decision Framework through the CTR process, and to the Annual Transmission Planning Process as inputs to assessments of grid capability.

A.2.3 Asset Feedback Process

The E&D Planning Process utilises our Asset Feedback Process to capture and record information from around the business relating to the performance and operation of the system and existing grid assets. This information is appropriately tagged to identify its source and who should act on it.

The Asset Feedback Process provides a central location for information to be recorded, stored and shared, ensuring visibility of the issues raised across the business. The issues entered are reviewed regularly, with those requiring further investigation being passed to the Decision Framework for consideration. The initiator of the entry in the Asset Feedback register is informed of the action taken.

A.3 E&D process: Decision Framework

The Decision Framework allows us to make effective, consistent, repeatable asset planning decisions that balance risk, service levels and investment. It is used to justify and prioritise all grid expenditure within our Asset Management Plan (AMP) including both capex and opex expenditure across the following:

- Asset replacements and refurbishments
- Grid enhancement and development
- Customer projects
- Maintenance activities
- Investigations required to deliver the Asset Management Plan.

The Decision Framework has four decision steps:

- Identify and prioritise Needs
- Apply OAA to each Need
- Prioritise Solutions
- Develop Asset Management Plan.

E&D problems and opportunities are inputs to the Decision Framework, transitioning to a System Need once the Need is confirmed.

Assessing E&D System Needs through the Decision Framework allows for related Needs to be grouped together. This ensures that expenditure on asset replacement, refurbishment and

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

maintenance costs are appropriately considered alongside grid capability requirements and expenditure. It also allows System Needs to be considered together where resolution of one issue may impact decisions made for another.

A.3.1 Options Assessment Approach

The Decision Framework incorporates the Options Assessment Approach (OAA) which specifies how problems and opportunities are investigated, the level of analysis being commensurate with the complexity of the issue, level of expenditure and timing of the Need. The outcome of the OAA is selection of a preferred solution.

The OAA has four sequential stages as shown in Figure A-2:

- Verify Need and Determine Assessment Level
- Identify Options
- Assess Options
- Identify Solution.

Figure A-2: Steps in Options Assessment Approach

The OAA involves undertaking analysis commensurate with the certainty of the System Need and the complexity of the issue. As a result, E&D System Needs may progress through the OAA process more than once, with higher level investigations informing the timing and prioritisation of future delivery level investigations, as well as increasing our knowledge of the System Need, its associated risk, and credible options and costs to resolve. Higher level OAA planning assessments also inform our capex forecasting and regulatory reset proposals.

If the outcome of a high level OAA planning assessment is to undertake a delivery level OAA at a future point in time, this information will be recorded in the Asset Management Planning System and work picked up again at the appropriate point in time.

Detailed delivery level OAA investigations result in a preferred solution being identified. All preferred solutions are prioritised according to the principles of the Decision Framework. The preferred solution will also be used to inform our capex forecasting and regulatory processes. It will also become an input to the assessment of future grid capability in the Annual Transmission Planning Process.

A.3.2 Grid Enhancement Approach

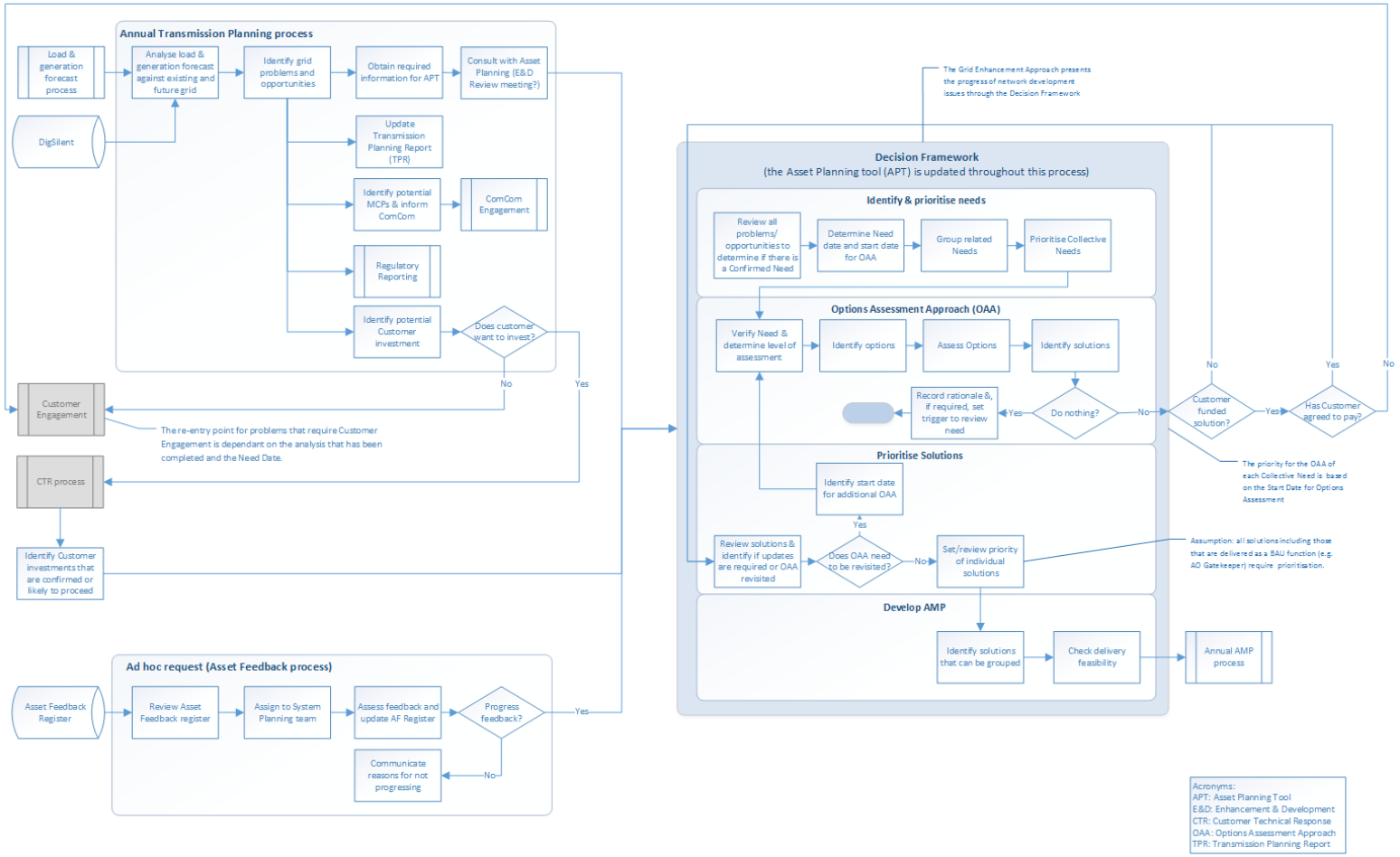
The Grid Enhancement Approach (GEA) is presented in this TPR to illustrate the progress of System Needs through the Decision Framework at a point in time. The GEA also discusses how investment drivers, uncertainties and interactions between System Needs impact our decision making and options analysis.

The GEA provides insight into decision making on E&D System Needs and proposals to address them. The accuracy of information in the GEA around options, costs and timing is commensurate with the OAA assessment level that has been completed. More detailed information with a higher degree of analysis will be available for System Needs that are more certain, or occur in the immediate and short term.

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

A.4 A3 Process diagram

The processes & tools that enable us to plan, prioritise & deliver the E&D Portfolio (detailed view)



Appendix B: Indicative forecast Fault Levels

This Appendix presents an update to the 10-year forecast fault levels report. The Connection Code contained in Schedule 8 of the Benchmark Agreement requires Transpower to publish, annually, a 10-year forecast of the fault levels at each customer point of service.[1]

Transpower last published the Ten-Year Forecast of Fault Levels in December 2024

B.1 Forecast fault levels calculation assumptions

Calculated fault levels are very dependent on the methodology and assumptions used in the calculation.

Minimum fault level calculations depend on generation and grid asset dispatch assumptions, and are generally used for ensuring the coordination of protection relays between asset owners. Protection coordination is very important for power system security and safety of people and assets. Accordingly, we will only publish the maximum fault levels, and encourage connected parties to contact us directly on matters concerning protection coordination.

Table B-3 and Table B-4 list the maximum three-phase fault current and maximum single-phase to ground fault current, respectively, for all of Transpower's transmission buses. Both tables list the 10-year forecast fault current for the existing grid configuration. The listed value is the initial RMS symmetrical short-circuit current (I_k'') as defined by IEC 60909 2001.

The 10-year forecast of maximum fault levels is based on information currently known to Transpower. The values in the tables should be regarded as indicative only. We have modelled committed future transmission upgrades and generation projects using the best information we have at this time. We know that towards the end of the 10-year period, there may be additional transmission upgrades and additional generation required to meet New Zealand's power and energy requirements. We cannot know exactly the nature or location of these future transmission upgrades and new generation. The maximum fault level at a bus[2] may also change where the number of supply transformers increases or transformers are replaced to meet load growth or provide supply security.

Therefore, the maximum short-circuit currents listed should not be relied upon for specifying short-circuit requirements for new substation equipment. **The forecast fault levels provide an early warning of when plant capability may be exceeded.**

Accordingly, while Transpower endeavours to forecast fault levels accurately, the levels may change for a number of reasons and Transpower does not accept liability for other parties' reliance on the fault values contained in the forecast. We encourage asset owners to consult with us for detailed information on maximum fault levels at specific sites relating to new equipment connection.

The Connection Code (5.1(h)) puts an obligation on Transpower and the customer to ensure that equipment connected to the grid does not cause the maximum short-circuit power and current limits in Appendix B of the Connection Code (see Table B-1) to be exceeded on or nearby to the grid. Note that the fault levels at some buses are already near or in excess of these values.

1 Connection Code clause 4.2(g): to publish annually a 10-year forecast of the expected minimum and maximum fault level at each customer point of service.

2 This report includes the maximum fault level for all Transpower's transmission buses, which includes customer points of service.

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Table B-1: Maximum short-circuit power and current limits

Nominal voltage (kV)	Maximum short-circuit power and current limits	
	MVA	kA
220	12,000	31.5
110	6,000	31.5
66	1,800	16
50	1,350	16
33	1,400	25
22	950	25
11	475	25

The fault levels have been calculated on the following basis:

- All generating units and all transmission assets are assumed to be in service.
- A full representation of the existing transmission grid, directly connected generation and large embedded generation known to us is assumed.
- Motor loads are not modelled.
- The fault impedance is zero ohms.
- Future committed changes to the power system including transmission upgrades and new generation are detailed in the 2025 Transmission Planning Report. We represented new transmission lines in the model with electrical parameters estimated from existing lines of the same conductor type. We have represented committed generation in our power system model with their electrical parameters scaled from the latest example of their type that is known to us. We based the timing of these connections on open discussion with the asset owner, and information from the generator's website. The actual commissioning dates may vary.

Table B-2 sets out our assumption of fault current contributions from future generation.

Table B-2: Maximum fault current contributions from future generation

Category	Technology / application	Fault current contribution (per unit of capacity)
Thermal	Coal, diesel, combined cycle gas turbine, open cycle gas turbine, gas-fired peaker, cogeneration	2.87
Thermal	Geothermal	3.60
Hydro	Peak hydro, stored hydro, run of river	3.67
Wind	Wind	2.00
Solar	Photovoltaic	2.00
BESS	Batteries	2.00
Load	Interruptible load, demand side response	0.00

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

B.2 Ten year forecast of maximum three-phase fault levels

Table B-3: Ten year forecast of maximum three-phase fault levels (kA)

Grid exit point	Transmission bus	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
NORTHLAND												
Bream Bay	33 kV	14.2	18.7	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Bream Bay	220 kV	6.2	6.4	6.8	6.8	6.8	6.9	6.9	6.9	6.9	6.9	6.9
Marsden	110 kV	9.0	9.3	9.9	9.9	9.9	10.0	10.0	10.0	10.0	10.0	10.0
Marsden	220 kV	6.2	6.5	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.0	7.0
Maungatapere	110 kV	7.8	8.0	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.8	8.8
Maungaturoto	33 kV	5.0	5.6	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Maungaturoto	110 kV (T1)	4.3	4.3	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Maungaturoto	110 kV (T2)	4.3	4.3	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Wellsford	33 kV	7.5	7.5	7.6	7.6	7.6	7.7	7.7	7.7	7.7	7.7	7.6
Wellsford	110 kV (T1)	4.1	4.2	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Wellsford	110 kV (T2)	4.1	4.2	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
AUCKLAND												
Albany	33 kV	20.8	21.1	21.2	21.2	21.2	21.3	21.3	21.3	21.3	21.3	21.3
Albany	110 kV	7.5	7.7	8.0	8.0	8.0	8.1	8.1	8.1	8.1	8.1	8.1
Albany	220 kV	13.6	14.3	14.7	14.7	14.7	15.2	15.2	15.2	15.2	15.2	15.2
Bombay	110 kV	9.4	9.5	9.5	9.5	9.5	9.6	9.6	9.6	9.6	9.6	9.6
Drury	220 kV	14.2	14.7	14.9	14.9	14.9	15.2	15.2	15.2	15.2	15.2	15.2
Glenbrook	33 kV (T4/T5)	15.9	16.0	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	15.8
Glenbrook	33 kV (T6)	20.5	20.6	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.5
Glenbrook	220 kV	11.0	11.3	11.5	11.5	11.5	11.6	11.6	11.6	11.6	11.6	10.5
Henderson	33 kV	19.0	19.2	19.3	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4
Henderson	110 kV	20.4	21.1	21.6	21.7	21.7	22.3	22.3	22.3	22.3	22.3	22.3
Henderson	220 kV	14.0	14.7	15.1	15.2	15.2	15.9	15.9	15.9	15.9	15.9	15.9
Hepburn Road	33 kV	21.3	21.5	21.7	21.7	21.7	21.8	21.8	21.8	21.8	21.8	21.8
Hepburn Road	110 kV	19.0	19.7	20.1	20.1	20.1	20.6	20.6	20.6	20.6	20.6	20.6
Hobson Street	110 kV	14.4	14.8	15.0	15.0	15.0	15.2	15.2	15.2	15.2	15.2	15.2
Hobson Street	220 kV	15.3	16.2	16.7	16.7	16.7	17.2	17.2	17.2	17.2	17.2	17.2
Huapai	220 kV	12.6	13.2	13.7	13.7	13.7	14.2	14.2	14.2	14.2	14.2	14.2
Mangere	33 kV	15.0	15.1	15.2	15.2	15.2	15.3	15.3	15.3	15.3	15.3	15.3
Mangere	110 kV	18.0	18.6	18.9	18.9	18.9	19.3	19.3	19.3	19.3	19.3	19.3
Mount Roskill	22 kV	25.1	25.3	25.5	25.5	25.5	25.6	25.6	25.6	25.6	25.6	25.6
Mount Roskill	110 kV	18.4	19.0	19.3	19.3	19.3	19.8	19.8	19.8	19.8	19.8	19.8
Otahuhu	22 kV	19.1	19.2	19.2	19.2	19.2	19.3	19.3	19.3	19.3	19.3	19.3
Otahuhu	110 kV	19.3	20.0	20.3	20.3	20.3	20.8	20.8	20.8	20.8	20.8	20.8
Otahuhu	220 kV	18.5	19.7	20.3	20.3	20.3	20.9	20.9	20.9	20.9	20.9	20.9
Pakuranga	33 kV	24.3	24.6	24.8	24.8	24.8	24.9	24.9	24.9	24.9	24.9	24.9
Pakuranga	220 kV	17.4	18.8	19.3	19.3	19.3	19.9	19.9	19.9	19.9	19.9	19.9
Penrose	22 kV	20.0	20.1	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2
Penrose	33 kV	28.6	29.0	29.2	29.2	29.2	29.4	29.4	29.4	29.4	29.4	29.4
Penrose	110 kV	14.9	15.4	15.6	15.6	15.6	15.8	15.8	15.8	15.8	15.8	15.8
Penrose	220 kV	16.6	17.6	18.1	18.1	18.1	18.7	18.7	18.7	18.7	18.7	18.7
Silverdale	33 kV	18.3	18.5	18.6	18.6	18.6	18.7	18.7	18.7	18.7	18.7	18.7
Silverdale	220 kV (T1)	9.0	9.3	9.4	9.4	9.4	9.6	9.6	9.6	9.6	9.6	9.6
Silverdale	220 kV (T2)	9.0	9.3	9.4	9.4	9.4	9.6	9.6	9.6	9.6	9.6	9.6
Southdown	220 kV	15.5	16.3	16.7	16.7	16.7	17.2	17.2	17.2	17.2	17.2	17.2
Takanini	33 kV	17.4	17.5	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
Takanini	220 kV (T5)	15.1	15.8	16.1	16.2	16.2	16.5	16.5	16.5	16.5	16.5	16.5
Takanini	220 kV (T8)	15.0	15.6	15.9	15.9	15.9	16.3	16.3	16.3	16.3	16.3	16.3
Wairau Road	33 kV	15.7	22.3	23.0	23.0	23.0	23.1	23.1	23.1	23.1	23.1	22.6
Wairau Road	220 kV	14.1	14.9	15.3	15.3	15.3	15.8	15.8	15.8	15.8	15.8	14.2
Wiri	33 kV	18.1	18.3	18.4	18.4	18.4	18.5	18.5	18.5	18.5	18.5	18.1
Wiri	110 kV (T1)	13.4	13.7	13.9	13.9	13.9	14.1	14.1	14.1	14.1	14.1	13.3

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Wiri	110 kV (T2)	13.3	13.6	13.8	13.8	13.8	14.0	14.0	14.0	14.0	14.0	13.3
WAIKATO												
Arapuni	110 kV (North Bus)	12.5	12.3	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Arapuni	110 kV (South Bus)											
Atiamuri	220 kV	16.0	16.3	16.3	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Cambridge	11 kV	22.7	22.7	22.9	22.9	22.9	23.0	23.0	23.0	23.0	23.0	23.0
Cambridge	110 kV (T3)	8.2	8.3	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Cambridge	110 kV (T4)	8.2	8.3	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Hamilton	11 kV	13.3	13.3	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
Hamilton	33 kV	21.2	21.2	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4
Hamilton	110 kV	13.7	14.0	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Hamilton	220 kV	13.1	13.3	13.7	13.7	13.7	13.8	13.8	13.8	13.8	13.8	13.8
Hangatiki	33 kV	5.5	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Hangatiki	110 kV	5.8	5.5	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Hautapu	33 kV	16.3	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Hautapu	220 kV	6.5	6.5	6.5	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.6
Hinuera	33 kV	7.2	7.2	7.2	7.2	7.2	7.3	7.3	7.3	7.3	7.3	7.3
Hinuera	110 kV	4.0	4.0	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Huntly	11 kV	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Huntly	33 kV	15.1	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7
Huntly	220 kV	26.0	26.2	26.6	26.6	26.6	26.9	26.9	26.9	26.9	26.9	26.9
Karapiro	110 kV	8.8	8.9	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Kinleith	11 kV (T7/8)	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
Kinleith	11 kV (T6)	9.1										
Kinleith	11 kV (T5)	35.5	35.4	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5	35.5
Kinleith	33 kV	5.6	5.6	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Kinleith	110 kV	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Kopu	66 kV	2.7	2.7	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Kopu	110 kV (T3)	2.4	2.4	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Kopu	110 kV (T4)	2.4	2.4	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Lichfield	110 kV (T1)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Lichfield	110 kV (T2)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Maraetai	220 kV	24.0	24.1	24.4	24.5	24.5	24.6	24.6	24.6	24.6	24.6	24.6
Ohakuri	220 kV	15.1	15.3	15.3	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
Ohinewai	220 kV	23.8	23.1	23.5	23.5	23.5	23.8	23.8	23.8	23.8	23.8	23.8
Piako	110 kV	5.3	5.4	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Te Awamutu	11 kV	20.5	20.4	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5	20.5
Te Awamutu	110 kV	5.6	5.5	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Te Kowhai	33 kV	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
Te Kowhai	220 kV	9.3	9.3	9.3	9.3	9.3	9.4	9.4	9.4	9.4	9.4	9.4
Waihou	33 kV	10.4	10.4	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.0
Waihou	110 kV	5.2	5.3	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Waikino	33 kV	7.6	7.6	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Waikino	110 kV	4.0	4.1	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Waipapa	220 kV	14.2	14.3	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.2
Whakamaru	220 kV	31.3	31.4	31.9	32.2	32.2	32.3	32.3	32.3	32.3	32.3	30.8
BAY OF PLENTY												
Aniwhenua	110 kV	4.9	4.8	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Edgecumbe	33 kV	17.8	17.8	17.8	17.9	17.9	17.9	17.9	17.9	17.9	17.9	17.9
Edgecumbe	110 kV	5.9	5.6	4.0	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Edgecumbe	220 kV	8.7	8.7	8.6	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Kaitimako	33 kV	7.5	7.5	7.5	7.5	7.5	7.7	7.7	7.8	7.8	7.8	7.8
Kaitimako	110 kV	8.7	8.7	8.7	8.8	8.8	9.9	10.0	10.0	10.0	10.0	10.0
Kaitimako	220 kV	7.2	7.2	7.2	7.3	7.3	7.3	7.4	7.4	7.4	7.4	7.4
Kawerau	11 kV (T2/T5)	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
Kawerau	11 kV (T6)	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3
Kawerau	11 kV (T7)											
Kawerau	11 kV (T8)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

Kawerau	11 kV (T9)	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
Kawerau	110 kV	12.9	12.9	12.9	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Kawerau	220 kV	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Matahina	110 kV	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Mt Maunganui	33 kV	10.9	10.9	10.9	10.9	10.9	11.3	11.4	11.4	11.4	11.4	11.4
Mt Maunganui	110 kV	7.0	7.0	7.0	7.0	7.0	7.7	7.8	7.8	7.8	7.8	7.8
Okere	110 kV	7.2	7.1	6.9	7.1	7.1	7.2	7.5	7.6	7.6	7.6	7.6
Owhata	11 kV	12.3	12.3	12.1	12.2	12.2	12.2	12.3	12.3	12.3	12.3	12.3
Owhata	110 kV	5.5	5.4	5.1	5.3	5.3	5.3	5.5	5.5	5.5	5.5	5.5
Rotorua	11 kV	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
Rotorua	33 kV	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Rotorua	110 kV (Tarukenga 1)	6.4	6.4	6.4	6.4	6.4	6.5	6.5	6.5	6.5	6.5	6.5
Rotorua	110 kV (Tarukenga 2)	6.7	6.7	6.7	6.7	6.7	6.8	6.8	6.8	6.8	6.8	6.8
Tarukenga	11 kV	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Tarukenga	110 kV	11.1	11.1	11.1	11.2	11.2	11.2	11.3	11.3	11.3	11.3	11.3
Tarukenga	220 kV	11.1	11.1	11.2	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3
Tauranga	11 kV	14.2	14.2	14.2	14.2	14.2	14.5	14.5	14.5	14.5	14.5	14.5
Tauranga	33 kV	13.1	13.1	13.1	13.1	13.1	13.6	13.7	13.7	13.7	13.7	13.7
Tauranga	110 kV	8.1	8.1	8.1	8.1	8.1	9.0	9.2	9.2	9.2	9.2	9.2
Te Matai	33 kV	9.8	9.8	9.7	9.8	9.8	10.0	10.1	10.2	10.2	10.2	10.2
Te Matai	110 kV	6.3	6.3	6.2	6.3	6.3	6.5	6.7	7.0	7.0	7.0	7.0
Waiotahe	11 kV	8.1										
Waiotahe	33 kV	5.3	6.0	5.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Waiotahe	110 kV	2.7	2.4	2.0	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
CENTRAL NORTH ISLAND												
Aratiatia	220 kV	21.5	22.0	21.8	21.8	21.8	21.9	21.9	21.9	21.9	21.9	21.9
Bunnythorpe	33 kV	17.7	17.7	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8
Bunnythorpe	110 kV	11.9	11.4	11.5	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Bunnythorpe	220 kV	15.6	15.5	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7
Dannevirke	11 kV	16.5	16.4	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
Dannevirke	110 kV (T1)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Dannevirke	110 kV (T2)	4.1	4.0	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Linton	33 kV	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Linton	220 kV (T2)	10.8	10.7	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Linton	220 kV (T3)	11.7	11.6	11.7	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
Mangahao	33 kV	8.9	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Mangahao	110 kV (T3)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Mangahao	110 kV (T4)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Mangamaire	33 kV	4.7	4.6	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Mangamaire	110 kV	5.0	5.0	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Marton	33 kV	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Marton	110 kV (T1)	5.3	5.2	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Marton	110 kV (T2)	5.3	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Mataroa	33 kV	3.1	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Mataroa	110 kV	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
National Park	33 kV	2.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
National Park	110 kV	1.7	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Nga Awa Purua	220 kV	20.1	20.9	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Ngatamariki	220 kV	13.8	14.5	14.4	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.4
Ohaaki	220 kV	16.1	16.5	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4
Ohakune	11 kV	7.2	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Ohakune	110 kV	1.8	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Ongarue	33 kV	2.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ongarue	110 kV	2.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Poihipi	220 kV	22.9	23.4	23.7	23.7	23.7	23.8	23.8	23.8	23.8	23.8	23.8
Rangipo	220 kV	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Tangiwai	11 kV	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9
Tangiwai	220 kV	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Tararua Central	220 kV	10.9	10.8	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Te Mihi	220 kV	25.7	26.3	26.6	26.7	26.7	26.8	26.8	26.8	26.8	26.8	26.8

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Tokaanu	33 kV	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Tokaanu	220 kV	12.8	13.6	14.4	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Waipawa	11 kV	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Waipawa	33 kV	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Waipawa	110 kV (T1)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Waipawa	110 kV (T2)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Wairakei	33 kV	22.6	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Wairakei	220 kV	28.8	29.8	29.3	29.4	29.4	29.5	29.5	29.5	29.5	29.5	29.0
Woodville	11 kV	10.2	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Woodville	110 kV	8.1	7.9	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
TARANAKI												
Brunswick	33 kV	9.1	9.1	9.1	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Brunswick	220 kV	11.4	11.4	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Carrington St	33 kV	13.1	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Carrington St	110 kV	11.1	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Hawera	33 kV (T1/T2)	4.8	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Hawera	33 kV (T3)	8.4	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Hawera	110 kV	8.7	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Huirangi	33 kV	12.8	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7
Huirangi	110 kV	8.9	8.7	8.7	8.7	8.7	8.8	8.8	8.8	8.8	8.8	8.8
Junction Road Tee	110 kV	10.4	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Kapuni Tee	110 kV	6.6	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
McKee Tee	110 kV	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Motunui	11 kV (T3)	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9
Motunui	11 kV (T4)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Motunui	110 kV	8.7	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Opunake	33 kV	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Opunake	110 kV (T4)	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Opunake	110 kV (T5)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Stratford	33 kV	12.1	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Stratford	110 kV	17.2	16.5	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
Stratford	220 kV	14.1	13.9	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Taumarunui	220 kV	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Wanganui	33 kV	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Wanganui	110 kV	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Waverley	11 kV	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Waverley	110 kV	5.6	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
HAWKES BAY												
Fernhill	33 kV	13.3	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
Fernhill	110 kV	9.5	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Harapaki	220 kV	8.6	9.5	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4
Redclyffe	33 kV	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
Redclyffe	110 kV	11.6	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Redclyffe	220 kV	8.8	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Tauhara	220 kV	21.8	22.9	22.7	22.7	22.7	22.8	22.8	22.8	22.8	22.8	22.8
Tuai	110 kV	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Whakatu	33 kV	13.5	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Whakatu	220 kV (T3)	7.1	7.3	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Whakatu	220 kV (T4)	7.1	7.3	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Whirinaki	11 kV (T1)	23.6	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7	23.7
Whirinaki	11 kV (T2)	23.4	23.6	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5	23.5
Whirinaki	11 kV (T3)	23.9	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1
Whirinaki	220 kV	9.3	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.6
WELLINGTON												
Central Park	11 kV (T11)	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Central Park	11 kV (T12)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Central Park	33 kV	19.9	19.9	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Central Park	110 kV (T3)	8.2	8.1	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

Central Park	110 kV (T4)	8.1	8.1	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
Central Park	110 kV (T5)	12.2	12.2	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3
Gracefield	33 kV	11.5	11.5	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Gracefield	110 kV (T5)	10.0	10.0	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Gracefield	110 kV (T6)	10.0	10.0	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Greytown	33 kV	3.8	3.8	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Greytown	110 kV (T2)	5.8	5.8	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Greytown	110 kV (T3)	5.8	5.8	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Haywards	11 kV	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Haywards	33 kV	7.3	7.3	7.3	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Haywards	110 kV	22.3	22.3	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Haywards	220 kV	13.4	13.3	13.5	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Kaiwharawhara	11 kV (T1)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Kaiwharawhara	11 kV (T3)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Kaiwharawhara	110 kV (T1)	12.1	12.1	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
Kaiwharawhara	110 kV (T3)	12.1	12.1	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
Masterton	33 kV	8.9	8.9	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Masterton	110 kV	5.8	5.7	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Melling	11 kV	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
Melling	33 kV	9.6	9.6	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
Melling	110 kV (T1/T3)	10.4	10.4	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Melling	110 kV (T2/T4)	10.6	10.6	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Paraparaumu	33 kV	21.6	21.5	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6	21.6
Paraparaumu	220 kV (T1)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Paraparaumu	220 kV (T2)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Pauatahanui	33 kV	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Pauatahanui	110 kV (T1)	10.5	10.5	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
Pauatahanui	110 kV (T2)	10.5	10.5	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
Takapu Road	33 kV	15.2	15.2	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Takapu Road	110 kV	18.0	18.0	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3
Upper Hutt	33 kV	9.8	9.8	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Upper Hutt	110 kV	15.6	15.6	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1
West Wind	110 kV (Circuit 2)	9.2	9.2	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
West Wind	110 kV (Circuit 3)	9.3	9.3	9.3	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.3
Wilton	33 kV	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9
Wilton	110 kV	15.4	15.4	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Wilton	220 kV	9.9	9.9	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
NELSON-MARLBOROUGH												
Argyle	110 kV	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Blenheim	33 kV	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Blenheim	110 kV	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Stoke	33 kV	12.3	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
Stoke	66 kV	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Stoke	110 kV	4.4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Stoke	220 kV	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
WEST COAST												
Arthurs Pass	11 kV	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Arthurs Pass	66 kV	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Atarau	110 kV	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Castle Hill	11 kV	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Castle Hill	66 kV	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Dobson	33 kV	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Dobson	66 kV	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Dobson	T11 (110 kV)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Dobson	T12 (110 kV)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Greymouth	66 kV	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Hokitika	66 kV	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Inangahua	110 kV	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Kikiwa	11 kV	27.4	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7
Kikiwa	110 kV	5.1	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Kikiwa	220 kV	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Kumara	66 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Murchison	11 kV	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Murchison	110 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Orowaiti	110 kV (Circuit 1)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Orowaiti	110 kV (Circuit 2)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Otira	11 kV	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Otira	66 kV	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Reefton	110 kV (Circuit 1)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Reefton	110 kV (Circuit 2)	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CANTERBURY												
Ashburton	66 kV	12.1	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3
Ashburton	220 kV	8.2	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Ashley	11 kV (T5)	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Ashley	11 kV (T3)											
Ashley	66 kV	5.2	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Bromley	66 kV	10.1	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Bromley	220 kV	6.1	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Coleridge	11 kV	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Coleridge	66 kV	4.1	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Culverden	33 kV	7.2	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Culverden	66 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Culverden	220 kV (T22)	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Culverden	220 kV (T23)	3.4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Hororata	33 kV	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Hororata	66 kV	4.5	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Islington	33 kV	15.1	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Islington	66 kV	16.1	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8
Islington	220 kV	7.4	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Kaiapoi	11 kV	13.1	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3
Kaiapoi	66 kV	5.7	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Kimberley	66 kV (T1)	3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Kimberley	66 kV (T2)	3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Southbrook	66 kV	7.3	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Waipara	33 kV	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Waipara	66 kV	8.5	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Waipara	220 kV (T12)	4.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Waipara	220 kV (T13)	4.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
SOUTH CANTERBURY												
Albury	11 kV	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Albury	110 kV	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Aviemore	220 kV	18.2	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3
Bells Pond	110 kV	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Benmore	220 kV	23.4	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6
Black Point	110 kV	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Livingstone	220 kV	10.1	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Oamaru	33 kV	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
Oamaru	110 kV (T1)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Oamaru	110 kV (T2)	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Ohau A	220 kV	20.2	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
Ohau B	220 kV	22.1	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Ohau C	220 kV	19.5	19.6	19.7	19.7	19.7	19.7	19.7	19.7	19.7	19.7	19.7
Studholme	11 kV	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Studholme	110 kV	4.0	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

Tekapo A	11 kV	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Tekapo A	33 kV	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Tekapo A	110 kV	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Tekapo B	220 kV	12.9	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
Temuka	33 kV	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Temuka	110 kV (T1)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Temuka	110 kV (T2)	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Timaru	11 kV	17.2	17.3	17.3	17.3	17.3	17.3	17.3	17.3	17.3	17.3	17.3
Timaru	110 kV	9.9	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Timaru	220 kV (T5)	5.8	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Timaru	220 kV (T8)	5.8	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Twizel	33 kV	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Twizel	220 kV	24.0	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4	24.4
Waitaki	11 kV (T21)	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
Waitaki	11 kV (T22)	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8
Waitaki	33 kV (T28)	0	0	0	0	0	0	0	0	0	0	0
Waitaki	220 kV	15.2	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
OTAGO-SOUTHLAND												
Balclutha	33 kV	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Balclutha	110 kV	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Berwick	110 kV	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Brydone	11 kV	14.3	14.3	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
Brydone	110 kV	5.6	5.6	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Clyde	33 kV	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Clyde	220 kV	16.9	16.9	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Cromwell	33 kV	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Cromwell	110 kV (T5A/B)	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Cromwell	110 kV (T8)	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4
Cromwell	220 kV (T5A/B)	10.6	10.6	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Cromwell	220 kV (T8)	10.6	10.6	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Edendale	33 kV	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Edendale	110 kV			7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Edendale	110 kV	4.7	4.7	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Frankton	33 kV	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Frankton	110 kV (T2)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Frankton	110 kV (T4)	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Gore	33 kV	14.8	14.8	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Gore	110 kV	9.2	9.2	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Gore	220 kV (T11)	6.0	6.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Gore	220 kV (T12)	6.0	6.0	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Halfway Bush	33 kV	22.0	22.0	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1
Halfway Bush	110 kV	7.0	7.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Halfway Bush	220 kV	8.2	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Invercargill	33 kV	17.9	17.9	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1
Invercargill	110 kV	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Invercargill	220 kV	10.7	10.7	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Manapouri	220 kV	13.3	13.3	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
North Makarewa	33 kV	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
North Makarewa	220 kV	11.0	11.0	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
Naseby	33 kV	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Naseby	220 kV	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Roxburgh	110 kV	11.1	11.1	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
Roxburgh	220 kV	17.3	17.4	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
South Dunedin	33 kV	18.0	18.0	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2
South Dunedin	220 kV	7.7	7.7	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Three Mile Hill	220 kV	8.7	8.7	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Tiwai	220 kV	9.6	9.6	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

B.3 Ten year forecast of maximum single-phase to ground fault levels

Table B-4: Ten year forecast of maximum single-phase to ground fault levels (kA)

Grid exit point	Transmission bus	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
NORTHLAND												
Bream Bay	33 kV	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Bream Bay	220 kV	6.1	6.2	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Marsden	110 kV	9.9	10.0	10.2	10.2	10.2	10.3	10.3	10.3	10.3	10.3	10.3
Marsden	220 kV	6.3	6.4	6.5	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.6
Maungatapere	110 kV	6.0	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Maungaturoto	33 kV	5.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Maungaturoto	110 kV (T1)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Maungaturoto	110 kV (T2)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Wellsford	33 kV	8.4	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.4
Wellsford	110 kV (T1)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Wellsford	110 kV (T2)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
AUCKLAND												
Albany	33 kV	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Albany	110 kV	8.8	9.0	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Albany	220 kV	16.7	17.4	17.6	17.6	17.6	17.9	17.9	17.9	17.9	17.9	17.9
Bombay	110 kV	10.9	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Drury	220 kV	14.1	14.4	14.5	14.5	14.5	14.6	14.6	14.6	14.6	14.6	14.6
Glenbrook	33 kV (T4/T5)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Glenbrook	33 kV (T6)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Glenbrook	220 kV	10.9	11.1	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	10.4
Henderson	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Henderson	110 kV	23.3	24.0	24.2	24.2	24.3	24.8	24.8	24.7	24.7	24.8	24.8
Henderson	220 kV	15.2	15.7	15.9	15.9	15.9	16.7	16.7	16.7	16.7	16.7	16.7
Hepburn Road	33 kV	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Hepburn Road	110 kV	18.1	18.4	18.6	18.6	18.8	19.1	19.1	18.7	18.7	18.8	18.8
Hobson Street	110 kV	17.0	17.4	17.5	17.5	17.5	17.6	17.6	17.5	17.5	17.5	17.5
Hobson Street	220 kV	18.8	19.7	20.0	20.0	20.0	20.3	20.3	20.3	20.3	20.3	20.3
Huapai	220 kV	13.2	13.6	13.7	13.8	13.8	14.1	14.1	14.1	14.1	14.1	14.1
Mangere	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Mangere	110 kV	17.3	17.7	17.8	17.8	17.8	18.0	18.0	17.9	17.9	17.9	17.9
Mount Roskill	22 kV	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Mount Roskill	110 kV	16.5	16.9	17.0	17.0	17.1	17.2	17.2	17.1	17.1	17.2	17.2
Otahuhu	22 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Otahuhu	110 kV	22.4	23.0	23.2	23.2	23.2	23.4	23.4	23.4	23.4	23.4	23.4
Otahuhu	220 kV	21.9	23.0	23.3	23.3	23.3	23.6	23.6	23.6	23.6	23.6	23.6
Pakuranga	33 kV	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Pakuranga	220 kV	21.3	22.7	22.9	23.0	23.0	23.3	23.3	23.2	23.2	23.2	23.2
Penrose	22 kV	12.8	12.8	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Penrose	33 kV	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Penrose	110 kV	17.7	18.1	18.2	18.3	18.3	18.4	18.4	18.3	18.3	18.3	18.3
Penrose	220 kV	20.3	21.4	21.7	21.7	21.7	22.0	22.0	22.0	22.0	22.0	22.0
Silverdale	33 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silverdale	220 kV (T1)	9.2	9.4	9.4	9.4	9.4	9.5	9.5	9.5	9.5	9.5	9.0
Silverdale	220 kV (T2)	9.1	9.3	9.4	9.4	9.4	9.5	9.5	9.5	9.5	9.5	8.9
Southdown	220 kV	16.0	16.6	16.7	16.8	16.8	17.0	17.0	17.0	17.0	17.0	15.3
Takanini	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Takanini	220 kV (T5)	15.5	16.0	16.1	16.1	16.1	16.2	16.2	16.2	16.2	16.2	14.5
Takanini	220 kV (T8)	15.1	15.6	15.7	15.7	15.7	15.8	15.8	15.8	15.8	15.8	14.2
Wairau Road	33 kV	14.6	17.8	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	17.8
Wairau Road	220 kV	17.4	18.1	18.4	18.4	18.4	18.7	18.7	18.7	18.7	18.7	16.7
Wiri	33 kV	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

Wiri	110 kV (T1)	11.8	12.0	12.0	12.0	12.1	12.1	12.1	12.1	12.1	12.1	11.6
Wiri	110 kV (T2)	11.7	11.9	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	11.5
WAIKATO												
Arapuni	110 kV (North Bus)	12.9	12.7	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8
Arapuni	110 kV (South Bus)											
Atiamuri	220 kV	15.2	15.4	15.4	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Cambridge	11 kV	24.6	24.6	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
Cambridge	110 kV (T3)	7.5	7.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Cambridge	110 kV (T4)	7.5	7.5	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Hamilton	11 kV	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Hamilton	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Hamilton	110 kV	14.9	15.0	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Hamilton	220 kV	12.3	12.4	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Hangatiki	33 kV	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Hangatiki	110 kV	4.1	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Hautapu	33 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hautapu	220 kV	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Hinuera	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Hinuera	110 kV	3.0	3.0	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Huntly	11 kV	17.7	17.7	17.7	17.7	17.7	17.8	17.8	17.8	17.8	17.8	17.8
Huntly	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Huntly	220 kV	29.1	28.8	29.0	29.1	29.1	29.2	29.2	29.2	29.2	29.2	29.2
Karapiro	110 kV	9.5	9.5	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Kinleith	11 kV (T7/8)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Kinleith	11 kV (T6)	0.6										
Kinleith	11 kV (T5)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kinleith	33 kV	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Kinleith	110 kV	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Kopu	66 kV	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Kopu	110 kV (T3)	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Kopu	110 kV (T4)	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Lichfield	110 kV (T1)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Lichfield	110 kV (T2)	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Maraetai	220 kV	24.0	24.4	24.5	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6
Ohakuri	220 kV	14.5	14.6	14.5	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Ohinewai	220 kV	19.6	18.2	19.2	19.2	19.2	19.3	19.3	19.3	19.3	19.3	19.3
Piako	110 kV	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Te Awamutu	11 kV	23.3	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2
Te Awamutu	110 kV	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Te Kowhai	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Te Kowhai	220 kV	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	7.8
Waihou	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Waihou	110 kV	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Waikino	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Waikino	110 kV	2.0	2.0	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Waipapa	220 kV	12.4	12.5	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.4
Whakamaru	220 kV	30.5	32.0	32.1	32.3	32.3	32.3	32.3	32.3	32.3	32.3	31.0
BAY OF PLENTY												
Aniwhenua	110 kV	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Edgecumbe	33 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Edgecumbe	110 kV	6.1	6.0	4.2	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Edgecumbe	220 kV	8.7	8.7	8.2	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Kaitimako	33 kV	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Kaitimako	110 kV	10.6	10.6	10.6	10.6	10.6	12.2	12.3	12.4	12.4	12.4	12.4
Kaitimako	220 kV	7.0	7.0	7.0	7.0	7.0	7.6	7.6	7.6	7.6	7.6	7.6
Kawerau	11 kV (T2/T5)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Kawerau	11 kV (T6)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Kawerau	11 kV (T7)											
Kawerau	11 kV (T8)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Kawerau	11 kV (T9)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Kawerau	110 kV	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7
Kawerau	220 kV	9.6	9.6	9.5	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Matahina	110 kV	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Mt Maunganui	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Mt Maunganui	110 kV	7.0	7.1	7.0	7.1	7.1	7.7	7.8	7.8	7.8	7.8	7.8
Okere	110 kV	5.7	5.7	5.6	5.6	5.6	5.7	5.9	5.9	5.9	5.9	5.9
Owhata	11 kV	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2	2.2
Owhata	110 kV	3.9	3.9	3.8	3.8	3.8	3.8	3.9	3.9	3.9	3.9	3.9
Rotorua	11 kV	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Rotorua	33 kV	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Rotorua	110 kV (Tarukenga 1)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Rotorua	110 kV (Tarukenga 2)	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Tarukenga	11 kV	10.8	10.8	10.8	10.8	10.8	10.8	10.9	10.9	10.9	10.9	10.9
Tarukenga	110 kV	12.9	12.9	12.9	12.9	12.9	12.9	13.0	13.1	13.1	13.1	13.0
Tarukenga	220 kV	10.2	10.2	10.2	10.2	10.2	10.4	10.4	10.4	10.4	10.4	10.3
Tauranga	11 kV	15.1	15.1	15.1	15.1	15.1	15.3	15.3	15.3	15.3	15.3	15.3
Tauranga	33 kV	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Tauranga	110 kV	9.4	9.4	9.4	9.4	9.4	10.5	10.6	10.7	10.7	10.7	10.6
Te Matai	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Te Matai	110 kV	5.1	5.1	5.1	5.1	5.1	5.2	5.3	5.5	5.5	5.5	5.5
Waiotahe	11 kV	9.7										
Waiotahe	33 kV	0.9	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Waiotahe	110 kV	3.1	3.0	2.6	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
CENTRAL NORTH ISLAND												
Aratiatia	220 kV	20.5	20.9	20.2	20.2	20.2	20.3	20.3	20.3	20.3	20.3	20.3
Bunnythorpe	33 kV	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Bunnythorpe	110 kV	12.9	12.4	12.4	12.5	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Bunnythorpe	220 kV	14.1	13.9	14.0	14.1	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Dannevirke	11 kV	18.1	18.0	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1
Dannevirke	110 kV (T1)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Dannevirke	110 kV (T2)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Linton	33 kV	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Linton	220 kV (T2)	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Linton	220 kV (T3)	10.6	10.5	10.5	10.6	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Mangahao	33 kV	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Mangahao	110 kV (T3)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Mangahao	110 kV (T4)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Mangamaire	33 kV	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Mangamaire	110 kV	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Marton	33 kV	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Marton	110 kV (T1)	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Marton	110 kV (T2)	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Mataroa	33 kV	3.7	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Mataroa	110 kV	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
National Park	33 kV	2.2	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
National Park	110 kV	1.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Nga Awa Purua	220 kV	18.7	19.6	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
Ngatamariki	220 kV	12.6	13.5	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.3
Ohaaki	220 kV	12.3	12.5	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4
Ohakune	11 kV	8.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2
Ohakune	110 kV	1.2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Ongarue	33 kV	2.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Ongarue	110 kV	1.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Poihipi	220 kV	21.9	22.4	22.5	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6
Rangipo	220 kV	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Tangiwai	11 kV	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2
Tangiwai	220 kV	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Tararua Central	220 kV	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

Te Mihi	220 kV	25.6	26.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.2
Tokaanu	33 kV	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Tokaanu	220 kV	12.6	13.1	13.7	13.8	13.7	13.7	13.7	13.7	13.7	13.7	13.5
Waipawa	11 kV	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Waipawa	33 kV	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Waipawa	110 kV (T1)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Waipawa	110 kV (T2)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Wairakei	33 kV	22.7	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9	18.9
Wairakei	220 kV	29.9	30.9	29.1	29.2	29.2	29.2	29.2	29.2	29.2	29.2	28.7
Woodville	11 kV	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Woodville	110 kV	4.9	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
TARANAKI												
Brunswick	33 kV	9.4	9.4	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Brunswick	220 kV	7.0	7.2	7.2	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Carrington St	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Carrington St	110 kV	10.4	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Hawera	33 kV (T1/T2)	5.0	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Hawera	33 kV (T3)	9.2	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Hawera	110 kV	8.7	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Huirangi	33 kV	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Huirangi	110 kV	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Junction Road Tee	110 kV	11.0	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Kapuni Tee	110 kV	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
McKee Tee	110 kV	8.1	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Motunui	11 kV (T3)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Motunui	11 kV (T4)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Motunui	110 kV	9.0	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Opunake	33 kV	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Opunake	110 kV (T4)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Opunake	110 kV (T5)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Stratford	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Stratford	110 kV	19.2	18.5	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.5
Stratford	220 kV	15.0	14.9	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.0
Taumarunui	220 kV	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Wanganui	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Wanganui	110 kV	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Waverley	11 kV	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Waverley	110 kV	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
HAWKES BAY												
Fernhill	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Fernhill	110 kV	8.9	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
Harapaki	220 kV	8.4	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Redclyffe	33 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Redclyffe	110 kV	13.4	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Redclyffe	220 kV	8.5	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Tauhara	220 kV	20.2	21.0	20.5	20.6	20.6	20.6	20.6	20.6	20.6	20.6	20.4
Tuai	110 kV	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Whakatu	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Whakatu	220 kV (T3)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Whakatu	220 kV (T4)	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Whirinaki	11 kV (T1)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Whirinaki	11 kV (T2)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Whirinaki	11 kV (T3)	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Whirinaki	220 kV	10.0	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
WELLINGTON												
Central Park	11 kV (T11)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Central Park	11 kV (T12)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Central Park	33 kV	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Central Park	110 kV (T3)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Central Park	110 kV (T4)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Central Park	110 kV (T5)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9
Gracefield	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Gracefield	110 kV (T5)	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Gracefield	110 kV (T6)	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Greytown	33 kV	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Greytown	110 kV (T2)	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Greytown	110 kV (T3)	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Haywards	11 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Haywards	33 kV	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Haywards	110 kV	24.5	24.4	24.6	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
Haywards	220 kV	15.8	15.7	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Kaiwharawhara	11 kV (T1)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Kaiwharawhara	11 kV (T3)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Kaiwharawhara	110 kV (T1)	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Kaiwharawhara	110 kV (T3)	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Masterton	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Masterton	110 kV	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Melling	11 kV	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
Melling	33 kV	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Melling	110 kV (T1/T3)	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
Melling	110 kV (T2/T4)	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Paraparaumu	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Paraparaumu	220 kV (T1)	6.5	6.4	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Paraparaumu	220 kV (T2)	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Pauatahanui	33 kV	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Pauatahanui	110 kV (T1)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Pauatahanui	110 kV (T2)	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Takapu Road	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Takapu Road	110 kV	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
Upper Hutt	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Upper Hutt	110 kV	11.8	11.7	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8
West Wind	110 kV (Circuit 2)	6.9	6.8	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
West Wind	110 kV (Circuit 3)	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9
Wilton	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Wilton	110 kV	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
Wilton	220 kV	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
NELSON-MARLBOROUGH												
Argyle	110 kV	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Blenheim	33 kV	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Blenheim	110 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Stoke	33 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Stoke	66 kV	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Stoke	110 kV	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Stoke	220 kV	3.7	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
WEST COAST												
Arthurs Pass	11 kV	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Arthurs Pass	66 kV	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Atarau	110 kV	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Castle Hill	11 kV	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Castle Hill	66 kV	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Dobson	33 kV	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Dobson	66 kV	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Dobson	T11 (110 kV)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Dobson	T12 (110 kV)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Greymouth	66 kV	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

Hokitika	66 kV	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Inangahua	110 kV	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Kikiwa	11 kV	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Kikiwa	110 kV	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Kikiwa	220 kV	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
Kumara	66 kV	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Murchison	11 kV	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Murchison	110 kV	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Orowaiti	110 kV (Circuit 1)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Orowaiti	110 kV (Circuit 2)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Otira	11 kV	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Otira	66 kV	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Reefton	110 kV (Circuit 1)	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Reefton	110 kV (Circuit 2)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
CANTERBURY												
Ashburton	66 kV	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Ashburton	220 kV	8.2	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Ashley	11 kV (T5)	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Ashley	11 kV (T3)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Ashley	66 kV	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Bromley	66 kV	13.4	13.5	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Bromley	220 kV	6.4	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Coleridge	11 kV	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Coleridge	66 kV	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Culverden	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Culverden	66 kV	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Culverden	220 kV (T22)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Culverden	220 kV (T23)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Hororata	33 kV	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Hororata	66 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Islington	33 kV	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Islington	66 kV	21.6	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Islington	220 kV	8.9	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Kaiapoi	11 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Kaiapoi	66 kV	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Kimberley	66 kV (T1)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Kimberley	66 kV (T2)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
Southbrook	66 kV	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Waipara	33 kV	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Waipara	66 kV	7.7	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
Waipara	220 kV (T12)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Waipara	220 kV (T13)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
SOUTH CANTERBURY												
Albury	11 kV	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Albury	110 kV	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Aviemore	220 kV	18.7	18.7	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8
Bells Pond	110 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Benmore	220 kV	27.7	27.7	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8
Black Point	110 kV	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Livingstone	220 kV	7.7	7.7	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Oamaru	33 kV	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Oamaru	110 kV (T1)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Oamaru	110 kV (T2)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Ohau A	220 kV	19.1	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
Ohau B	220 kV	22.1	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2
Ohau C	220 kV	19.2	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3	19.3
Studholme	11 kV	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved.

Studholme	110 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Tekapo A	11 kV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tekapo A	33 kV	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Tekapo A	110 kV	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Tekapo B	220 kV	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Temuka	33 kV	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Temuka	110 kV (T1)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Temuka	110 kV (T2)	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Timaru	11 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Timaru	110 kV	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Timaru	220 kV (T5)	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Timaru	220 kV (T8)	5.7	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Twizel	33 kV	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Twizel	220 kV	24.0	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1
Waitaki	11 kV (T21)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Waitaki	11 kV (T22)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Waitaki	33 kV (T28)	0	0	0	0	0	0	0	0	0	0	0
Waitaki	220 kV	15.4	15.4	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
OTAGO-SOUTHLAND												
Balclutha	33 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Balclutha	110 kV	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Berwick	110 kV	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Brydone	11 kV	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
Brydone	110 kV	4.5	4.5	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Clyde	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Clyde	220 kV	17.7	17.7	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8
Cromwell	33 kV	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cromwell	110 kV (T5A/B)	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Cromwell	110 kV (T8)	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Cromwell	220 kV (T5A/B)	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Cromwell	220 kV (T8)	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Edendale	33 kV	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
Edendale	110 kV			8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Edendale	110 kV	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Frankton	33 kV	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Frankton	110 kV (T2)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Frankton	110 kV (T4)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Gore	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Gore	110 kV	10.5	10.5	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Gore	220 kV (T11)	5.5	5.5	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Gore	220 kV (T12)	5.5	5.5	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Halfway Bush	33 kV	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Halfway Bush	110 kV	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Halfway Bush	220 kV	8.0	8.0	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Invercargill	33 kV	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Invercargill	110 kV	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Invercargill	220 kV	11.2	11.2	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Manapouri	220 kV	15.3	15.3	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
North Makarewa	33 kV	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
North Makarewa	220 kV	10.8	10.8	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Naseby	33 kV	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Naseby	220 kV	7.0	7.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
Roxburgh	110 kV	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2	12.2
Roxburgh	220 kV	16.6	16.6	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7
South Dunedin	33 kV	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
South Dunedin	220 kV	7.2	7.2	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Three Mile Hill	220 kV	8.2	8.2	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
Tiwai	220 kV	8.1	8.1	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3

2025 Annual Planning Report © Transpower New Zealand Limited 2024. All rights reserved

Appendix C: Glossary

Term	Description
bay (of a station)	That part of a substation or power station where a given circuit's switchgear is located. According to the type of circuit, a substation or power station may include feeder bays, transformer bays, bus coupler bays, etc.
bus	A common primary conductor where a component or several components such as lines, loads and generators are connected.
bus section	Part of a bus that can be isolated from another part of the same bus.
cable	One or more insulated conductors forming a transmission circuit above or below ground.
capacitor bank	A number of capacitors connected together in series and/or parallel to form the requisite capacitance and voltage rating for reactive compensation and harmonic filters on the HVAC and HVDC power systems.
circuit (transmission)	A set of conductors (normally three) plus associated hardware and insulation on a transmission line, which together form a single electrical connection between two or more stations and which, when faulted, is removed automatically from the system (by circuit-breakers) as a single entity.
circuit-breaker	A switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal conditions, such as those of short circuit.
cogeneration	The use of high-pressure steam from a turbo-generator set for an industrial process. The production of electricity is usually secondary to the requirements of the industrial process.
commissioned	The operational state of equipment that has undergone the commissioning process and is brought under the operational control of a service centre/controller.
committed projects	Refers to actual proposed projects that satisfy a number of criteria indicating that they are extremely likely to proceed in the near future. For example: • land has been acquired for construction of the project • planning consents, construction approvals and licences have been obtained • construction has begun, or a firm commencement date has been set • contracts for supply and construction have been finalised, and • financing arrangements are largely complete.
constraint	A local limitation in the transmission capacity of the grid required to maintain grid security or power quality.
contingency	The uncertainty of an event occurring, and the planning to cover for this. For example, a single contingency could be: • in relation to transmission, the unplanned tripping of a single item of equipment, or • in relation to a fall in frequency, the loss of the largest single block of generation in service, or the loss of one HVDC pole.
contingent event	Those events for which, in the reasonable opinion of the system operator, resources can be economically provided to maintain the security of the grid and power quality without the shedding of demand.
continuous rating	The maximum rating to which equipment can be operated continuously.
decommissioned	The status of equipment that is permanently disconnected from the power system, made permanently inoperable, and free of any operational identification.
demand	A measure of the rate of consumption of electrical energy.
disconnector	A switch that, when in the open position, provides an isolating distance in accordance with specified requirements.
dispatch	The process of: • pre-dispatch scheduling to allocate active and reactive power generation, including additional ancillary services and reserve, to match expected demand, within the limitations of the grid and equipment • rescheduling to meet forecast demand, and • issuing instructions based on the schedule and the real-time conditions to manage resources to meet the actual demand.
distribution (of electricity)	The transfer of electricity between the transmission network and end users through a local network.

2022 Transmission Planning Report © Transpower New Zealand Limited 2022. All rights reserved.

Term	Description
distribution line	An electric line that is part of a local network.
double circuit line	A transmission line carrying two circuits.
duplicate protection	A protection scheme for a plant item such that any fault on the plant item can be cleared by two independent sets of relays, either of which is able to operate correctly even if the other fails completely.
electricity distributor	An asset owner whose assets are predominantly for the distribution of electricity to customers.
Electricity Industry Act 2010	The Act setting out the present framework including the Electricity Industry Participation Code.
Electricity Industry Participation Code	The requirements on the electricity industry made pursuant to the Electricity Industry Act 2010.
embedded generators	Smaller power plants connected to a regional electricity line business's distribution network (as opposed to the high voltage transmission network).
end user	An entity connected to the power system for the primary purpose of consuming electricity.
event	A term identifying undesired or untoward operational happenings, principally: • accidents (resulting in loss) • near-misses (which, under slightly different circumstances, could have caused loss) to people, process, equipment, material or the environment • a disturbance to the power system • a significant change in the state of the grid • equipment defects, and • fire or intruder alarm operation.
feeder	A circuit that provides a direct connection to a customer.
firm capacity	Power capacity intended to be available at all times during the period covered by a guaranteed commitment to deliver, even under adverse conditions.
forced outage	The automatic or urgent removal from service of an item of equipment.
frequency (power)	The rate of cyclic change in value of current and voltage, quantified by the international standard term 'Hertz' (Hz).
frequency excursion	A variation of the power system frequency above 50.25 Hz or below 49.75 Hz.
gas turbine (GT)	A heat engine that uses the energy of expanding gases passing through a multi-stage turbine to create rotational power.
generating set	A group of rotating machines transforming mechanical or thermal energy into electricity. Note: for the purposes of the operating codes and the output ratings referred to, the set is taken to include the limitations of the energy source, turbine, generator, cable, set transformer and switchgear. [GOSP glossary - IEC 50 (602-02-01)]
generation	The electrical energy produced by a generator, a generating station or within a power system as a whole. The process of producing electricity.
generator	A person who owns and/or manages one or more generating sets that are physically connected to the grid assets or to a network or to other assets connected to the grid assets.
grid	That part of the New Zealand electricity transmission system, the operation of which is undertaken by the grid operator.
grid asset owner	Transpower New Zealand Limited.
grid assets	At any time, the plant, transmission lines and other facilities, owned or managed by the grid asset owner, and which are used to interconnect all the points of connection for connected parties.
grid exit point (GXP)	A point of connection where electricity may flow out of the grid.
grid injection point (GIP)	A point of connection where electricity may flow into the grid.
HVAC	High voltage alternating current.
HVDC	High voltage direct current.
in service	The state of equipment that is connected to a source of energy or may be connected to a source of energy by an operating action.

2022 Transmission Planning Report © Transpower New Zealand Limited 2022. All rights reserved.

Term	Description
islanded operation	The condition that arises when a section of the power system is disconnected from and operating independently of the remainder of the power system.
line [overhead]	A series of structures carrying overhead one or more transmission circuits.
load control	Types of load control include: • automatic under frequency load shedding (see MW reserve of a power system) • interruptible load (see MW reserve of a power system), and • manual load shedding (see manual load shedding).
load shedding	The forced disconnection of load, in stages. This is either manual (see load control) or automatic (see MW reserve [of a power system]).
manual load shedding	The forced disconnection of load by an operator/controller.
maximum continuous rating (MCR)	The value assigned to an equipment parameter by the manufacturer, and at which the equipment may be operated for an unlimited period without damage.
maximum demand	The peak consumption of energy (averaged over a half-hour period and expressed in watts) recorded during a given time, for example, a day, week, or year.
MegaVoltAmpere (MVA)	1000 kVA. The flow of active power is measured in megaWatts (MW). When compounded with the flow of reactive power, which is measured in Mvar, the resultant is measured in MegaVoltAmperes (MVA).
n-1, “n”	Refers to the planning standard that Transpower generally plans the grid to. The n-1 security level provides supply security to the connected loads under a single credible contingency with all the assets that can reasonably be expected in service. The single credible contingencies that are defined in the Rules are: • a single transmission circuit interruption • the failure or removal from operational service of a single generating unit • an HVDC link single pole interruption • the failure or removal from service of a single bus section • a single interconnecting transformer interruption, and • the failure or removal from service of a single shunt connected reactive component. • An ‘’n” security standard means that any outage will trip load. It is often found in smaller supply areas, where just one transmission circuit or supply transformer provides supply.
nominal rating	The design rating of the equipment or transmission circuit. For equipment, this is often referred to as the 'nameplate rating'.
nominal system frequency	50 Hertz.
on-load tap-changer (OLTC)	Equipment fitted to a power transformer by which the voltage ratio between the windings can be varied while the transformer is on-load.
outage	The state of an item of equipment when it is not available to perform its intended function. An outage may or may not cause an interruption of supply to customers.
overhead line	A transmission line.
overload	A load greater than the maximum continuous rating.
overload protection scheme	A type of special protection scheme that prevents loading of assets above their stated capacity
peak demand	See maximum demand.
peak load	The maximum peak load (in amps) that can be expected to be carried within a twelve-month period on the circuit or by the equipment/component.
planned outage	A deliberate outage scheduled for maintenance purposes.
power factor	The ratio between active power (expressed in watts, W) and true power (expressed in volt-amperes, VA). Can vary between 1 and 0. A load with a low power factor uses more reactive current than a load with a high power factor for the same amount of useful power transferred.
power flow analysis	Simulation of the actual power system using computer models, so as to analyse the effects of changes to inputs (like demand, supply, and asset ratings), and identify constraints or other issues that might affect security of supply to a region.
power system stability	The capability of a power system to regain a steady state, characterised by the synchronous operation of the generators after a disturbance due, for example, to variation of power or impedance.

2022 Transmission Planning Report © Transpower New Zealand Limited 2022. All rights reserved.

Term	Description
power transformer	A transformer that primarily changes voltage and current for the efficient conveyance of electricity over the circuits connected to it.
protection	The equipment provided for detecting abnormal conditions in a power system and then initiating fault clearance or actuating signals or indications.
reactive power	Energy that flows in the power system between alternators, capacitors, SVCs, etc., and inductive and capacitive equipment such as transmission lines and low power factor loads. It is the product of the voltage and out-of-phase components of the alternating current and is measured in vars.
relay	A device designed to produce predetermined changes in one or more electrical output circuits, when certain conditions are fulfilled in the electrical input circuits controlling the device.
reliability	The failure rate. For example, the number of failures per year based on experience over a long time period, say 10 years or more.
resource consent	A consent to use land, air or water granted by the local government under the Resource Management Act. The consent usually imposes limits on that use.
return period	The statistical return period of a weather-related event, load or load effect.
risk based condition replacement	Replacement of existing assets based on risk of failure due to asset condition
runback scheme	An automatic limit on generation or HVDC transfer, which typically would be enabled when there is loss of a particular circuit, transformer, signalling or control system.
security	A term used to describe the ability or capacity of a network to provide service after one or more equipment failures. It can be defined by deterministic planning criteria such as (n), (n-1), (n-2) security contingency. A security contingency of (n-m) at a particular location in the network means that 'm' component failures can be tolerated without loss of service.
short circuit rating	The three second fault rating of equipment.
short term rating	The maximum rating to which equipment can be operated for a specified duration.
single-circuit line	A transmission line carrying one circuit.
spur	A line or circuit connected to the transmission system at only one point.
stability limit	The critical value of a given system state variable that cannot be exceeded without endangering power system stability. For a power system without a fault, this concept is related to the steady state stability of the system.
steady state stability	A power system stability in which disturbances have only small rates of change and small relative magnitudes.
substation	A building, structure or enclosure incorporating equipment used principally for the control of the transmission or distribution of electricity.
switchgear	A collective term for switches of all types and their associated equipment, including circuit-breakers, disconnectors, and earthing switches.
switching station	A station existing solely for the purpose of transmission rather than supply.
synchronous condenser	A synchronous machine running without mechanical load and supplying or absorbing reactive power to regulate local voltage.
system frequency	At any instant the value of the frequency of the power in the North Island or South Island. See also Hertz, nominal system frequency, and frequency.
system operator	The person responsible from time to time for the operation of the grid system. The system operator is Transpower New Zealand Limited.
tee (or T) point	The point at which a branch transmission circuit is solidly and permanently connected to a main circuit, usually without switchgear. See also tee-off.
tee-off	A branch transmission circuit joining a main circuit and that is protected as part of the main circuit.
thermal constraints/limits/ capacities	Refers to the temperature ratings of the assets (lines, generators, transformers) connected to the power system, beyond which the assets cannot securely be operated.
thermal upgrade	The increase in temperature ratings of assets to provide more capacity.

2022 Transmission Planning Report © Transpower New Zealand Limited 2022. All rights reserved.

Term	Description
transformer	A static electric device consisting of a winding or two or more coupled windings which transfer power by electromagnetic induction between circuits of the same frequency, usually with changed values of voltage and current.
transient (in)stability	Refers to the response of the power system when it experiences a large disturbance like a line fault or outage of a generator.
transmission	The conveying of bulk electricity from power stations to points of supply (compared with distribution).
transmission circuit	An electrical circuit the primary purpose of which is the transmission of electricity from one geographical location to another.
transmission line	A series of structures carrying one or more transmission circuits overhead.
transmission system	That part of the power system primarily intended for the conveyance of bulk electricity.
variable generation	generation such as wind and solar where the energy source is not controllable by the operator.
voltage	The nominal potential difference between conductors or the nominal potential difference between a conductor and earth, whichever is applicable.
voltage collapse	A sudden and large decrease in the voltage of the electrical system.
voltage (in)stability	Refers to the power system's ability to maintain a satisfactory voltage at all buses for any disturbance, such as a variation in load or an outage of plant.

2022 Transmission Planning Report © Transpower New Zealand Limited 2022. All rights reserved.

Appendix D: Grid Exit and Injection Points

Key	
GXP	The connection point behaves solely as a Grid Exit Point throughout a normal year
GIP	The connection point behaves solely as a Grid Injection Point throughout a normal year
GXP/GIP	The connection point behaves at times as a Grid Exit Point and at other times as a Grid Injection point throughout a normal year.
SWI	Switching Station

Table D-1: North Island Grid Exit and Injection Points

North Island															
Northland		Auckland		Waikato		Bay of Plenty		Central North Island		Taranaki		Hawkes Bay		Wellington	
Bream Bay	GXP/ GIP	Albany	GXP	Arapuni	GXP/GIP	Edgecumbe	GXP	Bunnythorpe	GXP	Brunswick	GXP	Fernhill	GXP	Central Park	GXP
Kaikohe	GXP/ GIP	Bombay	GXP	Atiamuri	GIP	Kaitemako	GXP	Aratiatia	GIP	Carrington Street	GXP	Harapaki	GIP	Gracefield	GXP
Marsden	SWI	Drury	SWI	Cambridge	GXP	Kawerau	GXP/GIP	Dannevirke	GXP	Hawera	GXP/ GIP	Redclyffe	GXP	Greytown	GXP
Maungatapere	GXP	Glenbrook	GXP/GIP	Hamilton	GXP	Matahina	GIP	Linton	GXP/ GIP	Huirangi	GXP	Tauhara	GXP/ GIP	Haywards	GXP
Maungaturoto	GXP	Henderson	GXP	Hangatiki	GXP	Mt Maunganui	GXP	Mangahao	GXP/ GIP	Junction Road	GIP	Tuai	GXP/ GIP	Kaiwharawhara	GXP
Wellsford	GXP	Hepburn Road	GXP	Hautapu	GXP	Okere	SWI	Mangamaire	GXP	Kaponga (Kapuni)	GXP/ GIP	Whakatu	GXP	Masterton	GXP
		Hobson Street	GXP	Hinuera	GXP	Owhata	GXP	Marton	GXP	McKee	GIP	Whirinaki	GXP/ GIP	Melling	GXP
		Huapai	SWI	Huntly	GXP/GIP	Rotorua	GXP/GIP	Mataroa	GXP	Motunui	GXP			Paraparaumu	GXP
		Mangere	GXP	Karapiro	GIP	Tarukenga	GXP	National Park	GXP	Opunake	GXP			Pauatahanui	GXP

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

North Island												
Northland	Auckland		Waikato		Bay of Plenty		Central North Island		Taranaki		Hawkes Bay	Wellington	
	Mount Roskill	GXP	Kinleith	GXP/GIP	Tauranga	GXP	Nga Awa Purua	GIP	Stratford	GXP/ GIP		Takapu Rd	GXP
	Otahuhu	GXP	Kopu	GXP	Te Matai	GXP	Ohaaki	GIP	Taumarunui	GXP		Upper Hutt	GXP
	Pakuranga	GXP	Lichfield	GXP	Waiotahe	GXP/GIP	Ohakune	GXP	Wanganui	GXP		West Wind	GIP
	Penrose	GXP	Maraetai	GIP			Ongarue	GXP	Waverley	GXP/ GIP		Wilton	GXP/ GIP
	Silverdale	GXP	Mokai	GIP			Poihipi	GIP					
	Southdown	GXP	Ohakuri	GIP			Rangipo	GIP					
	Takanini	GXP	Ohinewai	SWI			Tangiwai	GXP					
	Wairau Road	GXP	Piako	GXP			Tararua Wind central	GIP					
	Wiri	GXP	Te Awamutu	GXP			Te Mihi	GIP					
			Te Kowhai	GXP			Tokaanu	GXP/ GIP					
			Waihou	GXP			Waipawa	GXP					
			Waikino	GXP			Wairakei	GXP/ GIP					
			Waipapa	GIP			Woodville	GXP/ GIP					
			Whakamaru	GXP/GIP									

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.

Table D-2: South Island Grid Exit and Injection Points

South Island									
Nelson/Marlborough		**West Coast**		**Canterbury**		**South Canterbury**		**Otago/Southland**	
Argyle	GIP	Arthurs Pass	GXP	Ashburton	GXP/GIP	Albury	GXP/GIP	Balclutha	GXP
Blenheim	GXP	Castle Hill	GXP	Ashley	GXP	Aviemore	GIP	Berwick	GIP
Stoke	GXP/GIP	Dobson	GXP/GIP	Bromley	GXP	Benmore	GIP	Brydone	GXP
Kikiwa	GXP	Greymouth	GXP	Coleridge	GXP/GIP	Black Point	GXP	Clyde	GXP/GIP
		Hokitika	GXP/GIP	Culverden	GXP	Bells Pond	GXP	Cromwell	GXP
		Inangahua	SWI	Hororata	GXP	Livingstone	SWI	Edendale	GXP
		Kumara	GXP/GIP	Islington	GXP	Oamaru	GXP	Frankton	GXP
		Murchison	GXP/GIP	Kaiapoi	GXP	Ohau A	GIP	Gore	GXP/GIP
		Orowaiti (Robertson St)	GXP/GIP	Kimberley	GXP	Ohau B	GIP	Halfway Bush	GXP/GIP
		Otira	GXP	Norwood	GXP	Ohau C	GIP	Invercargill	GXP
		Reefton	GXP	Southbrook	GXP	Studholme	GXP	Manapouri	GIP
				Waipara	GXP	Tekapo A	GXP/GIP	Naseby	GXP/GIP
						Tekapo B	GIP	North Makarewa	GXP/GIP
						Temuka	GXP	Roxburgh	GIP
						Timaru	GXP	South Dunedin	GXP
						Twizel	GXP	Three Mile Hill	SWI
						Waitaki	GXP/GIP	Tiwai	GXP

2025 Transmission Planning Report © Transpower New Zealand Limited 2025. All rights reserved.