Taranaki

Spare Capacity and Load Characteristics Report

EECA

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E	Final - Stage 2 updated for Blackyard Consulting comments

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1. Executive Summary

Transpower maintains/manages the transmission network in New Zealand and supplies the Taranaki region (as described in this report) via six GXP's supplying Powerco's Western network (Taranaki and Egmont network areas, with a section of the network Whanganui area), and three GXPs directly supplying industrial loads.

One Electrical Distribution Business (EDB), Powerco, then takes supply from Transpower and distributes the electricity to end customers in the various regions. In this region, some large customers take supply directly from Transpower.

The Energy Efficiency & Conservation Authority (EECA) is running a flagship program that is called Regional Energy Transition Accelerator (RETA)[1]. The program is targeted at large energy-using businesses and public sector organisations that are committed to reducing carbon emissions, and seeks to identify the barriers involved and opportunities available.

As part of the RETA program, EECA has developed a set of Load Sites for the Taranaki region. The Load Sites involve existing consumers/plants that use fossil fuel, and which could potentially be converted to using electricity, resulting in an overall lower carbon footprint.

EECA contracted Ergo to determine the following for the Taranaki region:

- The current supply and demand characteristics (peak & average supply and seasonality information) at the major electrical substations.
- The (N) and (N-1) capacity available for each grid exit point and substations.
- A capital cost estimate to supply electricity to each of the Load Sites.

The purpose of the Load Site cost analysis is to provide options for investment that will provide significant reduction in the use of fossil fuels.

1.1 Network Spare Capacity

The following Figure 1 illustrates the (N) and (N-1) spare capacity at the Transpower Grid Exit Point (GXP) substations in the Taranaki region. This figure is based on historical maximum loadings and the Transpower planning report 2023 and does not incorporate any future load growth. It is important to note that these spare capacities also do not include any voltage constraints or upstream transmission constraints (which would have to be confirmed by Transpower or Powerco). As such, it is highly likely that those constraints would prevent some of the spare capacity shown below being utilised.

[1] https://www.eeca.govt.nz/co-funding-and-support/products/about-reta/

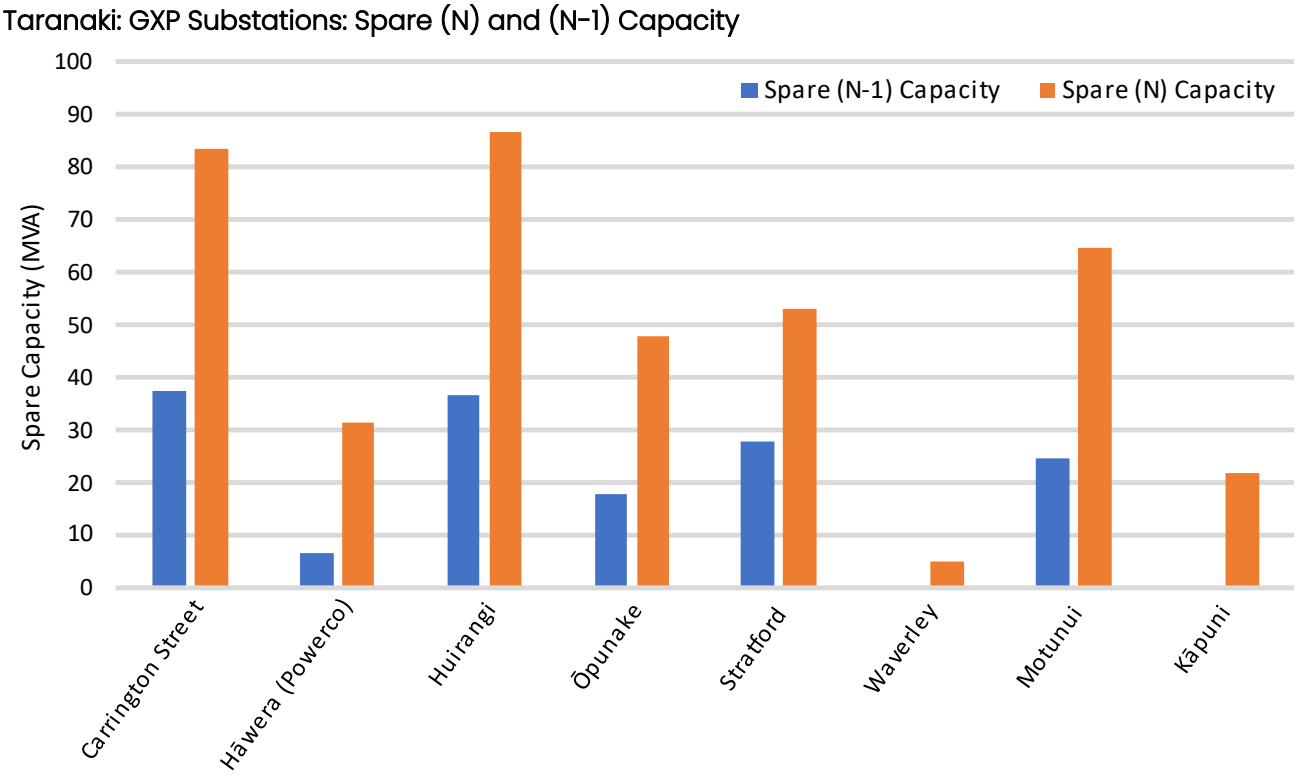


Figure 1 Summary: Approximate N and N-1 spare capacity at GXP substations.

The following Figure 2 illustrates the (N) and (N-1) spare capacity at the Powerco zone substations in the Taranaki region. This figure is based on the maximum loadings and the Powerco 2023 disclosures. Negative numbers for (N-1) capacity indicate zone substations where the load has exceeded the (N-1) capacity in the past.

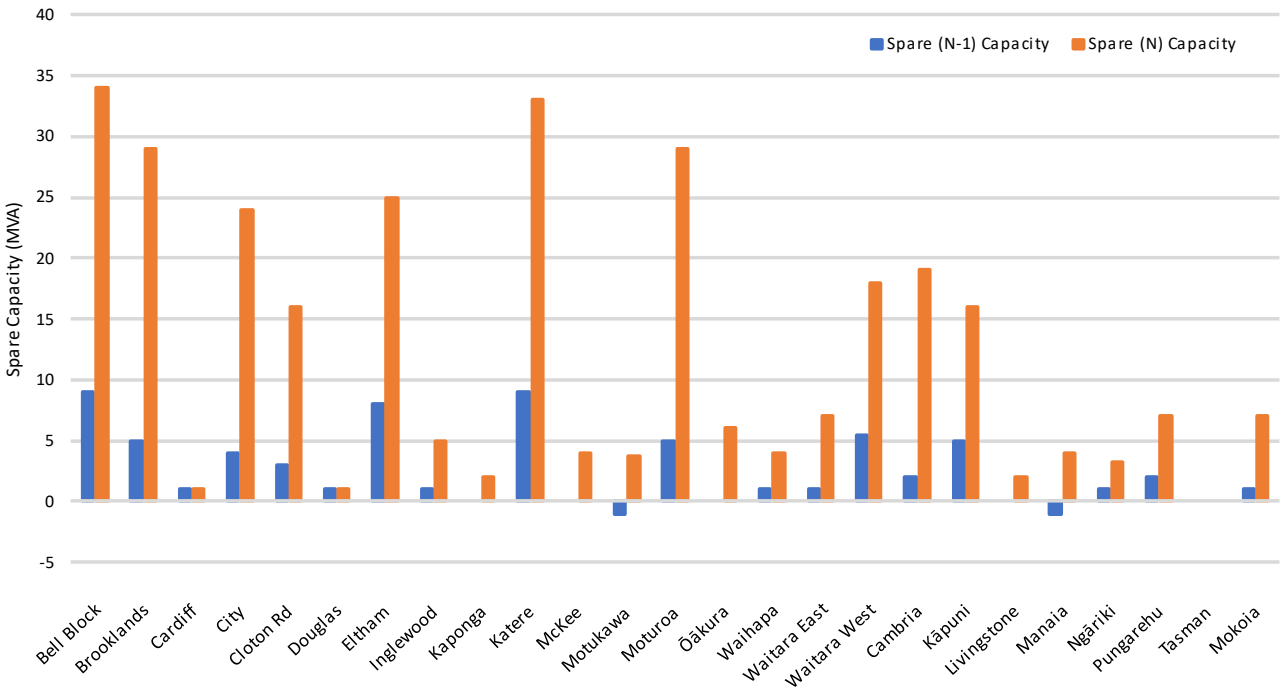


Figure 2. Summary: Approximate (N) and (N-1) spare capacity at Powerco's zone substations.

1.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 23163-RPT-001) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Carrington St GXP* – Supplies New Plymouth city, including some heavy industry, oil/gas production, and agricultural loads resulting in a mix of residential, commercial, and industrial loads. Winter peaking with a typical daily morning and evening peak. In summer, the load is typically almost flat between the morning and evening peaks, indicating a higher industrial or agricultural (e.g. irrigation) load over summer.
- *Hāwera GXP* – Supplies a large rural area, including the large town Hāwera and surrounding agricultural areas, resulting in a mix of residential, commercial, and industrial loads. The GXP is winter peaking though there is only a small seasonal difference in load. Typical daily morning and evening peaks.
- *Huirangi GXP* – Supplies the town of Waitara, and industrial area between New Plymouth and Waitara (i.e. Bell Block), and a large agricultural area, resulting in a mix of residential, commercial, and industrial loads. Load peaks are similar throughout the year, with a lower load around June. The daily load appears to be highly influenced by industrial loads in summer, and has typical morning and evening peaks in winter.
- *Ōpunake GXP* – Supplies a large rural/tourist area, resulting in a mix of residential, commercial, and industrial (including agricultural) loads, with a significant drop in network loading during winter. Typical morning and evening peaks.
- *Stratford GXP* – Supplies the town of Stratford as well as a large agricultural area, resulting in a mix of residential, commercial, and industrial loads, with a slight drop in network loading during winter. Typical morning and evening peaks.
- *Waverley GXP* – Supplies the area around the town of Waverley, so load is largely residential. Summer peaking with typical morning and evening peaks.

Zone Substations:

- The load characteristics of the zone substations vary widely depending on the connected consumers/generators. Zone substations typically share load characteristics with their GXPs, with zone substations in cities and towns typically having a mix of industrial, commercial, and residential loads, while more rural zone substations have a mix of industrial (e.g. milk plants), irrigation, and residential loads.

1.3 EECA Load Sites

The following table shows EECA's Load Sites together with:

- The peak electrical power requirements of the Load Site.
- The distribution zone substation to which the Load Site would connect.
- The transmission substation/GXP which supplies the relevant zone substation.
- Ergo's estimate of the capital cost to increase the capacity of the relevant transmission assets (lines and substations).
- Ergo's estimate of the capital cost to install the necessary distribution assets to supply the Load Site.
- The cost efficiency associated with the Load Site in terms of $M/MW.
- The 'complexity of connection' based on the level of upgrades required.

The costs are preliminary and Ergo is of the view that they have an accuracy of Class 5[2], which is only suitable for concept screening. (Refer to the assumptions outlined in Section 8.2 for more details)

[2] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

Summary: Load Sites vs transmission/distribution capital cost estimates

Table 1 Summary of Load Sites and estimated capital costs

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
TAR24	Downer New Zealand Limited New Plymouth Asphalt	3.37	Carrington Street	$0.00	Katere	$1.30	$1.30	$0.39	Minor	1
TAR14	New Plymouth District Council Wastewater treatment	2.70	Carrington Street	$0.00	Katere	$1.90	$1.90	$0.70	Minor	1
TAR21	Downer New Zealand Limited New Plymouth Bitumen	2.10	Carrington Street	$0.00	Moturoa	$0.58	$0.58	$0.28	Minor	1
TAR45	Technix Bitumen Technologies Limited	1.23	Carrington Street	$0.00	Moturoa	$0.58	$0.58	$0.47	Minor	1
TAR38	Tegel Bell Block Feedmill	0.64	Carrington Street	$0.00	Katere	$0.07	$0.07	$0.10	Minor	1
TAR10	Ministry of Health Taranaki Base Hospital	0.47	Carrington Street	$0.00	Moturoa	$0.00	$0.00	$0.00	Minor	1
TAR37	Western Institute of Technology in Taranaki (WITT) Ta	0.36	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR25	New Plymouth District Council Todd Energy Aquatic Ce	0.23	Carrington Street	$0.00	Moturoa	$0.00	$0.00	$0.00	Minor	1
TAR27	New Plymouth District Council Puke Ariki	0.12	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR31	New Plymouth District Council Civic Centre	0.10	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR28	State-integrated school Francis Douglas Memorial Col	0.09	Carrington Street	$0.00	Moturoa	$0.00	$0.00	$0.00	Minor	1
TAR29	New Plymouth District Council Len Lye Centre	0.06	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR4	Fonterra Limited Whareroa - Total (N)	88.14	Hāwera 110 kV	$14.00	N/A	$0.00	$14.00	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 1	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 2	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 3	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 4	22.14	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
TAR4	Fonterra Limited Whareroa - Total (N-1)	88.14	Hāwera 110 kV	$36.80	N/A	$0.00	$36.80	$0.42	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 1	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 2	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 3	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 4	22.14	Hāwera 110 kV	$26.30	N/A	$0.00	$26.30	$1.19	Moderate	1, 2
TAR6	Taranaki By-Products Hawera	12.47	Hāwera (Powerco)	$9.00	Kāpuni	$7.35	$16.35	$1.31	Major	1, 3
TAR9	Silver Fern Farms Limited Hawera	1.47	Hāwera (Powerco)	$0.00	Cambria	$6.72	$6.72	$4.56	Moderate	1, 3
TAR19	Little Knoll Greenhouses Ltd Patea	0.28	Hāwera (Powerco)	$0.00	Livingstone	$0.00	$0.00	$0.00	Minor	1
TAR2	Ballance Agri-Nutrients Ltd Kapuni - Total (N)	TBC	Hāwera (Powerco)	$222.00	Kāpuni	$1.60	$223.60	N/A	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 1	5.00	Hāwera (Powerco)	$0.00	Kāpuni	$0.00	$0.00	$0.00	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 2	8.00	Hāwera (Powerco)	$0.50	Kāpuni	$1.10	$1.60	$0.20	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 3	25.00	Hāwera (Powerco)	$9.00	Kāpuni	$0.50	$9.50	$0.38	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 4	32.00	Hāwera (Powerco)	$28.60	Kāpuni	$0.00	$28.60	$0.89	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 5	100.00	Hāwera (Powerco)	$38.70	Kāpuni	$0.00	$38.70	$0.39	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 6	80.00	Hāwera (Powerco)	$53.20	Kāpuni	$0.00	$53.20	$0.67	Major	1, 2
TAR2	Ballance Agri-Nutrients Ltd Kapuni - Total (N-1)	TBC	Hāwera (Powerco)	$393.20	Kāpuni	$13.70	$406.90	N/A	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 1	5.00	Hāwera (Powerco)	$9.00	Kāpuni	$0.00	$9.00	$1.80	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 2	8.00	Hāwera (Powerco)	$0.00	Kāpuni	$5.70	$5.70	$0.71	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 3	25.00	Hāwera (Powerco)	$0.00	Kāpuni	$8.00	$8.00	$0.32	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 4	32.00	Hāwera (Powerco)	$99.30	Kāpuni	$0.00	$99.30	$3.10	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 5	100.00	Hāwera (Powerco)	$60.70	Kāpuni	$0.00	$60.70	$0.61	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 6	80.00	Hāwera (Powerco)	$40.20	Kāpuni	$0.00	$40.20	$0.50	Major	1, 2
TAR7	Mckechnie Aluminium Solutions Limited Bell Block - St	4.60	Huirangi	$0.00	Bell Block	$1.18	$1.18	$0.26	Minor	1
	Mckechnie Aluminium Solutions Limited Bell Block - St	3.70	Huirangi	$0.00	Bell Block	$1.18	$1.18	$0.32	Minor	1
	Mckechnie Aluminium Solutions Limited Bell Block - St	7.70	Huirangi	$0.00	Bell Block	$13.39	$13.39	$1.74	Moderate	1, 3
TAR16	ANZCO Foods Waitara	0.80	Huirangi	$0.00	Waitara West	$0.00	$0.00	$0.00	Minor	1
TAR20	La Nuova Inglewood	0.73	Huirangi	$0.00	Inglewood	$0.00	$0.00	$0.00	Minor	1
TAR43	Poppas Peppers 2009 Limited New Plymouth	0.71	Huirangi	$0.00	Bell Block	$1.56	$1.56	$2.20	Minor	1
TAR26	Tegel New Plymouth	1.30	Huirangi	$0.00	Bell Block	$0.96	$0.96	$0.74	Minor	1
TAR35	Van Dyck New Plymouth	0.07	Huirangi	$0.00	Bell Block	$0.00	$0.00	$0.00	Minor	1
TAR30	New Plymouth District Council Waitara Pool	0.06	Huirangi	$0.00	Waitara East	$0.00	$0.00	$0.00	Minor	1
TAR1	Methanex Motunui - Total (N)	TBC	Motunui	$941.22	N/A	$0.00	$941.22	N/A	Major	1, 2
	Methanex Motunui - (N) Stage 1	25.00	Motunui	$0.00	N/A	$0.00	$0.00	$0.00	Minor	1, 2
	Methanex Motunui - (N) Stage 2	40.00	Motunui	$0.50	N/A	$0.00	$0.50	$0.01	Major	1, 2
	Methanex Motunui - (N) Stage 3	55.00	Motunui	$13.20	N/A	$0.00	$13.20	$0.24	Major	1, 2
	Methanex Motunui - (N) Stage 4	120.00	Motunui	$34.02	N/A	$0.00	$34.02	$0.28	Major	1, 2
TAR1	Methanex Motunui - Total (N-1)	TBC	Motunui	$1,284.62	N/A	$0.00	$1,284.62	N/A	Major	1, 2
	Methanex Motunui - (N-1) Stage 1	25.00	Motunui	$0.00	N/A	$0.00	$0.00	$0.00	Minor	1, 2
	Methanex Motunui - (N-1) Stage 2	40.00	Motunui	$12.70	N/A	$0.00	$12.70	$0.32	Major	1, 2
	Methanex Motunui - (N-1) Stage 3	55.00	Motunui	$12.70	N/A	$0.00	$12.70	$0.23	Major	1, 2
	Methanex Motunui - (N-1) Stage 4	120.00	Motunui	$261.22	N/A	$0.00	$261.22	$2.18	Major	1, 2

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
TAR15	Fonterra Brands Limited Eltham Bridge St	5.79	Stratford	$0.00	Eltham	$0.70	**$0.70**	**$0.12**	Minor	1
TAR13	Fonterra Limited Eltham Collingwood St	2.69	Stratford	$0.00	Eltham	$1.30	**$1.30**	**$0.48**	Minor	1
TAR18	Taranaki Abbattoir Stratford	0.94	Stratford	$0.00	Cloton Rd	$0.00	**$0.00**	**$0.00**	Minor	1
TAR8	ANZCO Foods Eltham	1.80	Stratford	$0.00	Eltham	$1.30	**$1.30**	**$0.72**	Minor	1
TAR22	Ministry of Education Stratford High School	0.25	Stratford	$0.00	Cloton Rd	$0.00	**$0.00**	**$0.00**	Minor	1
TAR42	Taranaki Galvanizers Stratford	0.15	Stratford	$0.00	Cloton Rd	$0.00	**$0.00**	**$0.00**	Minor	1
TAR17	Silver Fern Farms Limited Waitotara	0.54	Waverley	$0.00	Waverley	$0.00	**$0.00**	**$0.00**	Minor	1
TAR5	Fonterra Limited Kapuni - Total (N)	45.91	Kāpuni	$28.60	N/A	$0.00	**$28.60**	**$0.62**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 1	11.00	Kāpuni	$12.10	N/A	$0.00	**$12.10**	**$1.10**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 2	11.00	Kāpuni	$4.50	N/A	$0.00	**$4.50**	**$0.41**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 3	11.00	Kāpuni	$12.00	N/A	$0.00	**$12.00**	**$1.09**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 4	12.91	Kāpuni	$0.00	N/A	$0.00	**$0.00**	**$0.00**	Minor	1, 2
TAR5	Fonterra Limited Kapuni - Total (N-1)	45.91	Kāpuni	$82.30	N/A	$0.00	**$82.30**	**$1.79**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 1	11.00	Kāpuni	$33.80	N/A	$0.00	**$33.80**	**$3.07**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 2	11.00	Kāpuni	$4.50	N/A	$0.00	**$4.50**	**$0.41**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 3	11.00	Kāpuni	$44.00	N/A	$0.00	**$44.00**	**$4.00**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 4	12.91	Kāpuni	$0.00	N/A	$0.00	**$0.00**	**$0.00**	Minor	1, 2
	TOTAL =>	**191.57**	**TOTAL =>**	**$128.10**	**TOTAL =>**	**$40.07**	**$168.17**			

Notes

1 Doesn't include distribution transformer or switchgear costs for Load Sites (details provided in body of report). Estimated between $50k - $350k depending on size.

2 Total costs for this table do not include Methanex or Ballance, and include the (N-1) total for other staged load analysis.

3 (N-1) scenario cost shown

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites.

2. Introduction

The consumers in the Taranaki region are supplied with electricity via electrical networks that are owned by the following Electrical Distribution Business (EDB):

- Powerco Ltd (Taranaki and Egmont network areas, with a section of the network Whanganui area) - 25 zone substations

The relevant Powerco network areas are shown in Figure 3.

The Energy Efficiency & Conservation Authority (EECA) is running a flagship program that is called Regional Energy Transition Accelerator (RETA)[3]. The program is targeted at large energy-using businesses and public sector organisations that are committed to reducing carbon emissions, and seeks to identify the barriers involved and opportunities available.

As part of the RETA program, EECA contracted Ergo to determine the existing spare supply capacity and the load characteristics at the major electrical substations within the Taranaki region.

Ergo previously developed similar reports for Southland, South Canterbury, West Coast, North Canterbury, and more regions.

Figure 3 Powerco network areas[4]

[3] https://www.eeca.govt.nz/co-funding-and-support/products/about-reta/

[4] Powerco *2023 AMP*: https://www.powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

3. Scope of Work

The scope requested of Ergo was to assess the existing capacity (both (N) and (N-1) security) and supply characteristics (peak and average supply and seasonality information) for the major electrical infrastructure in the Taranaki region. This included reviewing both the GXP's and local distribution zone substations along with their associated lines/cables within the Taranaki region.

Ergo's assessments and analysis were based on the following information sources:

- Transpower's *Transmission Planning Report 2023*.
- Powerco's 2023 regulatory information disclosures[5] and *Asset Management Plan* (AMP).
- SCADA substation loading data provided by Powerco.
- GXP metering data extracted from the Electricity Authority's website[6].
- Network diagrams provided by Powerco.
- Geographic Information System (GIS) asset and location data provided by Powerco.

[5] https://www.powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

[6] https://www.emi.ea.govt.nz/Wholesale/Datasets

4. Taranaki Network

The following sections describe (at a high level), the locations of the relevant substations and lines. For the purposes of this document the franchise areas defined above and supplied by Powerco are referred to as the Taranaki region.

4.1 Transmission/GXP Substations

The following Figure 4 illustrates the relevant transmission substations (GXPs) within the Taranaki region, which include the following:

- Powerco:
    - Carrington St GXP.
    - Hāwera GXP.
    - Huirangi GXP.
    - Ōpunake GXP.
    - Stratford GXP.
    - Waverley GXP.

Three further GXPs are present in the region, at Motunui, Kāpuni, and Taumaranui. Motunui directly supplies the large industrial Methanex and OMV Production loads, while Kāpuni supplies the Fonterra Kāpuni load, and allows for connection of the Kāpuni cogeneration. Kāpuni is owned by Nova Energy, instead of Transpower. Taumaranui provides supply at 55 kV to the KiwiRail North Island Main Trunk railway line.

Additionally, there are a number of generation plants connected to Taranaki at present, which connect at dedicated GIPs (Grid Injection Points), or at the GXPs listed above. These include:

- Kāpuni (co-generation) (24 MW) – connects at Kāpuni GXP
- Waipipi (wind farm) (130 MW) – connects at Waverley GXP
- Patea (hydro generation) (32 MW) – connects at Hāwera GXP
- Whareroa (co-generation) (64 MW) – connects at Hāwera GXP
- Taranaki Combined Cycle (natural gas generation) (383 MW) – connects at Stratford GXP[7]
- Stratford Peakers (natural gas generation) (220 MW) – connects at Stratford GXP
- Junction Road (natural gas generation) (98 MW) – dedicated GIP
- McKee (natural gas generation) (94 MW) – dedicated GIP

Many of these generation plants (particularly the natural gas plants) are peaker plants, meaning they are typically used only when required, for example when the national electricity price is high due to a mismatch in supply and demand (or low hydro supply), when the gas price is low, or when there are network constraints.

[7] Taranaki combined cycle generation is expected to go out-of-service at the end of 2024

The transmission network in the Taranaki region is also shown schematically in Figure 5. Due to the high total capacity of the generation in the region, depending on the load and generation levels at a given time, the region may import or export electricity from/to the national grid.
The region connects to the national grid through two 220 kV circuits which run north-east from Stratford to Huntly; three 220 kV circuits which run south-east from Stratford to Brunswick (two of which continue on to Bunnythorpe); and one 110 kV circuit which runs south-east from Stratford to Bunnythorpe (via Hāwera, Waverley, Whanganui, and Marton).
The transmission network in the Taranaki region comprises mostly of 110 kV circuits, with interconnecting (220/110 kV) transformers located at Stratford.

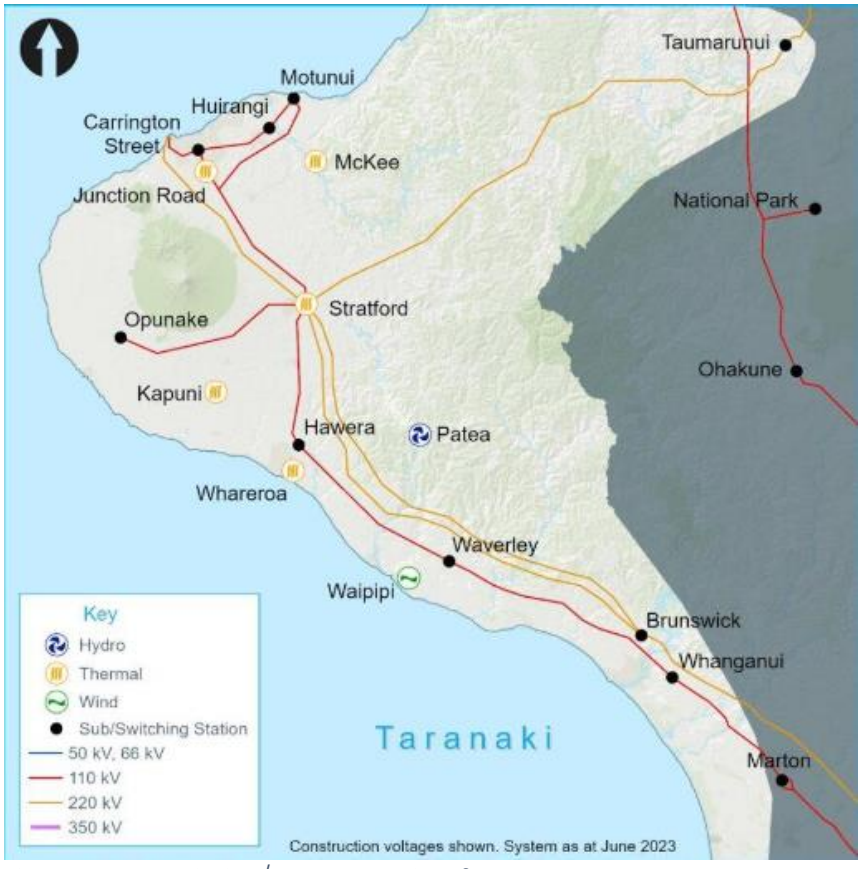


Figure 4 Transmission/GXP substations[8]

[8] *Transmission Planning Report 2023*.

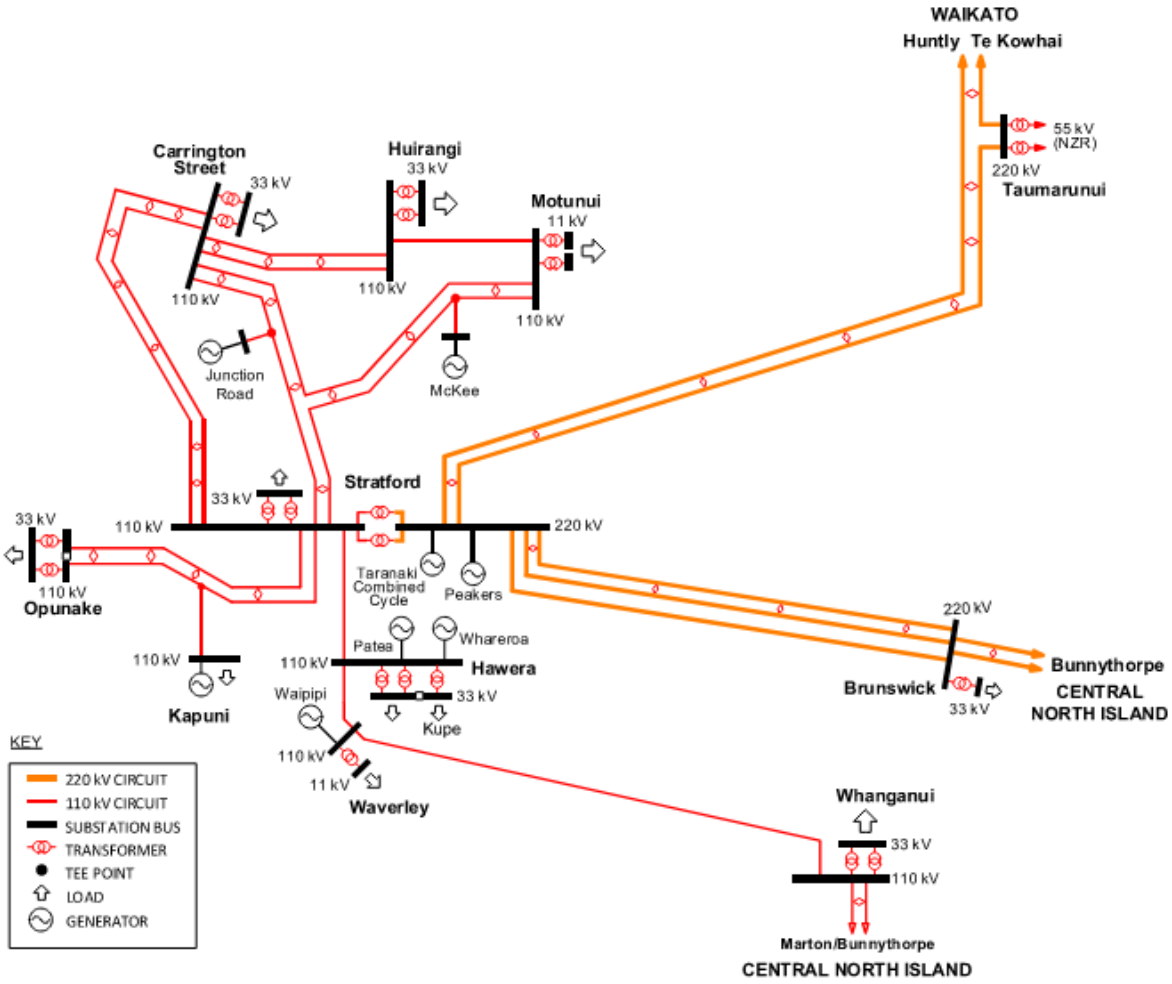


Figure 5 Existing transmission/GXP substations[8]

4.2 Powerco Zone Substations

As mentioned earlier, in the Taranaki area, there is only one relevant EDB: Powerco. Powerco has a total of 25 zone substations connected to the 6 GXPs in the region.

The following Figure 6 and Figure 7 show the subtransmission networks, zone substations, and GXPs for Powerco's Taranaki and Egmont regions (as well as Waverley GXP in Powerco's Whanganui region) respectively. The substations include:

- Carrington St GXP:
    - Brooklands 33/11 kV zone substation
    - Moturoa 33/11 kV zone substation
    - City 33/11 kV zone substation
    - Katere 33/11 kV zone substation
    - Ōākura 33/11 kV zone substation
- Hāwera GXP:
    - Kāpuni 33/11 kV zone substation
    - Manaia 33/11 kV zone substation
    - Cambria 33/11 kV zone substation
    - Mokoia 33/11 kV zone substation
    - Livingstone 33/11 kV zone substation
- Huirangi GXP:
    - Bell Block 33/11 kV zone substation
    - Waitara East 33/11 kV zone substation
    - Waitara West 33/11 kV zone substation
    - McKee 33/11 kV zone substation
    - Inglewood 33/11 kV zone substation
- Ōpunake GXP:
    - Pungarehu 33/11 kV zone substation
    - Ngāriki 33/11 kV zone substation
    - Tasman 33/11 kV zone substation
- Stratford GXP:
    - Motukawa 33/6.6 kV zone substation
    - Douglas 33/11 kV zone substation
    - Cardiff 33/11 kV zone substation
    - Cloton Road 33/11 kV zone substation
    - Waihapa 33/11 kV zone substation
    - Kaponga 33/11 kV zone substation
    - Eltham 33/11 kV zone substation
- Waverley GXP:
    - Waverley 11 kV zone substation (Transpower owned and operated substation)

Figure 6 Powerco's Taranaki region zone substations and interconnecting subtransmission circuits [9]

Figure 7 Powerco's Egmont region zone substations and interconnecting subtransmission circuits [9]

Figure 8 Powerco's Whanganui region zone substation (Waverley) [9]

[9] Powerco's *2023 Asset Management Plan* found here: https://www.powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

5. (N) and (N-1) Security Classifications

Both Transpower and the Powerco's develop and operate their networks in accordance with a set of reliability standards. In the context of Transpower it is required to meet the grid reliability standards that are outlined in the *Electricity Industry Participation Code* (EIPC)[10]. In contrast, EDBs (such as Powerco) are required to publish an annual AMP which often details a network specific security standard, which is used to plan/develop its network.

In both cases, these standards are usually quantified in terms of the following terminology:

- **(N) security:** The network is designed and operates such that it will be unable to supply load in the event of a single asset failure (i.e., a line, transformer or other primary asset). This is equivalent to a single-engine airplane, which in the event of engine failure will result in the aircraft crashing.
- **(N-1) security:** The network is designed and operates such that it can continue to supply load uninterrupted in the event of a single asset failure. This scenario can be compared with to an aircraft, but in this case with two engines, which in the event of single engine failure will not crash.

The decision around whether to develop/operate a network supply with (N) or (N-1) security is typically driven by the size and criticality of the load versus the investment costs.

Typically, in New Zealand, this results in the following:

- Transmission GXP substations and lines being designed and operated with (N-1) security of supply.
- Distribution zone substations are designed and operated as follows:
    - Loads ≥ 12 MW designed and operated with (N-1) security of supply.
    - Loads < 12 MW designed and operate with (N) security of supply.

Transpower is required to provide (N-1) for "core grid" (i.e. 220 kV and >150 MVA loads, along with some 110 kV loads) interconnected assets (i.e. transmission lines that supply multiple GXP substations). For "non-core grid" assets (i.e. <220 kV and <150 MVA loads), the decision to supply (N-1) is still made by Transpower but must be economically justified.

For connection assets that are dedicated to a single consumer the decision regarding security is made by the consumer/customer. The customer can be an industrial consumer, but in most cases is an EDB and usually (N-1) security of supply is specified. However, for GXPs that supply small consumer load or where a large industrial customer does not want to pay for (N-1) security, an N security connection is not uncommon.

The Transpower GXPs discussed in this report are considered connection assets and therefore decisions around their security classifications lie with their end customers (i.e., Powerco). For those substations that are supplied via dedicated incoming lines, the lines are also considered to be connection assets. The remaining lines that are not dedicated to a single substation are interconnection assets.

[10] https://www.ea.govt.nz/code-and-compliance/the-code/

The distribution networks owned/operated by EDBs generally supply multiple consumers and thus, in most cases, EDBs have to make security of supply decisions on behalf of their consumers. These decisions are based on the EDB's disclosed network security criteria, that have been ratified by their respective boards of directors.

Both Transpower and Powerco have taken advantage of technology to make the above-mentioned standards more flexible, by managing consumer demand where possible. Initially this involved the use of mains borne ripple injection equipment to manage the load drawn by consumer's hot water cylinders. But more recently this has involved, for example, special protection systems (SPS) that, in the event of the loss of specific network equipment will shed specific consumer loads. More recently, the development of a market for interruptible load[11] has been initiated. There are examples of this at both transmission and distribution levels. This has allowed Transpower and Powerco to operate some sections of their networks well beyond their (N-1) limits, whilst still maintaining sufficient security of supply to the majority of their consumers.

There is potential to significantly reduce the costs associated with electrical network upgrades if load sites can be designed to:

- Operate during times of minimum network loading (typically late in the evening and early in the morning) such that they do not significantly increase existing peak network loading.
- Swiftly and safely disconnect from the relevant electrical network during periods of peak loading.

[11] Demand side participation | Transpower

6. Spare Capacity – Transmission Substations (GXPs)

The following sections document the spare capacity that is available at the GXP's that supply the Taranaki region.

Transpower has identified the following "*grid issues*" that result from increasing electrical demand and generation in the Taranaki region including:

- During an outage of the higher-rated of the two Stratford interconnecting transformers, the capacity of the smaller transformer may be exceeded. There is also a risk of low network voltages during this contingency (in periods of low generation and high load in the network).
- When there is no generation available at Hāwera, an outage of the 110 kV Hāwera-Stratford circuit may cause low voltages/voltage drops larger than 5% at Hāwera, Whanganui, and Waverley.
- During an outage of the Hāwera transformer T3 (which solely supplies the Beach Energy Kupe load under normal conditions), transfer of the Beach Energy load to T1 and T2 (Powerco supply) would likely exceed the (N-1) capacity of T1 and T2.
- Bus section contingencies at either Stratford or Ōpunake would result in loss of supply to Kāpuni (GIP). However, the customer has not requested any improvements to the level of security at Kāpuni at present.
- The capacity of the three Brunswick-Stratford 220 kV circuits may constrain the amount of generation which can be exported from the Taranaki region (depending on HVDC flow and direction). One of these lines is also due for replacement.
- Proposed generation connecting at Huirangi may be constrained by the lower rated Carrington St-Huirangi 110 kV circuits. Similarly, additional generation connecting at Whanganui, Waverley, Hāwera, or Stratford may be constrained by the capacity of the single 110 kV Whanganui-Waverley-Hāwera-Stratford circuit.

Many of the transmission capacity issues in the region relate to capacity for new/excess generation connections, and as such, the region may be an optimal location for additional electrical load. Additionally, many of the transmission capacity issues in the region can be managed in the short-term with special protection schemes (SPS's) or transformer overload protection schemes (TOPS's), and in the long-term with planned equipment replacements or upgrades.

Figure 9 below illustrates Transpower's view of a possible 2038 configuration for the Taranaki region's transmission network. It includes:

- Replacement of the 110/33 kV transformers and a 33 kV switchboard ODID at the Ōpunake GXP.
- Reconductoring of a section of the 110 kV Stratford-Carrington St lines.
- Upgrade of one of the Stratford 220/110 kV interconnecting transformers.
- Replacement of two of the 110/33 kV transformers at Hāwera GXP.
- Replacement of the 11 kV switchboard at Waverley GXP.
- Upgrades of the lines connecting the region to the rest of the North Island Transmission network, including of the Whanganui-Bunnythorpe 110 kV and reconductoring of the Stratford-Brunswick 220 kV lines.

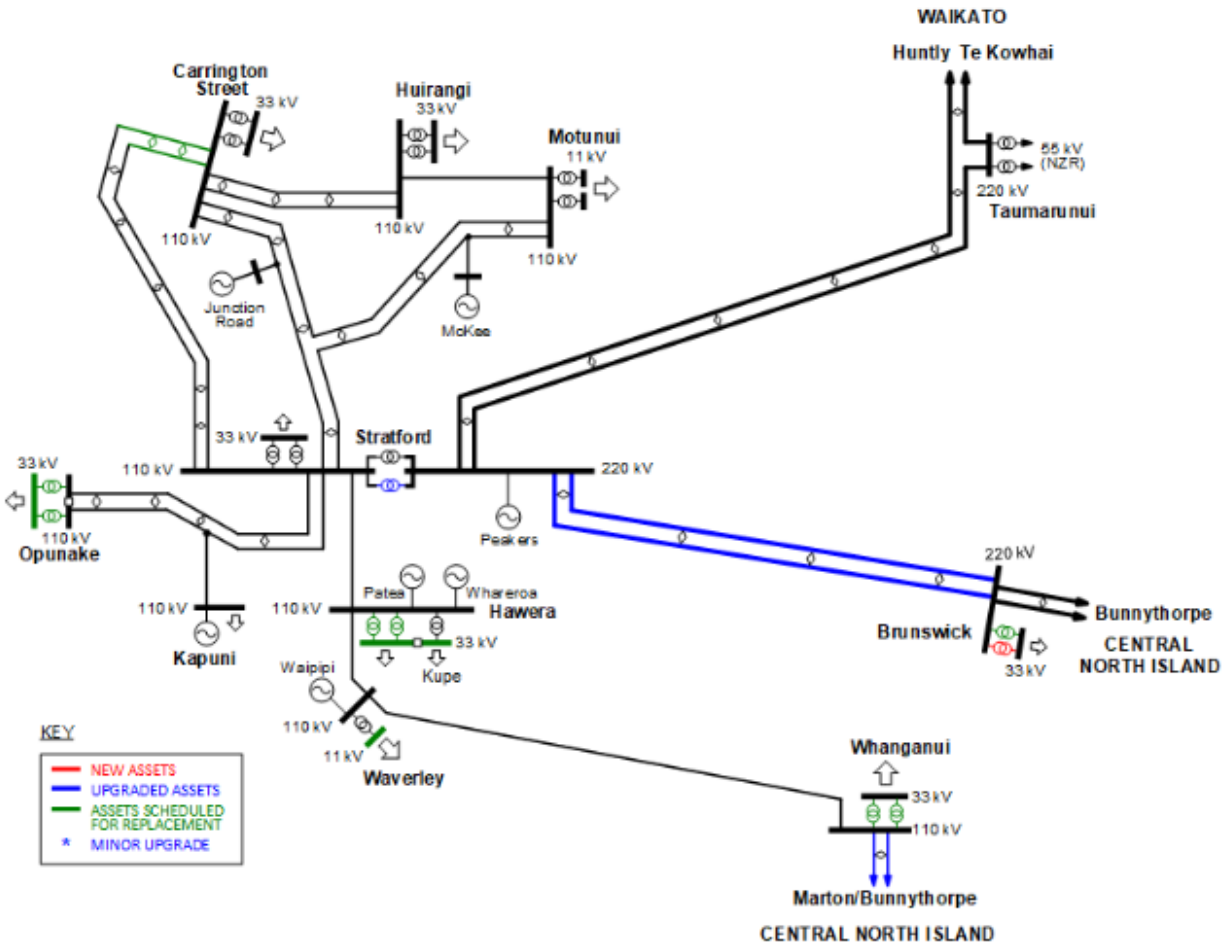


Figure 9 Existing transmission/GXP substations together with future possible upgraded/new assets[12]

[12] Transmission Planning Report 2023

6.1 Demand Forecast

The following Table 2 illustrates Transpower's forecast demand at the transmission substations in the Taranaki region from its annual *Transmission Planning Report 2023*[13]. The forecast predicts the demand growing at an average of 1.8% per annum over the next fifteen years which is lower than the national average of 2.0%.

Table 2 Forecast prudent annual peak demand (MW) at Taranaki grid exit points to 2038.

GXP	Power factor	Peak demand (MW)											
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2038
Carrington Street	1.00	71	74	77	78	80	81	83	84	85	86	88	91
Hāwera (Powerco)[1]	1.00	30	33	36	36	37	38	38	38	39	39	40	41
Huirangi[2]	0.97	36	39	40	41	42	43	43	44	44	45	45	47
Ōpunake	0.93	12	12	13	13	13	13	13	13	13	14	14	14
Stratford 33 kV	0.97	33	33	34	35	35	36	36	37	37	38	38	40
Waverley	0.93	6	7	7	7	7	7	7	7	7	7	7	8
Motunui	0.97	21	21	22	22	22	22	22	22	22	22	22	22

Notes:

1. Load increase from industrial sector demand: 2.5 MW in 2024, 2.5 MW in 2025.
2. Load increase from industrial sector demand: 2.0 MW in 2023, 2.0 MW in 2024.

[13] Transmission Planning Report 2023

6.1.1 Carrington St GXP

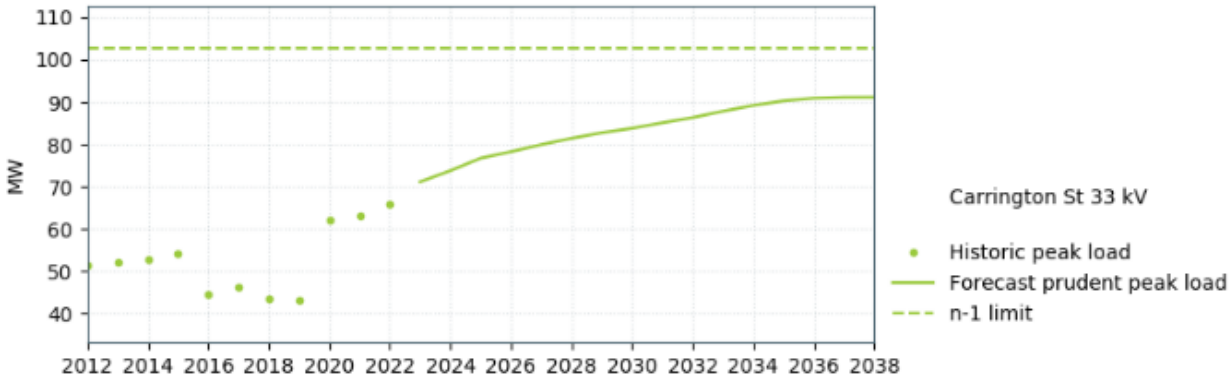
Transpower's demand forecast indicates that the Carrington St GXP was expected to have a 2023 peak demand of 71 MW at 1.00 power factor (71 MVA). This aligns with the historical SCADA data that indicates that, in 2023 the Carrington St GXP experienced a peak load of 66.4 MVA.

The Carrington St GXP is equipped with two 110/33 kV transformers providing:

- (N) capacity of 150 MVA and
- (N-1) capacity of 103 MVA.

The lines suppling the Carrington St-Huirangi-Motunui ring from Stratford GXP are sized well above the total transformer (N) rating of the substations in the loop.

The peak load is not forecast to exceed the (N-1) capacity of the transformers within the planning period. The following graph[14] compares Carrington St GXP's supply capacity with the historical loading and Transpower's demand forecast.
Powerco's 2016 AMP[15] notes that the Bell Block substation was shifted from Carrington St to Huirangi GXP in ~2016, which may be the reason for the drop in load on Carrington St from 2016-2020. Transpower's New Plymouth GXP was recently decommissioned, which may have resulted in the load increase at Carrington St around 2020.



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 following Figure 10 illustrates Carrington St's 2023 loading in comparison to its substation capacity.

[14] Sourced from Transpower's *Transmission Planning Report 2023*.
[15] Powerco's historical *Asset Management Plans* are available at: https://www.powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures

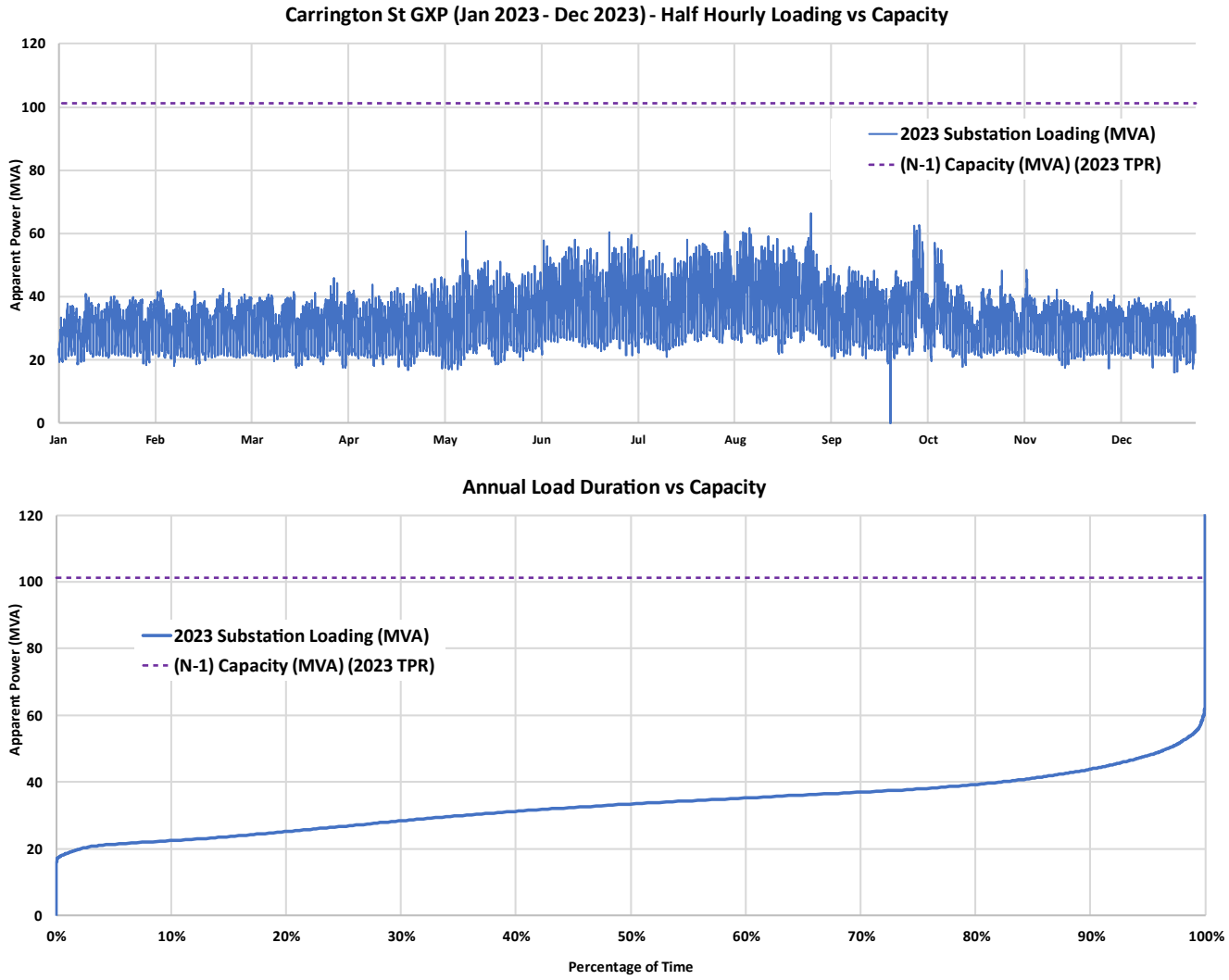


Figure 10 Carrington St GXP: 2023 Loading: Substation capacity

6.1.2 Hāwera GXP

Hāwera GXP is typically operated with a split 33 kV bus, where one bus half supplies the Beach Energy (Kupe) customer, while Powerco takes supply from the other. This report typically refers to the Powerco supply from Hāwera when the GXP is mentioned.

Transpower's demand forecast indicates that the Hāwera GXP was expected to have a 2023 peak demand of 30 MW at 1.00 power factor (30 MVA). This value aligns with the historical SCADA data that indicates the Powerco supply at the Hāwera GXP recorded a peak load of 28.4 MVA during the 2023 year.

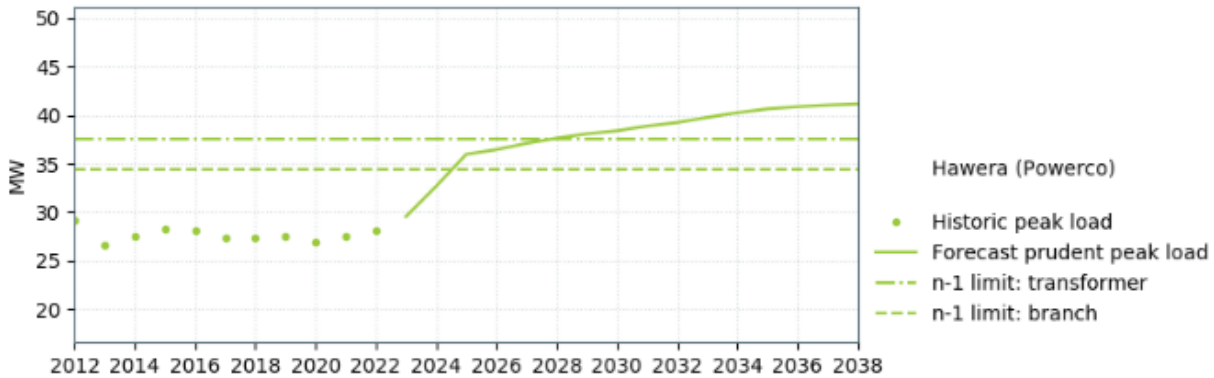
The Hāwera GXP (Powerco supply) is equipped with two 110/33 kV transformers providing:

- (N) capacity of 60 MVA and
- (N-1) capacity of 35 MVA.

The 110 kV Stratford-Hāwera-Waverley-Whanganui line is sized at approximately 153/165 MVA (summer/winter).

An outage of the 110 kV Hāwera-Stratford circuit can result in low voltages or voltage drops larger than 5% at Hāwera when there is no local generation at Hāwera. As this is a rare occurrence (high load coupled with low generation and loss of an asset), it is not an urgent issue at present. Transpower has identified installation of capacitors at Hāwera or managing pre-contingency voltages at Stratford as possible options for mitigating this issue in the future.

The peak load is forecast to exceed the (N-1) capacity of the transformers from winter of 2025. The following graph[16] compares Hāwera GXP's supply capacity with the historical loading and Transpower's demand forecast. The increase in load in 2024 and 2025 is resultant of 2x 2.5 MW step increases in industrial load over the two years, along with the typical forecasted load growth of other load types.



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 branch limit (caused by a limitation of the existing 33 kV outdoor switchgear) in the above graph will be removed as part of the Hāwera outdoor to indoor (ODID) project, which is presently underway.

[16] Sourced from Transpower's *Transmission Planning Report 2023*.

The capacity issue will then be delayed to 2028. Transpower plans to discuss options for increasing the capacity of the GXP with Powerco closer to the need date.

The following Figure 11 illustrates Hāwera's 2023 loading in comparison to its substation capacity. It is noted that, although generation is connected to Hāwera GXP as described in Section 4.1, the generation connects at the 110 kV bus. The SCADA data used for the graphs below is as metered at the 33 kV bus and as such does not include the generation.

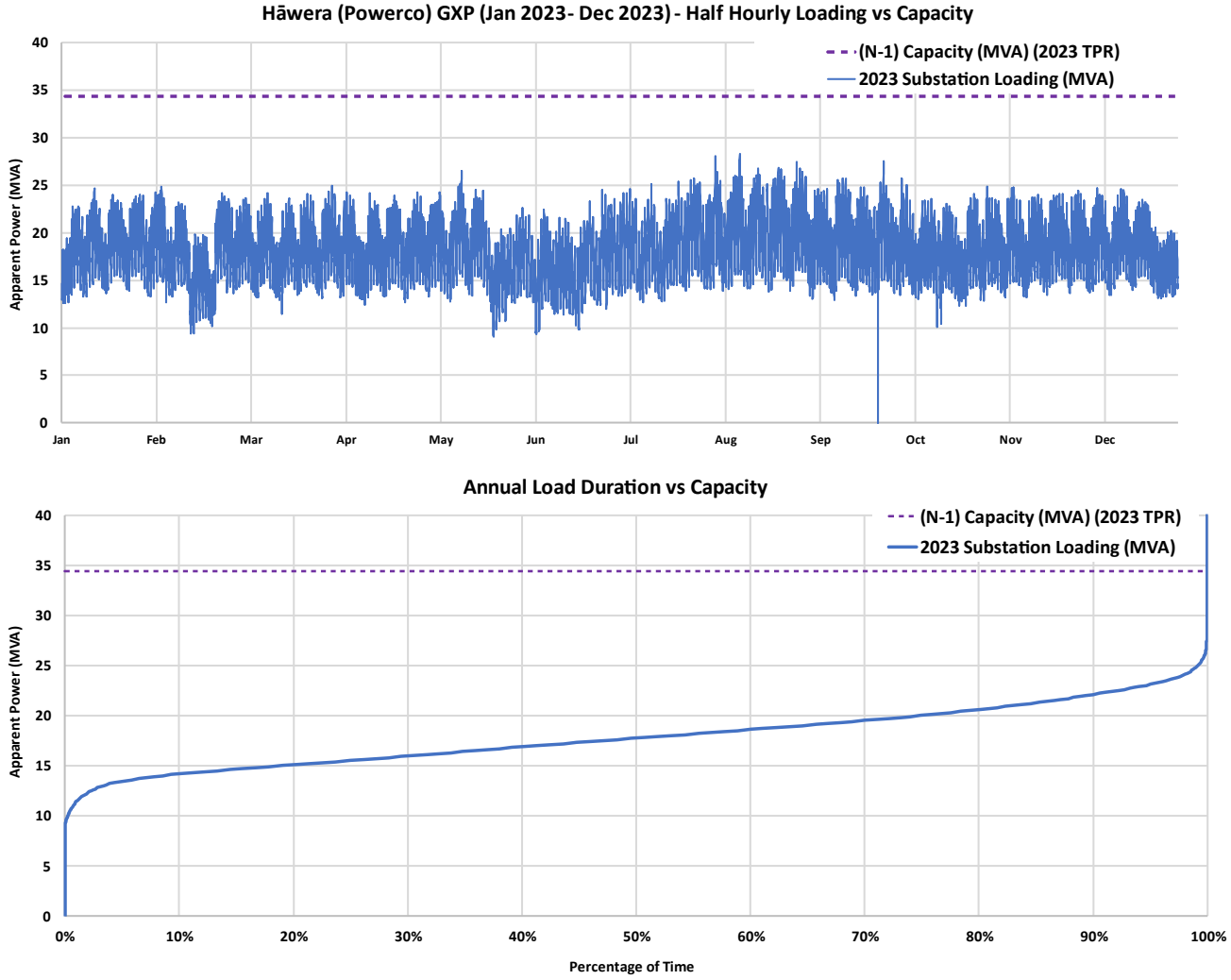


Figure 11 Hāwera GXP: 2023 Loading, capacity, and load duration.

6.1.3 Huirangi GXP

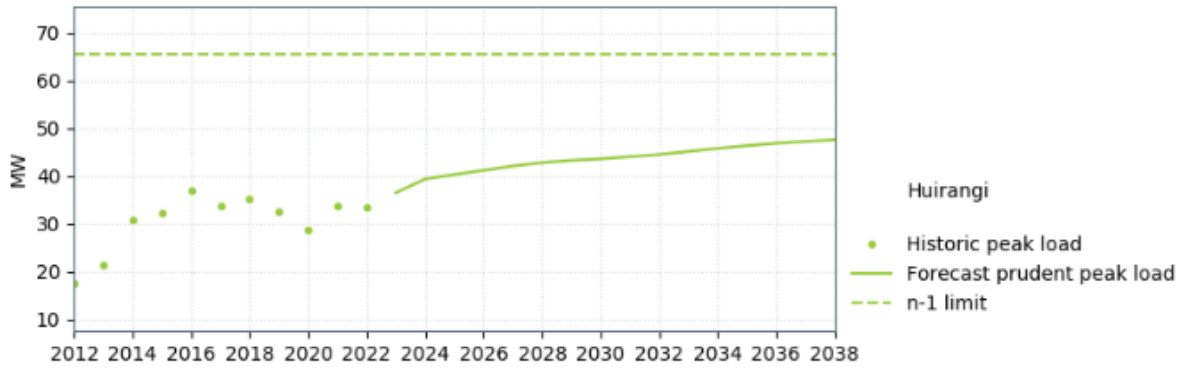
Transpower's demand forecast indicates that the Huirangi GXP was expected to have a 2023 peak demand of 36 MW at 0.97 power factor (~37.1 MVA). This aligns with the historical SCADA data that indicates that during 2023 the Huirangi GXP experienced a peak load of 33.2 MVA.

The Huirangi GXP is equipped with two 110/33 kV transformers providing:

- (N) capacity of 120 MVA and
- (N-1) capacity of 70 MVA.

The lines suppling the Carrington St-Huirangi-Motunui ring from Stratford GXP are sized well above the total transformer (N) rating of the substations in the loop.

The peak load is not forecast to exceed the (N-1) capacity of the transformers within the planning period. The following graph[17] compares Huirangi GXP's supply capacity with the historical loading and Transpower's demand 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.

The following Figure 12 illustrates Huirangi's 2023 loading in comparison to its substation capacity.

[17] Sourced from Transpower's *Transmission Planning Report 2023*.

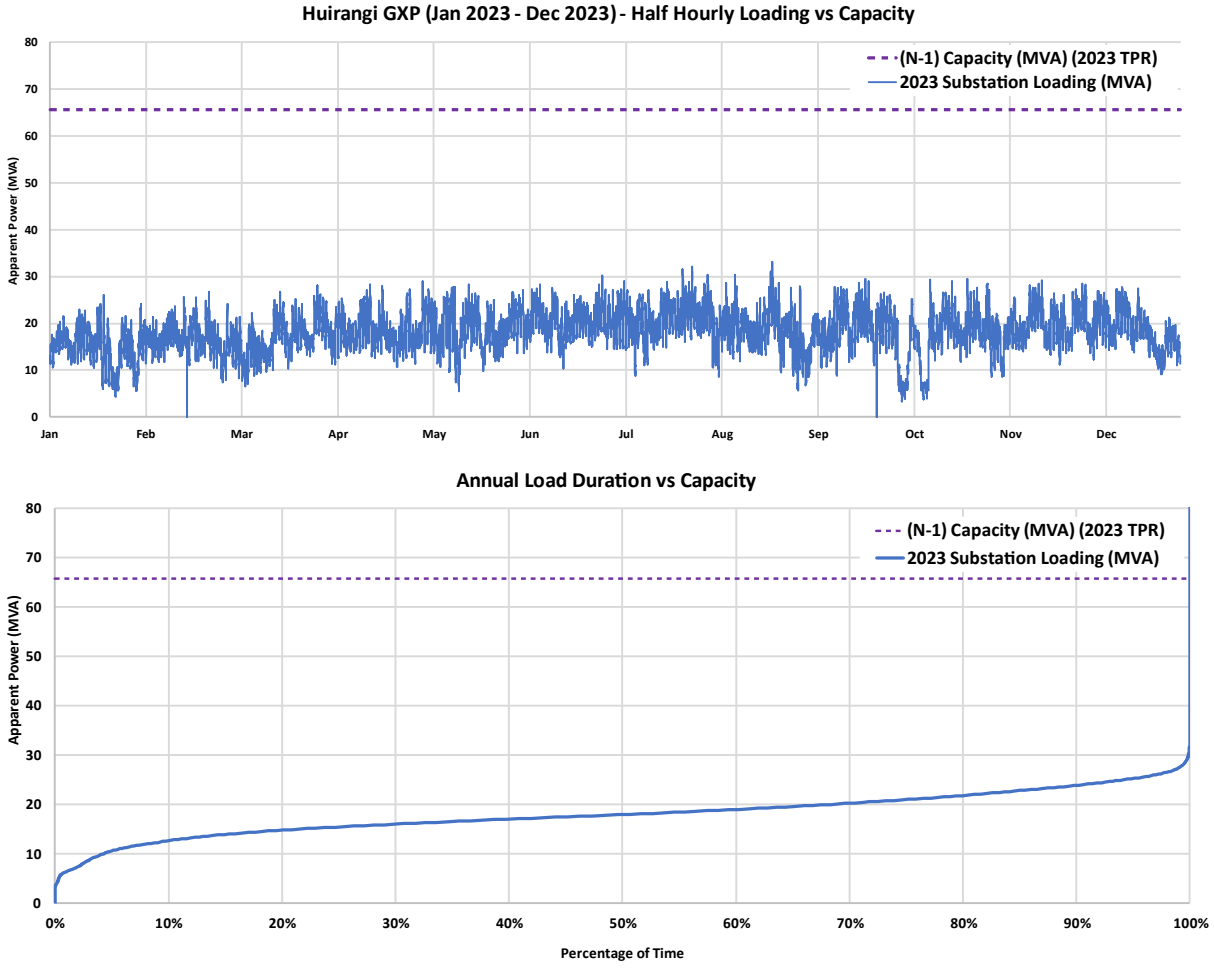


Figure 12 Huirangi GXP: 2023 Loading: Substation capacity:

6.1.4 Ōpunake GXP

Transpower's demand forecast indicates that the Ōpunake GXP was expected to have a 2023 peak demand of 12 MW at 0.93 power factor (~12.9 MVA). This aligns with the historical SCADA data that indicates that, during 2023, the Ōpunake GXP experienced a peak load of 12.3 MVA.

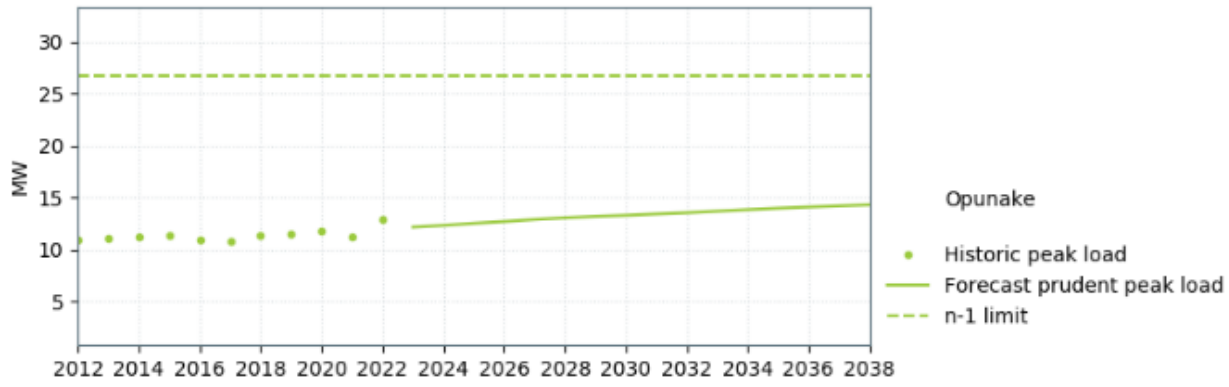
The Ōpunake GXP is equipped with two 110/33 kV transformers providing:

- (N) capacity of 60 MVA and
- (N-1) capacity of 30 MVA. It is noted that the Powerco AMP states a 14 MVA (N-1) rating for this GXP, which may be lower than the transformer rating due to the downstream assets (such as the 33 kV switchgear). If there is a downstream constraint on these transformers, Ergo expects the Outdoor to Indoor upgrade (ODID) project which is presently underway will address this.

Two 110 kV lines connect Ōpunake GXP to Stratford. Each of these lines is rated to 67/79 MVA (summer/winter), which well exceeds the present transformer capacities.

Some outages at Ōpunake require the GXP's 110 kV bus split to be closed. Switching to open or close the bus split requires a short interruption to supply to Ōpunake's load. This issue may become more significant if/when solar generation connects at Ōpunake (due to interruption of generation). Transpower plans to work with Powerco to improve supply security at Ōpunake.

The peak load is not forecast to exceed the (N-1) capacity of the transformers within the planning period. The following graph[18] compares Ōpunake GXP's supply capacity with the historical loading and Transpower's demand 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.

The following Figure 13 illustrates Ōpunake's 2023 loading in comparison to its substation capacity.

[18] Sourced from Transpower's *Transmission Planning Report 2023*.

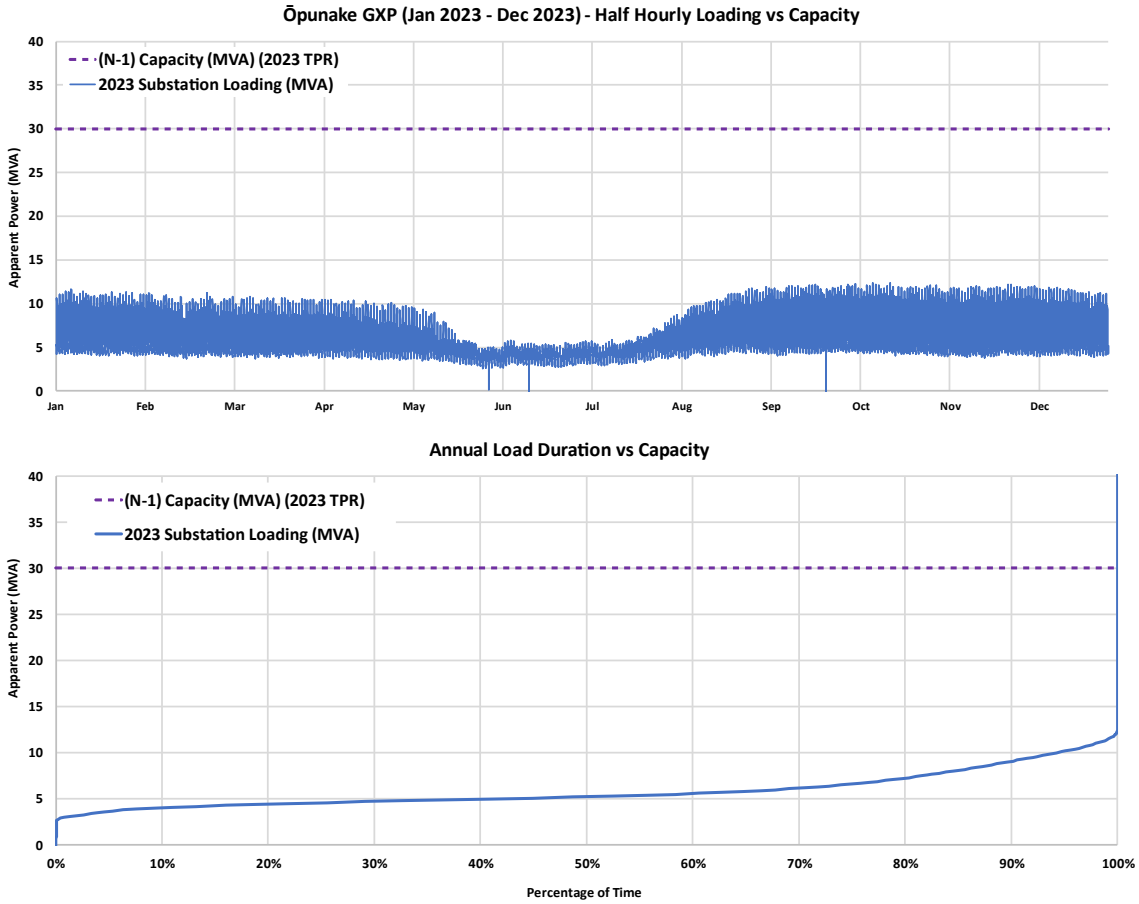


Figure 13 Ōpunake GXP: 2023 Loading: Substation capacity

6.1.5 Stratford GXP

Supply into Stratford GXP is provided by the 5x 220 kV transmission lines (ratings between 177 and 235 MVA per line), along with the 1x 110 kV transmission line (Stratford-Hāwera-Waverley-Whanganui) (rating 153/165 MVA (summer/winter)). Together these transmission lines which connect to Stratford supply the entire load of the Taranaki region (i.e. do not only supply Stratford's load), and are sized well above the total transformer (N) rating of the GXP substations in the Taranaki region.

Two 220/110 kV interconnecting transformers enable the Taranaki region loads to be supplied by the 220 kV lines which connect to Stratford GXP. The interconnecting transformers are rated at 200 MVA and 100 MVA. The following issues relate to the interconnecting transformers:

- An outage of the larger transformer during low generation and high load may cause the smaller transformer's capacity to be exceeded, and may also result in low voltages (below 0.95 p.u.) in the Taranaki region.
- High generation and low load scenarios may result in the smaller transformer's capacity being exceeded.

In the short-term, these issues will be managed by managing generation dispatch in the region. In the long-term, the smaller of the two interconnecting transformers may be replaced with a larger unit, which Transpower expects to cost $13M.

Transpower's demand forecast indicates that the Stratford (33 kV) GXP was expected to have a 2023 peak demand of 33 MW at 0.97 power factor (~34.0 MVA). This is 18% higher than the historical SCADA data which indicates that, during 2023, the Stratford GXP experienced a peak load of 27 MVA. This is at least partially because there generation connected within Powerco's network off Stratford GXP ("embedded generation"), which is not included in Transpower's prudent demand forecast.

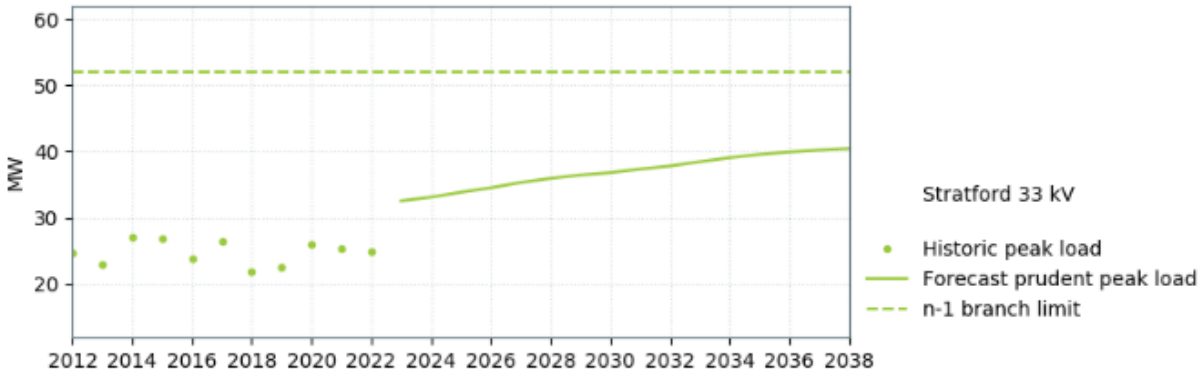
The Stratford GXP is equipped with two 110/33 kV transformers providing:

- (N) capacity of 80 MVA and
- (N-1) capacity of 55 MVA.

The transformer capacity at Stratford is presently limited by a metering limit.

The peak load is not forecast to exceed the (N-1) capacity of the 110/33 kV transformers within the planning period. The following graph[19] compares Stratford GXP's supply capacity with the historical loading and Transpower's demand forecast.

[19] Sourced from Transpower's *Transmission Planning Report 2023*.



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 following Figure 14 illustrates Stratford's 2023 loading in comparison to its substation capacity. It is noted that, although generation is connected to Stratford GXP as described in Section 4.1, the generation connects at the 220 kV bus. The SCADA data used for the graphs below is as metered at the 33 kV bus and as such does not include the generation.

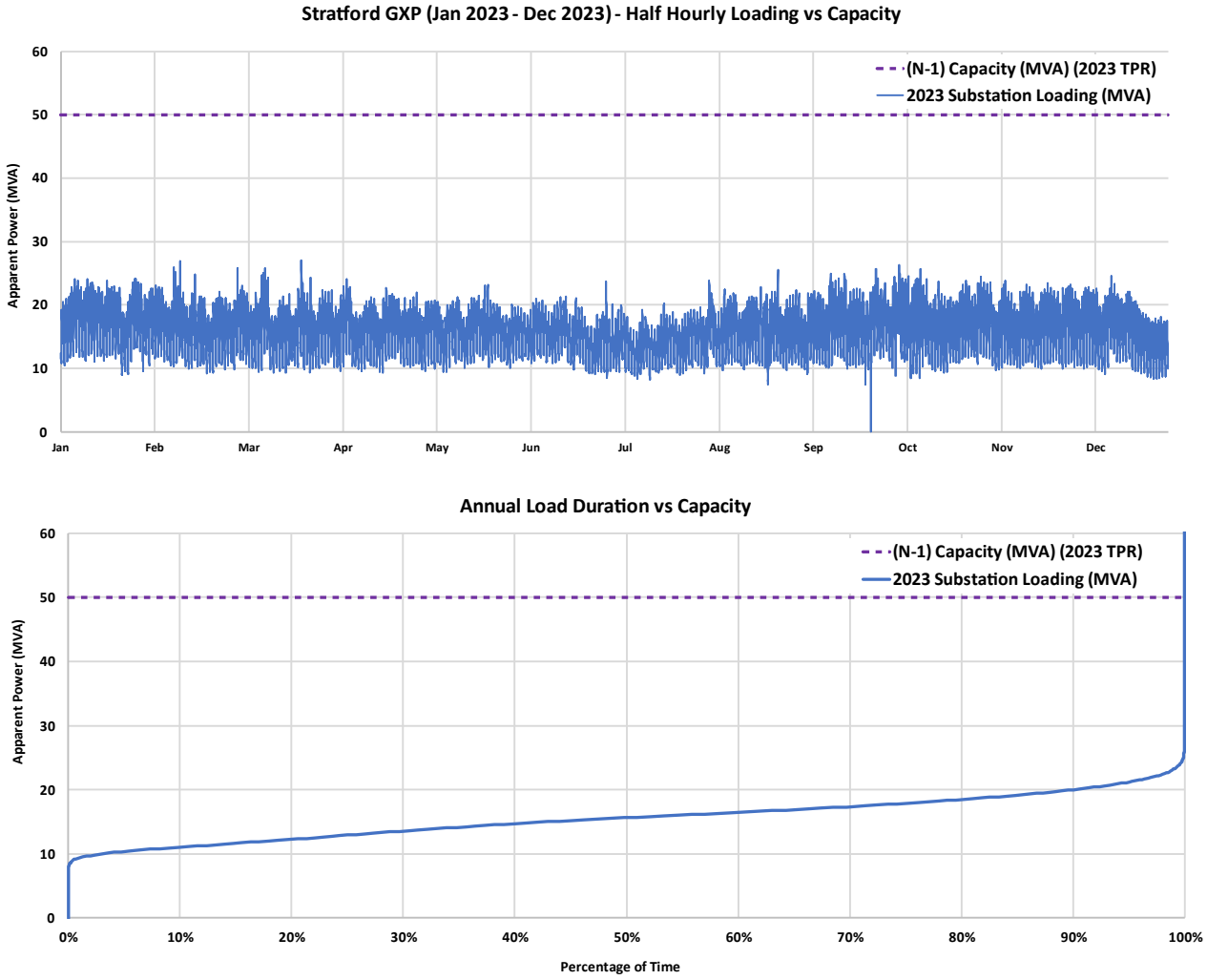


Figure 14 Stratford GXP: 2023 Loading: Substation capacity

6.1.6 Waverley GXP

Transpower's demand forecast indicates that the Waverley GXP was expected to have a 2023 peak demand of 6 MW at 0.93 power factor (~6.5 MVA). This is 18% higher than the historical SCADA data which indicates that, during 2023, the Waverley GXP experienced a peak load of 4.9 MVA.

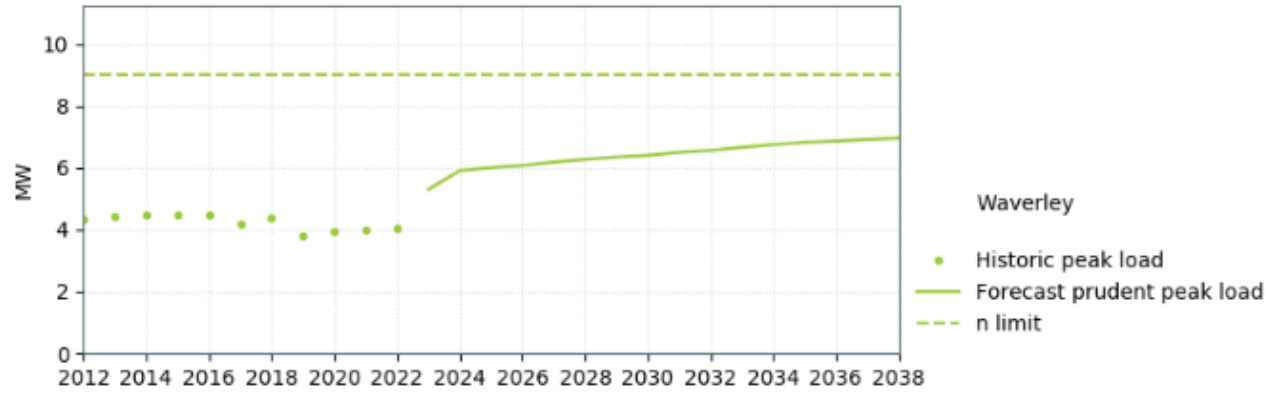
The Waverley GXP is equipped with a single 110/11 kV transformer providing the site with 10 MVA of capacity, with (N) security. There is a national spare transformer located off-site that would enable replacement of the Waverley transformer within 2-4 weeks in the case of a failure.

The 110 kV Stratford-Hāwera-Waverley-Whanganui line is sized at approximately 153/165 MVA (summer/winter).

An outage of the 110 kV Hāwera-Stratford circuit can result in low voltages or voltage drops larger than 5% at Waverley when there is no local generation at Hāwera. As this is a rare occurrence (high load coupled with low generation and loss of an asset), it is not an urgent issue at present. Transpower has identified installation of capacitors at Hāwera or managing pre-contingency voltages at Stratford as possible options for mitigating this issue in the future.

Ergo notes that the Powerco side of the Waverley GXP is undergoing an outdoor to indoor (ODID) project at present.

The peak load is not forecast to exceed the (N) capacity of the transformer within the planning period. The following graph[20] compares Waverley GXP's supply capacity with the historical loading and Transpower's demand 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.

The following Figure 15 illustrates Waverley's 2023 loading in comparison to its substation capacity. It is noted that, although generation is connected to Waverley GXP as described in Section 4.1, the generation connects at the 110 kV bus. The SCADA data used for the graphs below is as metered at the 33 kV bus and as such does not include the generation.

[20] Sourced from Transpower's *Transmission Planning Report 2023*.

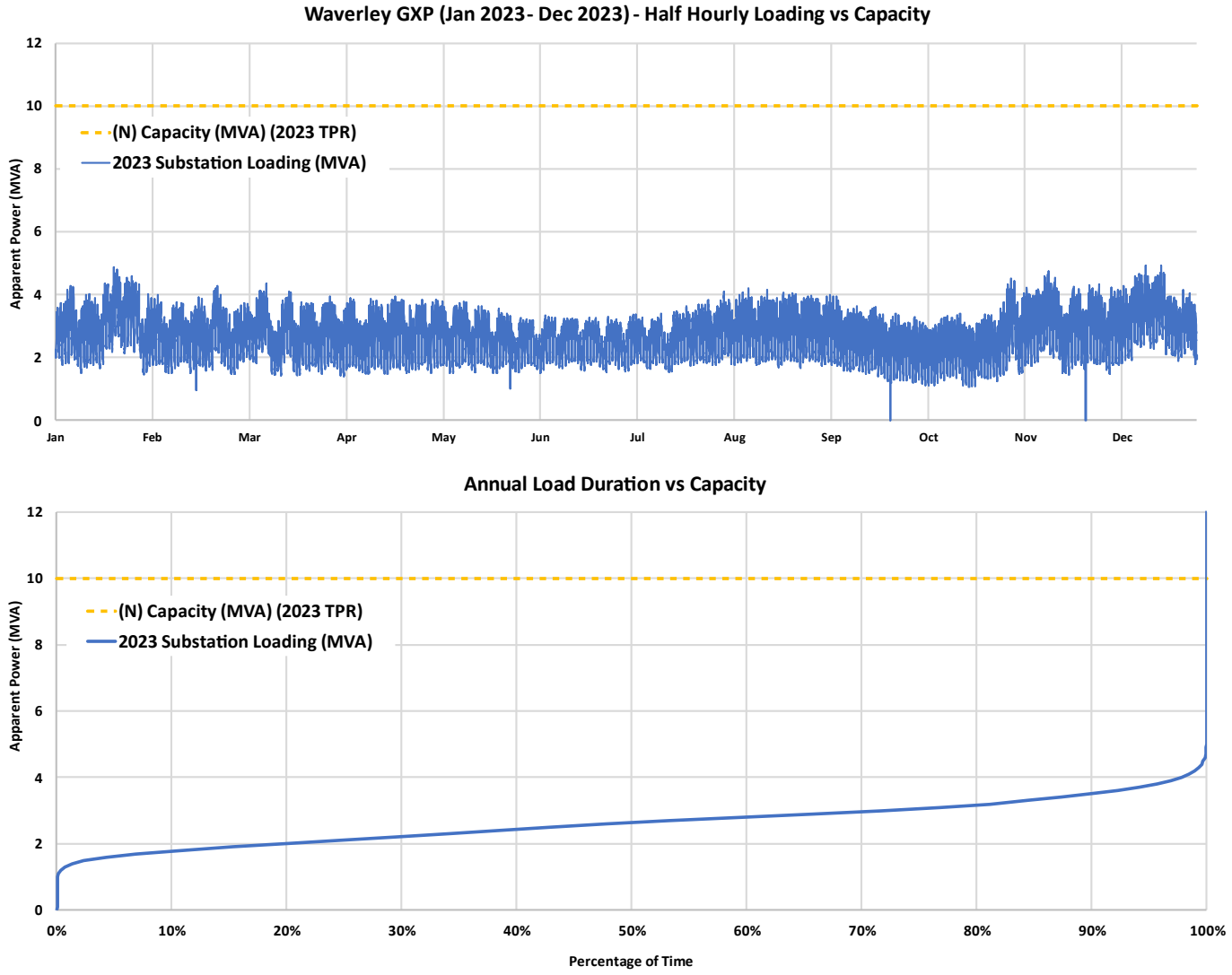


Figure 15 Waverley GXP: 2023 Loading: Substation capacity

6.1.7 Motunui GXP

Transpower's demand forecast indicates that the Motunui GXP was expected to have a 2023 peak demand of 21 MW at 0.97 power factor (~21.7 MVA). This is 28% higher than the historical SCADA data which indicates that, during 2023, the Motunui GXP experienced a peak load of 15.5 MVA.

The Motunui GXP is equipped with two 110/11 kV transformers providing:

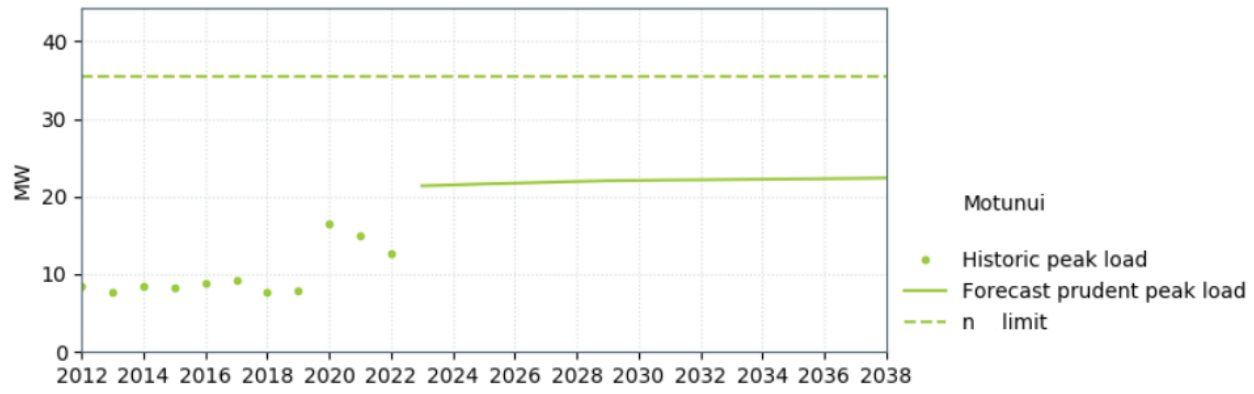
- (N) capacity of 80 MVA and
- (N-1) capacity of 40 MVA.

The transformer capacity at Motunui is presently limited by the 11 kV bus.

The 11 kV bus at Motunui is operated split. Tripping either transformer may result in a partial loss of supply, which can be restored via the customer network (i.e. reconfiguration of the 11 kV feeders). Motunui GXP provides a direct supply to two customers – Methanex and OMV Production.

Motunui is supplied as part of the 110 kV ring including Motunui, Huirangi, and Carrington St GXPs. Two lines from Stratford to Carrington St are each rated at 232/238 MVA (summer/winter), with a third rated at 92/101 MVA (summer/winter). Carrington St is then connected to Huirangi via two lines each rated at 63/77 MVA (summer/winter). Motunui is supplied by one line each from Stratford, Carrington St, and Huirangi, which are rated at 95/105 MVA, 62/76 MVA, and 95/105 MVA, respectively.

The peak load is not forecast to exceed the (N-1) capacity of the 110/11 kV transformers within the planning period. The following graph[21] compares Motunui GXP's supply capacity with the historical loading and Transpower's demand 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.

The following Figure 16 illustrates Motunui's 2023 loading in comparison to its substation capacity.

[21] Sourced from Transpower's *Transmission Planning Report 2023*.

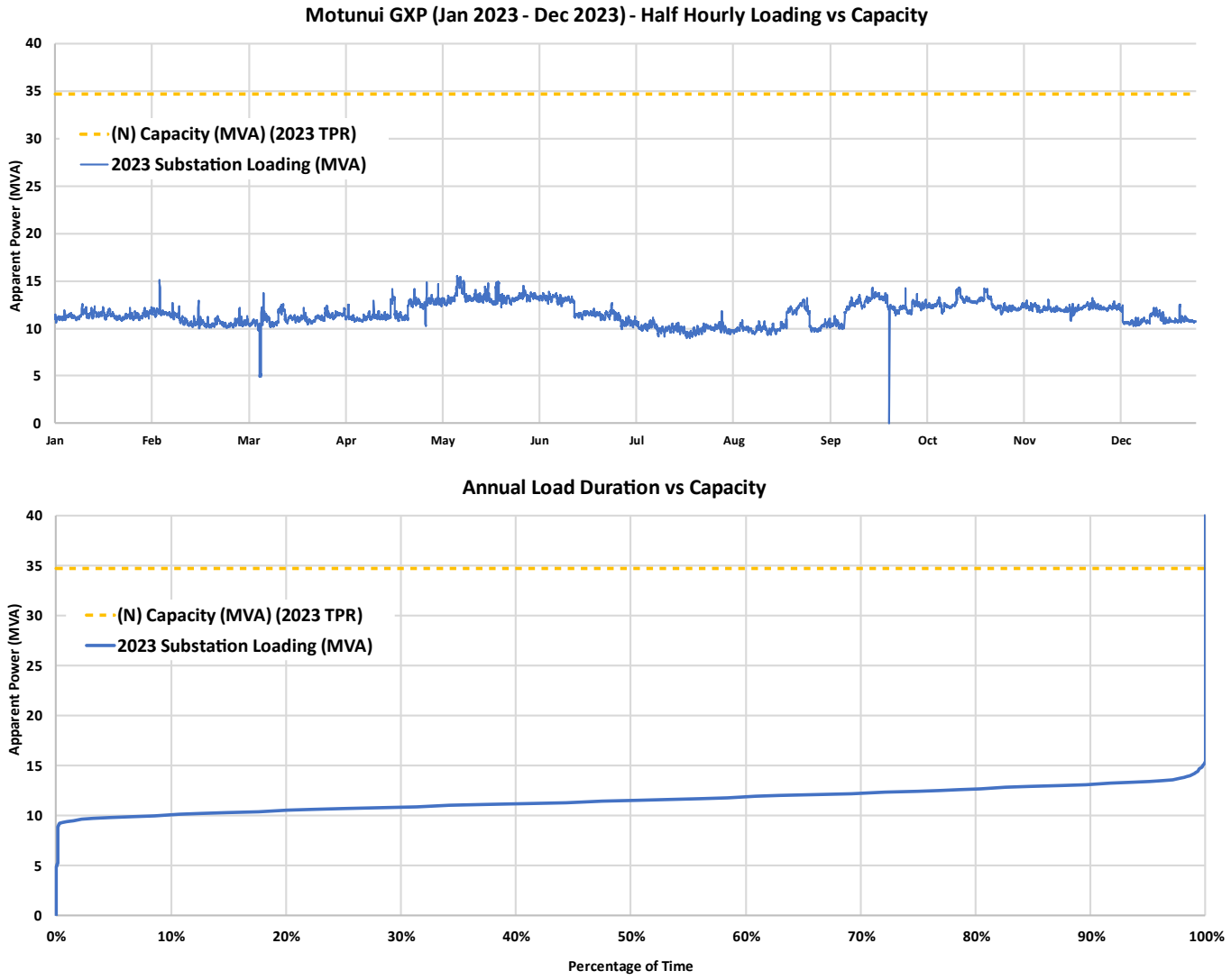


Figure 16 Motunui GXP: 2023 Loading: Substation capacity

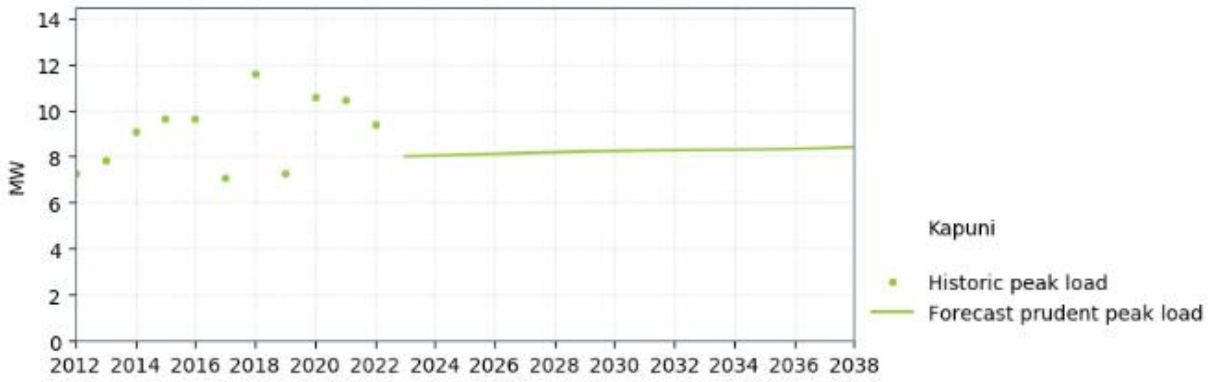
6.1.8 Kāpuni GXP

Transpower's demand forecast indicates that the Kāpuni GXP was expected to have a 2023 peak demand of 8 MW at 1.00 power factor (8 MVA). Historical SCADA data is not available for this GXP. The line supplying Kāpuni, and all other downstream 110/11 kV assets, are owned by Nova Energy, rather than Transpower.

The Nova Energy Kāpuni substation is equipped with a single 110/11 kV transformer providing the site with 30 MVA of capacity, with (N) security.

Kāpuni is supplied off as a tee off the 110 kV Ōpunake-Stratford 2 circuit. A single circuit runs from the tee point to Kāpuni, with a rating of 52/63 MVA (summer/winter). The 110 kV lines connecting Ōpunake GXP to Stratford are rated to 67/79 MVA (summer/winter).

The following graph[22] shows Kāpuni GXP's historical loading and Transpower's demand forecast.



[22] Sourced from Transpower's *Transmission Planning Report 2023*.

6.2 Spare Capacity based on Transpower's 2023 Forecast

The following Figure 17 summarises the approximate, all year, (N-1) and (N) spare capacities at each GXP based on:

- The substation capacity disclosed in Transpower's *Transmission Planning Report 2023*
- The 2023 forecast load provided in Transpower's *Transmission Planning Report 2023* (refer to Table 2).
- Half hourly load data from Electricity Market Information website.
- The 2023 Powerco *Asset Management Plan.*

Negative values are only possible for (N-1) capacities and indicate that there is no spare (N-1) capacity, and that consumer load cannot be supplied for (N-1) conditions. The negative amount indicates the capacity increase that is required to achieve a secure firm capacity at the substation.

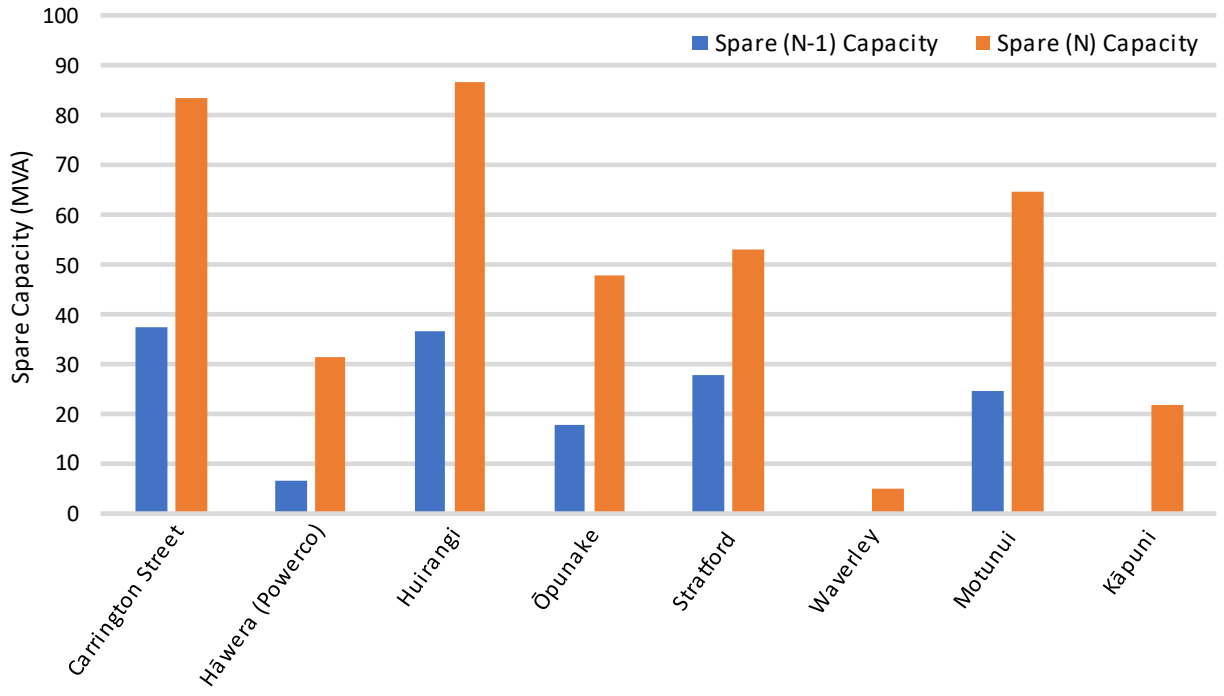


Figure 17 Summary: GXP Spare Capacity based on GXP 2023 EMI loading data.

It should be noted that the spare capacities are based on the asset rating values disclosed by Transpower, and the actual 2023 load data as recorded and presented on The Electricity Market Information website. **Also, the spare (N) capacities do not include any voltage constraints or upstream transmission constraints, which would need to be confirmed by Transpower or Powerco. These are however considered in the individual load assessments in Section 8, particularly for larger loads.**

7. Spare Capacity – Powerco Zone Substations

In determining the (N) and (N-1) spare capacities for the zone substation, Ergo reviewed the Powerco 2023 disclosure data and the historical substation loading data for 2023. Actual historical loading data was provided by Powerco, and all data is shown in Table 3.

Table 3 Powerco: Spare capacity for each Zone Substation

No.	Substation Name	Spare (N) Capacity		Spare (N-1) Capacity	
		Disclosure Data	Historical Data	Disclosure Data	Historical Data
1	Bell Block	34.00	35.1	9.0	10.1
2	Brooklands	29.00	32.8	5.0	8.8
3	Cardiff	1.00	1.5	1.0	1.5
4	City	24.00	26.4	4.0	6.4
5	Cloton Rd	16.00	15.0	3.0	2.0
6	Douglas	1.00	0.7	1.0	0.7
7	Eltham	25.00	11.4	8.0	-5.6
8	Inglewood	5.00	4.5	1.0	0.5
9	Kaponga	2.00	1.6	0.0	-0.4
10	Katere	33.00	32.3	9.0	8.3
11	McKee	4.00	4.2	N/A	N/A
12	Motukawa	3.75	4.0	-1.0	-0.7
13	Moturoa	29.00	29.9	5.0	5.9
14	Ōākura	6.00	6.4	N/A	N/A
15	Waihapa	4.00	4.6	1.0	1.6
16	Waitara East	7.00	1.0	1.0	-5.0
17	Waitara West	18.00	18.9	5.5	6.4
18	Cambria	19.00	19.2	2.0	2.2
19	Kāpuni	16.00	15.1	5.0	4.1
20	Livingstone	2.00	2.2	0.0	0.2
21	Manaia	4.00	4.7	-1.0	-0.3
22	Ngāriki	3.25	3.5	1.0	1.2
23	Pungarehu	7.00	7.2	2.0	2.2
24	Tasman	0.00	0.0	0.0	0.0
25	Mokoia	7.00	6.1	1.0	0.1

Note: The negative (N-1) ratings represent a zone substation where the (N-1) rating is already exceeded at times throughout the year.

7.1 Summary

A number of Powerco's zone substations in the region (namely: Cardiff, Douglas, Motukawa, Waihapa, Manaia, Ngāriki, Tasman, and Mokoia) have (N-1 switched) security rather than full (N-1) security. These substations each have one transformer only, however, some backfeed is available through the local network in the case that the transformer is out of service. For these substations, the total (N) capacity is typically taken as the transformer capacity, while the total (N-1) capacity is taken as the backfeed capability (also called "transfer capacity") for that substation's load.

(N-1) Capacity Summary

The following Figure 18 illustrates the approximate (N-1) spare capacities at Powerco's zone substations, for the disclosed peak demand estimates. It should be noted that these have been calculated based on the transformer ratings disclosed by Powerco.

The spare capacities shown do not include any upstream or downstream conductor or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8.

The negative (N-1) ratings represent a zone substation where the (N-1) rating is already exceeded at times throughout the year. This means there is no spare (N-1) capacity left and the red graph indicates the extent that the (N-1) secure capacity has been exceeded in the past. Zone substations with (N) security have been omitted from this graph. This means that two of the twenty five zone substations (McKee and Ōākura) do not have (N-1) security with respect to the supply transformers. At three of the zone substations, the (N-1) supply capacity has been exceeded in 2023.

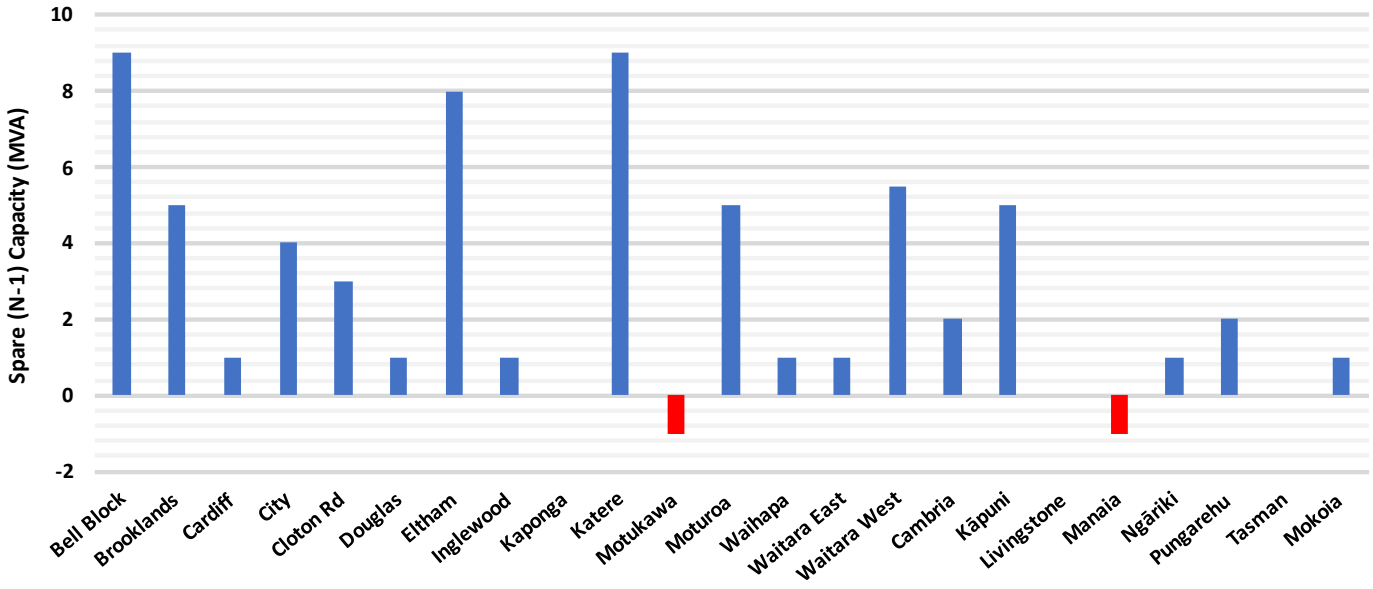


Figure 18. Summary: Approximate (N-1) spare capacity at Powerco's zone substations

The zone substations with spare (N-1) capacity left vary from 12% (for Cambria) to 50% (for Douglas and Waihapa) available capacity.

(N) Capacity Summary

The following Figure 19 illustrates the approximate (N) spare capacities at Powerco's zone substations, for the disclosed peak demand estimates[23]. Again, it should be noted that these have been calculated based on the transformer ratings disclosed by Powerco.

The spare capacities shown do not include any upstream or downstream lines, cables or other equipment thermal constraints, which may be discussed for selected zone substations in Section 8. Figure 19 indicates that there is a significant volume of spare (N) capacity, more than 30%, at Powerco's substations, although we note that many of them are in urban/CBD locations where (N-1) security of supply would be a standard requirement.

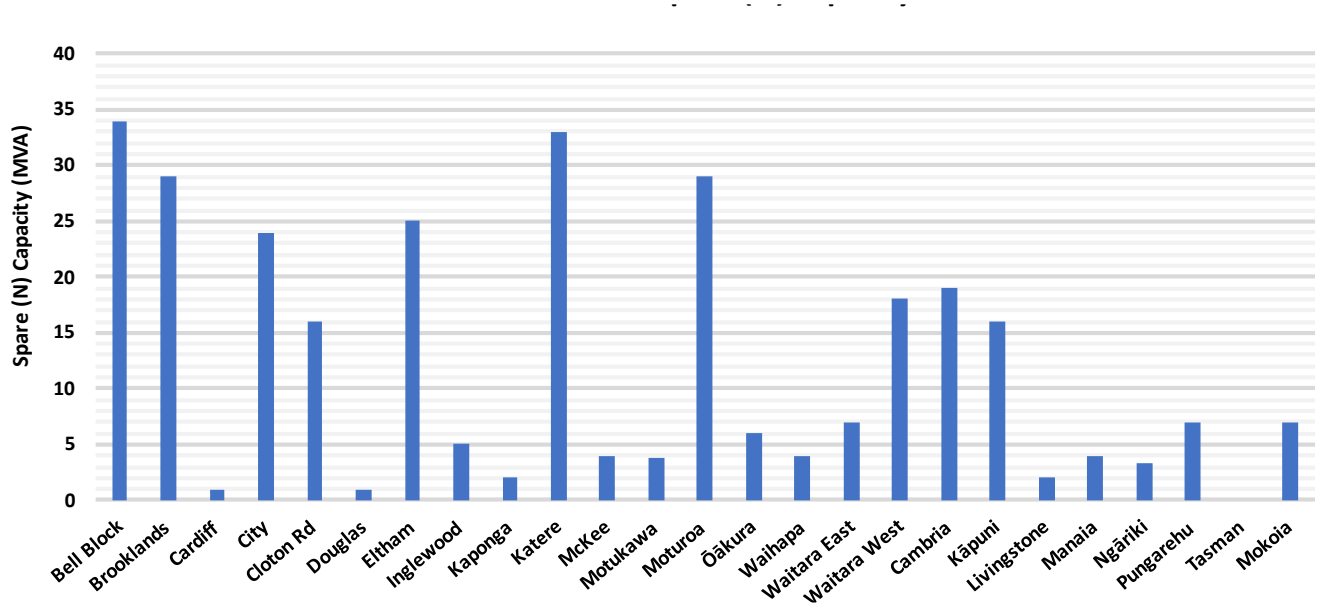


Figure 19. Summary: Approximate (N) spare capacity at Powerco's zone substations

[23] Powerco 's 2023 AMP available here: https://www.Powerco.co.nz/who-we-are/disclosures-and-submissions/electricity-disclosures.

8. Connection Options

The following sections describe the potential connection options for EECA's Load Sites. For simplicity Ergo has categorised (and discusses) the connection options for the Load Site's in terms of the local substations, as follows:

- Transpower GXP substations (shaded blue colour in diagrams).
- The Powerco zone substations (shaded yellow in diagrams).

The purpose of this section is to provide a high-level assessment regarding the feasibility of connecting the Load Sites to the existing electrical infrastructure (both transmission and distribution) and where upgrades would be needed, provide an indication of potential scope, capital costs and timeframes.

The assessments made have involved a desk-based assessment using the various information provided to Ergo. Where information was not available, we have used engineering judgement. If the Load Sites are progressed further, Ergo recommends more detailed engineering assessments are undertaken in consultation with Transpower and Powerco. This would likely entail powerflow modelling, optioneering and concept designs to provide more refined cost estimates.

8.1 Assessment Methodology

The assessment of each individual Load Site uses a top-down approach where the Load Site's peak load is used to determine whether there appears to be spare capacity at:

- The incoming transmission lines.
- The GXP substation.
- The sub-transmission lines feeding the nearby zone substation.
- The nearby zone substation.
- The adjacent 11 kV or 22 kV feeder.

The spare capacity across each asset type has been determined using the information provided by Transpower and Powerco or in the absence of information, assumptions made based on the asset type/voltage and typical capacity expectations.

Once the load implications across the supply network are understood, Ergo has been able to determine the implications of connecting that load (i.e. the necessary infrastructure upgrades). Ergo has used a building block approach to the costing of the necessary upgrades where typical assets have a unit rate associated with them.

In terms of upgrades, these can typically be classified as:

- **Minor** – The "as designed" electrical system can likely connect the Load Site with minor distribution level changes and without the need for substantial infrastructure upgrades costs.
- **Moderate** – The "as designed" electrical system requires some infrastructure upgrades including new connections into the local zone substation and/or upgrades at the local zone substation or sub-transmission network.

- **Major** – The "as designed" electrical system requires substantial upgrades at both the transmission and distribution level, likely requiring significant investment.

8.2 Engineering Assumptions:

Specific engineering assumptions in this section include:

- We have used the spare capacities of both the GXP, and zone substations based on the publicly disclosed loading and capacity data (instead of the 2022 loading data provided by Transpower, and Powerco). Ergo's view is that these are typically more conservative than the actual loading and are therefore appropriate for this sort of high-level assessment.
- We have assumed the existing site security should be maintained (unless otherwise stated). For example, if the site currently presently has (N-1) security, we have recommended infrastructure upgrades to maintain this.
- The upgrades and costs of individual Load Sites are considered in isolation of the adjacent Load Sites. We have not considered the scope and costs associated with connecting multiple Load Sites at this stage.
- The Load Site loads will have unity power factor which is reasonable considering the preliminary nature of the assessment.
- Unless otherwise stated, we have assumed the existing incoming sub-transmission line/cable capacities exceed the capacity of the existing zone substation(s) they supply.
- Unless capacity information is available, we assumed existing 33 kV and 11 kV feeders are capable of supplying up to 12 MVA and 4.5 MVA respectively which is generally accepted as a conservative capacity limit in the absence of detailed information.
- Cost estimates have a Class 5[24] accuracy - suitable for concept screening. Appendix 2 outlines accuracy of the cost estimates and the general assumptions.
- Cost estimates exclude land purchase, easements and consenting. These costs are difficult to estimate without undertaking a detailed review of the available land (including a site visit) and the local council rules in relation to electrical infrastructure. For example, the upgrade of existing overhead lines or new lines/cables across private land does require utilities to secure easements to protect their assets. Securing easements can be a very time consuming and costly process. For this reason, Ergo's estimates for new electrical circuits are generally based on assuming they are installed in road reserve and involve underground cables in urban locations and overhead lines in rural locations. We note that, as a general rule, 110 kV and 220 kV lines cannot be installed in road reserve due to wide corridor requirements. In some locations the width of the road reserve is such that 66 kV and 33 kV lines cannot be installed. This issue only becomes transparent after a preliminary line design has been undertaken.
- Cost estimates only include the incumbent network operator's distribution/transmission equipment and do not include onsite equipment that may be required to supply the Load Sites (for example, MV switchboards/cabling and LV switchboards/cables within the respective Load Site sites are not included).

[24] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

- The time estimates provided are based on Ergo's experience. These can vary significantly depending on the scope of the project and the appetite for expediting. These should be used as a guide only.
- Some of the large loads (i.e. Methanex, Ballance Kāpuni, and Fonterra Whareroa) assessed include estimates of where loads would trigger significant network upgrades. However, due to the size of the loads and therefore complexity involved in connecting these loads, the extent of network upgrades is very difficult to estimate. Therefore, Ergo's costs associated with these are viewed as less accurate than the smaller load sites (i.e. may not be considered Class 5).

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate.

8.3 Carrington St GXP

The "Large" EECA Load Sites connecting to the Carrington St GXP include:

- Downer New Zealand Ltd New Plymouth Asphalt (3.37 MVA)
- New Plymouth District Council Wastewater Treatment Plant (2.70 MVA)
- Downer New Zealand Ltd New Plymouth Bitumen (2.10 MVA)
- Technix Bitumen Technologies Ltd (1.23 MVA)

The "Small" Load Sites connecting to the Carrington St GXP include (refer to sections 8.3.7 and 8.3.9):

- Tegel Bell Block Feedmill (0.48 MVA)
- Ministry of Health Taranaki Base Hospital (0.47 MVA)
- Western institute of Technology in Taranaki (WITT) (0.36 MVA)
- New Plymouth District Council Todd Energy Aquatic Centre (0.23 MVA)
- New Plymouth District Council Puke Ariki (0.12 MVA)
- New Plymouth District Council Civic Centre (0.10 MVA)
- State-integrated school Francis Douglas Memorial College (0.09 MVA)
- New Plymouth District Council Len Lye Centre (0.06 MVA)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

Figure 20 Carrington St GXP: EECA Load Sites vs local substations

8.3.1 Carrington St GXP Upgrade

The Carrington St GXP presently has 38 MVA of spare (N-1) capacity and 84 MVA of spare (N) capacity, based on the transformer ratings.

Analysis in Section 8.3.10 indicates that the spare (N-1) capacity of the Carrington St GXP is not expected to be exceeded if all the load sites connect. Therefore, upgrades of the Carrington St GXP are not considered.

8.3.2 Downer New Zealand Limited New Plymouth Asphalt

DOWNER NEW ZEALAND LIMITED NEW PLYMOUTH ASPHALT		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	3.373	Carrington St

Existing Electrical Supply to the Plant

Downer New Zealand Limited New Plymouth Asphalt is presently supplied by Powerco's Katere substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Katere is in turn supplied from Carrington St GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 540 A (30 MVA) each.

This site is located approximately 1.0 km from Katere ZS. In turn, Katere ZS is approximately 5.2 km from Carrington St GXP.

There is currently a maximum loading of 15 MVA on Katere zone substation, with 33 MVA of spare (N) capacity and 9 MVA of spare (N-1) capacity. Carrington St GXP presently has ~84 MVA of spare (N) capacity and ~38 MVA of spare (N-1) capacity.

Figure 21 Downer NZ Ltd New Plymouth Asphalt geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, it is expected that 1x new 11 kV feeder from Katere substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~2 km long.

Ergo notes that the size and proximity of this load and the New Plymouth District Council Wastewater Treatment Plant load could allow for the two loads to share one new feeder (and the associated

costs) from the zone substation instead of one dedicated feeder to each load. This would allow improved cost efficiency for each load.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 4 Downer NZ Ltd New Plymouth Asphalt: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	2.00	$1.20
		TOTAL	**$1.30**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.3 New Plymouth District Council Wastewater Treatment Plant

	NEW PLYMOUTH DISTRICT COUNCIL WASTEWATER TREATMENT PLANT	
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers	2.700	Carrington St
Existing Electrical Supply to the Plant		

New Plymouth District Council Wastewater Treatment Plant is presently supplied by Powerco's Katere substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Katere is in turn supplied from Carrington St GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 540 A (30 MVA) each.

This site is located approximately 1.0 km from Katere ZS. In turn, Katere ZS is approximately 5.2 km from Carrington St GXP.

There is currently a maximum loading of 15 MVA on Katere zone substation, with 33 MVA of spare (N) capacity and 9 MVA of spare (N-1) capacity. Carrington St GXP presently has ~84 MVA of spare (N) capacity and ~38 MVA of spare (N-1) capacity.

Figure 22 New Plymouth District Council Wastewater Treatment Plant geographic location in relation to the surrounding zone substations

NEW PLYMOUTH DISTRICT COUNCIL WASTEWATER TREATMENT PLANT

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, it is expected that 1 x new 11 kV feeder from Katere substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~3 km long.

Ergo notes that the size and proximity of this load and the Downer New Zealand Limited New Plymouth Asphalt load could allow for the two loads to share one new feeder (and the associated costs) from the zone substation instead of one dedicated feeder to each load. This would allow improved cost efficiency for each load.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 5 New Plymouth District Council Wastewater Treatment Plant: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	3.00	$1.80
		TOTAL	**$1.90**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.4 Downer New Zealand Limited New Plymouth Bitumen

DOWNER NEW ZEALAND LIMITED NEW PLYMOUTH BITUMEN		
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	2.099	Carrington St
Existing Electrical Supply to the Plant		

Downer New Zealand Limited New Plymouth Bitumen is presently supplied by Powerco's Moturoa substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Moturoa is in turn supplied from Carrington St GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 680 A (38.8 MVA) each.

Ergo notes that Powerco's existing supply for Port Taranaki, where the Downer plant is, allows for an auto-changeover of the Port load between two of the 11 kV feeders at Moturoa.

This site is located approximately 1.0 km from Moturoa ZS. In turn, Moturoa ZS is approximately 5 km from Carrington St GXP.

There is currently a maximum loading of 19 MVA on Moturoa zone substation, with 29 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Carrington St GXP presently has ~84 MVA of spare (N) capacity and ~38 MVA of spare (N-1) capacity.

Figure 23 Downer NZ Ltd New Plymouth Bitumen geographic location in relation to the surrounding zone substations

DOWNER NEW ZEALAND LIMITED NEW PLYMOUTH BITUMEN

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load and existing feeder loading, it is expected that 1x new 11 kV feeder from Moturoa substation would be required for this project. Due to the urban/industrial topography, it is expected that this feeder would be underground, and would be ~0.8 km long.

Ergo notes that the size and proximity of this load and the Technix Bitumen Technologies Limited load could allow for the two loads to share one new feeder (and the associated costs) from the zone substation instead of one dedicated feeder to each load. This would allow improved cost efficiency for each load.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 6 Downer NZ Ltd New Plymouth Bitumen: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.80	$0.48
		TOTAL	**$0.58**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.5 Technix Bitumen Technologies Limited

TECHNIX BITUMEN TECHNOLOGIES LIMITED		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	1.234	Carrington St
Existing Electrical Supply to the Plant		

Technix Bitumen Technologies Limited is presently supplied by Powerco's Moturoa substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Moturoa is in turn supplied from Carrington St GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 680 A (38.8 MVA) each.

Ergo notes that Powerco's existing supply for Port Taranaki, where the Technix plant is, allows for an auto-changeover of the Port load between two of the 11 kV feeders at Moturoa.

This site is located approximately 1.0 km from Moturoa ZS. In turn, Moturoa ZS is approximately 5 km from Carrington St GXP.

There is currently a maximum loading of 19 MVA on Moturoa zone substation, with 29 MVA of spare (N) capacity and 5 MVA of spare (N-1) capacity. Carrington St GXP presently has ~84 MVA of spare (N) capacity and ~38 MVA of spare (N-1) capacity.

Figure 24 Technix Bitumen Technologies Ltd geographic location in relation to the surrounding zone substations

TECHNIX BITUMEN TECHNOLOGIES LIMITED

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load and existing feeder loading, it is expected that 1x new 11 kV feeder from Moturoa substation would be required for this project. Due to the urban/industrial topography, it is expected that this feeder would be underground, and would be ~0.8 km long.

Ergo notes that the size and proximity of this load and the Downer New Zealand Limited New Plymouth Bitumen load could allow for the two loads to share one new feeder (and the associated costs) from the zone substation instead of one dedicated feeder to each load. This would allow improved cost efficiency for each load.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 7 Technix Bitumen Technologies Ltd: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	0.80	$0.48
	TOTAL	**$0.58**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.6 Tegel Bell Block Feedmill

		TEGEL BELL BLOCK FEEDMILL
Load Site Description	Electrical Demand (MW)	Transpower GXP
New electrical boilers and high temperature heat pumps	0.64	Carrington St
Existing Electrical Supply to the Plant		

While Tegel Bell Block Feedmill is a "small opportunity" (being <1 MW), due to high existing feeder loading (~5.32 MW on the feeder presently feeding the Tegel plant), an individual assessment is carried out here.

Tegel Bell Block Feedmill is presently supplied by Powerco's Katere substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Katere is in turn supplied from Carrington St GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 540 A (30 MVA) each.

This site is located approximately 2.0 km from Katere ZS. In turn, Katere ZS is approximately 5.2 km from Carrington St GXP.

There is currently a maximum loading of 15 MVA on Katere zone substation, with 33 MVA of spare (N) capacity and 9 MVA of spare (N-1) capacity. Carrington St GXP presently has ~84 MVA of spare (N) capacity and ~38 MVA of spare (N-1) capacity.

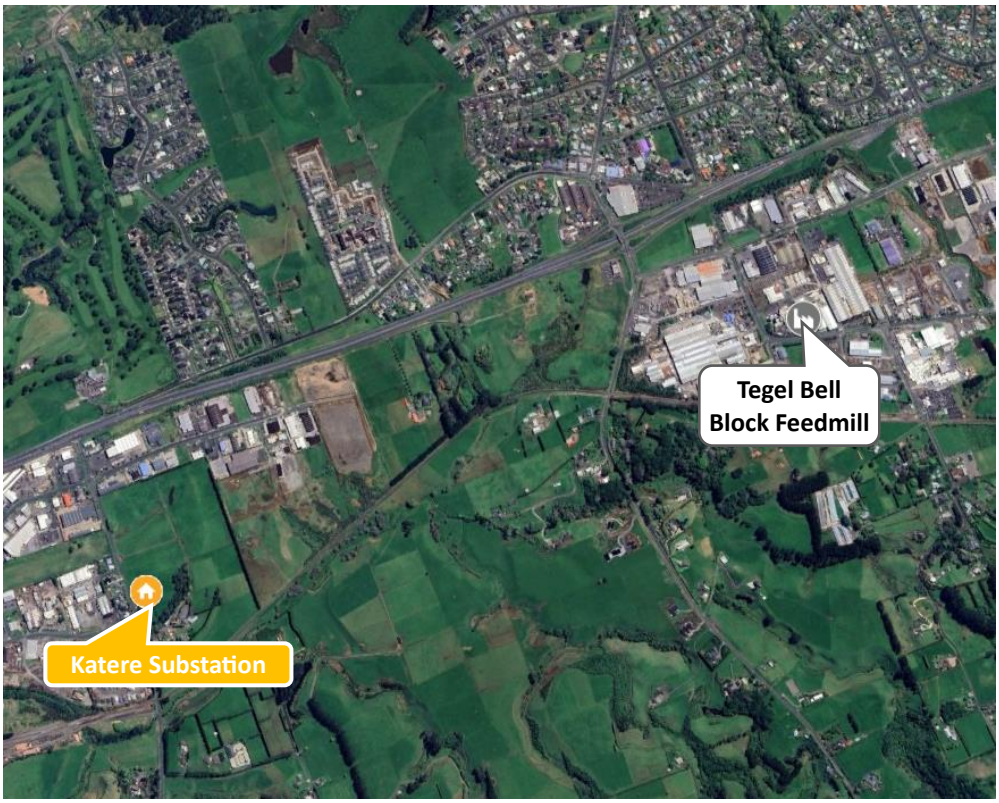


Figure 25 Tegel Bell Block Feedmill geographic location in relation to the surrounding zone substations

TEGEL BELL BLOCK FEEDMILL

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load and existing feeder loading, it is expected that ~110 m of existing underground cable on the feeder currently supplying the site would need to be replaced in order to supply the proposed load.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 8 Tegel Bell Block Feedmill: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Single underground 11kV cable	0.11	$0.07
		TOTAL	**$0.07**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.3.7 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 9 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
Ministry of Health Taranaki Base Hospital	Moturoa	5	29	3.03	0.47	130
Western Institute of Technology in Taranaki (WITT) Taranaki	City	4	24	2.51	0.36	130
New Plymouth District Council Todd Energy Aquatic Centre	Moturoa	4	24	4.14	0.23	130
New Plymouth District Council Puke Ariki	City	4	24	3.86	0.12	80
New Plymouth District Council Civic Centre	City	4	24	3.74	0.10	50
State-integrated school Francis Douglas Memorial College	Moturoa	5	29	3.47	0.09	50
New Plymouth District Council Len Lye Centre	City	4	24	3.86	0.06	50

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.3.8 Combined Load on Zone Substations

The following sections assume that any loads which are staged are connected at their final stage.

8.3.8.1 Katere

Three of the loads on Carrington St GXP are expected to connect to Katere zone substation. The loads are Downer NZ Ltd. New Plymouth Asphalt, New Plymouth District Council Wastewater Treatment Plant, and Tegel Bell Block Feedmill. The sum of peaks of these loads is 6.71 MVA, which the zone substation does have (N-1) capacity for. Therefore no further upgrades at Katere are considered.

8.3.8.2 Moturoa

Five of the loads on Carrington St GXP are expected to connect to Moturoa zone substation. The loads are Downer NZ Ltd. New Plymouth Bitumen, Technix Bitumen Technologies Ltd, Taranaki Base Hospital, Todd Energy Aquatic Centre, and Francis Douglas Memorial College. The sum of peaks of these loads is 4.12 MVA, which the zone substation does have (N-1) capacity for. Therefore no further upgrades at Moturoa are considered.

8.3.8.3 City

Four of the loads on Carrington St GXP are expected to connect to City zone substation. The loads are Western Institute of Technology in Taranaki (WITT), and the New Plymouth District Council Len Lye Centre, Puke Ariki, and Civic Centre. The sum of peaks of these loads is 0.64 MVA, which the zone substation does have (N-1) capacity for. Therefore no further upgrades at City are considered.

8.3.9 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Carrington St GXP gives a combined load of 2.07 MVA. When the load shapes are combined, they result in the following load shape (Figure 26), with a maximum load of 1.681 MVA, with a diversity factor of 0.87.

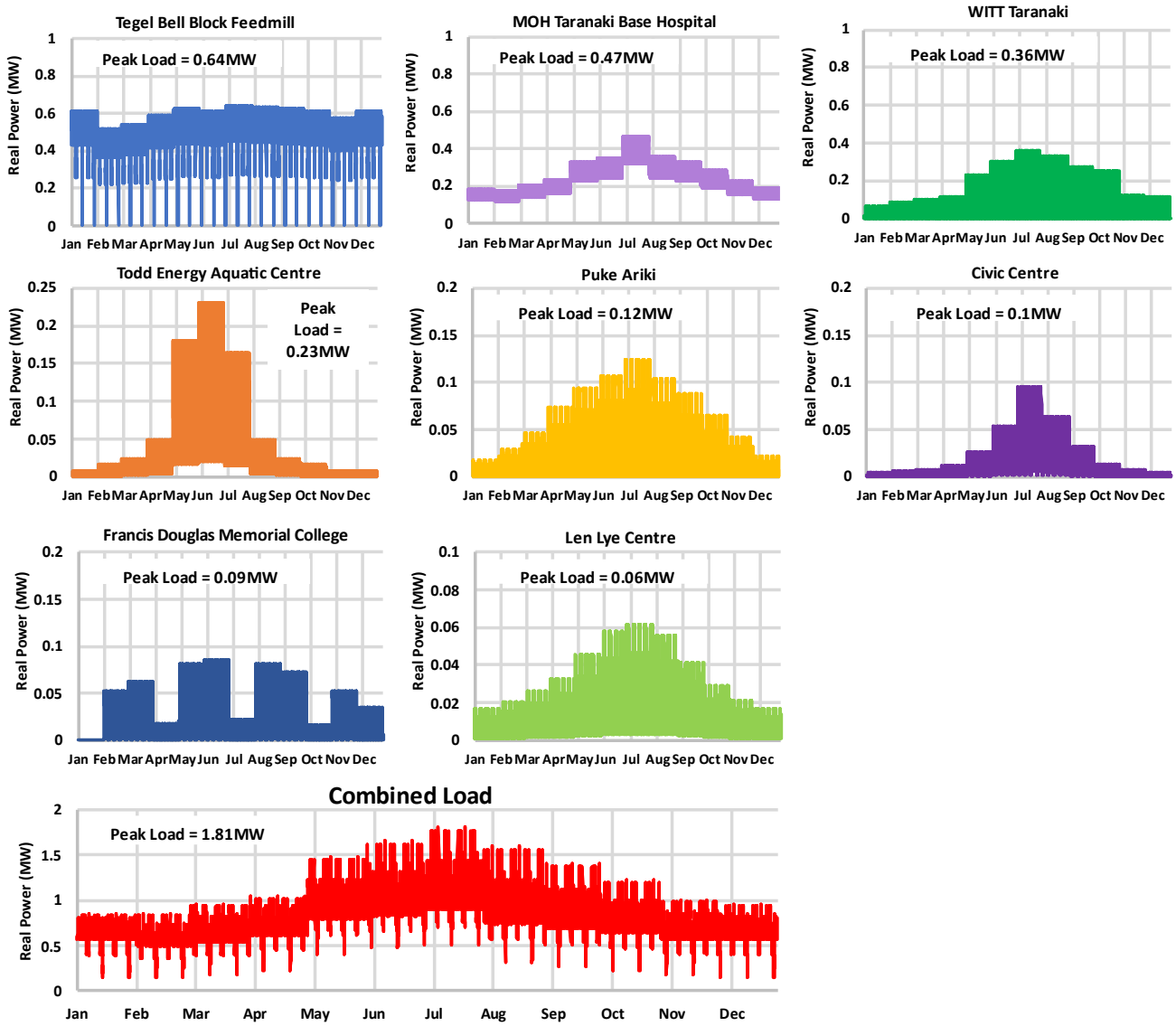


Figure 26 Loading Profiles: Carrington St GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.3.10 Effect of all Load Sites Connecting to Carrington St GXP

The following Figure 27 illustrates the Carrington St GXP load profile together with the load profiles of all the Load Sites within the Carrington St GXP region. Also shown in Figure 27 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Carrington GXP would increase to 67.8 MW, an increase of 1.6 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 77.4 MW there is a diversity factor of 0.88 between the loads.
- Based on Ergo's analysis, the Carrington GXP's (N-1) limit is not expected to be exceeded.

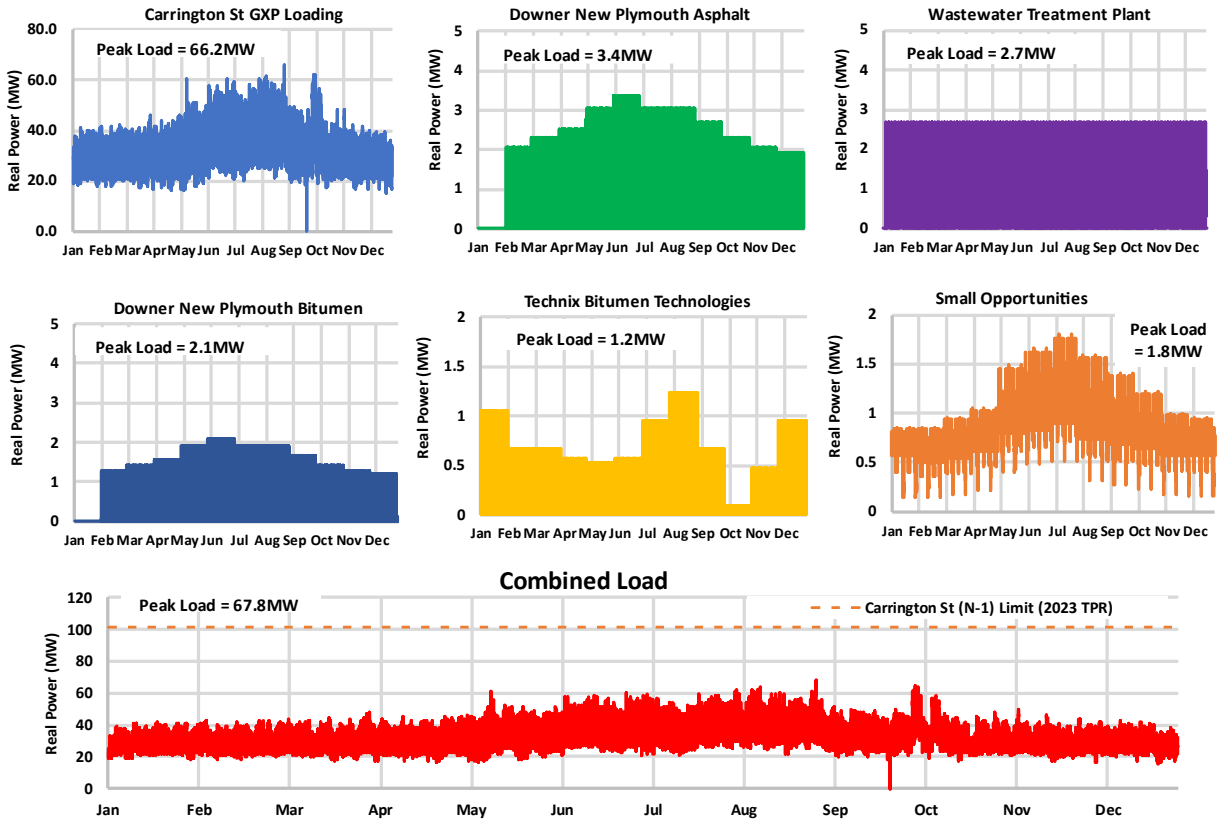


Figure 27 Loading Profiles: Carrington St GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.4 Hāwera GXP

The "Large" EECA Load Sites connecting to the Hāwera GXP include:

- Fonterra Ltd. Whareroa (88.14 MVA) (connected to the GXP at 110 kV)
- Ballance Agri-Nutrients Kāpuni (TBC MVA)
- Taranaki By-Products Hāwera (10.86 MVA)
- Silver Fern Farms Ltd. Hāwera (1.47 MVA)

Ballance Agri-Nutrients has a high demand and as such the load analysis at this stage looks to determine sizes of connection which would trigger different levels of network upgrades.

The "Small" Load Sites connecting to the Hāwera GXP include (refer to section 8.4.6):

- Little Knoll Greenhouses Ltd. Patea (0.14 MVA)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

Figure 28 Hāwera GXP: EECA Load Sites vs local substations

8.4.1 Hāwera GXP Upgrade

The Hāwera GXP presently has 7 MVA of spare (N-1) capacity and 32 MVA of spare (N) capacity, based on the transformer ratings. Additionally, the 110 kV Stratford-Hāwera-Waverley-Whanganui line is sized at approximately 153/165 MVA (summer/winter).

If Silver Fern Farms, and/or Little Knoll Greenhouses Ltd connect, the spare (N-1) capacity of the GXP is not expected to be exceeded.

If any one of the larger loads were to connect, it is expected that the GXP upgrades mentioned in their respective sections would be adequate to supply the load. If, however, multiple of the larger sites (Fonterra Whareroa, Ballance, or Taranaki By-Products) connect, then further upgrades of the GXP and surrounding areas of the transmission network would be required.

If all of the load sites connected, except for Ballance (which would require further study), then the maximum load on Hāwera GXP would be expected to increase to 37 MW on the 33 kV side and 79.4 MW on the 110 kV side (see Section 8.4.7). This assumes that all loads are connected at the final stage of their connection, meaning the Fonterra Whareroa and Kāpuni sites would not be connected to the Hāwera GXP 33 kV supply (being connected at 110 kV to the Hāwera GXP, and at 110 kV to the Opunake GXP, respectively), leaving Taranaki By-Products, Silver Fern Farms, and Little Knoll Greenhouses connected at 11 kV off their respective zone substations (which are in turn supplied by the 33kV bus at the Hāwera GXP).

Ergo expects that if all of the above loads connect, upgrades of the Marton-Bunnythorpe lines would be required (e.g. installation of a third line), along with an additional line between Hāwera and Stratford (included in the upgrades associated with Fonterra Whareroa). It is also expected that voltage support would be required at the Hāwera GXP.

Additionally, while the larger projects all include upgrades/replacements of the Hāwera transformers for an (N-1) supply, should all of the projects connect, care should be taken to coordinate between projects to ensure that the transformer upgrades are sufficient for all of the connecting loads. This may present an opportunity to share costs between the loads, however the required transformer upgrades are likely to be overall more costly should multiple large load sites connect.

8.4.2 Fonterra Limited Whareroa

		FONTERRA LIMITED WHAREROA
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	88.141	Hāwera
Existing Electrical Supply to the Plant		
Fonterra Whareroa is presently supplied off Hāwera GXP's 110 kV bus via a double circuit 110 kV line (each circuit rated at 89MVA). The 110 kV line supplies a 110/11 kV substation on the Whareroa site, which is owned by Fonterra. Fonterra presently has 64 MW of cogeneration connected to the 110 kV bus at the site (consisting of 4 x 10MW gas turbines and 1 x 25MW steam turbine). Five 40 MVA 110/11 kV transformers at the site allow for connection of the cogeneration and local load. This site is located approximately 4.7 km from Hāwera GXP. Loading on the Hāwera 110 kV bus indicates that the generation connected to the 110 kV bus, at Whareroa, typically supplies the whole site load, and the surplus is exported to the national grid, with periods of up to ~12 MW of loading and up to ~60 MW of generation export. Ergo notes that cogeneration is dependent upon the existing fossil-fuel energy supply and so would not remain should the site decarbonise. The analysis presented here assumes that the cogeneration is decommissioned as the site decarbonises.		

FONTERRA LIMITED WHAREROA

Figure 29 Fonterra Whareroa geographic location in relation to the Hāwera GXP

Supply Option(s) for New Load

Due to the size of this load, analysis focuses on a staged approach to connecting the load.

Stage 1 – 22 MVA

The first stage of Fonterra expansion adds an additional 22 MVA onto the existing load.

No upgrades are expected, for either an (N-1) security supply, at this stage, other than installation of a dedicated switchboard for the new 11 kV load. It is expected that with the progressive decommissioning of the cogeneration plant, the transformers which presently connect to the generators could be reused for connection of the new load, however it is assumed that the existing generation switchboard would remain partially in operation and would not be suitable for the 11 kV

load, meaning a new 11 kV switchboard would be required for the new load. As there is capacity for an (N-1) supply, an (N) security supply is not considered at this stage.

Stage 2 – 44 MVA

The second stage of Fonterra expansion adds an additional 22 MVA onto the stage 1 load, for a total additional load of 44 MVA.

Similarly as for stage 1, it is expected that the only upgrades required to establish an (N-1) supply are installation of a new 11 kV switchroom. It is expected that with the progressive decommissioning of the cogeneration plant, the transformers which presently connect to the generators could be reused for connection of the new load, however it is assumed that the existing generation switchboard would remain partially in operation and would not be suitable for the 11 kV load. As there is capacity for an (N-1) supply, an (N) security supply is not considered at this stage.

Stage 3 – 66 MVA

The third stage of Fonterra expansion adds an additional 22 MVA onto the stage 2 load, for a total additional load of 66 MVA.

Similarly as for stage 2, it is expected that the only upgrades required to establish an (N-1) supply are installation of a new 11 kV switchroom. It is expected that with the progressive decommissioning of the cogeneration plant, the transformers which presently connect to the generators could be reused for connection of the new load, however it is assumed that the existing generation switchboard would remain partially in operation and would not be suitable for the 11 kV load. As there is capacity for an (N-1) supply, an (N) security supply is not considered at this stage.

Stage 4 – 88.14 MVA

The fourth stage of Fonterra expansion adds an additional 22.14 MVA onto the stage 3 load, for a total load of 88.14 MVA.

Similarly as for stage 3, it is expected that to establish an (N-1) or (N) supply, a new 11 kV switchroom would be required. It is expected that with the progressive decommissioning of the cogeneration plant, the transformers which presently connect to the generators could be reused for connection of the new load, however it is assumed that the existing generation switchboard would require upgrades or replacements to supply the new load.

For an (N-1) supply, an additional 110 kV circuit would be required between Hāwera GXP and Stratford GXP. This line would be approximately 27 km long.

FONTERRA LIMITED WHAREROA

Capital Cost Estimate

Table 10 Fonterra Whareroa: Capital cost estimate to supply the Load Site with (N) or (N-1) subtransmission supply security (Stage 1).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Medium switchroom (ZS)	1.00	$3.00
Transmission	11kV circuit breaker (ZS)	5.00	$0.50
		TOTAL	**$3.50**

Table 11 Fonterra Whareroa: Capital cost estimate to supply the Load Site with (N) or (N-1) subtransmission supply security (Stage 2).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Medium switchroom (ZS)	1.00	$3.00
Transmission	11kV circuit breaker (ZS)	5.00	$0.50
		TOTAL	**$3.50**

Table 12 Fonterra Whareroa: Capital cost estimate to supply the Load Site with (N) or (N-1) subtransmission supply security (Stage 3).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Medium switchroom (ZS)	1.00	$3.00
Transmission	11kV circuit breaker (ZS)	5.00	$0.50
		TOTAL	**$3.50**

Table 13 Fonterra Whareroa: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 4).

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Medium switchroom (ZSS)	1.00	$3.00
Transmission	11kV circuit breaker (ZSS)	5.00	$0.50
		TOTAL	**$3.50**

Table 14 Fonterra Whareroa: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 4).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	110kV single cct line	27.00	$21.60

Transmission	Medium switchroom (ZSS)	1.00	$3.00
Transmission	11kV circuit breaker (ZSS)	5.00	$0.50
		TOTAL	**$26.30**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

For the (N) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 12-24 months
- Stage 2 – 12-24 months
- Stage 3 – 12-24 months
- Stage 4 – 12-24 months

For the (N-1) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 12-24 months
- Stage 2 – 12-24 months
- Stage 3 – 12-24 months
- Stage 4 – 36-48 months

Excluded are any works required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.4.3 Ballance Agri-Nutrients Limited Kāpuni

BALLANCE AGRI-NUTRIENTS LIMITED KĀPUNI		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and/or high temperature heat pumps	TBC	Hāwera
Existing Electrical Supply to the Plant		

Ballance Kāpuni is presently supplied by Powerco's Kāpuni substation via two dedicated 11 kV feeders. Kāpuni ZS is in turn supplied by a 33 kV ring from the Hāwera GXP consisting of two 33 kV sub transmission circuits, which also supply Manaia substation. These 33 kV circuits have a maximum capacity of ~330 A (18.8 MVA) and are ~16.5 km and ~20 km long.

The Ballance Kāpuni site is adjacent to the Kāpuni substation and Kāpuni GXP as shown in the image below.

There is currently a maximum loading of 6 MVA on each of Kāpuni and Manaia substations. The current Hāwera GXP 33kV ODID project will replace the cables which presently limit the capacity on the 33 kV ring, after which the two 33 kV lines will each be rated to ~437 A (25 MVA). After completion of the ODID project, the 33 kV ring will have 13 MVA of spare (N-1) capacity, and 38 MVA of spare (N) capacity.

Assuming the ODID project has been carried out before the load site connects, the Hāwera GXP has 9 MVA of spare (N-1) capacity, and 32 MVA of spare (N) capacity. Kāpuni zone substation has 5 MVA of spare (N-1) capacity, and 16 MVA of spare (N) capacity.

There is an existing 2.5 MW of cogeneration installed at Ballance Kāpuni.

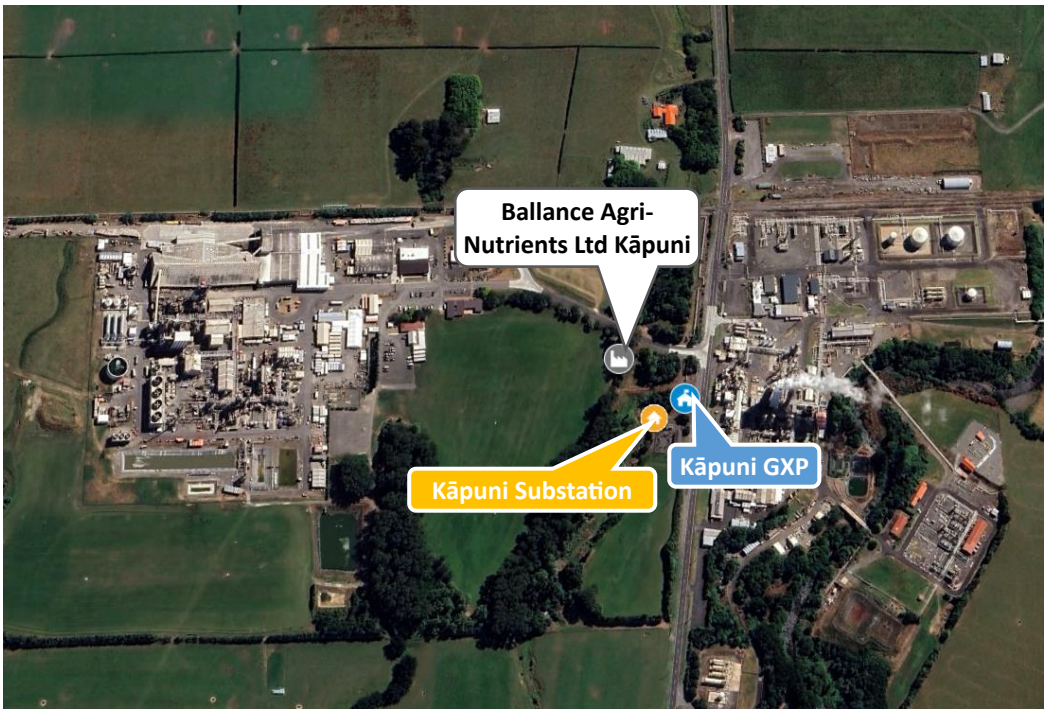


Figure 30 Ballance Agri-Nutrients Ltd Kāpuni geographic location in relation to the surrounding substations

BALLANCE AGRI-NUTRIENTS LIMITED KĀPUNI

Supply Option(s) for New Load

Due to the unknown size of this load, analysis focuses on a staged approach to connecting the load, and considers connection up to 250 MW. Analysis assumes that upgrades continue along the (N) or (N-1) path, and do not mix the two between stages. Costs are cumulative through stages (i.e. the total cost is the sum of costs of each stage).

Stage 1 – 5 MVA

The first stage of Ballance expansion may be up to 5 MVA (utilising the remaining 5 MVA of spare (N-1) capacity at the Kāpuni zone substation).

No upgrades of the GXP, zone substation, or incoming 33 kV lines are expected for an (N) security supply for this stage.

It is taken that the load growth in the Hāwera GXP area coupled with this additional load would necessitate GXP upgrades (transformer replacements), for an (N-1) security supply. These transformer replacements should consider the size of the future loading. It is possible that the cost of these transformer replacements may be shared between the loads connecting, Transpower, and Ballance, however are conservatively attributed entirely to Ballance for the sake of this cost exercise.

Stage 2 – 13 MVA

The second stage of Ballance expansion adds an additional 8 MVA onto the stage 1 load, for a total of 13 MVA (utilising the remaining (N-1) capacity of the 33 kV ring).

For an (N) security supply, it is expected that a special protection system (SPS) would be required at the Hāwera GXP to manage the load in the case of the loss of one of the Hāwera GXP transformers. Another two additional 11 kV feeders to the Ballance site would also be required (these are assumed to be built with a 33 kV rating to account for Stage 3).

For an (N-1) security supply, replacements of the Kāpuni zone substation transformers would be required for this stage. These transformer replacements should consider the size of the future loading. Another two additional 11 kV feeders to the Ballance site would also be required (again, these are assumed to be built with a 33 kV rating to account for Stage 3).

Stage 3 – 38 MVA

The third stage of Ballance expansion adds an additional 25 MVA onto the stage 2 load, for a total of 38 MVA (utilising the remaining (N) capacity of the 33 kV ring).

At this stage, for both the (N) and (N-1) security supplies, it is assumed that the Ballance site would be supplied at 33 kV. Two new 33 kV circuit breakers would be required at Kāpuni zone substation for connection of this supply.

For an (N) security supply, replacements of the transformers at Hāwera GXP would be required.

For an (N-1) security supply, a third line would be required in parallel to the existing 2x 33 kV lines making up the 33 kV ring supplying the Kāpuni and Manaia zone substations.

Stage 4 – 70 MVA

The fourth stage of Ballance expansion adds an additional 32 MVA onto the stage 3 load, for a total additional load of 70 MVA.

It is expected that at this size, a new, 110/11 kV GXP would be established at the Ballance site, supplied off the 110 kV bus at Kāpuni GXP (note as this GXP is owned by Nova Energy, connection would be contingent on a suitable agreement being reached with Nova Energy). It is expected that for an (N) supply, this would be a 2x transformer GXP. For an (N-1) supply, this would be a 3x transformer GXP. Ergo notes that the Kāpuni GXP substation is fed off the 110 kV lines which presently mainly supply Ōpunake GXP.

For an (N) security supply, a single 110 kV line (analysis has allowed for ~0.5 km) would be required between Kāpuni GXP and the new Ballance GXP, as well as upgrades/replacements of the existing 110 kV line from Kāpuni GXP to its tee connection to one of the Ōpunake-Stratford circuits (~15 km).

For an (N-1) security supply, a double circuit 110 kV line would be required between Kāpuni GXP and the new GXP, as well as upgrades/replacements of the existing 110 kV line from Kāpuni GXP to its tee connection to one of the Ōpunake-Stratford circuits, and installation of a new line from Kāpuni GXP to the other Ōpunake-Stratford line (~15 km each). It is also expected that upgrades of the Ōpunake-Stratford lines from the tee point to Stratford would be required (~20 km per line). Upgrades/replacement of the smaller of the two Stratford interconnecting transformers would also be required.

Ergo notes that due to the scale of the above upgrades, and resulting reconfiguration of the supply, Ballance may wish to skip the upgrades required for stages 1-3, carrying out this stage instead, if a supply of this size is required.

Stage 5 – 170 MVA

The fifth stage of Ballance expansion adds an additional 100 MVA onto the stage 4 load, for a total additional load of 170 MVA.

For both an (N) and an (N-1) security supply at this stage, it is expected that an additional 110 kV line would be required between the Ballance site and Stratford (~30 km long).

It is also expected that 3x additional 110/11 kV transformers would be required at the Ballance site for either an (N) or an (N-1) security supply. Additional switchboards/switchboard expansions would also be required for connection of these transformers.

For an (N-1) supply, upgrades of the other existing Stratford interconnecting transformer may be required.

Stage 6 – 250 MVA

The sixth stage of Ballance expansion adds an additional 80 MVA onto the stage 5 load, for a total load of 250 MVA.

Similarly as for Stage 5, for both an (N) and an (N-1) supply, an additional 110 kV line between the Ballance site and Stratford would be required, as well as 2x new 110/11 kV transformers at the Ballance site.

For an (N) supply, upgrades/replacement of the smaller of the two Stratford interconnecting transformers would also be required.

For an (N-1) supply, no further upgrades other than those mentioned above are expected.

Capital Cost Estimate

Table 15 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) security (Stage 1 – 5MVA).

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
		TOTAL	**$9.00**

Table 16 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 2 – 13MVA).

Transmission => (N)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	11kV circuit breaker (ZS)	2.00	$0.20
Distribution	Single underground 33kV cable	1.00	$0.90
		TOTAL	**$1.60**

BALLANCE AGRI-NUTRIENTS LIMITED KĀPUNI

Table 17 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) security (Stage 2 – 13MVA).

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Large supply transformer (ZS)	2.00	$4.60
Distribution	11kV circuit breaker (ZS)	2.00	$0.20
Distribution	Single underground 33kV cable	1.00	$0.90
		TOTAL	**$5.70**

Table 18 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 3 – 38MVA).

Transmission => (N-1)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	33kV circuit breaker bay	2.00	$0.50
		TOTAL	**$9.50**

Table 19 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) security (Stage 3 – 38MVA).

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Single overhead 33kV line	20.00	$7.00
Subtransmission	33kV circuit breaker bay	4.00	$1.00
		TOTAL	**$8.00**

Table 20 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 4 – 70MVA).

Transmission => (N)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Medium GXP	1.00	$15.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	110kV single cct line	0.50	$0.40
Transmission	110kV single cct line	15.00	$12.00
		TOTAL	**$28.60**

BALLANCE AGRI-NUTRIENTS LIMITED KĀPUNI

Table 21 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) security (Stage 4 – 70MVA).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large GXP	1.00	$20.00
Transmission	110kV circuit breaker bay	4.00	$2.40
Transmission	110kV double cct line	0.50	$0.90
Transmission	110kV double cct line	15.00	$27.00
Transmission	110kV double cct line	20.00	$36.00
Transmission	Stratford Interconnecting TX Replacement	1.00	$13.00
		TOTAL	**$99.30**

Table 22 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 5 – 170MVA).

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	110kV single cct line	30.00	$24.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	Large supply transformer (GXP)	3.00	$13.50
Transmission	Medium switchroom (ZS)	3.00	$9.00
		TOTAL	**$38.70**

Table 23 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) security (Stage 5 – 170MVA).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Stratford Interconnecting TX Replacement	1.00	$13.00
Transmission	110kV single cct line	30.00	$24.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	Large supply transformer (GXP)	3.00	$13.50
Transmission	Medium switchroom (ZS)	3.00	$9.00
		TOTAL	**$60.70**

BALLANCE AGRI-NUTRIENTS LIMITED KĀPUNI

Table 24 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) subtransmission supply security (Stage 6 – 250MVA).

Transmission => (N)	Subtransmission => (N)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Stratford Interconnecting TX Replacement	1.00	$13.00
Transmission	110kV single cct line	30.00	$24.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	Large supply transformer (GXP)	2.00	$9.00
Transmission	Medium switchroom (ZS)	2.00	$6.00
		TOTAL	**$53.20**

Table 25 Ballance Agri-Nutrients Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) security (Stage 6 – 250MVA).

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	110kV single cct line	30.00	$24.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	Large supply transformer (GXP)	2.00	$9.00
Transmission	Medium switchroom (ZS)	2.00	$6.00
		TOTAL	**$40.20**

Does not include the costs of all electrical equipment (i.e. distribution transformers/switchgear and cabling) on the plant site.

Timeframe to Establish New Electrical Infrastructure

For each stage, it is estimated to take 36-48 months to plan, design, procure, construct, and commission the works. Those stages involving 110 kV and 220kV lines are expected to take longer in order to secure a suitable route, which may require public consultation and the purchase of multiple parcels of land. Ergo note that it took >10 years to plan, consult and construct the new 220kV line between Whakamaru and Brownhill (into Auckland) that is insulated at 400kV.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.4.4 Taranaki By-Products Hāwera

TARANAKI BY-PRODUCTS HĀWERA		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	12.470	Hāwera

Existing Electrical Supply to the Plant

Taranaki By-Products Hāwera is presently supplied by Powerco's Kāpuni substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Kāpuni ZS is in turn supplied by a 33 kV ring from Hāwera GXP consisting of two 33 kV sub transmission circuits, which also supply Manaia substation. These 33 kV circuits have a maximum capacity of ~330 A (18.8 MVA) and are ~16.5 km and ~20 km long.

This site is located approximately 5.3 km from Kāpuni ZS. In turn, Kāpuni ZS is approximately 16 km from Hāwera GXP.

There is currently a maximum loading of 6 MVA on each of Kāpuni and Manaia substations. The current Hāwera GXP ODID project will replace the cables which presently limit the capacity on the 33 kV ring, after which the two 33 kV lines will each be rated to ~437 A (25 MVA). After completion of the ODID project, the 33 kV ring will have 13 MVA of spare (N-1) capacity, and 38 MVA of spare (N) capacity.

Assuming the ODID project has been carried out before the load site connects, the Hāwera GXP has 9 MVA of spare (N-1) capacity, and 32 MVA of spare (N) capacity. Kāpuni zone substation has 5 MVA of spare (N-1) capacity, and 16 MVA of spare (N) capacity.

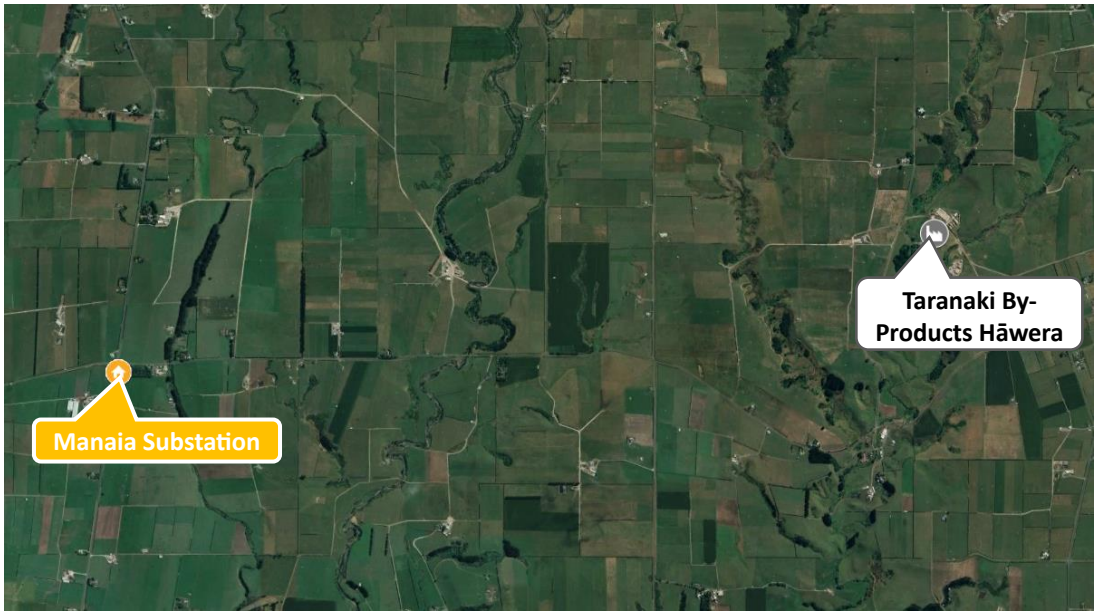


Figure 31 Taranaki By-Products Hāwera geographic location in relation to the surrounding zone substations

TARANAKI BY-PRODUCTS HĀWERA

Supply Option(s) for New Load

Neither the GXP nor the Kāpuni substation have sufficient (N-1) spare capacity for this load, however both have sufficient (N) spare capacity.

To establish an (N) security supply to the load site, it is expected that two new dedicated 11 kV feeders from Kāpuni to the site would be required. These feeders would likely be overhead due to the rural topography, and would be approximately 6.8 km long (each). Additionally, it is expected that a special protection scheme would be required for the transformers at Hāwera GXP, to avoid overloading the remaining transformer in the event of a single transformer outage.

To establish an (N-1) security supply to the load site, similar to the (N) security supply, two new dedicated 11 kV feeders from Kāpuni to the site would be required. Additionally, replacements of the transformers at Hāwera GXP and Kāpuni substation would be required.

Capital Cost Estimate

Table 26 Taranaki By-Products Hāwera: Capital cost estimate to supply the Load Site with (N) security.

Transmission => (N)	**Subtransmission => (N)**		**Distribution => (N)**
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Special protection system (GXP)	1.00	$0.50
Distribution	11kV circuit breaker (ZS)	2.00	$0.20
Distribution	Double overhead 11kV line	6.80	$2.55
		TOTAL	**$3.25**

Table 27 Taranaki By-Products Hāwera: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	**Subtransmission => (N-1)**		**Distribution => (N)**
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	Large supply transformer (ZS)	2.00	$4.60
Distribution	11kV circuit breaker (ZS)	2.00	$0.20
Distribution	Double overhead 11kV line	6.80	$2.55
		TOTAL	**$16.35**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cabling) on the plant site.

TARANAKI BY-PRODUCTS HĀWERA
Timeframe to Establish New Electrical Infrastructure
For the (N) security case, it is estimated to take 24-36 months to plan, design, procure, construct, and commission the works. For the (N-1) security case, it is estimated to take 36-48 months to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.4.5 Silver Fern Farms Limited Hāwera

		SILVER FERN FARMS HĀWERA
Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	2.700	Hāwera
Existing Electrical Supply to the Plant		

Silver Fern Farms Whareroa is presently supplied by Powerco's Cambria substation via a dedicated underground 11 kV feeder (rated at approximately 475 A (~9.05 MVA)); with a backfeed option provided by an adjacent Cambria 11 kV feeder. Cambria is in turn supplied from Hāwera GXP by two 33 kV subtransmission circuits. The subtransmission circuits are rated to approximately 157 A (9 MVA) each.

This site is located approximately 3 km from Cambria ZS. In turn, Cambria ZS is approximately 3 km from Hāwera GXP.

Due to capacity constraints of the existing 11 kV distribution feeders at Cambria, Powerco is planning a new substation, Normanby. Additionally, replacements of the two subtransmission cables are also planned, as they are aging, oil-filled cables. This should increase the capacity of the two subtransmission circuits to Cambria to at least 437 A (25 MVA) each. The planned cable replacements are expected to cost ~$2.121M total.

There is currently a maximum loading of 15 MVA on Cambria zone substation, with 19 MVA of spare (N) capacity and 2 MVA of spare (N-1) capacity (limited by the transformer capacity, assuming the cable replacements have been carried out). Assuming the 33kV ODID project has been carried out before the load site connects, the Hāwera GXP would have 9 MVA of spare (N-1) capacity, and 32 MVA of spare (N) capacity.

Figure 32 Silver Fern Farms Hāwera geographic location in relation to the surrounding zone substations

SILVER FERN FARMS HĀWERA

Supply Option(s) for New Load

The Hāwera GXP has sufficient (N) and (N-1) capacity for the additional load, while Cambria substation and the oil-filled cables feeding it have sufficient (N) capacity and insufficient (N-1) capacity.

It is expected that the 2.7 MW of additional load could be accommodated on the existing dedicated 11 kV feeder from the Cambria substation.

For an (N) security option, no further upgrades are expected, other than the related load-side costs (e.g. distribution transformers, switchgear), which are excluded in the costings.

For an (N-1) security option, replacements of the Cambria substation transformers, and of the existing oil-filled cables would be required. The oil-filled cable replacements are presently planned to be complete before 2030, however if the load connects before then, the cable replacement may be brought forward. If the load connection brings these replacements forward, some of the cost of replacement may fall to the load.

Capital Cost Estimate

Table 28 Silver Fern Farms Hāwera: Capital cost estimate to supply the Load Site with (N) security.
N/A

Table 29 Silver Fern Farms Hāwera: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Subtransmission	Large supply transformer (ZS)	2.00	$4.60
Subtransmission	Hāwera to Cambria Cables Replacement	1.00	$2.12
		TOTAL	**$6.72**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

For the (N) security case, it is estimated to take 6-12 months to plan, design, procure, construct, and commission the works.

For the (N-1) security case, it is estimated to take 24-36 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.4.6 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 30 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
Little Knoll Greenhouses Ltd Patea	Livingstone	0	2	0.66	0.28	130

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.4.7 Effect of all Load Sites Connecting to Hāwera GXP

The following Figure 33 illustrates the Hāwera GXP (33 kV) load profile together with the load profiles of all the Load Sites within the Hāwera GXP (33 kV) region. Also shown in Figure 33 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Hāwera GXP 33 kV would increase to 38.2 MW, an increase of 9.9 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 42.52 MW there is a diversity factor of 0.90 between the loads.
- Based on Ergo's analysis, the Hāwera GXP's 33 kV (N-1) limit is expected to be exceeded. Ergo has discussed mitigation for this in Section 8.4.1.

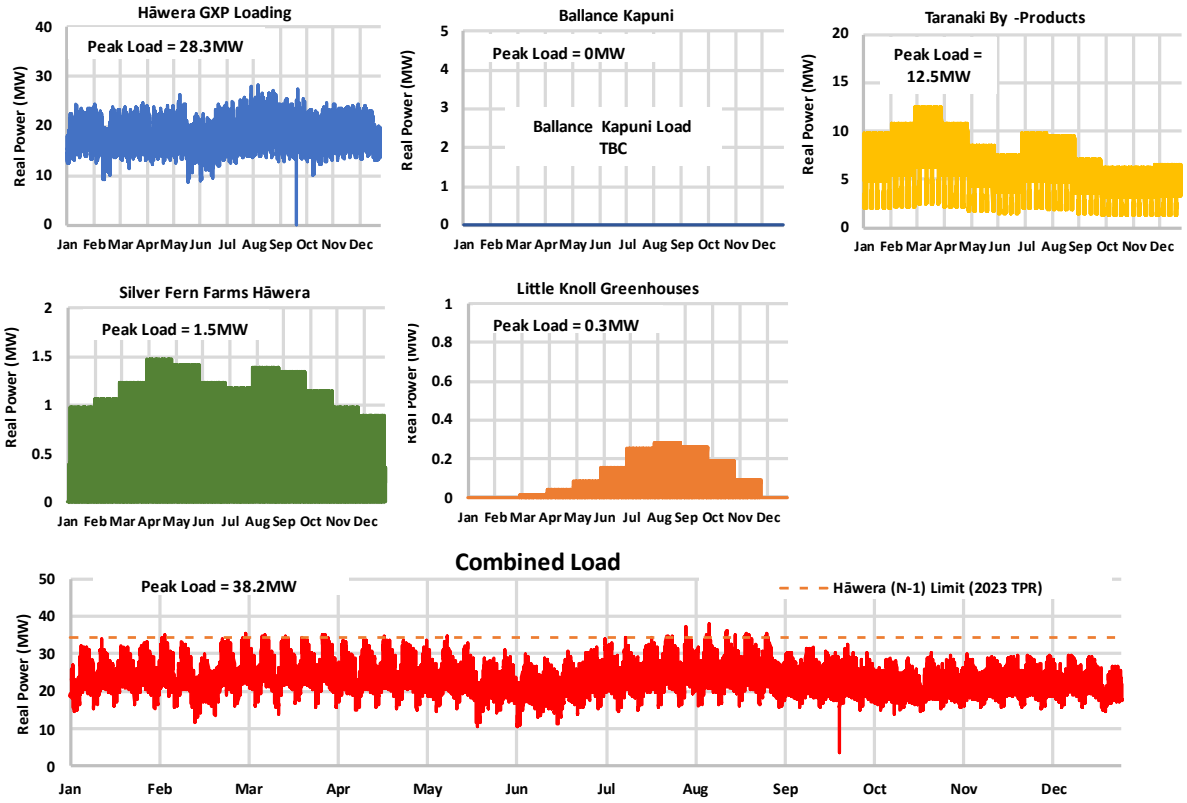


Figure 33 Loading Profiles: Hāwera GXP 33 kV 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

The following Figure 34 illustrates the Hāwera GXP (110 kV) load profile together with the load profiles of all the Load Sites within the Hāwera GXP (110 kV) region. Also shown in Figure 34 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Hāwera GXP 110 kV would increase to 79.4 MW, an increase of 66.6 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 100.9 MW there is a diversity factor of 0.79 between the loads.
- Ergo additionally notes that there is a significant portion of cogeneration at the Fonterra site which results in the negative loadings (excess generation) in the graphs below. With decarbonisation, it is likely that much of this cogeneration would become unavailable, and so the GXP loading may be higher (by up to 64 MW, based on the present loading).

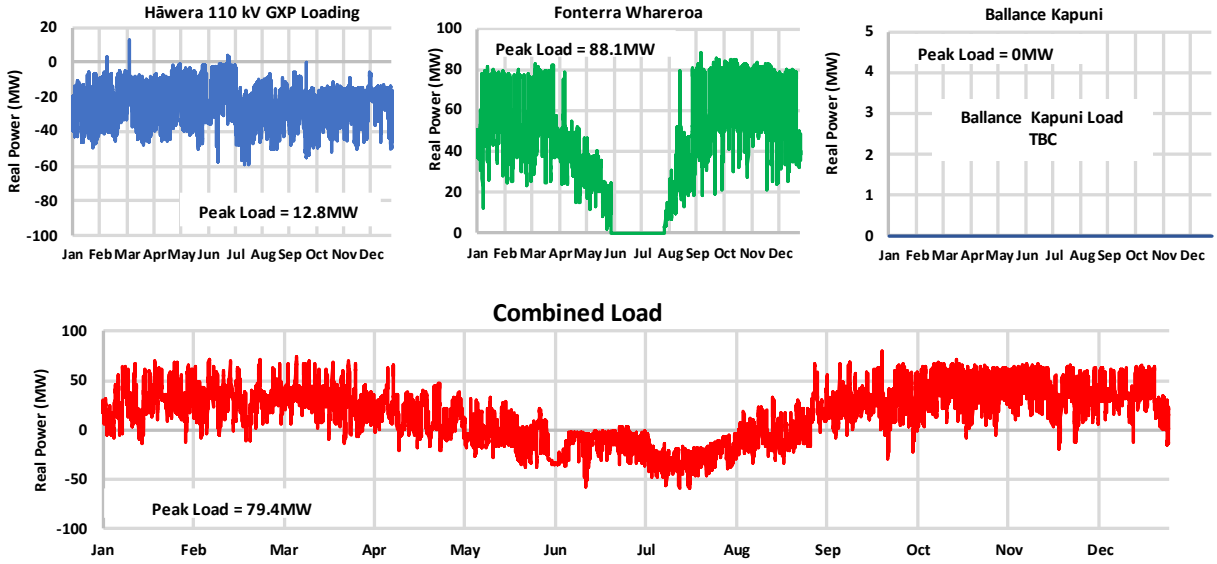


Figure 34 Loading Profiles: Hāwera GXP 110 kV 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.5 Huirangi GXP

The "Large" EECA Load Sites connecting to the Huirangi GXP include:

- Mckechnie Aluminium Solutions Ltd (4.59 MVA)

The "Small" Load Sites connecting to the Huirangi GXP include (refer to sections 8.5.5 and 8.5.7):

- ANZCO Foods Waitara (0.80 MVA)
- La Nuova Inglewood (0.73 MVA)
- Poppas Peppers 2009 Ltd (0.71 MVA)
- Tegel New Plymouth (0.70 MVA)
- Van Dyck New Plymouth (0.07 MVA)
- New Plymouth District Council Waitara Pool (0.06 MVA)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

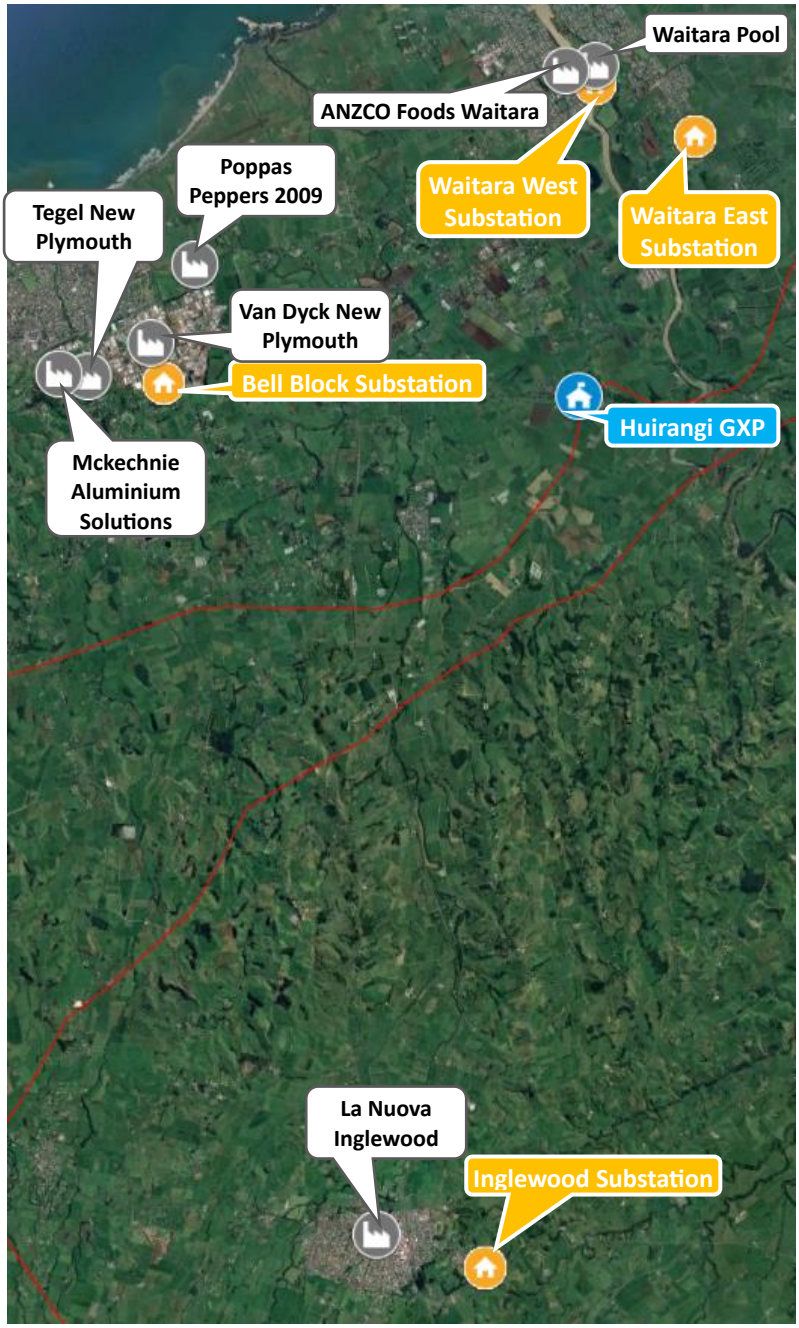


Figure 35 Huirangi GXP: EECA Load Sites vs local substations

8.5.1 Huirangi GXP Upgrade

The Huirangi GXP presently has 37 MVA of spare (N-1) capacity and 87 MVA of spare (N) capacity, based on the transformer ratings.

Analysis in Section 8.5.8 indicates that the spare (N-1) capacity of the Huirangi GXP is not expected to be exceeded if all the load sites connect. Therefore, upgrades of the Huirangi GXP are not considered.

8.5.2 Mckechnie Aluminium Solutions Limited Bell Block

MCKECHNIE ALUMINIUM SOLUTIONS LIMITED BELL BLOCK		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	4.589	Huirangi

Existing Electrical Supply to the Plant

Mckechnie Aluminium Solutions Limited is presently supplied by Powerco's Bell Block substation via an 11 kV feeder which consists of a mixture of underground cable and overhead, which is in turn supplied from Huirangi GXP by two 33 kV sub transmission circuits. These circuits have a maximum capacity of 430 A (25 MVA) each.

This site is located approximately 1.6 km from Bell Block. In turn, Bell Block zone substation is approximately 6.3 km from Huirangi GXP.

There is currently a maximum loading of 16 MVA on Bell Block zone substation. This would leave the substation with 34 MVA of spare (N) capacity, and 9 MVA of spare (N-1) capacity. The Huirangi GXP currently has 37 MVA of spare (N-1) capacity, and 87 MVA of spare (N) capacity.

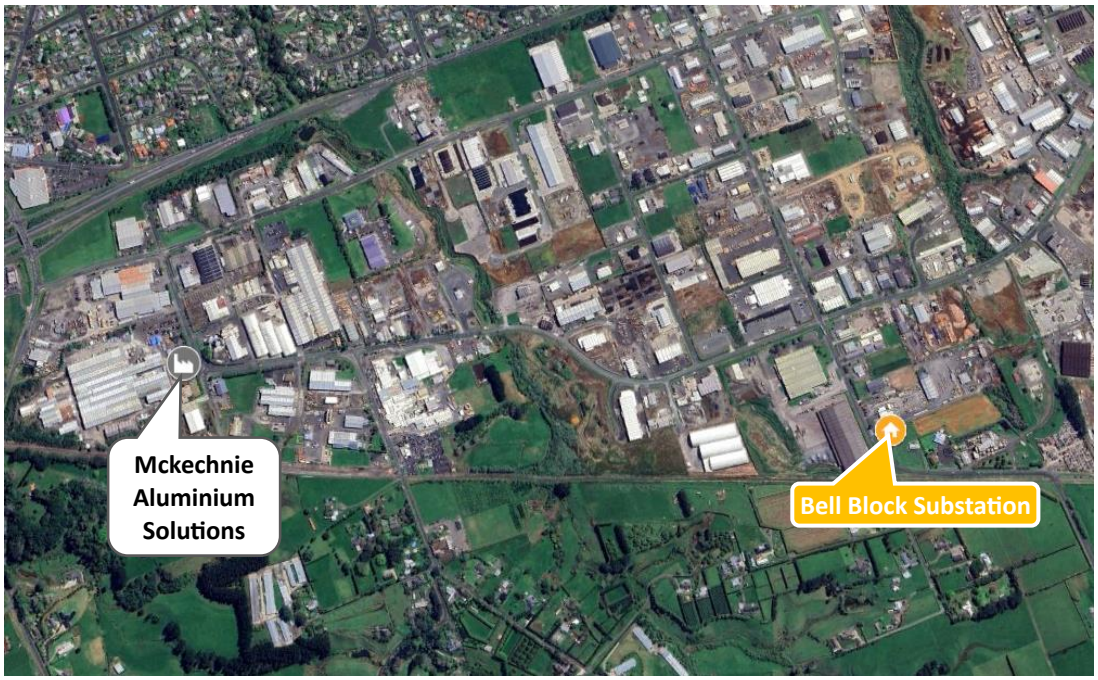


Figure 36 Mckechnie Aluminium geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, it is expected that a new 11 kV feeder from Bell Block substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~1.8 km long. Due to the proximity and size of the two sites, it is possible that this feeder may

be shared with the Tegel New Plymouth site, which could additionally result in cost savings for each site.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 31 Mckechnie Aluminium: Capital cost estimate to supply the Load Site with (N-1) security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Single underground 11kV cable	1.80	$1.08
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
		TOTAL	**$1.18**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.3 Poppas Peppers 2009 Limited New Plymouth

POPPAS PEPPERS 2009 LIMITED NEW PLYMOUTH		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	0.71	Huirangi
Existing Electrical Supply to the Plant		

While Poppas Peppers 2009 Limited New Plymouth is a "small opportunity" (being <1 MW), due to high existing feeder loading, an individual assessment is carried out here.

Poppas Peppers 2009 Limited is presently supplied by Powerco's Bell Block substation via an 11 kV feeder which consists of a mixture of underground cable and overhead, which is in turn supplied from Huirangi GXP by two 33 kV sub transmission circuits. These circuits have a maximum capacity of 430A (25 MVA) each.

This site is located approximately 1.9 km from Bell Block. In turn, Bell Block zone substation is approximately 6.3 km from Huirangi GXP.

There is currently a maximum loading of 16 MVA on Bell Block zone substation. This would leave the substation with 34 MVA of spare (N) capacity, and 9 MVA of spare (N-1) capacity. The Huirangi GXP currently has 37 MVA of spare (N-1) capacity, and 87 MVA spare (N) capacity.

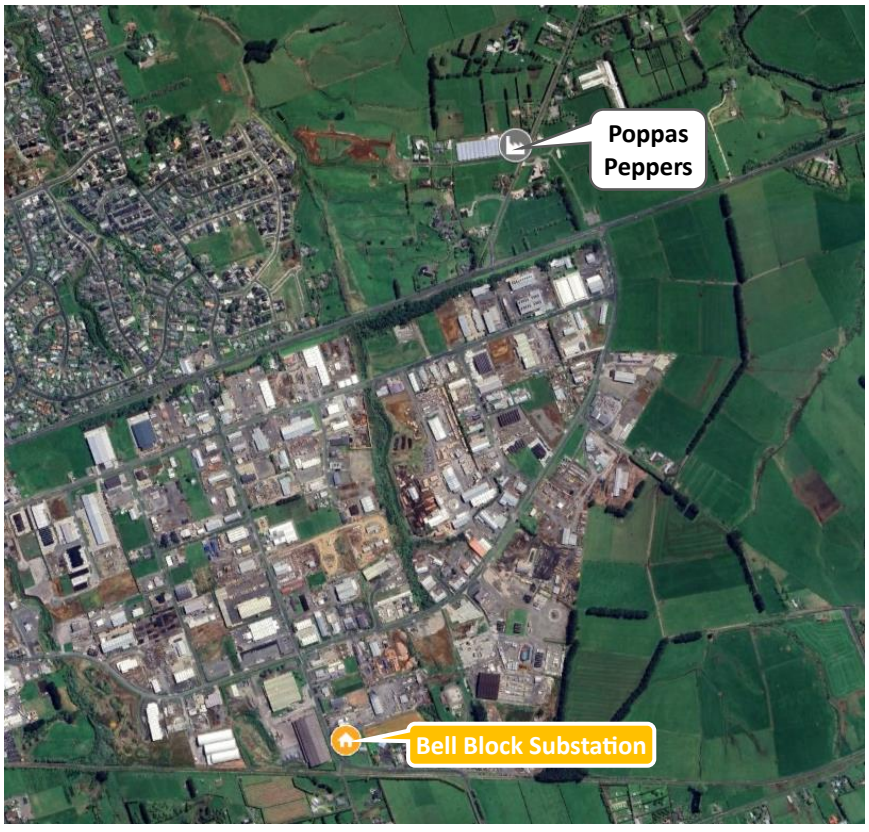


Figure 37 Poppas Peppers 2009 Limited New Plymouth geographic location in relation to the surrounding zone substations

POPPAS PEPPERS 2009 LIMITED NEW PLYMOUTH

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, it is expected that a new 11 kV feeder from Bell Block substation would be required for this project. It is expected that the new feeder would be a mixture of underground cable (~2.1 km) and overhead line (~0.8 km), with cable through the urban area and overhead line over the more rural section of the route.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 32 Poppas Peppers 2009 Limited New Plymouth: Capital cost estimate to supply the Load Site with (N-1) security.

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Single underground 11kV cable	2.10	$1.26
Distribution	Single overhead 11kV line	0.80	$0.20
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
		TOTAL	**$1.56**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.4 Tegel New Plymouth

		TEGEL NEW PLYMOUTH
Load Site Description	Electrical Demand (MW)	Transpower GXP
New high temperature heat pumps	1.3	Huirangi
Existing Electrical Supply to the Plant		

Tegel New Plymouth is presently supplied by Powerco's Bell Block substation via an 11 kV feeder which consists of a mixture of underground cable and overhead, which is in turn supplied from Huirangi GXP by two 33 kV sub transmission circuits. These circuits have a maximum capacity of 430 A (25 MVA) each.

This site is located approximately 1.2 km from Bell Block. In turn, Bell Block zone substation is approximately 6.3 km from Huirangi GXP.

There is currently a maximum loading of 16 MVA on Bell Block zone substation. This would leave the substation with 34 MVA of spare (N) capacity, and 9 MVA of spare (N-1) capacity. The Huirangi GXP currently has 37 MVA of spare (N-1) capacity, and 87 MVA spare (N) capacity.

Figure 38 Tegel New Plymouth geographic location in relation to the surrounding zone substations

TEGEL NEW PLYMOUTH

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, it is expected that replacements of ~1.6 km of underground cable of the existing 11 kV feeder to the site would be required for this project. Due to the proximity and size of the two sites, it is possible that this feeder may be shared with the McKechnie Aluminium site, which could additionally result in cost savings for each site.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 33 Tegel New Plymouth: Capital cost estimate to supply the Load Site with (N-1) security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	Single underground 11kV cable	1.60	$0.96
		TOTAL	**$0.96**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.5.5 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 34 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
ANZCO Foods Waitara	Waitara West	5.5	18	1.49	0.80	260
La Nuova Inglewood	Inglewood	1	5	3.65	0.73	200
Van Dyck New Plymouth	Bell Block	9	34	4.38	0.07	50
New Plymouth District Council Waitara Pool	Waitara East	1	7	2.53	0.06	50

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.5.6 Combined Load on Zone Substations

The following sections assume that any loads which are staged are connected at their final stage.

8.5.6.1 Bell Block

Four of the loads on Huirangi GXP are expected to connect to Bell Block zone substation. The loads are Mckechnie Aluminium Solutions, Poppas Peppers, Tegel New Plymouth, and Van Dyck. The sum of peaks of these loads is 6.67 MVA, which the zone substation has (N-1) capacity for. Therefore no further upgrades at Bell Block are considered.

8.5.7 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Huirangi GXP gives a combined load of 3.67 MVA. When the load shapes are combined, they result in the following load shape (Figure 39), with a maximum load of 1.91 MVA, with a diversity factor of 0.52.

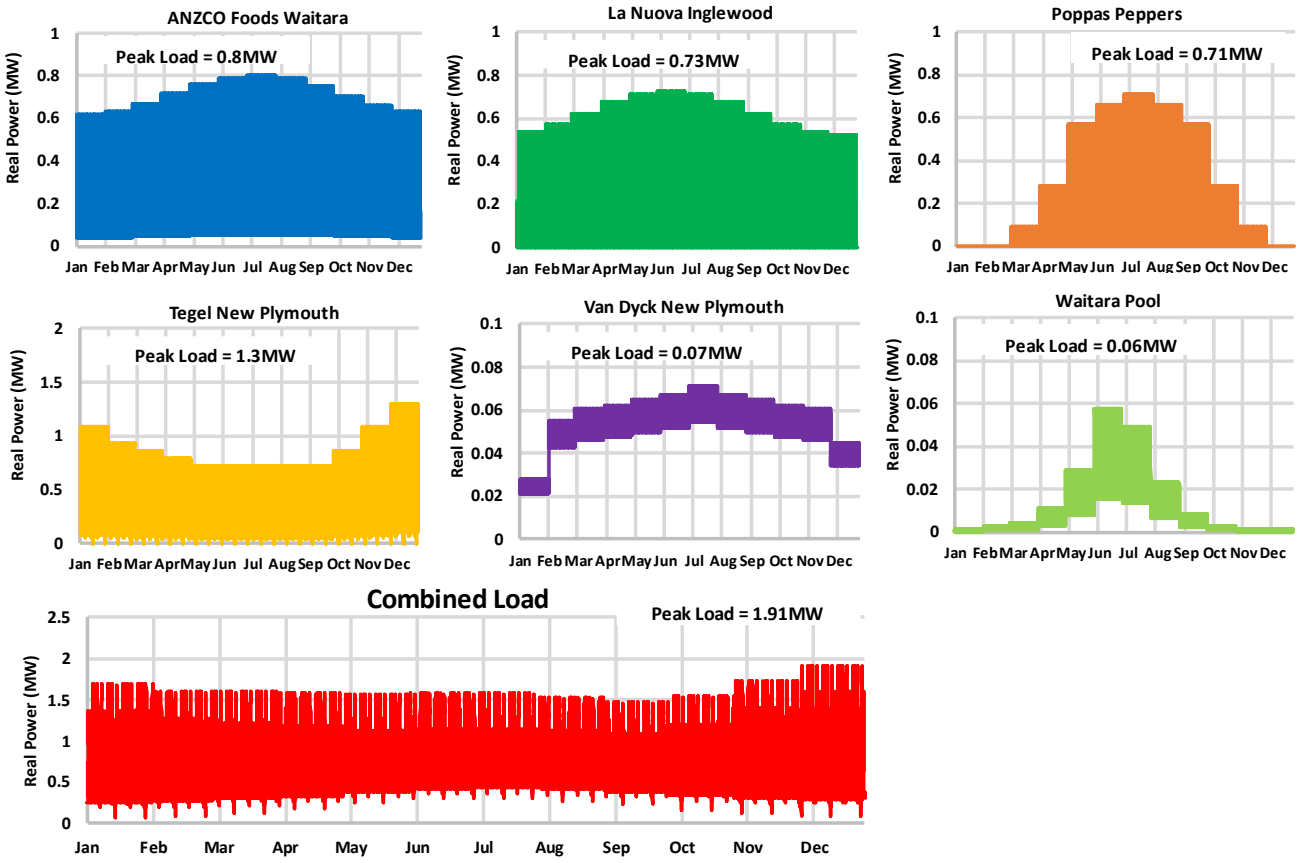


Figure 39 Loading Profiles: Huirangi GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.5.8 Effect of all Load Sites Connecting to Huirangi GXP

The following Figure 40 illustrates the Huirangi GXP load profile together with the load profiles of all the Load Sites within the Huirangi GXP region. Also shown in Figure 40 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Huirangi GXP would increase to 37.5 MW, an increase of 4.8 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 39.2 MW there is a diversity factor of 0.96 between the loads.
- Based on Ergo's analysis, the Huirangi GXP's (N-1) limit is not expected to be exceeded.

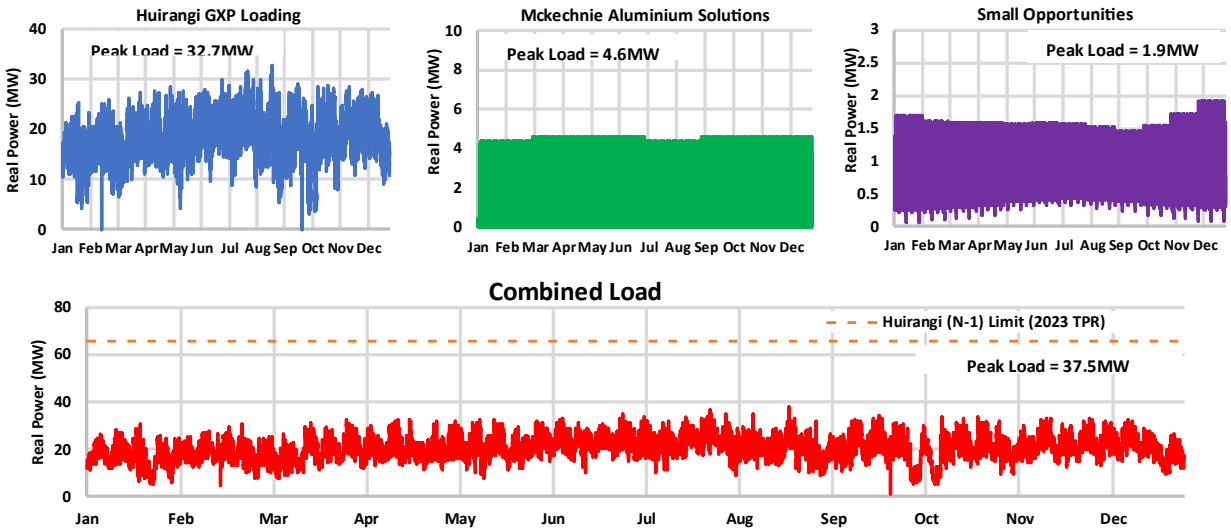


Figure 40 Loading Profiles: Huirangi GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.6 Ōpunake GXP

None of the Load Sites are connecting to Ōpunake GXP and therefore upgrades of this GXP are not considered.

Ergo notes that the Ballance Kāpuni load, when large, may connect to off the Kāpuni GXP 110 kV line, which is fed by the same lines which supply Ōpunake GXP. Required network upgrades for this are discussed in Section 8.4.3.

8.7 Stratford GXP

The "Large" EECA Load Sites connecting to the Stratford GXP include:

- Fonterra Brands Ltd Eltham Bridge St (4.95 MVA)
- Fonterra Ltd Eltham Collingwood St (2.69 MVA)

The "Small" Load Sites connecting to the Stratford GXP include (refer to sections 8.7.5 and 8.7.7):

- Taranaki Abbatoir Stratford (0.94 MVA)
- ANZCO Foods Eltham (0.78 MVA)
- Ministry of Education Stratford High School (0.25 MVA)
- Taranaki Galvanizers Stratford (0.15 MVA)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

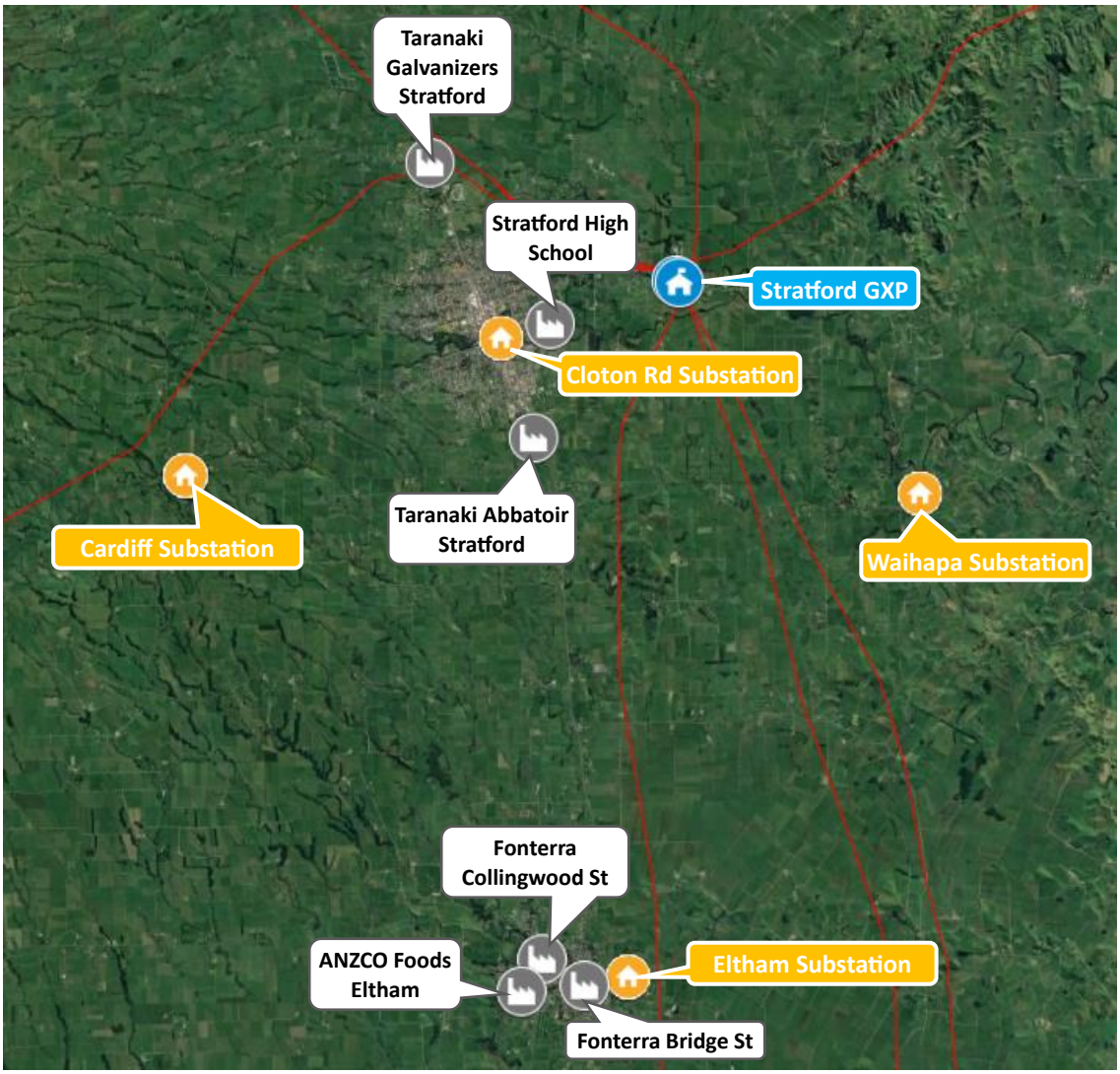


Figure 41 Stratford GXP: EECA Load Sites vs local substations

8.7.1 Stratford GXP Upgrade

The Stratford GXP presently has 28 MVA of spare (N-1) capacity and 53 MVA of spare (N) capacity, based on the transformer ratings.

Analysis in Section 8.7.8 indicates that the spare (N-1) capacity of the Stratford GXP is not expected to be exceeded if all the load sites connect. Therefore, upgrades of the Stratford GXP are not considered.

8.7.2 Fonterra Brands Limited Eltham Bridge St

FONTERRA BRANDS LIMITED ELTHAM BRIDGE ST		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	5.79	Stratford
Existing Electrical Supply to the Plant		
Fonterra Ethan Bridge St is presently supplied by Powerco's Eltham substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Eltham is operated with a split 33 kV bus, with each side supplied via a 33 kV circuit from Stratford GXP, one of which also tees off to supply Waihapa substation, and the other via Cloton Road substation. The subtransmission circuits are both majority overhead lines and are rated to approximately 380 A (~21 MVA) (limited by a short section of smaller cable) and 540 A (~30 MVA). This site is located approximately 0.7 km from Eltham ZS. In turn, Eltham ZS is approximately 10.7 km from Stratford GXP. The two transformers at Eltham had upgrades to increase their capacity to 17 MVA capacity each in 2023-2024. The line which supplies Eltham via Cloton Road is constrained between Cloton Road and the GXP. Powerco has an upgrade planned for 2030-2032 to install a second line between Cloton Road and Stratford GXP, at a cost of $3.408M. There is currently a maximum loading of 9 MVA on Eltham zone substation, with 25 MVA of spare (N) capacity and 8 MVA of spare (N-1) capacity (assuming the transformer upgrades are/were carried out). Stratford GXP has 28 MVA of spare (N-1) capacity, and 53 MVA of spare (N) capacity. The maximum loading on Waihapa substation is 1 MVA, and the maximum loading on Cloton Road substation is 10 MVA. This means the lines supplying Eltham have approximately 15 MVA of spare capacity each.		

FONTERRA BRANDS LIMITED ELTHAM BRIDGE ST

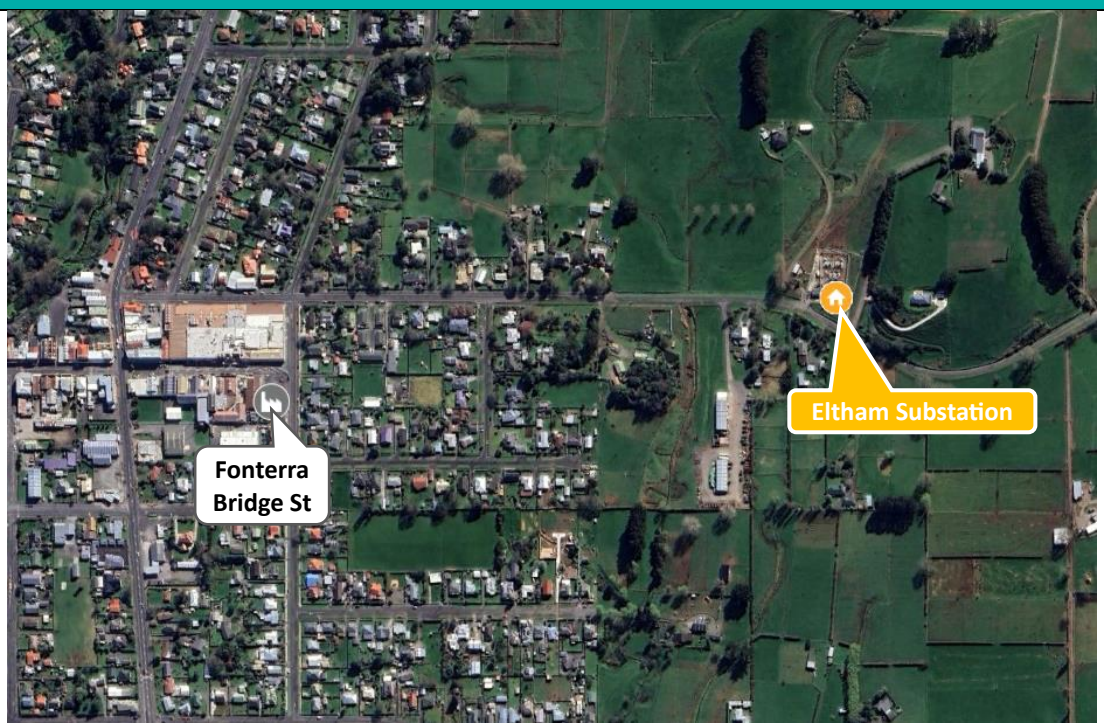


Figure 42 Fonterra Brands Ltd Eltham Bridge St geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, it is expected that 1x new 11 kV feeder from Eltham substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~1 km long.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 35 Fonterra Brands Ltd Eltham Bridge St: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	1.00	$0.60
		TOTAL	**$0.70**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

FONTERRA BRANDS LIMITED ELTHAM BRIDGE ST
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-18 months to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.7.3 Fonterra Limited Eltham Collingwood St

FONTERRA LIMITED COLLINGWOOD ST		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	2.686	Stratford
Existing Electrical Supply to the Plant		
Fonterra Eltham Collingwood St is presently supplied by Powerco's Eltham substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Eltham is operated with a split 33 kV bus, with each side supplied via a 33 kV circuit from Stratford GXP, one of which also tees off to supply Waihapa substation, and the other via Cloton Road substation. The subtransmission circuits are both majority overhead lines and are rated to approximately 380 A (~21 MVA) (limited by a short section of smaller cable) and 540 A (~30 MVA). This site is located approximately 1.4 km from Eltham ZS. In turn, Eltham ZS is approximately 10.7 km from Stratford GXP. The two transformers at Eltham had upgrades to increase their capacity to 17 MVA capacity each in 2023-2024. The line which supplies Eltham via Cloton Road is constrained between Cloton Road and the GXP. Powerco has an upgrade planned for 2030-2032 to install a second line between Cloton Road and Stratford GXP, at a cost of $3.408M. There is currently a maximum loading of 9 MVA on Eltham zone substation, with 25 MVA of spare (N) capacity and 8 MVA of spare (N-1) capacity (assuming the transformer upgrades are/were carried out). Stratford GXP has 28 MVA of spare (N-1) capacity, and 53 MVA of spare (N) capacity. The maximum loading on Waihapa substation is 1 MVA, and the maximum loading on Cloton Road substation is 10 MVA. This means the lines supplying Eltham have approximately 15 MVA of spare capacity each.		

FONTERRA LIMITED COLLINGWOOD ST

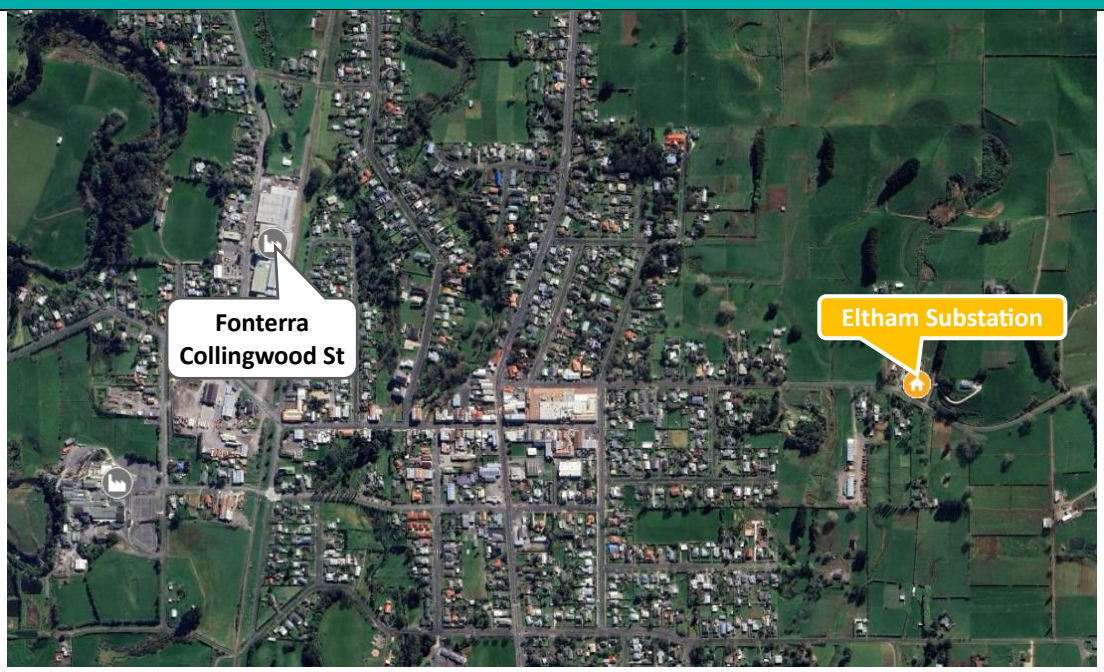


Figure 43 Fonterra Ltd Eltham Collingwood St geographic location in relation to the surrounding zone substations

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, it is expected that 1x new 11 kV feeder from Eltham substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~2 km long.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 36 Fonterra Ltd Eltham Collingwood St: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	2.00	$1.20
		TOTAL	**$1.30**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

FONTERRA LIMITED COLLINGWOOD ST
Timeframe to Establish New Electrical Infrastructure
It is estimated to take 12-24 months to plan, design, procure, construct, and commission the works. Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.7.4 ANZCO Foods Eltham

ANZCO FOODS ELTHAM		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New high temperature heat pumps	1.80	Stratford
Existing Electrical Supply to the Plant		

Fonterra Eltham Collingwood St is presently supplied by Powerco's Eltham substation via an 11 kV feeder which consists of a mixture of underground cable and overhead line. Eltham is operated with a split 33 kV bus, with each side supplied via a 33 kV circuit from Stratford GXP, one of which also tees off to supply Waihapa substation, and the other via Cloton Road substation.

The subtransmission circuits are both majority overhead lines and are rated to approximately 380 A (~21 MVA) (limited by a short section of smaller cable) and 540 A (~30 MVA).

This site is located approximately 1.7 km from Eltham ZS. In turn, Eltham ZS is approximately 10.7 km from Stratford GXP.

The two transformers at Eltham had upgrades to increase their capacity to 17 MVA capacity each in 2023-2024. The line which supplies Eltham via Cloton Road is constrained between Cloton Road and the GXP. Powerco has an upgrade planned for 2030-2032 to install a second line between Cloton Road and Stratford GXP, at a cost of $3.408M.

There is currently a maximum loading of 9 MVA on Eltham zone substation, with 25 MVA of spare (N) capacity and 8 MVA of spare (N-1) capacity (assuming the transformer upgrades are/were carried out). Stratford GXP has 28 MVA of spare (N-1) capacity, and 53 MVA of spare (N) capacity.

The maximum loading on Waihapa substation is 1 MVA, and the maximum loading on Cloton Road substation is 10 MVA. This means the lines supplying Eltham have approximately 15 MVA of spare capacity each.

Figure 44 Fonterra Ltd Eltham Collingwood St geographic location in relation to the surrounding zone substations

ANZCO FOODS ELTHAM

Supply Option(s) for New Load

Both the zone substation and the GXP have adequate spare (N-1) capacity for this load. Due to the size of the load, and unknown existing feeder loading, it is expected that 1x new 11 kV feeder from Eltham substation would be required for this project. Due to the urban topography, it is expected that this feeder would be underground, and would be ~2 km long.

As the zone substation and GXP have adequate (N-1) capacity for this load, consideration has not been given to an (N) security supply.

Capital Cost Estimate

Table 37 Fonterra Ltd Eltham Collingwood St: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security.

Transmission => (N-1)	Subtransmission => (N-1)		Distribution => (N)
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Distribution	11kV circuit breaker (ZS)	1.00	$0.10
Distribution	Single underground 11kV cable	2.00	$1.20
		TOTAL	**$1.30**

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

It is estimated to take 12-24 months to plan, design, procure, construct, and commission the works.

Excluded are any work required to establish the Load Site.

Any land acquisition and consenting, if required, is excluded.

8.7.5 Small Opportunities

Below is a summary of the "small" Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 38 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N-1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
Taranaki Abbattoir Stratford	Cloton Rd	3	16	TBC	0.94	260
Ministry of Education Stratford High School	Cloton Rd	3	16	TBC	0.25	130
Taranaki Galvanizers Stratford	Cloton Rd	3	16	TBC	0.15	80

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.7.6 Combined Load on Zone Substations

The following sections assume that any loads which are staged are connected at their final stage.

8.7.6.1 Cloton Road

Three of the loads on Stratford GXP are expected to connect to Cloton Road zone substation. The loads are Taranaki Abbatoir Stratford, Stratford High School, and Taranaki Galvanizers Stratford. The sum of peaks of these loads is 1.34 MVA, which the zone substation does have (N-1) capacity for. Therefore no further upgrades at Cloton Road are considered.

8.7.6.2 Eltham

Three of the loads on Stratford GXP are expected to connect to Eltham zone substation. The loads are Fonterra Eltham Bridge St, Fonterra Eltham Collingwood St, and ANZCO Foods Eltham. The sum of peaks of these loads is 10.28 MVA, which the zone substation does not have (N-1) capacity for.

If all three loads were to connect, or the two Fonterra loads only, it is possible that replacements of the Eltham transformers would be required, at an estimated cost of $4.6M.

8.7.7 Combined Load of Small Opportunities

Summing the maximum values of the "small" loads on Stratford GXP gives a combined load of 1.34 MVA. When the load shapes are combined, they result in the following load shape (Figure 45), with a maximum load of 1.11MVA, with a diversity factor of 0.83.

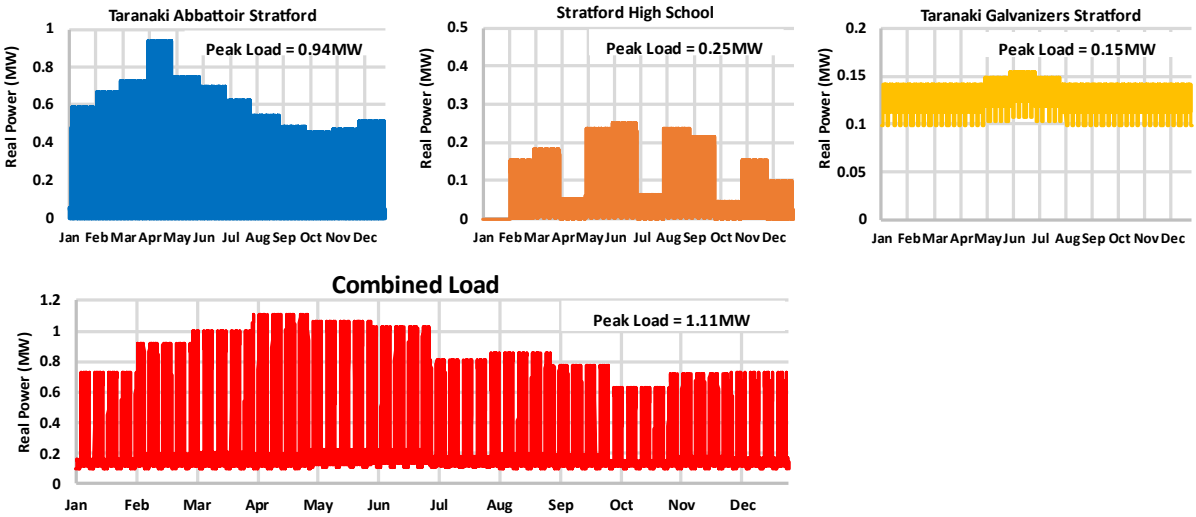


Figure 45 Loading Profiles: Stratford GXP "small" Load Site Profiles: Combined Load (sum of all profiles)

8.7.8 Effect of all Load Sites Connecting to Stratford GXP

The following Figure 46 illustrates the Stratford GXP load profile together with the load profiles of all the Load Sites within the Stratford GXP region. Also shown in Figure 46 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Stratford GXP would increase to 32.0 MW, an increase of 6.4 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 36.2 MW there is a diversity factor of 0.89 between the loads.
- Based on Ergo's analysis, the Stratford GXP's (N-1) limit is not expected to be exceeded.

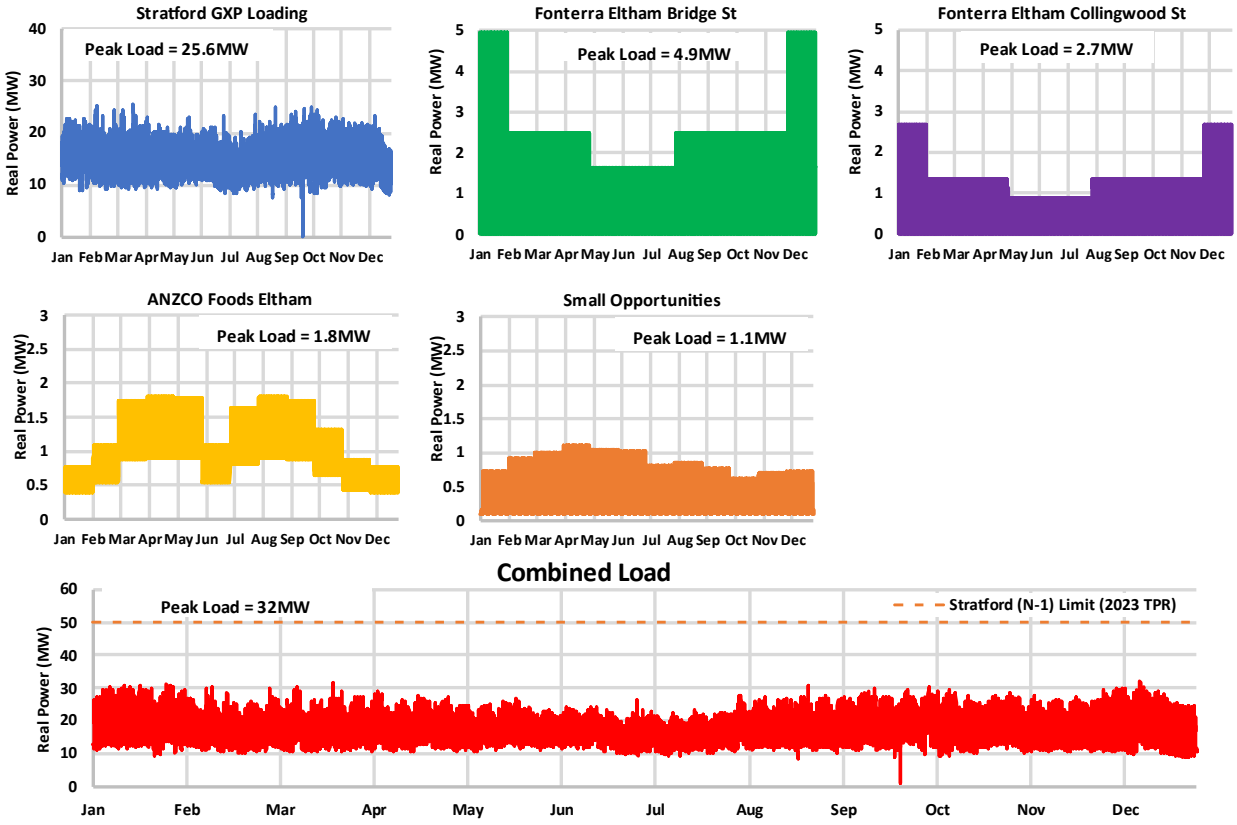


Figure 46 Loading Profiles: Stratford GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.8 Waverley GXP

lNo “Large” EECA Load Sites are connecting to the Waverley GXP.

Only one “Small” Load Site is connecting to the Waverley GXP include (refer to section 8.8.2):

- Silver Fern Farms Limited Waitotara (0.54 MVA)

The geographic locations of the Load Sites are shown on the following map in relation to the local transmission and distribution substations.

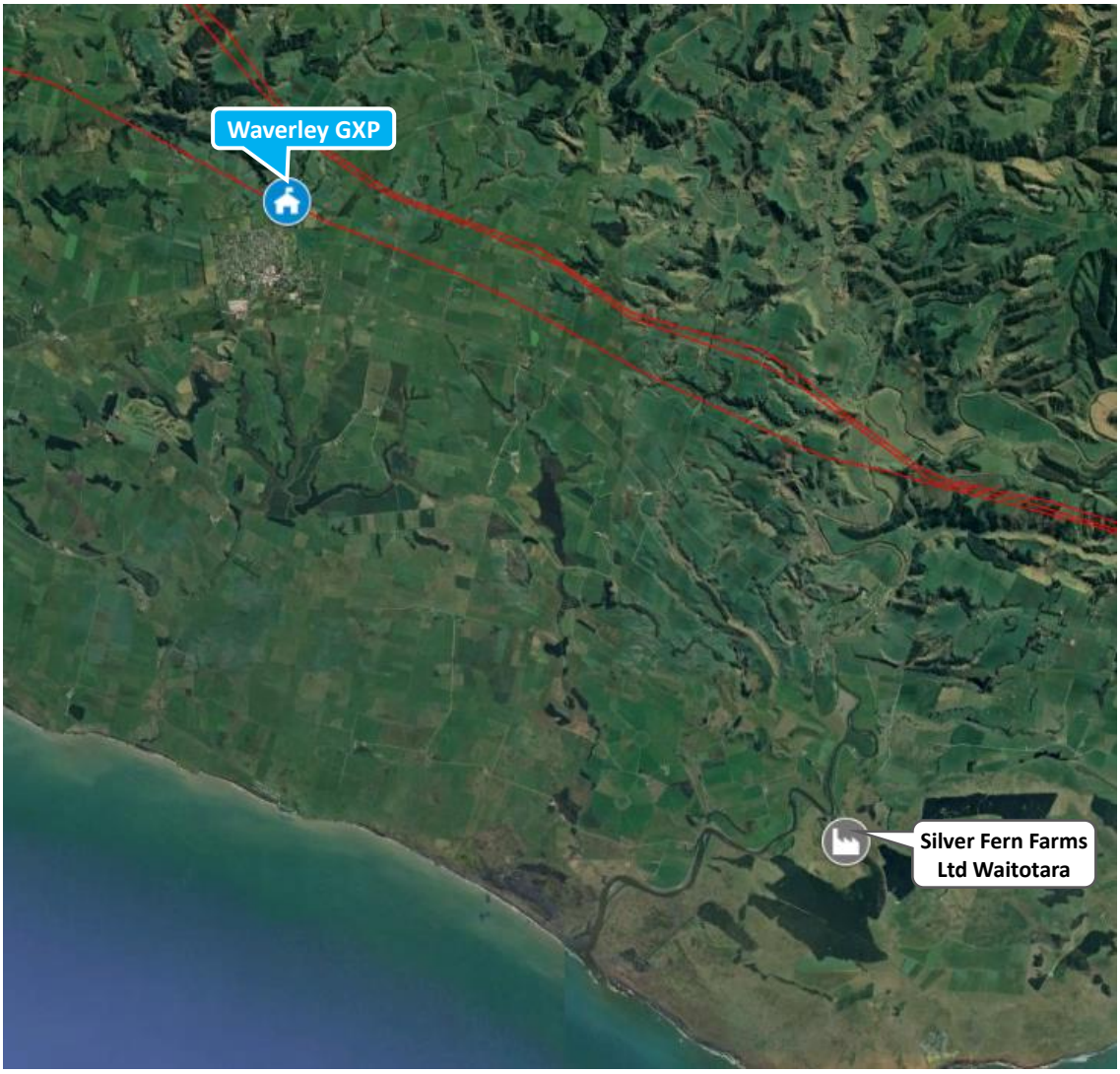


Figure 47 Waverley GXP: EECA Load Sites vs local substations

8.8.1 Waverley GXP Upgrade

The Waverley GXP presently has 5 MVA of spare (N) capacity, based on the transformer rating.

Analysis in Section 8.8.3 indicates that the spare (N) capacity of the Waverley GXP is not expected to be exceeded if all the load sites connect. Therefore, upgrades of the Waverley GXP are not considered.

8.8.2 Small Opportunities

Below is a summary of the “small” Load Sites that were provided by EECA but due to their size, are unlikely to have a material effect on the distribution or transmission network. The costs provided are estimates to provide RMUs and appropriately sized distribution transformers to supply the site.

Table 39 Summary of the "small" Load Sites that are unlikely to have a material effect on the MV/HV network

Opportunity name	Zone sub	Zone sub (N_1) spare capacity (MVA)	Zone sub (N) spare capacity (MVA)	Current Feeder loading (MW)	Opportunity Load (MW)	Estimate cost ($k)
Silver Fern Farms Limited Waitotara	Waverley	0	5.1	TBC	0.54	200

Each Load Site is estimated to take 3 - 6 months to plan, design, procure, construct and commission the works.

Estimates exclude:

- The work required to establish the Load Site.
- Land acquisition and consenting, if required.

8.8.3 Effect of all Load Sites Connecting to Waverley GXP

The following Figure 48 illustrates the Waverley GXP load profile together with the load profiles of all the Load Sites within the Waverley GXP region. Also shown in Figure 48 is:

- The cumulative sum of all the loads (Combined Load), which forecasts that the maximum load on the Waverley GXP would increase to 4.8 MW, an increase of 0.3 MW on the 2023 maximum demand. Given that the independent sum of the individual load peaks is 5.0 MW there is a diversity factor of 0.95 between the loads.
- Based on Ergo's analysis, the Waverley GXP's (N) limit is not expected to be exceeded.

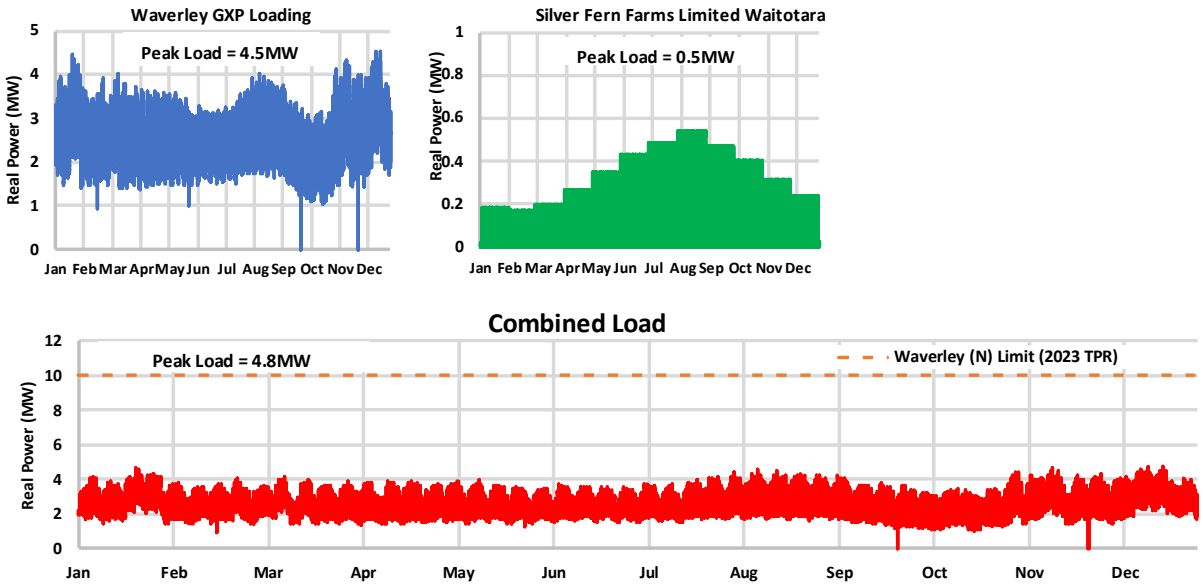


Figure 48 Loading Profiles: Waverley GXP 2023 historical loading: Load Site Profiles: Combined Load (sum of all profiles)

8.9 Motunui GXP

One "Large" EECA Load Site is connecting to the Motunui GXP:

- Methanex (TBC MVA)

Due to the unknown size of this load, analysis focuses on a staged approach to connecting the load. Analysis assumes that upgrades continue along the (N) or (N-1) path, and do not mix the two between stages. Costs are cumulative through stages (i.e. the total cost is the sum of costs of each stage).

The geographic location of the Load Site is shown on the following map in relation to the local transmission substation. At present, the Motunui GXP is a direct supply to Methanex, along with another customer, and as such there is no EDB assets such as zone substations supplying the load.

Figure 49 Motunui GXP: EECA Load Sites vs local substations

8.9.1 Motunui GXP Upgrade

As there is only one Load Site at this GXP, analysis includes any required GXP upgrades at each stage investigated.

8.9.2 Methanex

METHANEX		
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and/or high temperature heat pumps	TBC	Motunui

Existing Electrical Supply to the Plant

Methanex is presently supplied directly via the Motunui GXP. All loads on Motunui GXP are presently supplied by the 11 kV bus and therefore the capacity is limited by the 110/11 kV transformers and 11 kV bus.

Motunui is supplied as part of the 110 kV ring including Motunui, Huirangi, and Carrington St GXPs. Two lines from Stratford to Carrington St are each rated at 232/238 MVA (summer/winter), with a third rated at 92/101 MVA (summer/winter). Carrington St is then connected to Huirangi via two lines each rated at 63/77 MVA (summer/winter). Motunui is supplied by one line each from Stratford, Carrington St, and Huirangi, which are rated at 95/105 MVA, 62/76 MVA, and 95/105 MVA, respectively.

Motunui GXP presently has ~25 MVA of spare (N-1) capacity, and ~65 MVA of spare (N) capacity.

Figure 50 Merthanex geographic location in relation to the Motunui GXP

Supply Option(s) for New Load

Due to the unknown size of this load, analysis focuses on a staged approach to connecting the load, and considers connection up to 240 MW.

METHANEX

Due to the unknown size of this load, analysis focuses on a staged approach to connecting the load. Analysis assumes that upgrades continue along the (N) or (N-1) path, and do not mix the two between stages. Costs are cumulative through stages (i.e. the total cost is the sum of costs of each stage).

Stage 1 – 25 MVA

A first stage of development which would likely require no network upgrades is a 25 MVA load. This would utilise the remaining 25 MVA of (N-1) spare capacity at the GXP. No upgrades of the GXP or incoming lines are expected for this stage.

Stage 2 – 65 MVA

The second stage of development could utilise the remaining (N) capacity at the substation adds up to a further 40 MVA on top of the Stage 1 load for a total load of 65 MVA.

For an (N) security supply, it is expected that an SPS (special protection scheme) may be required to avoid transformer overload in the case of a transformer outage.

For an (N-1) security supply, the GXP transformers would require replacements. Ideally these transformer replacements would account for the future stages of the load connection at the site. At a minimum (accounting only for the load of this stage), the transformers would be 80 MVA each (double their existing capacity). At this size, it is likely that Methanex would be supplied at 33 kV, with the new transformers being 110/33 kV units. With the increased size and new voltage rating of the transformers, a new switchboard would be required at 33 kV, and upgrades at 110 kV.

Stage 3 – 120 MVA

The third stage of development considers adding up to a further 55 MVA on top of the Stage 2 load for a total load of 120 MVA.

For an (N) security supply, it is expected that transformer replacements similar to those carried out for the (N-1) option for stage 2 would be required. The SPS installed in stage 2 would need to be updated/revised for the increased capacity and would remain in place.

For an (N-1) security supply, it is expected that two additional 110/33 kV transformers would be required at Motunui (additional to the two installed in stage 2). For addition of these transformers, expansions of the 110 kV and 33 kV switchboards at Motunui would be required.

Stage 4 – 240 MVA

The third stage of development considers adding up to a further 120 MVA on top of the Stage 3 load for a total load of 240 MVA.

METHANEX
Both supply options, (N) and (N-1) would require upgrades of the 110 kV Motunui-McKee tee, Carrington St-Junction Road and Motunui-Huirangi lines, which are ~5.8 km, ~4.6 km, and ~8.5 km respectively. For an (N) security supply, the lines upgrades mentioned above are the main expected upgrades. • For an (N-1) security supply, additional to the line upgrades above, it is expected that the replacement of the smaller interconnecting transformer at Stratford would be required, at a cost of $13M (as per Section 6.1.5). Upgrades of the Huirangi-Carrington St, Motunui-Carrington St, McKee Tee-Stratford, and Junction Rd-Stratford 110 kV circuits would also be required, with lengths of ~16 km, ~23 km, ~48 km, and ~32 km respectively.
Capital Cost Estimate

Table 40. Methanex Motunui: Capital cost estimate to supply the Load Site with (N) security (Stage 1)

N/A

Table 41. Methanex Motunui: Capital cost estimate to supply the Load Site with (N-1) security (Stage 1)

N/A

Table 42. Methanex Motunui: Capital cost estimate to supply the Load Site with (N) security (Stage 2)

Transmission =>	(N)	Subtransmission =>	(N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Special protection system (GXP)	1.00	$0.50
		TOTAL	$0.50

Table 43. Methanex Motunui: Capital cost estimate to supply the Load Site with (N-1) security (Stage 2)

Transmission =>	(N-1)	Subtransmission =>	(N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	33kV circuit breaker bay	10.00	$2.50
		TOTAL	$12.70

Table 44. Methanex Motunui: Capital cost estimate to supply the Load Site with (N) security (Stage 3)

Transmission =>	(N)	Subtransmission =>	(N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Special protection system (GXP)	1.00	$0.50
Transmission	Large supply transformer (GXP)	2.00	$9.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	33kV circuit breaker bay	10.00	$2.50
		TOTAL	$13.20

Table 45. Methanex Motunui: Capital cost estimate to supply the Load Site with (N-1) security (Stage 3)

Transmission =>	(N-1)	Subtransmission =>	(N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	Large supply transformer (GXP)	2.00	$9.00
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	33kV circuit breaker bay	10.00	$2.50
		TOTAL	$12.70

METHANEX

Table 46. Methanex Motunui: Capital cost estimate to supply the Load Site with (N) security (Stage 4)

Transmission =>	(N)	Subtransmission =>	(N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	110kV double cct line	18.90	$34.02
			$34.02

Table 47. Methanex Motunui: Capital cost estimate to supply the Load Site with (N-1) security (Stage 4)

Transmission =>	(N-1)	Subtransmission =>	(N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	110kV double cct line	137.90	$248.22
Transmission	Stratford Interconnecting TX Replacement	1.00	$13.00
		TOTAL	**$261.22**

Costs do not include the cost of any Methanex-owned equipment (e.g. 33/0.4 kV transformers for supply of individual boilers or heat pumps), which would be significant.

Timeframe to Establish New Electrical Infrastructure

For the (N) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 3-6 months
- Stage 2 – 12-24 months
- Stage 3 –36-48 months
- Stage 4 – 36-48 months

For the (N-1) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 3-6 months
- Stage 2 – 36-48 months
- Stage 3 – 36-48 months
- Stage 4 – 36-48 months

Those stages involving 110 kV lines may take longer in order to secure a suitable route, which may require public consultation and the purchase of multiple parcels of land. Ergo note that it took >10 years to plan, consult and construct the new 220kV line between Whakamaru and Brownhill (into Auckland) that is insulated at 400kV.

Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.9.3 Effect of all Load Sites Connecting to Motunui GXP

As no load shape is available for Methanex, the actual increase in peak load due to the single load site is unknown. However, Ergo notes that there is likely to be some diversity between the existing load and the additional load.

Analysis in Section 8.9.2 has assumed no diversity between the existing and additional new load.

8.10 Kāpuni GXP

The "Large" EECA Load Site connecting to the Kāpuni GXP is:

- Fonterra Ltd. Kāpuni (45.91 MVA)

The geographic location of the Load Site is shown on the following map in relation to the local transmission and distribution substations.

Figure 51 Kāpuni GXP: EECA Load Sites vs local substations

8.10.1 Kāpuni GXP Upgrade

As there is only one Load Site at this GXP, analysis includes any required GXP upgrades at each stage investigated.

8.10.2 Fonterra Limited Kāpuni

		FONTERRA LIMTIED KĀPUNI
Load Site Description	**Electrical Demand (MW)**	**Transpower GXP**
New electrical boilers and high temperature heat pumps	45.906	Kāpuni

Existing Electrical Supply to the Plant

Fonterra Limited Kāpuni is presently supplied by the Kāpuni GXP near the site. Kāpuni is supplied off as a tee off the 110 kV Ōpunake-Stratford 2 circuit. A single circuit runs from the tee point to Kāpuni, with a rating of 52/63 MVA (summer/winter). The 110 kV lines connecting Ōpunake GXP to Stratford are rated to 67/79 MVA (summer/winter). The Kāpuni GXP is presently equipped with a single 30 MVA transformer.

With a maximum load of 8 MVA at present, the GXP has ~22 MVA of spare (N) capacity. The GXP presently operates with (N) security. The Ōpunake GXP has a present max loading of ~12 MW.

Presently, Fonterra has 24 MW of cogeneration connected to this GXP. Ergo notes that cogeneration is dependent upon the existing fossil-fuel energy supply and so would not remain should the site decarbonise. The analysis presented here assumes that the cogeneration is decommissioned as the site decarbonises.

Figure 52 Fonterra Ltd Kāpuni geographic location in relation to the Kāpuni GXP

FONTERRA LIMTIED KĀPUNI
Supply Option(s) for New Load

Due to the size of this load, analysis focuses on a staged approach to connecting the load.

Stage 1 – 11 MVA

The first stage of Fonterra Kāpuni expansion adds an additional 11 MVA onto the existing load. This stage establishes supply more local to the Fonterra site at 110 kV.

For an (N) security supply, it is expected that a new 110 kV line (~3 km) from the Kāpuni GXP to the Fonterra site would be required, along with one 110/11 kV transformer at the Fonterra site, and associated switchgear.

For an (N-1) security supply, additional to the upgrades required for an (N) security supply, it is expected that a 110 kV line to Fonterra from the Ōpunake-Stratford 110 kV lines (similar to the one supplying Kāpuni GXP) would be required. This line would likely tee off the other Ōpunake-Stratford line from the existing tee connection, and is expected to be ~15 km long. Additionally, two transformers would be required at the Fonterra site, rather than the single one required for an (N) supply.

New transformers should be sized for the final stage of site development.

Stage 2 – 22 MVA

The second stage of Fonterra expansion adds an additional 11 MVA onto the stage 1 load, for a total addition load of 22 MVA.

For both an (N) and an (N-1) supply, replacement of the existing 110/11 kV transformer at the site would be required. This replacement should account for the load of future stages.

Stage 3 – 33 MVA

The third stage of Fonterra expansion adds an additional 11 MVA onto the stage 3 load, for a total additional load of 33 MVA.

For both an (N) or (N-1) security supply, the existing 110 kV line suppling Kāpuni would require replacements/thermal upgrades.

For an (N-1) security supply, upgrades of the Ōpunake-Stratford 110 kV lines between the Kāpuni tee and Stratford (~20 km per line) would be required.

Stage 4 – 45.91 MVA

The fourth stage of Fonterra expansion adds an additional 12.91 MVA onto the stage 3 load, for a total additional load of 45.91 MVA.

Assuming that the previous stages' transformer installations took into account this final load, no further upgrades are expected for an (N) or (N-1) security supply.

Capital Cost Estimate

Table 48 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) security (Stage 1).

Transmission => (N)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	110kV circuit breaker bay	2.00	$1.20
Transmission	110kV single cct line	3.00	$2.40
Transmission	Large supply transformer (GXP)	1.00	$4.50
Subtransmission	Large switchroom (ZSS)	1.00	$4.00
			$12.10

Table 49 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) security (Stage 1).

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	110kV circuit breaker bay	4.00	$2.40
Transmission	110kV single cct line	15.00	$12.00
Transmission	110kV single cct line	3.00	$2.40
Transmission	Large supply transformer (GXP)	2.00	$9.00
Subtransmission	Large switchroom (ZSS)	2.00	$8.00
			$33.80

Table 50 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) security (Stage 2).

Transmission => (N)	Subtransmission => (N)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
		TOTAL	**$4.50**

Table 51 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 2).

Transmission => (N-1)	Subtransmission => (N-1)	Distribution => (N)	
Network Asset	**Equipment**	**Number and Capital Cost ($M)**	
Transmission	Large supply transformer (GXP)	1.00	$4.50
		TOTAL	**$4.50**

Table 52 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) security (Stage 3).

FONTERRA LIMTIED KĀPUNI

Transmission => (N-1)		Subtransmission => (N)	Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	110kV single cct line	15.00	$12.00
		TOTAL	$12.00

Table 53 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 3).

Transmission => (N-1)		Subtransmission => (N-1)	Distribution => (N)
Network Asset	Equipment	Number and Capital Cost ($M)	
Transmission	110kV single cct line	15.00	$12.00
Transmission	110kV single cct line	40.00	$32.00
		TOTAL	$44.00

Table 54 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N) security (Stage 4).
(N/A)

Table 55 Fonterra Ltd Kāpuni: Capital cost estimate to supply the Load Site with (N-1) subtransmission supply security (Stage 4).
(N/A)

Does not include the costs of any electrical equipment (i.e. distribution transformers/switchgear and cables) on the plant site.

Timeframe to Establish New Electrical Infrastructure

For the (N) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 12-18 months
- Stage 2 – 36-48 months
- Stage 3 –36-48 months
- Stage 4 – 3-6 months
- Stage 5 –24-36 months

For the (N-1) security case, it is estimated to take the following periods to plan, design, procure, construct, and commission the works for each stage:

- Stage 1 – 12-18 months
- Stage 2 – 36-48 months
- Stage 3 – 24-36 months
- Stage 4 – 24-36 months
- Stage 5 – 24-36 months

FONTERRA LIMTIED KĀPUNI
Excluded are any work required to establish the Load Site. Any land acquisition and consenting, if required, is excluded.

8.10.3 Effect of all Load Sites Connecting to Kāpuni GXP

As no load shape is available for Kāpuni GXP (as it is not Transpower owned and therefore not included in Transpower's information disclosures), the actual increase in peak load due to the single load site is unknown. However, Ergo notes that it is likely to be slightly lower than the ~45 MVA size of the load, as some diversity between the existing load and the additional load is expected.

Analysis in Section 8.10.2 has assumed no diversity between the existing and additional new load.

9. Conclusions

9.1 Network Spare Capacity

The following Figure 53 illustrates the (N) and (N-1) spare capacity at the Transpower GXP substations in the Taranaki region.

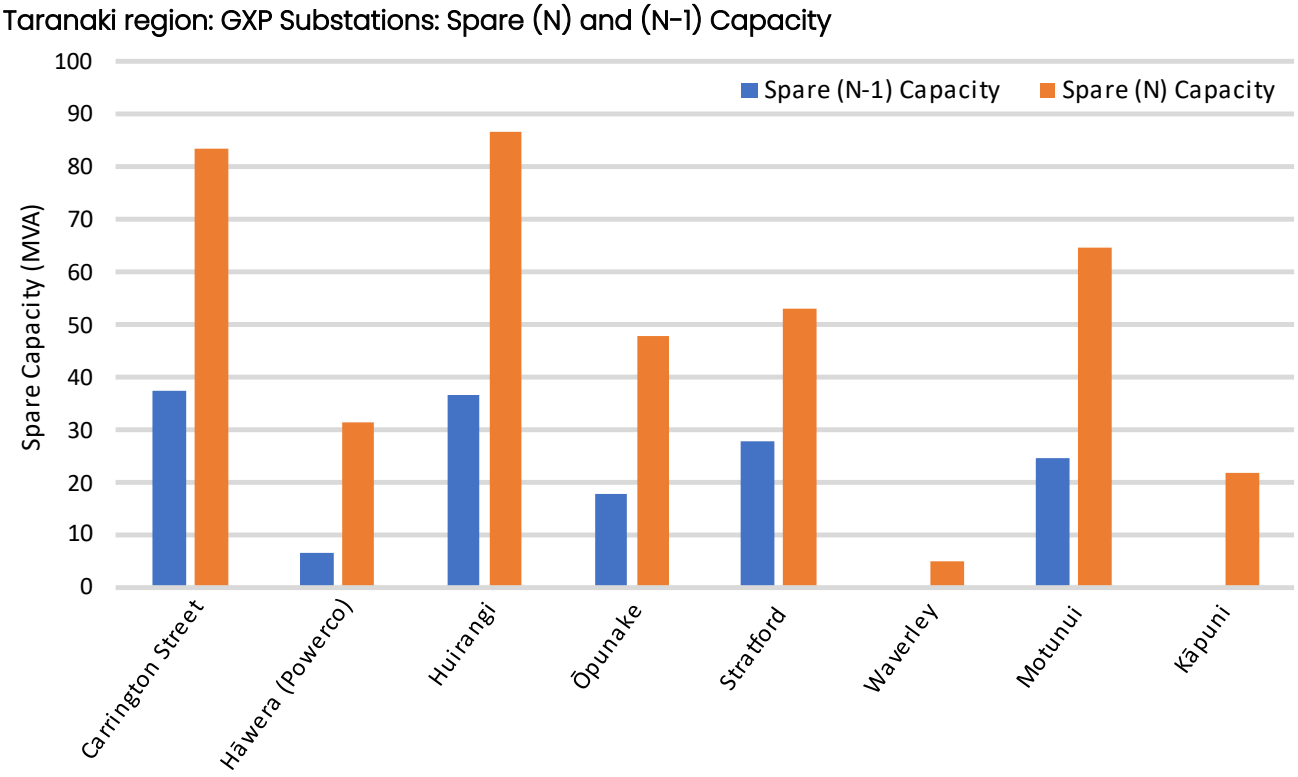


Figure 53 Summary: Approximate (N) and (N-1) spare capacity at GXP substations.

The following Figure 54 illustrates the (N) and (N-1) spare capacity at the Powerco Zone Substations in the Taranaki region. This figure is based on the maximum loadings and the Powerco 2023 disclosures.

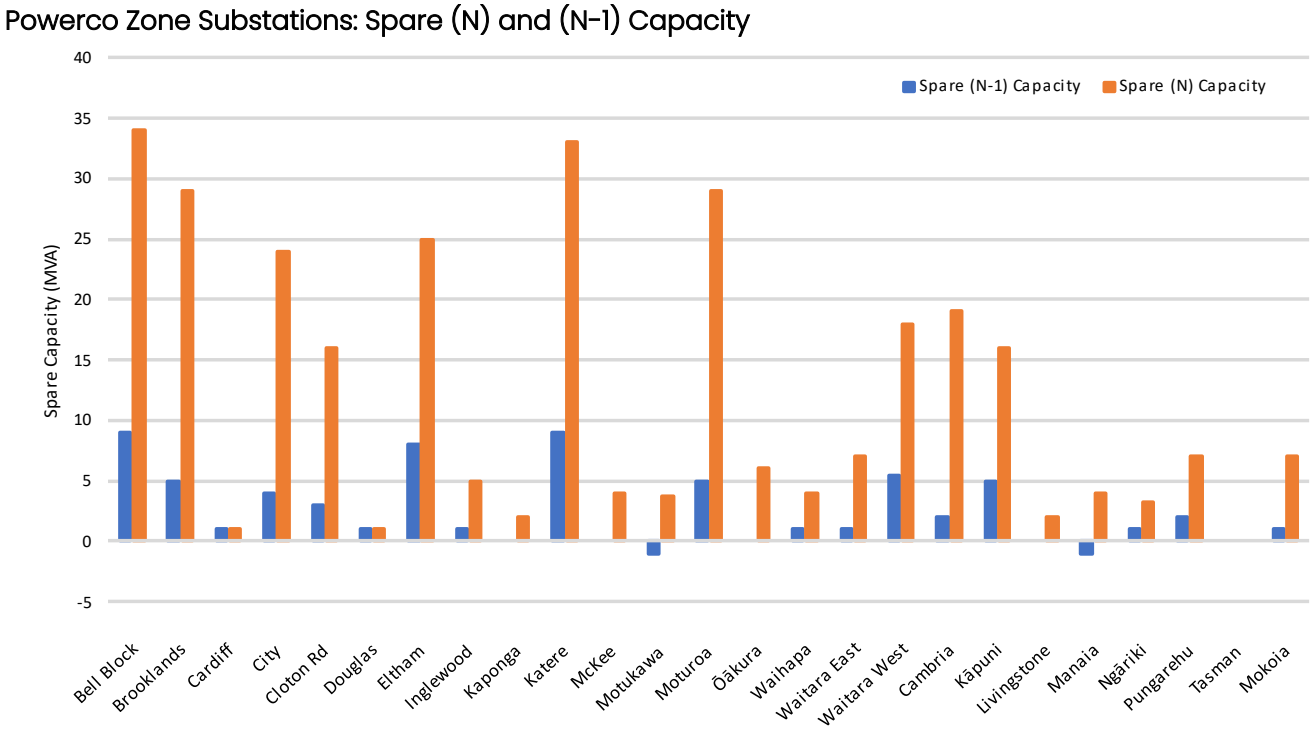


Figure 54 Summary: Approximate (N) and (N-1) spare capacity at Powerco's zone substations.

9.2 Load Characteristics

The substation load characteristics are documented in detail in the main body of the report (and the supplementary document 23163-RPT-001) and vary widely. However, at a high level, the general characteristics of the substation loads are as follows:

GXP substations:

- *Carrington St GXP* – Supplies New Plymouth city, including some heavy industry, oil/gas production, and agricultural loads resulting in a mix of residential, commercial, and industrial loads. Winter peaking with a typical daily morning and evening peak. In summer, the load is typically almost flat between the morning and evening peaks, indicating a higher industrial or agricultural (e.g. irrigation) load over summer.
- *Hāwera GXP* – Supplies a large rural area, including the large town Hāwera and surrounding agricultural areas, resulting in a mix of residential, commercial, and industrial loads. The GXP is winter peaking though there is only a small seasonal difference in load. Typical daily morning and evening peaks.
- *Huirangi GXP* – Supplies the town of Waitara, and industrial area between New Plymouth and Waitara (i.e. Bell Block), and a large agricultural area, resulting in a mix of residential, commercial, and industrial loads. Load peaks are similar throughout the year, with a lower load around June. The daily load appears to be highly influenced by industrial loads in summer, and has typical morning and evening peaks in winter.
- *Ōpunake GXP* – Supplies a large rural/tourist area, resulting in a mix of residential, commercial, and industrial (including agricultural) loads, with a significant drop in network loading during winter. Typical morning and evening peaks.
- *Stratford GXP* – Supplies the town of Stratford as well as a large agricultural area, resulting in a mix of residential, commercial, and industrial loads, with a slight drop in network loading during winter. Typical morning and evening peaks.
- *Waverley GXP* – Supplies the area around the town of Waverley, so load is largely residential. Summer peaking with typical morning and evening peaks.

Zone Substations:

- The load characteristics of the zone substations vary widely depending on the connected consumers/generators.

9.3 EECA Load Sites

The following table shows EECA's Load Sites together with:

- The peak electrical power requirements of the Load Site.
- The distribution zone substation to which the Load Site would connect.
- The transmission substation/GXP which supplies the relevant zone substation.
- Ergo's estimate of the capital cost to increase the capacity of the relevant transmission assets (lines and substations).
- Ergo's estimate of the capital cost to install the necessary distribution assets to supply the Load Site.
- The cost efficiency associated with the Load Site in terms of $M/MW.
- The 'complexity of connection' based on the level of upgrades required.

The costs are preliminary and Ergo is of the view that they have an accuracy of Class 5[25], which is only suitable for concept screening. (Refer to the assumptions outlined in Section 8.2 for more details)

[25] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.

Summary: Load Sites vs transmission/distribution capital cost estimates

Table 56 Summary of Load Sites and estimated capital costs

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
TAR24	Downer New Zealand Limited New Plymouth Asphalt	3.37	Carrington Street	$0.00	Katere	$1.30	$1.30	$0.39	Minor	1
TAR14	New Plymouth District Council Wastewater treatment	2.70	Carrington Street	$0.00	Katere	$1.90	$1.90	$0.70	Minor	1
TAR21	Downer New Zealand Limited New Plymouth Bitumen	2.10	Carrington Street	$0.00	Moturoa	$0.58	$0.58	$0.28	Minor	1
TAR45	Technix Bitumen Technologies Limited	1.23	Carrington Street	$0.00	Moturoa	$0.58	$0.58	$0.47	Minor	1
TAR38	Tegel Bell Block Feedmill	0.64	Carrington Street	$0.00	Katere	$0.07	$0.07	$0.10	Minor	1
TAR10	Ministry of Health Taranaki Base Hospital	0.47	Carrington Street	$0.00	Moturoa	$0.00	$0.00	$0.00	Minor	1
TAR37	Western Institute of Technology in Taranaki (WITT) Ta	0.36	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR25	New Plymouth District Council Todd Energy Aquatic Ce	0.23	Carrington Street	$0.00	Moturoa	$0.00	$0.00	$0.00	Minor	1
TAR27	New Plymouth District Council Puke Ariki	0.12	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR31	New Plymouth District Council Civic Centre	0.10	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR28	State-integrated school Francis Douglas Memorial Col	0.09	Carrington Street	$0.00	Moturoa	$0.00	$0.00	$0.00	Minor	1
TAR29	New Plymouth District Council Len Lye Centre	0.06	Carrington Street	$0.00	City	$0.00	$0.00	$0.00	Minor	1
TAR4	Fonterra Limited Whareroa - Total (N)	88.14	Hāwera 110 kV	$14.00	N/A	$0.00	$14.00	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 1	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 2	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 3	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N) Stage 4	22.14	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
TAR4	Fonterra Limited Whareroa - Total (N-1)	88.14	Hāwera 110 kV	$36.80	N/A	$0.00	$36.80	$0.42	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 1	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 2	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 3	22.00	Hāwera 110 kV	$3.50	N/A	$0.00	$3.50	$0.16	Moderate	1, 2
	Fonterra Limited Whareroa - (N-1) Stage 4	22.14	Hāwera 110 kV	$26.30	N/A	$0.00	$26.30	$1.19	Moderate	1, 2
TAR6	Taranaki By-Products Hawera	12.47	Hāwera (Powerco)	$9.00	Kāpuni	$7.35	$16.35	$1.31	Major	1, 3
TAR9	Silver Fern Farms Limited Hawera	1.47	Hāwera (Powerco)	$0.00	Cambria	$6.72	$6.72	$4.56	Moderate	1, 3
TAR19	Little Knoll Greenhouses Ltd Patea	0.28	Hāwera (Powerco)	$0.00	Livingstone	$0.00	$0.00	$0.00	Minor	1
TAR2	Ballance Agri-Nutrients Ltd Kapuni - Total (N)	TBC	Hāwera (Powerco)	$222.00	Kāpuni	$1.60	$223.60	N/A	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 1	5.00	Hāwera (Powerco)	$0.00	Kāpuni	$0.00	$0.00	$0.00	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 2	8.00	Hāwera (Powerco)	$0.50	Kāpuni	$1.10	$1.60	$0.20	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 3	25.00	Hāwera (Powerco)	$9.00	Kāpuni	$0.50	$9.50	$0.38	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 4	32.00	Hāwera (Powerco)	$28.60	Kāpuni	$0.00	$28.60	$0.89	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 5	100.00	Hāwera (Powerco)	$38.70	Kāpuni	$0.00	$38.70	$0.39	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N) Stage 6	80.00	Hāwera (Powerco)	$53.20	Kāpuni	$0.00	$53.20	$0.67	Major	1, 2
TAR2	Ballance Agri-Nutrients Ltd Kapuni - Total (N-1)	TBC	Hāwera (Powerco)	$393.20	Kāpuni	$13.70	$406.90	N/A	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 1	5.00	Hāwera (Powerco)	$9.00	Kāpuni	$0.00	$9.00	$1.80	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 2	8.00	Hāwera (Powerco)	$0.00	Kāpuni	$5.70	$5.70	$0.71	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 3	25.00	Hāwera (Powerco)	$0.00	Kāpuni	$8.00	$8.00	$0.32	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 4	32.00	Hāwera (Powerco)	$99.30	Kāpuni	$0.00	$99.30	$3.10	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 5	100.00	Hāwera (Powerco)	$60.70	Kāpuni	$0.00	$60.70	$0.61	Major	1, 2
	Ballance Agri-Nutrients Ltd Kapuni - (N-1) Stage 6	80.00	Hāwera (Powerco)	$40.20	Kāpuni	$0.00	$40.20	$0.50	Major	1, 2
TAR7	Mckechnie Aluminium Solutions Limited Bell Block - St	4.60	Huirangi	$0.00	Bell Block	$1.18	$1.18	$0.26	Minor	1
	Mckechnie Aluminium Solutions Limited Bell Block - St	3.70	Huirangi	$0.00	Bell Block	$1.18	$1.18	$0.32	Minor	1
	Mckechnie Aluminium Solutions Limited Bell Block - St	7.70	Huirangi	$0.00	Bell Block	$13.39	$13.39	$1.74	Moderate	1, 3
TAR16	ANZCO Foods Waitara	0.80	Huirangi	$0.00	Waitara West	$0.00	$0.00	$0.00	Minor	1
TAR20	La Nuova Inglewood	0.73	Huirangi	$0.00	Inglewood	$0.00	$0.00	$0.00	Minor	1
TAR43	Poppas Peppers 2009 Limited New Plymouth	0.71	Huirangi	$0.00	Bell Block	$1.56	$1.56	$2.20	Minor	1
TAR26	Tegel New Plymouth	1.30	Huirangi	$0.00	Bell Block	$0.96	$0.96	$0.74	Minor	1
TAR35	Van Dyck New Plymouth	0.07	Huirangi	$0.00	Bell Block	$0.00	$0.00	$0.00	Minor	1
TAR30	New Plymouth District Council Waitara Pool	0.06	Huirangi	$0.00	Waitara East	$0.00	$0.00	$0.00	Minor	1
TAR1	Methanex Motunui - Total (N)	TBC	Motunui	$941.22	N/A	$0.00	$941.22	N/A	Major	1, 2
	Methanex Motunui - (N) Stage 1	25.00	Motunui	$0.00	N/A	$0.00	$0.00	$0.00	Minor	1, 2
	Methanex Motunui - (N) Stage 2	40.00	Motunui	$0.50	N/A	$0.00	$0.50	$0.01	Major	1, 2
	Methanex Motunui - (N) Stage 3	55.00	Motunui	$13.20	N/A	$0.00	$13.20	$0.24	Major	1, 2
	Methanex Motunui - (N) Stage 4	120.00	Motunui	$34.02	N/A	$0.00	$34.02	$0.28	Major	1, 2
TAR1	Methanex Motunui - Total (N-1)	TBC	Motunui	$1,284.62	N/A	$0.00	$1,284.62	N/A	Major	1, 2
	Methanex Motunui - (N-1) Stage 1	25.00	Motunui	$0.00	N/A	$0.00	$0.00	$0.00	Minor	1, 2
	Methanex Motunui - (N-1) Stage 2	40.00	Motunui	$12.70	N/A	$0.00	$12.70	$0.32	Major	1, 2
	Methanex Motunui - (N-1) Stage 3	55.00	Motunui	$12.70	N/A	$0.00	$12.70	$0.23	Major	1, 2
	Methanex Motunui - (N-1) Stage 4	120.00	Motunui	$261.22	N/A	$0.00	$261.22	$2.18	Major	1, 2

No.	Load Site Name	Load (MW)	Transmission Details		Distribution		TOTAL	Cost Efficiency ($M/MW)	Complexity of Connection	Refer to notes
			GXP/Transmission Substation	Upgrade Costs ($M)	Zone Substation	Upgrade Costs ($M)	Upgrade Costs ($M)			
TAR15	Fonterra Brands Limited Eltham Bridge St	5.79	Stratford	$0.00	Eltham	$0.70	**$0.70**	**$0.12**	Minor	1
TAR13	Fonterra Limited Eltham Collingwood St	2.69	Stratford	$0.00	Eltham	$1.30	**$1.30**	**$0.48**	Minor	1
TAR18	Taranaki Abbattoir Stratford	0.94	Stratford	$0.00	Cloton Rd	$0.00	**$0.00**	**$0.00**	Minor	1
TAR8	ANZCO Foods Eltham	1.80	Stratford	$0.00	Eltham	$1.30	**$1.30**	**$0.72**	Minor	1
TAR22	Ministry of Education Stratford High School	0.25	Stratford	$0.00	Cloton Rd	$0.00	**$0.00**	**$0.00**	Minor	1
TAR42	Taranaki Galvanizers Stratford	0.15	Stratford	$0.00	Cloton Rd	$0.00	**$0.00**	**$0.00**	Minor	1
TAR17	Silver Fern Farms Limited Waitotara	0.54	Waverley	$0.00	Waverley	$0.00	**$0.00**	**$0.00**	Minor	1
TAR5	Fonterra Limited Kapuni - Total (N)	45.91	Kāpuni	$28.60	N/A	$0.00	**$28.60**	**$0.62**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 1	11.00	Kāpuni	$12.10	N/A	$0.00	**$12.10**	**$1.10**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 2	11.00	Kāpuni	$4.50	N/A	$0.00	**$4.50**	**$0.41**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 3	11.00	Kāpuni	$12.00	N/A	$0.00	**$12.00**	**$1.09**	Major	1, 2
	Fonterra Limited Kapuni - (N) Stage 4	12.91	Kāpuni	$0.00	N/A	$0.00	**$0.00**	**$0.00**	Minor	1, 2
TAR5	Fonterra Limited Kapuni - Total (N-1)	45.91	Kāpuni	$82.30	N/A	$0.00	**$82.30**	**$1.79**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 1	11.00	Kāpuni	$33.80	N/A	$0.00	**$33.80**	**$3.07**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 2	11.00	Kāpuni	$4.50	N/A	$0.00	**$4.50**	**$0.41**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 3	11.00	Kāpuni	$44.00	N/A	$0.00	**$44.00**	**$4.00**	Major	1, 2
	Fonterra Limited Kapuni - (N-1) Stage 4	12.91	Kāpuni	$0.00	N/A	$0.00	**$0.00**	**$0.00**	Minor	1, 2
	TOTAL =>	**191.57**	**TOTAL =>**	**$128.10**	**TOTAL =>**	**$40.07**	**$168.17**			

Notes

1 Doesn't include distribution transformer or switchgear costs for Load Sites (details provided in body of report). Estimated between $50k - $350k depending on size.

2 Total costs for this table do not include Methanex or Ballance, and include the (N-1) total for other staged load analysis.

3 (N-1) scenario cost shown

Disclaimer: The Load Site supply investigations and capital cost estimates outlined in this report are preliminary and are only suitable for screening purposes. The capital cost estimates should not be used for final budgeting purposes in order to connect the respective Load Sites. For the larger Load Sites Ergo recommend proceeding with a Concept Design Report (CDR) to improve the accuracy of the respective cost estimate.

Appendix 1 Glossary

CT	Current transformer
DG	Distributed generator
EDB	Electrical Distribution Business
EIPC	Electricity Industry Participation Code
ENA	Electricity Network Association
ESA	Electricity Supply Authority
GXP	Grid exit point substation
kV	Kilovolts
MW	Megawatts
MVArs	Mega volt amps reactive
MVA	Mega volt amps
ONAN	Oil natural air natural (the methods used to cool the windings and body of the transformer)
ONAF	Oil natural air forced (the methods used to cool the windings and body of the transformer)
SCADA	Supervisory control and data acquisition
CST	Carrington St GXP
HWA	Hāwera GXP
HUI	Huirangi GXP
OPK	Ōpunake GXP
SFD	Stratford GXP
WVY	Waverley GXP

Appendix 2 Accuracy of Cost Estimates and Assumptions

The amount of time available and effort expended to prepare a capital cost estimate has a significant bearing on the expected accuracy range. Accordingly the accuracy of capital cost estimates should be based on the amount and quality of information available at the time the estimate is developed. The Association for the Advancement of Cost Engineering (AACE) has developed a framework for the accuracy of cost estimates as a project progresses, which is illustrated below.

Table 57 Cost estimate classification matrix[26]

ESTIMATE CLASS	*Primary Characteristics*	*Secondary Characteristic*		
	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges at an 80% confidence level
Class 5 (Order of Magnitude)	***0% to 2%***	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	**L: -20% to -50%** **H: +30% to +100%**
Class 4 (Preliminary)	***1% to 15%***	Study or Feasibility	Equipment Factored or Parametric Models	**L: -15% to -30%** **H: +20% to +50%**
Class 3 (Early Budget)	***10% to 40%***	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	**L: -10% to -20%** **H: +10% to +30%**
Class 2 (Budget/Control)	***30% to 70%***	Control or Bid / Tender	Detailed Unit Cost With Forced Detailed Take-off	**L: -5% to -15%** **H: +5% to +20%**
Class 1 (Definitive/Construction)	***50% to 100%***	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	**L: -3% to -10%** **H: +3% to +15%**

Assumptions

Ergo is of the view that the capital cost estimates developed in this report are Class 5 and we note the following:

- Costs exclude land and/or land easements.
- Costs exclude planning/consenting.
- It is assumed there is sufficient space/land in switchrooms/switchyards to accommodate the new equipment.
- The estimates are based on the connection of Load Sites and do not consider the connection of multiple Load Sites.

[26] Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries, AACE International Recommended Practice No. 18R-97.