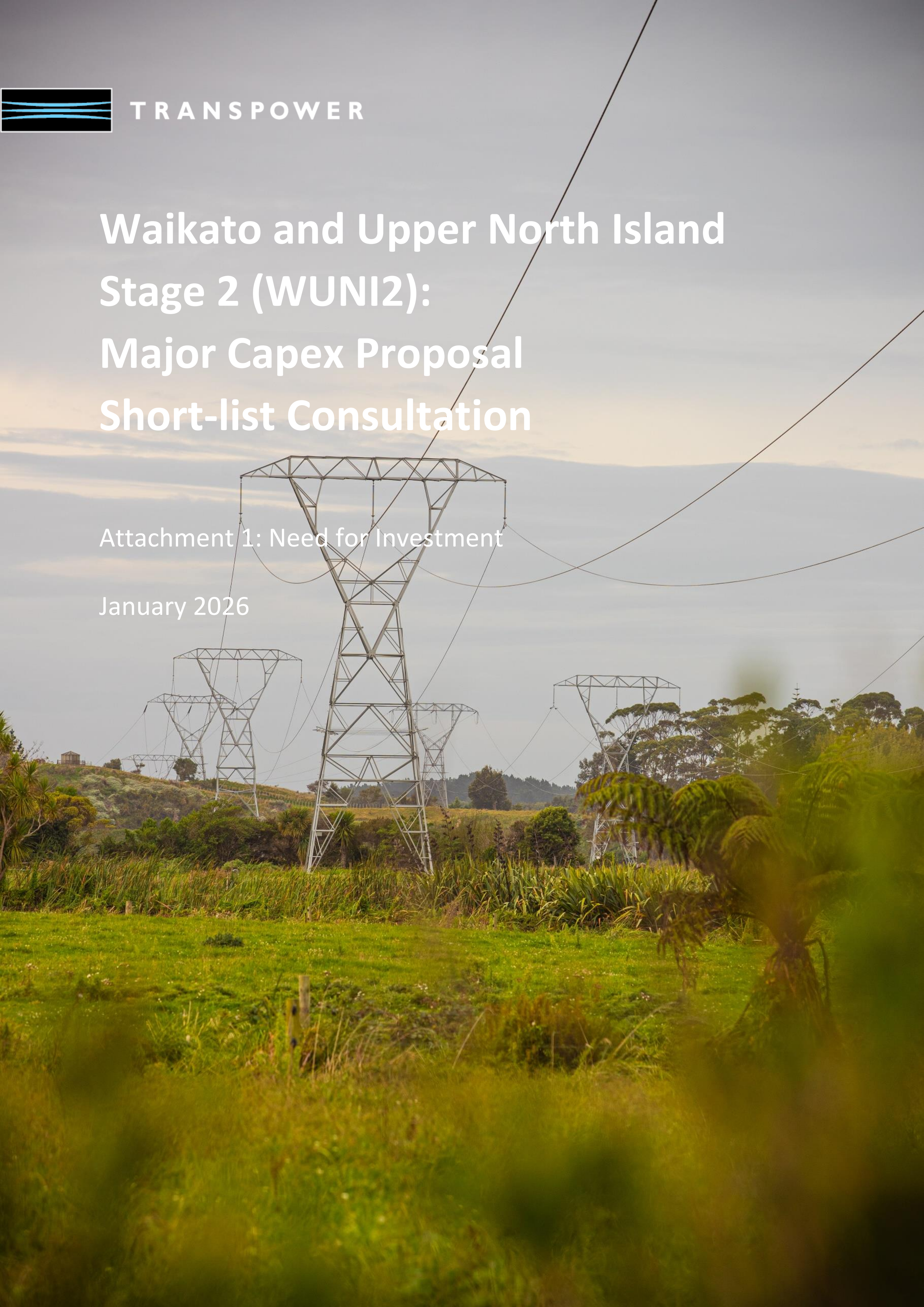


TRANSPOWER

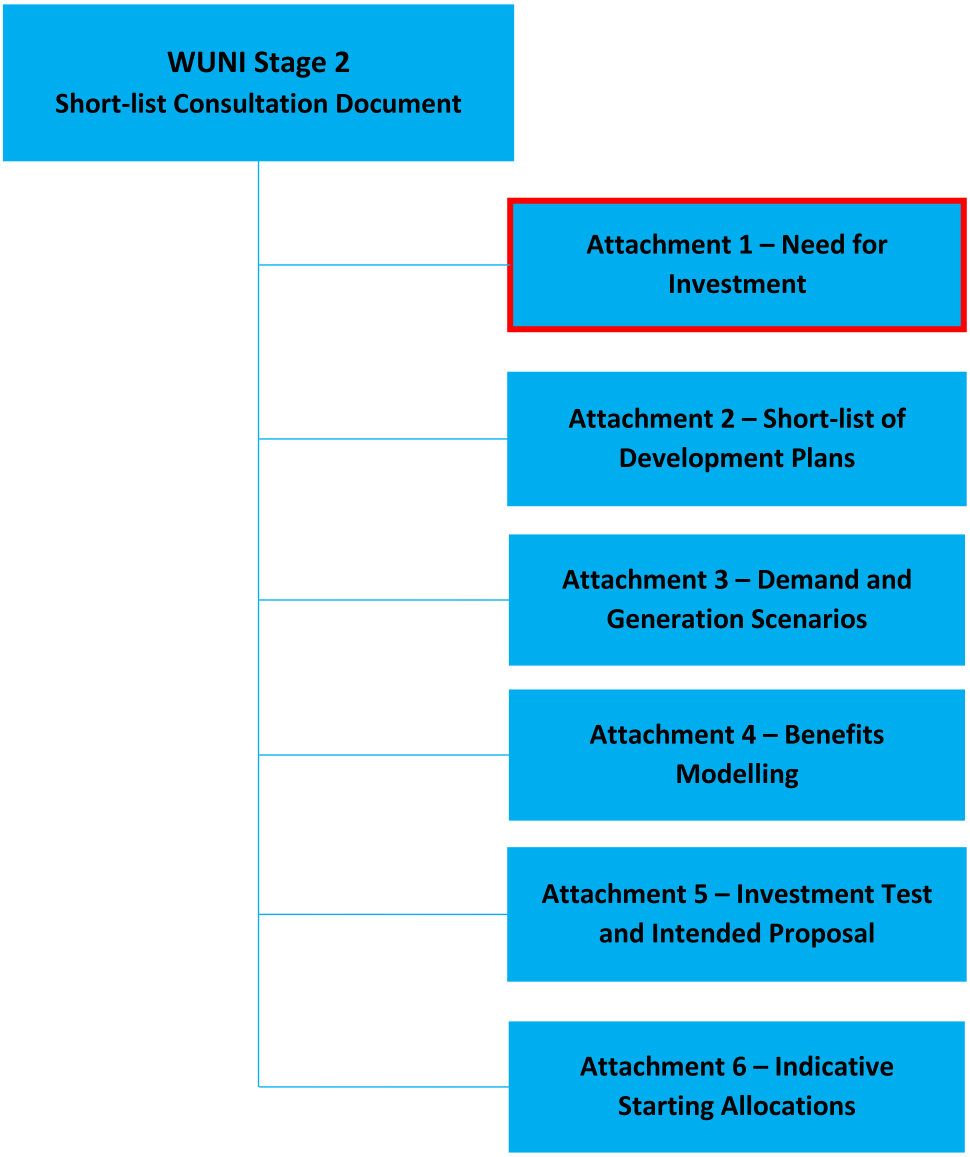
Waikato and Upper North Island Stage 2 (WUNI2): Major Capex Proposal Short-list Consultation

Attachment 1: Need for Investment

January 2026

Purpose

This Attachment forms part of our Waikato and Upper North Island (**WUNI**) Stage 2 short-list consultation. The purpose of this Attachment is to describe the investment need. The need for investment is driven by our assumptions regarding the physical constraints of the transmission system as well as demand and generation in the region.



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1.1 The Existing System

Together, Northland, Auckland and Waikato account for a significant portion of New Zealand's electricity demand. Today, most of this demand is met by electricity generated south of Bombay. Power is transmitted through Waikato and into Auckland via eight high-capacity 220 kV transmission lines originating from Whakamaru and Taranaki.

Historically the region was supplied by a mix of remote hydroelectric and geothermal generation from the central North Island, alongside significant thermal generation at Ōtāhuhu, Southdown and Huntly. However, over the past decade, the decommissioning and capacity reductions of these thermal plants have significantly changed the operation of the power system in the region. These changes created immediate challenges in maintaining voltage stability as they effectively lowered the static and dynamic voltage stability limits. Any further reduction in generation from the Huntly power station will exacerbate this issue.

These challenges are further compounded by continued demand growth – particularly from residential, commercial and increasing electrification of transport. As demand continues to rise, the thermal capacity of the transmission network to import power into the upper North Island from the south comes under increasing pressure and is forecast to result in binding capacity constraints.

Voltage stability remains a recurring concern in the region, requiring ongoing investment to maintain acceptable voltage levels in the face of this continued demand growth. Currently, voltage support is provided by static capacitors at multiple sites across the region. There are shunt reactors at Wairau Road, Pakuranga and Ōtāhuhu and dynamic reactive devices (STATCOMs and SVCs) at Albany, Hamilton, Ōtāhuhu, Penrose and Marsden. These help to maintain voltage stability during outages of circuits supplying Auckland or outages of major generation units near the Auckland region.

Figures 1 and 2 below provide a schematic and geographic overview of the region. Note that the schematic focuses on the transmission corridor between Ōtāhuhu (**OTA**) and Whakamaru (**WKM**) which is subject to this investigation while the geographic overview shows the wider region.

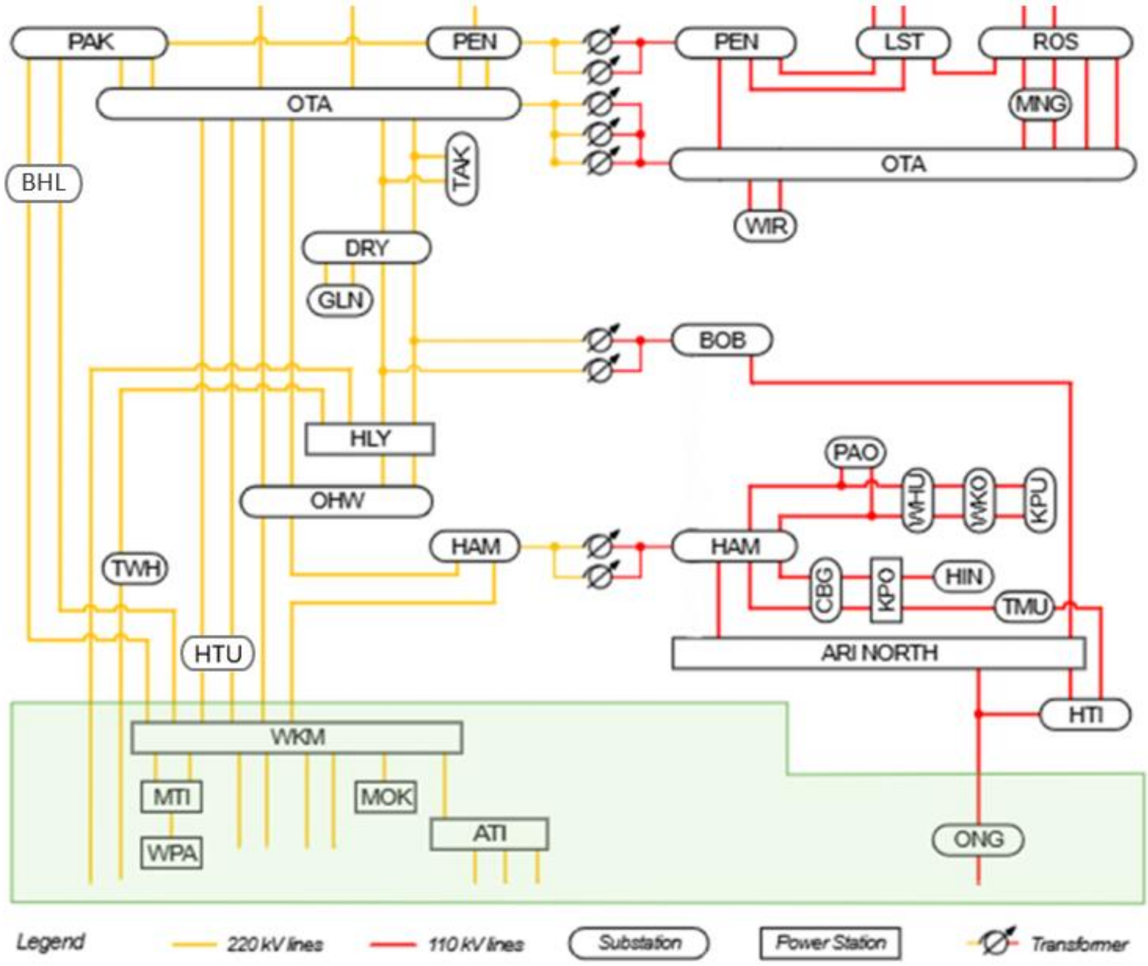

Figure 1: Illustration of the WUNI transmission system (schematic)

Figure 2: Illustration of the WUNI transmission system (geographic)

1.2 Prior Investigations and Investments

We have been closely monitoring the evolving challenges in the WUNI region for several years.

In 2015, we initiated studies to assess the impact of retiring thermal generation on the power system. The immediate issue was managing voltage of the electricity supply during periods of peak demand. Additionally, thermal transmission capacity was identified as an emerging issue in the WUNI region.

To address these issues, we initiated a major capex project (staged) aimed at efficiently managing both voltage and thermal constraints in the WUNI region. This approach aims to accommodate the exit of thermal generation while supporting continued load growth.

In July 2016, we issued our long-list consultation as part of this process,[1] followed by a short-list consultation in June 2019.[2] These consultations explored a broad range of options to identify solutions that address the immediate need for voltage stability while also considering emerging thermal capacity constraints in the WUNI region.

As such, we assessed different long-term development plans to ensure growing demand does not exceed the voltage and thermal n-1 limits in the WUNI region. To manage risk and optimise timing, the investment was split into multiple stages.

The first stage of investments (WUNI Stage 1), approved by the Commerce Commission in September 2020,[3] focused on enhancing voltage stability. Our preferred development plan included installing two STATCOMs at the Ōtāhuhu and Hamilton substations. These Stage 1 investments were successfully completed in 2023 and 2025.[4]

Future investments (potential Stages 2 and 3) were identified during Stage 1 planning as necessary to support ongoing regional demand growth and ensure a reliable, resilient transmission network through 2030 and beyond. The investigation further revealed that, subsequent to the Stage 1 investments, the next transmission upgrade would be required in 2028 (Stage 2), driven by voltage limitations, followed soon after by thermal limitations. This short-list consultation presents detailed analysis confirming the timeline to meet this transmission need.

1.3 Overview of the Need for Investment

1.3.1 Reliability Standards

Our planning studies that support our Transmission Planning Report[5] (**TPR**) regularly assess the needs of the national grid to ensure a reliable power supply across New Zealand. This planning includes maintaining a level of reliability based on prudent demand forecasts.[6]

The transmission lines supplying the WUNI region include parts of the core grid, which is defined in the Electricity Industry Participation Code 2010 (**Code**) as a specific list of transmission assets. The deterministic limb of the Grid Reliability Standards (**GRS**) requires Transpower to maintain at least

1 Transpower, Waikato and Upper North Island Voltage Management long-list consultation, July 2016
2 Transpower, WUNIVM short-list consultation, June 2019
3 Commerce Commission, Decision and reasons on Stage 1 of Transpower's WUNI staged major capex project, September 2020
4 Waikato and Upper North Island (WUNI) Upgrades | Transpower
5 Transpower Transmission Planning Report 2025
6 We use prudent peak demand forecasts in planning studies. This is equivalent to a P90 forecast, in which peak demand has a 90 per cent chance of being less than the prudent forecast. Put another way, we expect actual peak demand to exceed the forecast in just one year in ten.

an N-1 reliability on the core grid.[7] The N-1 standard ensures that the power system can remain stable and continue supplying power even if a single significant unplanned outage occurs in the core grid.

Investments on the core grid are made deterministically to meet the GRS N-1 reliability standard, by investing in the option that maximises expected net electricity market benefit, even when the net benefit is negative. This approach reflects the N-1 reliability standard as a necessary 'safety net' that underpins the core grid's operation, ensuring a secure and reliable electricity supply to New Zealand.

We develop potential investment options to ensure our N-1 capacity limits remain above the prudent peak demand forecast. As new components are commissioned, these limits increase, keeping grid capacity ahead of demand and improving grid reliability.

1.3.2 Need

Demand in the WUNI region has generally increased over recent years. With the ongoing shift towards electrification, this trend is expected to continue. While the Stage 1 investments addressed immediate system needs, continued demand growth in the WUNI region means that the N-1 thermal capacity and voltage stability limits on the transmission system are forecast to be exceeded in the near future. Further investment is therefore needed to meet the deterministic limb of the GRS (the N-1 standard).

Figure 3 shows the regional peak load forecast that we have considered in our analysis. To inform the timing of the investment need, we have used the prudent peak load forecast based on our EDGS Environmental variant. More details of the underlying demand and generation assumptions are provided in Attachment 3. This is consistent with the approach we used in our recent Upper South Island Upgrade Stage 1 Major Capex Proposal.[8]

Figure 3 also shows the relevant transmission limits (voltage stability and thermal capacity). The intersection of the peak load forecast and the initial voltage stability limit highlights the need for transmission upgrades by 2028.

The forecast, originally developed prior to the availability of 2024 actual demand figures, has a base forecast of 2,947 MW, growing with a CAGR of 0.6%.[9] The prudent forecast for 2025, of 3,292 MW, reflects this base forecast, adjusted by several factors as discussed in Attachment 3, section 2.

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7 The WUNI network is part of the core grid as defined in Schedule 12.3 of Part 12 of the Code (220 kV Otahuhu-Whakamaru, 220 kV Otahuhu-Huntly, 220 kV Huntly-Hamilton). The deterministic limb of the GRS is set out in clause 2(2)(b) of Schedule 12.2 of the Code (the N-1 reliability standard for the core grid) and provides that with all assets that are reasonably expected to be in service, the power system would remain in a satisfactory state during and following the tripping of a significant transmission asset in the core grid.

8 Transpower, USI Upgrade Stage 1 MCP - Overview, August 2025

9 CAGR: Compound Annual Growth Rate, representing the mean annualized growth rate for compounding values over a given time period.

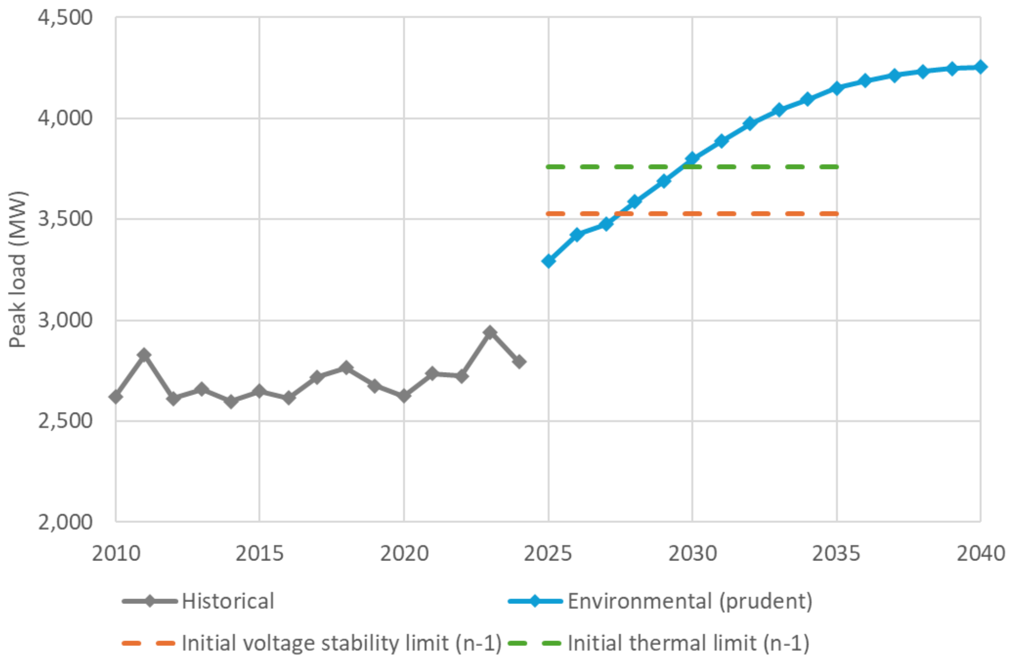

Figure 3: WUNI peak load (prudent forecast) and initial transmission limits

Thermal Capacity

Thermal constraints refer to the constraint on the amount of power that can be transmitted so that the conductors (and other equipment) do not overheat.

Thermal capacity limits or constraints can be addressed either by constructing new transmission lines or enhancing the capacity of existing ones. Capacity upgrades can be achieved through targeted thermal up-rates, which allow the lines to operate at higher temperatures, thereby increasing their capacity to carry more power. Another option is replacing existing conductors with higher-capacity alternatives to alleviate constraints.

Installing new overhead lines or underground cables offers the most significant increase in thermal capacity. However, this approach comes at a higher cost and requires early planning due lengthy consenting and construction timelines.

Voltage Stability

Voltage stability refers to the ability of the system to maintain acceptable voltage levels across all buses under normal conditions and following a disturbance such as generator trips, circuit faults or outages.

Voltage instability can result in a progressive and uncontrollable rise or decline in voltage. Voltage rise can damage transmission assets and connected equipment, while voltage collapse can result in widespread blackouts, requiring a 'black start' of the grid. While such an event could be confined to the WUNI region, it is more likely to impact the entire North Island.

A power system requires both long-term (static) voltage stability, and short-term (dynamic) stability in the event of a fault on the system. Static reactive devices such as capacitor banks provide binary on/off response and are generally used to support static voltage stability. Dynamic reactive devices such as SVCs, STATCOMs and synchronous condensers provide fast continuous response and are generally used to support dynamic voltage stability.

Voltage stability is typically a challenge when the generation source is remote from the load. This is the case for the WUNI region, with the large Auckland load connected to generation in the central North Island, some 200 km away.

With this reliance on remote generation, the region already experiences high static voltage levels during light-load periods and requires significant voltage support during high-load periods.

The System Operator's real-time tools provide alerts to impending voltage stability and thermal overload risks. Without investment to meet the need, the System Operator may resort to demand management in the WUNI region – limiting electricity supply in the region to maintain voltage stability and thermal limits.

As peak load continues to grow, without significant new generation and/or investment into the transmission grid, the extent of demand management is likely to increase.

1.3.3 Need Date

Recent and forecast load growth, emerging thermal capacity constraints and the need to maintain voltage stability highlight the importance of Stage 2 investments in the WUNI region. Without these investments, transmission limits will be exceeded, increasing reliance on demand management and threatening supply reliability in the WUNI region.

Our investigations indicate that voltage stability constraints in the WUNI region may begin to bind by winter 2028. Meanwhile, the thermal capacity of the transmission lines into the region is forecast to be exceeded by winter 2030.

Table 1 details the specific limits and the years in which they are forecast to be exceeded, based on our prudent Environmental forecast.

For this analysis, we assume one Huntly Rankine unit (250 MW) remains available during peak periods. In all scenarios, constraint dates occur earlier in winter than in summer. Therefore, only winter results are presented in Table 1. We also assume that the combined-cycle gas turbine (unit 5, 403 MW), which is in some cases the relevant N-1 contingency, and the open-cycle gas turbine (unit 6, 50 MW) are available in the analysed period.

Changing the Huntly generation assumption (i.e., reliably available units during winter peaks) could change the transmission limits and resulting need dates by several years; for example, with the addition of a second Rankine unit in the analysis. We will reassess the assumptions and implications based on feedback from this consultation.

Note that the generation assumptions in this part of the analysis focus on the availability during winter peaks to inform the need date of the required investments. For the modelling of the market benefits, we consider the period after the investments are commissioned and we model the plant dispatch over a year (see Attachment 3 for the demand and generation scenarios, and Attachment 4 for the modelling approach).

Table 1: Voltage stability and thermal limits, resulting need date

Constraint Type	WUNI load limit	Contingency[10]	Notes	Year of load exceeding limit
Static Voltage Stability Limit (N-1)	3,527 MW	Huntly Unit 5	-	2028
Dynamic Voltage Stability Limit (N-1)	3,746 MW	Huntly Unit 5	TUV: SWN 220 kV is constraint, 111 MW Group1 motors tripping[11]	2030
Thermal Capacity Limit (N-1)	3,761 MW	HAM-WKM-1	WKM-OTA (HTU-OTA) is constraint	2030

Q1. Are there any additional factors we should consider regarding our identified investment need in the Waikato and Upper North Island region?

Q2. Do you agree with our approach that the prudent Environmental forecast is the appropriate forecast to inform the investment need?

Q3. Do you agree with our assumptions on availability and type of generation at Huntly during winter peak periods? Are there other relevant generation projects we should consider in our analysis?

Q4. There is now a grid-connected battery energy storage system (BESS) in the WUNI region, with more projects committed. Based on very limited data available we are proposing an assumption that average BESS output is 15% of nominal capacity during peak load periods. Do you consider this to be appropriately conservative?

10 A contingency is the loss or failure of a part of the power system (e.g., a transmission line or a generator). This is also called an "unplanned outage".

11 Transient under voltage limit (**TUV**): a transient under voltage recovery issue occurs when a dip in the voltage, due to a fault, takes too long to recover to acceptable levels.

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