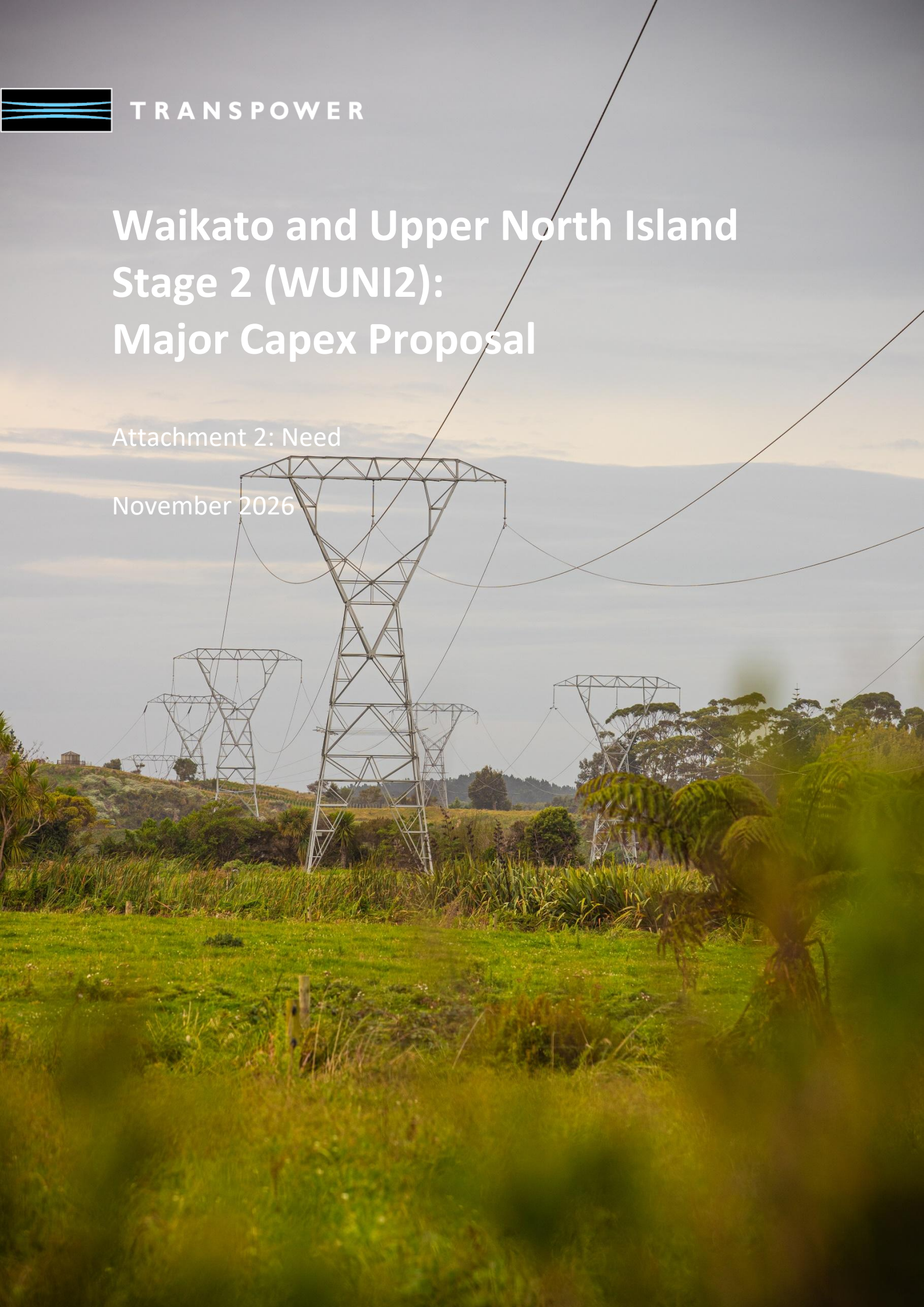


TRANSPOWER

Waikato and Upper North Island Stage 2 (WUNI2): Major Capex Proposal

Attachment 2: Need

November 2026

Purpose

This Attachment forms part of our Waikato and Upper North Island (WUNI) Stage 2 Major Capex Proposal (MCP). The purpose of this Attachment is to describe the investment need for Stage 2 of the WUNI Upgrade major capex project (Stage 2). The need for investment is driven by our assumptions regarding the physical constraints of the transmission system, the asset condition, as well as demand and generation in the region.

Contents

Purpose 2

1 The need for investment 4

1.1 The existing system 4
1.2 Prior investigations and investments 6
1.3 Overview of the need for investment 7

1 The need for investment

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 at Huntly and further south. 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 the residential and commercial sectors 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 also shunt reactors at Wairau Road, Pakuranga and Ōtāhuhu and dynamic reactive devices (STATCOMs and SVCs[1]) at Albany, Hamilton, Ōtāhuhu, Penrose and Marsden. These help to maintain voltage stability on the system from light system load to peak system load, and during outages of circuits supplying Auckland or outages of major generation units near the Auckland region.

Figures 1 and 2 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 the subject of this investigation, while the geographic overview shows the wider region.

[1] Static synchronous compensator (STATCOM) and static var compensator (SVC).

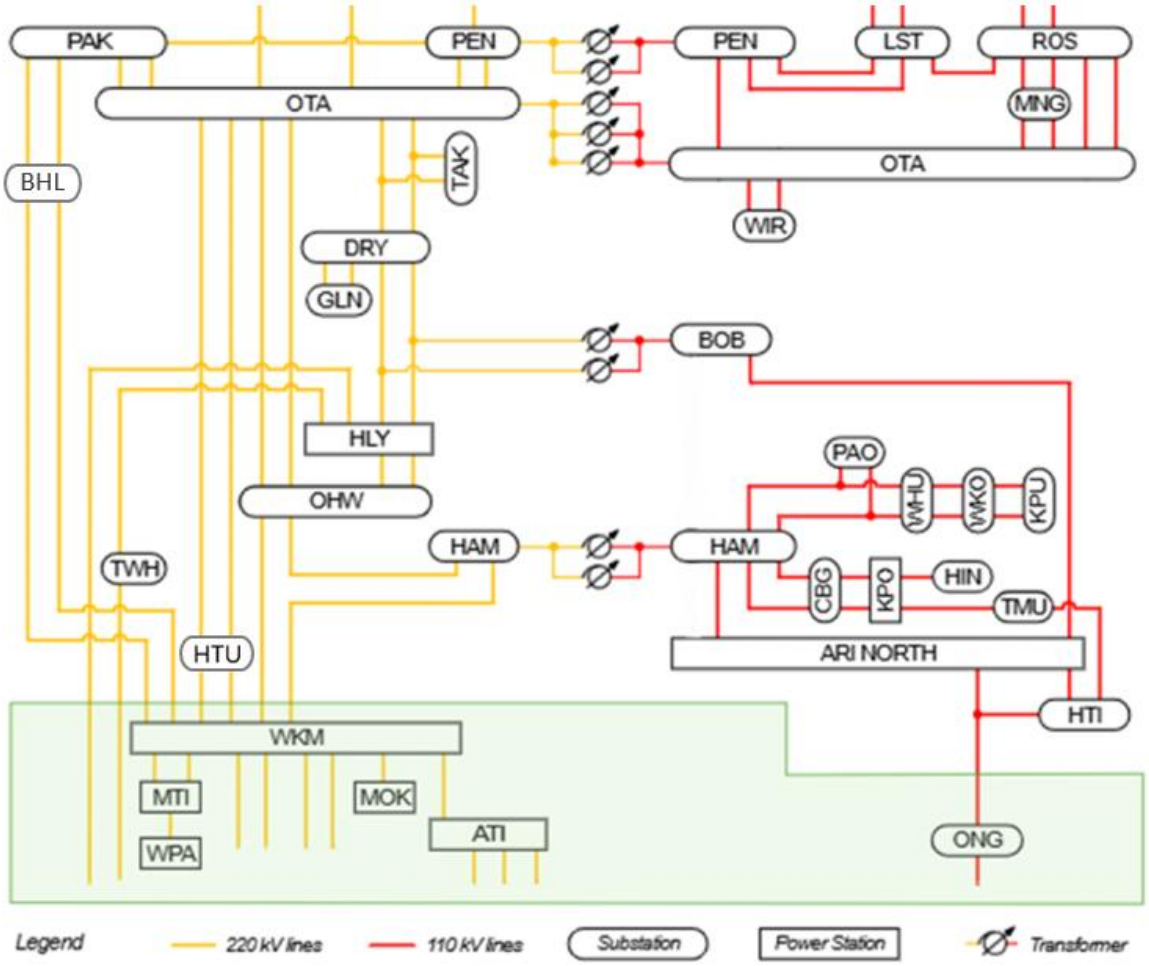


Figure 1: Illustration of the WUNI transmission system (schematic)



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 on the electricity network 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 staged major capex project aimed at efficiently managing both voltage and thermal constraints in the WUNI region (the WUNI Upgrade major capex project). 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,[2] followed by a short list consultation in June 2019.[3] These consultations explored a broad range of options to identify solutions that addressed 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 (Stage 1 of the WUNI Upgrade major capex project (**Stage 1**)), approved by the Commerce Commission in September 2020,[4] focused on enhancing voltage stability. Our Stage 1 proposed investments included installing two STATCOMs at the Ōtāhuhu and Hamilton substations. These Stage 1 investments were successfully completed in 2023 and 2025.[5]

Future investments (potential Stage 2 and future stages of the WUNI Upgrade major capex project) 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 MCP presents detailed analysis to establish updated timing for the proposed Stage 2 investments to meet this investment need.

1.3 Overview of the need for investment

1.3.1 Reliability standards

Our planning studies that support our Transmission Planning Report[6] (**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.[7] In the most recent 2026 TPR, the voltage management and thermal capacity issues in the WUNI region are presented as part of the North Island grid backbone.[8]

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

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2 Transpower, Waikato and Upper North Island Voltage Management long-list consultation, July 2016
3 Transpower, WUNIVM short-list consultation, June 2019
4 Commerce Commission, Decision and reasons on Stage 1 of Transpower's WUNI staged major capex project, September 2020
5 Transpower, Waikato and Upper North Island (WUNI) Upgrades
6 Transpower, Transmission Planning
7 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 prudent forecast in just one year in ten.
8 Transpower, 2026 Transmission Planning Report, section 6.5.1

an N-1 reliability standard on the core grid.[9] The N-1 reliability 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 are made deterministically to meet the N-1 reliability standard in the GRS, 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 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 increased over recent years. With the ongoing shift towards electrification, this trend is expected to continue and to accelerate. 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 early 2030s. Further investment is therefore needed to meet the deterministic limb of the GRS (the N-1 reliability standard).

Figure 3 shows the regional peak load forecast that we have considered in our analysis. Our planning utilises variants of the Electricity Demand and Generation Scenarios (**EDGS**) published by the Ministry of Business, Innovation and Employment (**MBIE**).[10] To inform the timing of the investment need, we have used the prudent (P90) peak load forecast based on our latest EDGS Environmental variant (blue line in chart). Compared to the forecast presented in the short list consultation (orange line in chart, labelled as SLC), the starting point of the forecast in 2026 is lower, reflecting the most recent historical peaks and an improved methodology, while the annual growth rate is similar in the initial years. The forecast update involved the adoption of MBIE's EDGS of July 2024 at a national level, and incorporated inputs from electricity distribution businesses regarding local demand growth and step loads that we received and consolidated in early 2026. In addition, we had detailed discussions with Vector to compare with its forecast for the Auckland region. More details of the underlying demand and generation assumptions are provided in Attachment 3.

Figure 3 also shows the initial transmission limits (i.e., before any grid upgrades in the region). Compared to the short list consultation, the limit is now approximately 170 MW higher. This reflects updates to our generation assumptions in the region. Based on consultation feedback – particularly from Genesis – we now assume:

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[9] 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.

[10] MBIE, Electricity Demand and Generation Scenarios (EDGS)

- All three Huntly Rankine units (240 MW each) and the peaking unit 6 (50 MW) are available during peak load periods until 2035.
- As a prudent assumption and reflecting the uncertain gas availability, we do not consider the combined-cycle gas turbine (unit 5, 400 MW) in the power system modelling.
- In terms of grid-scale battery energy storage systems (**BESS**), we assume 635 MW operational by 2029 (235 MW currently operational at Rotohiko, Ruakākā and Glenbrook, 400 MW under construction or committed at Huntly and Glenbrook) with an expected contribution during peak load of 15% of the nominal capacity.

The resulting impact of these changes on the need date for the first required grid upgrade can be derived from intersection of the peak load forecast and the initial load limit. Note that the final short-listed development plans presented in Attachment 4 are still based on the short list consultation forecast but reflect the updated load limits.

Only for the proposed Stage 2 investments, we have incorporated the updated peak load forecast out to 2035 (by lowering it) to determine the final need dates. The initial need date in the short list consultation was 2028 (highlighted by point (1) in the chart). The increased load limit shifts this need date to 2030 (point (2)), which forms the basis of the development plans. Finally, applying the lower peak load forecast shifts the need date further to 2034 (point (3)), which is used to set the timings of the proposed Stage 2 investments.

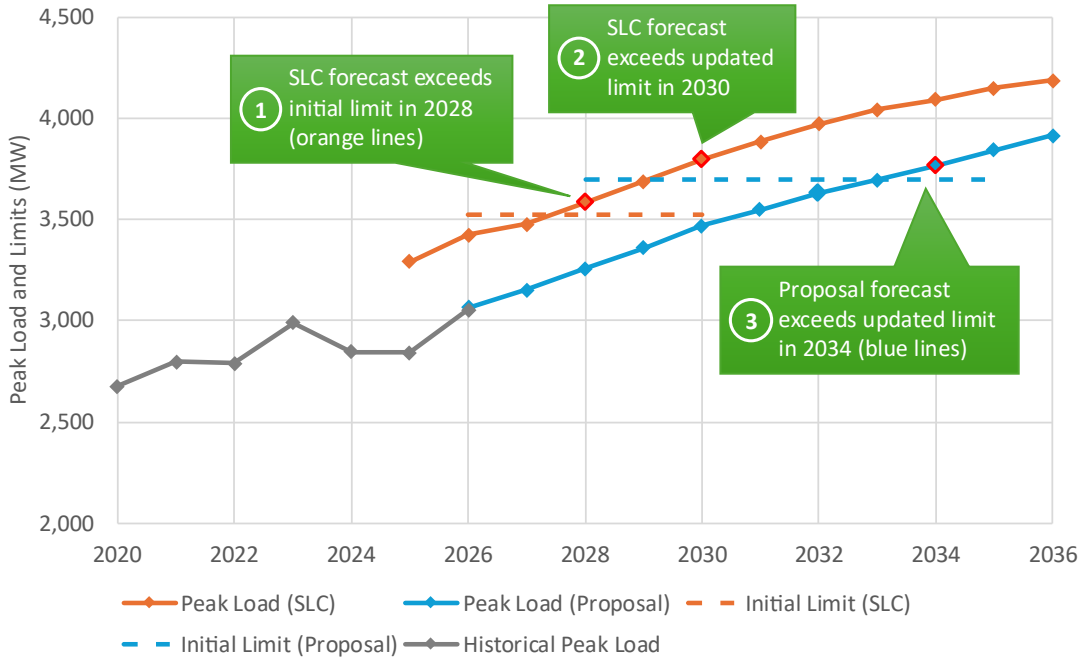


Figure 3: WUNI winter peak load (prudent forecast) and initial load limits

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 like a duplex configuration (reconductoring) 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 to 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 disturbances 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 a voltage collapse could cause widespread loss of supply and may have consequences beyond the WUNI region.

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 a discrete or stepped 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 supplied from 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 the proposed Stage 2 investments in the WUNI region. Without these investments, load limits will be exceeded, increasing reliance on demand management and threatening security of supply in the WUNI region.

Our investigations indicate that voltage stability constraints in the WUNI region may begin to bind by winter 2034. Meanwhile, the thermal capacity of the transmission lines into the region is forecast to be exceeded by winter 2036. Table 1 details the specific limits and the years in which they are forecast to be exceeded, based on the updated prudent Environmental forecast. In all

scenarios, constraint dates occur earlier in winter than in summer. Therefore, only winter results are presented in Table 1.

Note that the generation assumptions in this part of the analysis focus on the expected 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 proposed Stage 2 investments are commissioned (i.e., the calculation period as per the Capex IM) and we model the plant dispatch over a year (see Attachment 3 for the demand and generation scenarios, and Attachment 7 for the modelling approach).

A related consideration is the planned reconductoring works on the Ōtāhuhu–Whakamaru A and B lines. These lines are approaching the need for condition-based reconductoring (i.e., replacing the conductors due to corrosion). The condition assessment reports conclude that the southern section (between Ohinewai and Whakamaru) will require reconductoring during the 2030s. Updated conductor surveys over the next few years will provide greater confidence in the replacement need dates for the HTU–WKM sections.

Table 1: Voltage stability and thermal limits, condition-based need dates

Constraint type	WUNI load limit	Contingency[11]	Notes	Expected year of load exceeding limit
Static voltage stability limit (N-1)	3,696 MW	HAM–WKM-1	-	2034
Dynamic voltage stability limit (N-1)	3,922 MW	HAM–WKM-1	TUV: SWN 220 kV is the binding constraint, 109 MW Group1 motors tripping[12]	2037
Thermal capacity limit (N-1)	3,869 MW	HAM–WKM-1	OTA–WKM 1 and 2 (OTA–HTU section) is the binding constraint	2036
Condition-based reconductoring	-	-	OTA–WKM 1 and 2 (OHW–HTU section)	2034-35
Condition-based reconductoring	-	-	OTA–WKM 1 and 2 (HTU–WKM section)	2037-40

[11] 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". The plant listed in this column is the specific contingency assumed for the analysis.

[12] 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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