

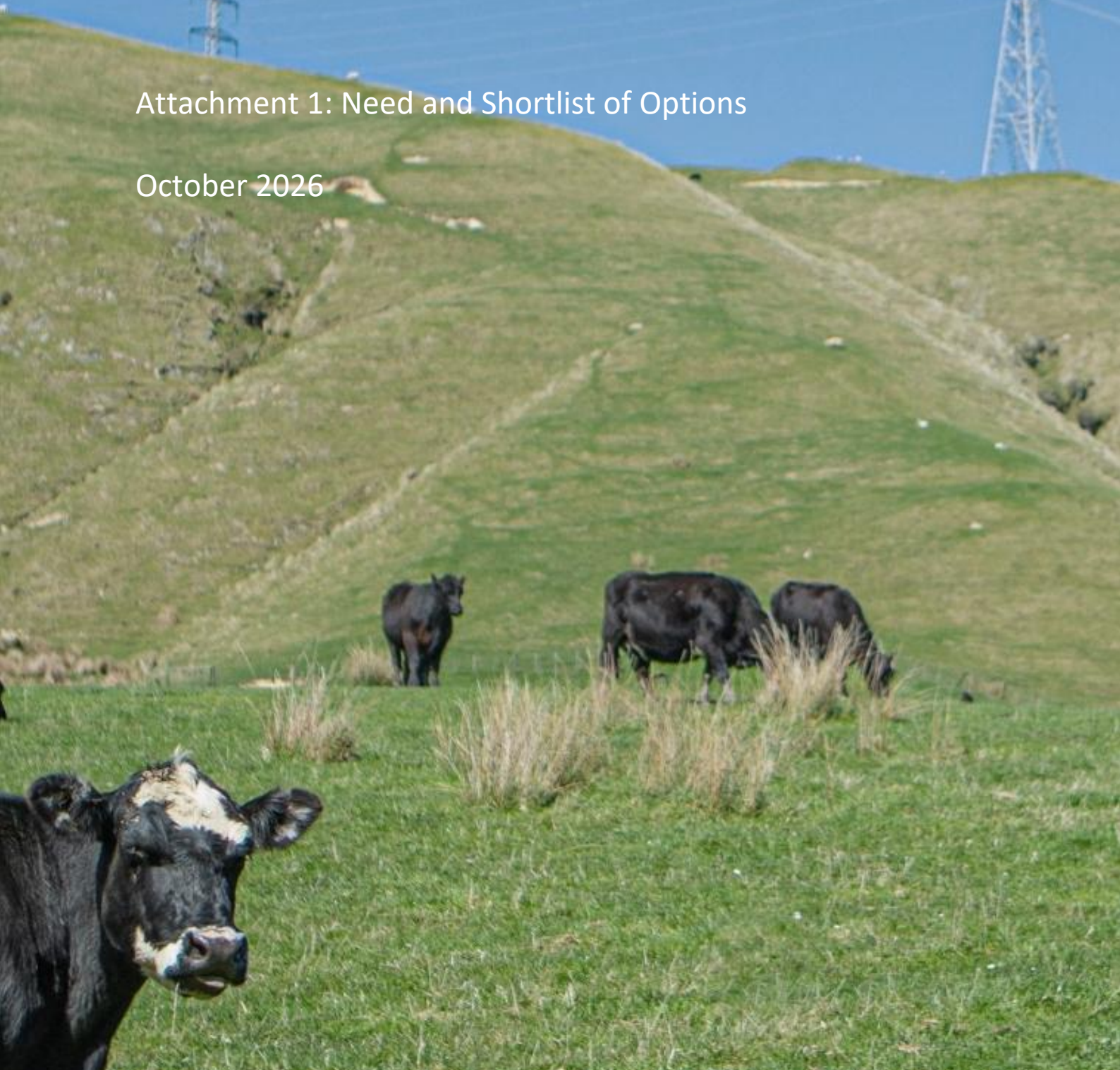


TRANSPOWER

Waikato Regional Interconnection Capacity (WRIC): Major Capex Proposal Shortlist Consultation

Attachment 1: Need and Shortlist of Options

October 2026



Contents

1	Background.....	3
2	Need.....	4
2.1	Interconnection capacity.....	4
2.2	Other 110 kV network upgrade needs	6
3	Longlist of options.....	7
3.1	Longlist consultation submissions	7
3.2	Longlist to shortlist screening.....	8
4	Shortlisted options.....	15
4.1	Option 1: Counterfactual.....	15
4.2	Option 2: Hamilton East	15
4.3	Option 3: Ōtorohanga	16
4.4	Suitability of the shortlist.....	17
4.5	Modelled projects.....	18

1 Background

The Waikato region comprises two distinct transmission networks at 110 kV and 220 kV. This Major Capex Proposal (MCP) focuses on the Waikato region's 110 kV transmission network, which connects most of the area's load to the grid backbone via two 220/110 kV transformers at Hamilton substation. Together, these transformers provide a nominal installed capacity of 420 MVA and an N-1 capacity of 248/259 MVA (summer/winter).

The 110 kV network has relatively limited interconnection capacity compared with the region's load. However, the network provides access to generation from the Arapuni and Karapiro hydro stations which play an important role in meeting regional demand. The region also hosts a growing portfolio of solar, wind, and battery storage developments that are expected to support future demand growth driven by electrification and industrial expansion.

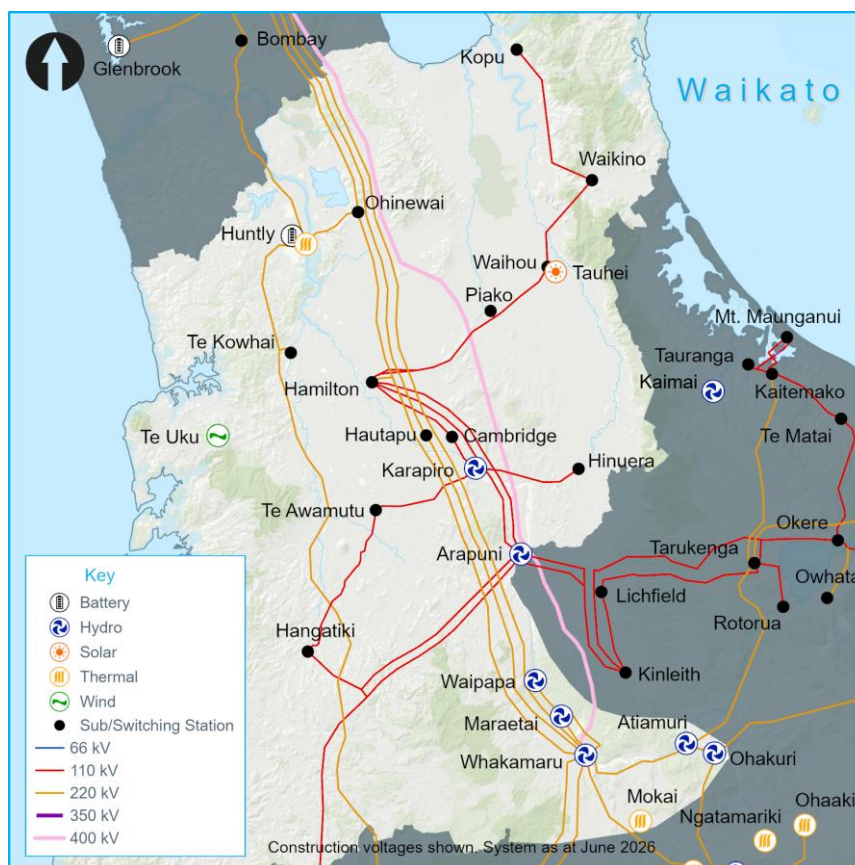


Figure 1: Regional schematic of the Waikato region's transmission network

Investment is needed because, from 2030, forecast peak net demand on the Waikato 110 kV network is expected to exceed the protection limit of the Hamilton 220/110 kV transformers, even after allowing for current and committed generation projects. This means that, if one transformer were unavailable, the remaining network might not be able to reliably supply forecast demand. This

shortlist consultation seeks feedback on the most economically efficient solution to address this need.

2 Need

2.1 Interconnection capacity

Investment in the Waikato region is required to increase interconnection capacity between the 220 kV grid backbone and the 110 kV regional network. This interconnection forms part of the core grid, which the Grid Reliability Standards (GRS) require to be planned so that, following the unexpected loss of any single transmission asset, the power system moves to a satisfactory state.

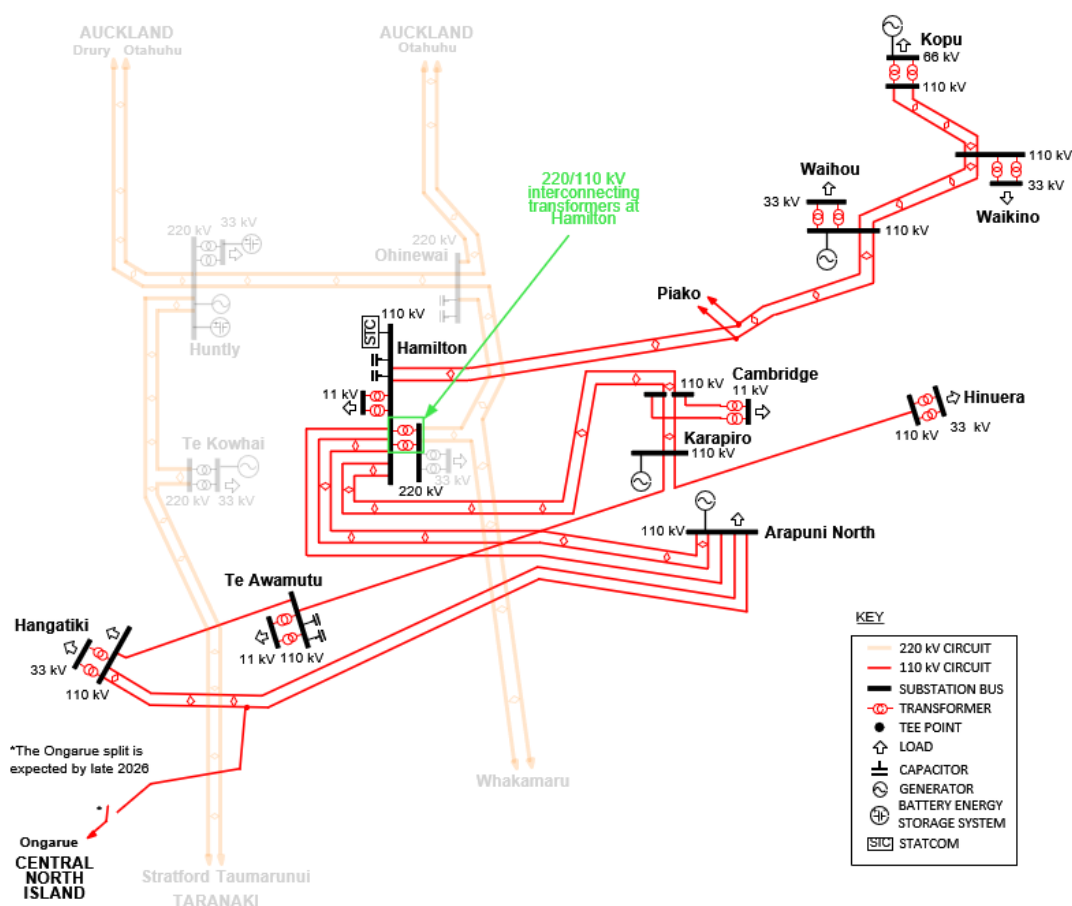


Figure 2: Schematic of the Waikato 110 kV network

During periods of high demand on the Waikato 110 kV network, the N-1 capacity of the Hamilton 220/110 kV transformers can be exceeded. Under these conditions, the loss of one transformer may overload the remaining transformer, increasing the risk of supply interruptions.

The available N-1 capacity is influenced by the level of generation operating within the Waikato 110 kV region. For this MCP, we have assumed that a minimum combined contribution of 150 MW from Arapuni and Karapiro hydro generation is available during relevant regional peak demand periods¹.

Solar generation in the region continues to grow, with Lodestone Energy's Pāmu Rā ki Whitianga Solar Farm (23.75 MW) and Harmony Energy's Tauhei Solar Farms (150 MW) both commissioned since publication of our longlist consultation. These solar farms are included in our assessment, however their contribution during winter evening peak demand periods is assumed to be zero as these peaks typically occur after sunset.

As demand continues to grow, the magnitude and duration of N-1 capacity exceedances increase. With 150 MW of generation, peak demand is forecast to exceed the N-1 capacity of the Hamilton transformers by winter 2027, and the N-1 protection limit by winter 2030. We therefore identify winter 2030 as the date by which additional investment is required, prior to which we can manage operationally. By 2033, peak demand is forecast to exceed the continuous rating of the transformers when Waikato 110 kV generation is below 60 MW, further increasing the amount of load at risk.

Table 1: Existing Hamilton 220/110 kV transformer ratings

	Rating (MVA)		
	Continuous	Summer (post-contingency)	Winter (post-contingency)
T6 (220/110 kV)	220	268	280
T9 (220/110 kV)	200	248	259

In addition to N-1 reliability concerns, the Waikato region also faces N-security challenges during planned maintenance outages on either Hamilton 220/110 kV transformer or their connecting 220 kV circuits (220 kV Hamilton–Ōhinewai circuit and 220 kV Hamilton–Whakamaru circuit).

During these outages, several GXP's in the Waikato region are placed on N-security. To manage the associated voltage-stability risk, the Waikato 110 kV network may need to be split at multiple locations so that any post-contingency voltage collapse is contained and does not propagate across the wider regional network. This maintenance outage exposure has been considered alongside the core interconnection capacity need when assessing options to increase capacity and improve security into the Waikato 110 kV network.

¹ During the longlist consultation, Mercury Energy advised that 150 MW of output from the Arapuni and Karapiro hydro stations is an appropriate assumption to calculate net demand during peak load periods. [Mercury submission - Waikato Regional Interconnection Capacity Project.pdf](#)

2.2 Other 110 kV network upgrade needs

The Waikato region's 110 kV network has relatively limited capacity compared with the scale of regional load and generation. Over the coming decades, a range of network upgrades will be required to address asset condition, thermal capacity, and voltage stability constraints.

Some of the investment options considered in this MCP may also defer, reduce, or eliminate the need for wider network upgrades across the region. These projects, detailed in Table 4, have been included in the economic assessment. Where a WRIC investment option defers or avoids the need for a future network project, the resulting reduction in expenditure is captured as a benefit.

Q1. Do you agree that investment is needed to increase interconnection capacity into the Waikato 110 kV network?

Q2. Do you agree with the timing of the identified need?

Q3. Are you aware of any customer, generation, demand response, battery storage, or network developments that could materially affect the timing of the need, or defer, reduce, or avoid the need for investment?

3 Longlist of options

In 2024, we consulted on a longlist of investment options to address the forecast interconnection capacity need in the Waikato region.²

3.1 Longlist consultation submissions

The submissions received on the 2024 longlist consultation generally supported the identified need for investment. Submitters emphasised the importance of resilience and security, uncertainty in future demand and generation, and the potential for an investment to address wider constraints within the Waikato 110 kV network. Transpower's responses to the matters raised are set out in the published *Summary of submissions*³. The principal matters relevant to the options assessed in this document are summarised below.

Counterfactual: Submitters generally agreed with the proposed Investment Test parameters but identified uncertainties that could affect the timing and cost of no investment, including regional demand growth, new generation and battery developments, future bidirectional power flows, and the reliability and outage duration of existing assets. We have addressed this feedback by updating the demand and generation scenarios, incorporating relevant customer and generation developments, and modelling the regional projects expected to be required if no additional interconnection investment is undertaken.

Hamilton East and Ōtorohanga: Electricity distribution businesses supported further consideration of options that establish an additional 220/110 kV connection, noting their potential to improve resilience and address constraints beyond the Hamilton interconnection capacity need. Submitters asked that the assessment recognise benefits relating to the Valley Spur, South Waikato constraints, maintenance outages, and future distribution-network development. These matters have been considered in the updated power system studies and through the modelled project benefits attributed to each option. The resulting assessment distinguishes the options according to the location and scale of the constraints each option addresses or defers.

Other transmission and non-transmission options: Powerco, The Lines Company, and Waipā Networks proposed additional transmission, grid operation, or distribution-led alternatives. Other submitters identified potential generation, battery energy storage, demand response, dynamic line ratings, and other non-transmission solutions. We considered these suggestions alongside the original longlist. Where relevant, they are represented in Table 2, reflected in the updated demand, generation, and network assumptions, or will be explored further through the non-transmission solutions process. Options not retained for detailed assessment either did not reliably meet the core interconnection need, were less economic than options providing similar or greater benefits, or presented material technical, delivery, property, consenting, or timing risks.

² [Waikato Regional Interconnection Capacity Project](#)

³ [Waikato Regional Interconnection Capacity Project - Summary of submissions.pdf](#)

3.2 Longlist to shortlist screening

Following consultation feedback, the longlist of options was evaluated against Transpower's standard MCP screening criteria to identify a shortlist of feasible investment options.

The screening criteria are set out below. Table 2 summarises the evaluation of the longlisted options against these criteria.

Fit for purpose

- The design will meet current and forecast energy demand
- The extent to which the option resolves the relevant issue

Technically feasible

- Complexity of solution
- Reliability, availability and maintainability of the solution
- Fit with long term strategy for the grid
- Ideally the design can be staged and/or has flexibility to preserve options for future changes

Practical to implement

- It must be possible to implement the solution by the required dates
- Implementation risks, including the likelihood of obtaining any necessary outages and potential delays due to property, social and environmental issues, are manageable

Good electricity industry practice

- Ensures safety
- Consistent with good international practice
- Accounts for relative size, duty, age and technological status
- Technology risks

Provides system security

- Improves resilience of the power system
- Has benefits for system operation (e.g., controllability)
- Improves voltage stability (e.g., has modulation features or improves system stability)

Indicative cost

- Whether an option will clearly be more expensive than another option with similar or greater benefits.

Table 2: Longlisted options for WRIC

Option	Option type	Option sub-type	Details	Comments	Shortlisted?
Non-transmission solutions					
A1	Generation	New generation	Transpower could enter a NTS with a new generator connected within the Waikato 110 kV network.	Additional generation connected to the 110 kV network may help reduce peak transmission loading and defer transmission investment. The Waikato network already relies on generation from the Arapuni and Karapiro hydro stations to support regional capacity, and further operational agreements or technologies such as battery energy storage systems (BESS) may provide additional firm capacity during peak demand periods.	✓
A2	Generation	Existing generation	Transpower could enter a NTS with an existing generator connected within the Waikato 110 kV network.	The Waikato 110 kV network already relies on significant generation from Karapiro and Arapuni hydro to offset demand above the current interconnection capacity limit. Transpower understands that only limited additional firm capacity can be provided by existing generators.	✗
A3	Load control	Demand response	Transpower could enter a NTS with a party to procure suitable demand-side services to defer transmission investments if offered.	Demand response to reduce load within the 110 kV network may defer the need for transmission investment. There is no significant demand response currently in operation.	✓
A4	Generation	Battery storage	Transpower could enter an NTS with a party/parties to provide battery support in the Waikato region.	A battery energy storage system (BESS) connected to the Waikato 110 kV network could be used to reduce loading on the transmission network at peak times. This may defer the need for transmission investment.	✓

Option	Option type	Option sub-type	Details	Comments	Shortlisted?
A5	Generation	Generation redispatch	Automatic scheme to detect overloading of Hamilton interconnectors and automatically and concurrently bring on Arapuni/Karapiro generation to remove the overload.	This option is feasible if (additional) generation from Arapuni/Karapiro is available. It helps to quickly remove the overload, minimising the risk of a transformer tripping. However, Transpower understands that only limited additional firm capacity can be provided by these existing generators.	✗
Transmission solutions: Upgrade existing assets – Maintain, upgrade, enhance, modify					
B1	Enhance	Existing 220/110 kV transformers	Replace existing 220/110 kV transformers with higher capacity units.	The existing Hamilton 220/110 kV transformers (200 MVA and 220 MVA) are less than 30 years old, and their sizes are already large. This is a technically feasible option, but the 110 kV bus capacity and circuit cable upgrades would be disruptive, with long shutdowns required and Waikato on N-security for weeks to months.	✗
B2	Replace existing / enhance	Supply transformers	Take Hamilton 11 kV load off the 110 kV network, by installing two new 220/11 kV transformers and removing the 110/11 kV transformers.	This option would not fully resolve the Hamilton interconnection capacity issue and may introduce a new constraint on generation export when Waikato generation is high and/or as solar generation connects.	✗
B3	Enhance	Special Protection Scheme (SPS)	Install transformer overload protection schemes (TOPS) on the two Hamilton 220/110 kV transformers to increase the available capacity pre-contingency using both	Does not meet the regulatory requirements for core grid assets.	✗

Option	Option type	Option sub-type	Details	Comments	Shortlisted?
			transformers and shed load if one fails.		
B4	Enhance	System reconfiguration	Apply system splits to remove GXPs being supplied from the Hamilton existing 220/110 kV transformers.	Our analysis has not identified any opportunities to reconfigure the grid which would address the issue.	✗
C1	New assets	New 220/110 kV transformer	Install a third 220/110 kV 250 MVA transformer at Hamilton.	While this option resolves the N-1 capacity issue, it maintains reliance on Hamilton as a single point of vulnerability and does not increase transmission security into the Waikato region during maintenance outages. An additional 220 kV switchyard bay may also be required. While this option was initially shortlisted, further technical assessment identified material constructability and delivery risks. Key concerns included congestion at Hamilton substation, design constraints, challenging cable routes, high-risk installation methods, and significant programme uncertainty associated with demolition and civil works. These issues were expected to introduce material deliverability, cost, and programme risks. As a result, the option was removed from the shortlist following this further technical assessment.	✗
C2(a)	New assets	New 220/110 kV connection	Construct a new 220/110 kV connection near the 220 kV and 110 kV crossing to the east of Hamilton to increase capacity into the 110 kV network.	This option is similar to adding a third 220/110 kV transformer (Option C1) at Hamilton except this option provides additional resilience and diversity to the Waikato 110 kV network and increases transmission security into the Waikato region during maintenance outages. It also avoids the constructability and delivery risks associated with Option C1.	✓

Option	Option type	Option sub-type	Details	Comments	Shortlisted?
				This option also defers voltage issues on the Valley Spur ⁴ and increases interconnection capacity more than a new connection near Ōtorohanga [Option C2(b)].	
C2(b)	New assets	New 220/110 kV connection	Construct a new 220/110 kV connection near the 220 kV and 110 kV crossing near Ōtorohanga to increase capacity into the 110 kV network.	This option is similar to adding a third 220/110 kV transformer (Option C1) at Hamilton except this option provides additional resilience and diversity to the Waikato 110 kV network and increases transmission security into the Waikato region during maintenance outages. It also avoids the constructability and delivery risks associated with Option C1. This option also defers 110 kV transmission constraints in the South Waikato ⁵ but does not increase interconnection capacity as much as a new connection east of Hamilton [Option C2(a)] and may introduce new constraints on generation export.	✓
C3	New assets	New 220/33/11 kV connection	Construct a new 220/33/11 kV grid exit point (GXP) to offload Hangatiki and Te Awamutu, shifting 110 kV load to the 220 kV lines.	This option would require significant load to be transferred to the new GXP to resolve the Hamilton interconnection capacity issue. Shifting loads to the new GXP would resolve/defer supply transformer capacity issues that are forecast to arise at Hangatiki and Te Awamutu and defer the same 110 kV transmission constraints in the South Waikato as option C2(b). This option would be driven by a need to offload the Te Awamutu and Hangatiki GXPs due to increasing peak demands, and would need to align with the Hamilton interconnection capacity need.	✗

⁴ The 110 kV loads in the Valley spur encompass the Piako, Waihou, Waikino, and Kopu grid exit points.

⁵ The 110 kV loads in the South Waikato encompass the Cambridge, Hinuera, Te Awamutu, Hangatiki, and Arapuni grid exit points.

Option	Option type	Option sub-type	Details	Comments	Shortlisted?
				This option would also require significantly higher investments in both transmission and sub-transmission networks to enable the load transfers required, resulting in significantly higher costs compared to options C2(a) and C2(b).	
C4	New assets	Reactive support	Install static reactive support (capacitors) in the Waikato area	Investing in capacitor banks is not an effective and viable solution to this thermal constraint.	×
C5	New assets	New 220 kV transmission line and new 220/110 kV transformer	Convert Hangatiki or Te Awamutu 110 kV substation to include a 220/110 kV connection, supplied off the existing 220 kV Huntly–Stratford circuit. A new 220 kV transmission line is needed.	This option is similar to adding a third 220/110 kV transformer at Hamilton (Option C1) except this option also adds resilience through diversifying the supply as well as increasing transmission security into the Waikato region during maintenance outages. This option also defers the same 110 kV transmission constraints in the South Waikato as option C2(b). This option requires the construction of a new 220 kV transmission line from the existing 220 kV Huntly–Stratford circuit, incurring significantly higher costs. Gaining the necessary consents for a new 220 kV line route could be challenging and is unlikely to be achievable in the timeframe.	×
C6	New assets	New 220/110 kV connection with new 110 kV transmission line	Construct a 220/110 kV connection near an existing 220 kV circuit. Construct a new 110 kV transmission line to connect the new substation to Hangatiki or Te Awamutu.	This option is similar to constructing a new 220/110 kV connection near the 220 kV and 110 kV crossing near Ōtorohanga [Option C2(b)], except this option also requires construction of a new 110 kV transmission line from the substation, to Hangatiki or Te Awamutu, resulting in significantly higher costs. There may also be challenges with acquiring a new site for the 220/110 kV station and with the consenting of the 110 kV line route.	×

Option	Option type	Option sub-type	Details	Comments	Shortlisted?
C7	New assets	New line(s) between Bombay and Kopu	Construct a new 60–70 km line that would support the Valley Spur.	This option does not resolve the Hamilton interconnection capacity issue and would have a significantly higher delivery cost (estimated at over \$200m). There are also significant property risks with a new 110 kV transmission line of that length.	✗

4 Shortlisted options

This section describes the defined shortlisted options and their associated costs, timeframes, and key features.

Table 3: Shortlisted assessment cases

Assessment case	Description	Indicative construction duration	Cost
Option 1: Counterfactual	No investment is undertaken.	-	-
Option 2: Hamilton East (C2(a))	Establish a new 220/110 kV connection to the east of Hamilton. The option includes two new switchyards, a 250 MVA 220/110 kV transformer and associated assets.	40 weeks	\$47.9m
Option 3: Ōtorohanga (C2(b))	Establish a new 220/110 kV connection near Ōtorohanga. The option includes two new switchyards, a 250 MVA 220/110 kV transformer and associated assets.	40 weeks	\$46.0m

4.1 Option 1: Counterfactual

We assess a do-nothing option in which no additional investment is made to increase interconnection capacity into the Waikato 110 kV network. Under this scenario, the capacity and N-1 limit of the existing two Hamilton 220/110 kV transformers remain unchanged, and the risk of unserved energy increases as demand grows. It is used as the economic comparison case for assessing the costs and benefits of the investment options and is not presented as a practical long-term solution because it does not maintain compliance with the Grid Reliability Standards (GRS).

4.2 Option 2: Hamilton East

The Hamilton East option involves constructing a new 220/110 kV connection at a greenfield site to the east of Hamilton, near the crossing of the 220 kV Ōhinewai–Whakamaru and 110 kV Hamilton–Piako–Waihou circuits. The option includes a new 220/110 kV transformer, 220 and 110kV switchyards, and connections to the nearby transmission network, including bonding the Hamilton–Hamilton East 110 kV circuits.

The investment would increase interconnection capacity into the Waikato 110 kV network, diversify supply away from the existing Hamilton substation, and improve transmission security during maintenance outages. Compared with installing a third 220/110 kV transformer at Hamilton, the option provides greater resilience and future network flexibility, while also alleviating voltage issues on the Valley Spur.

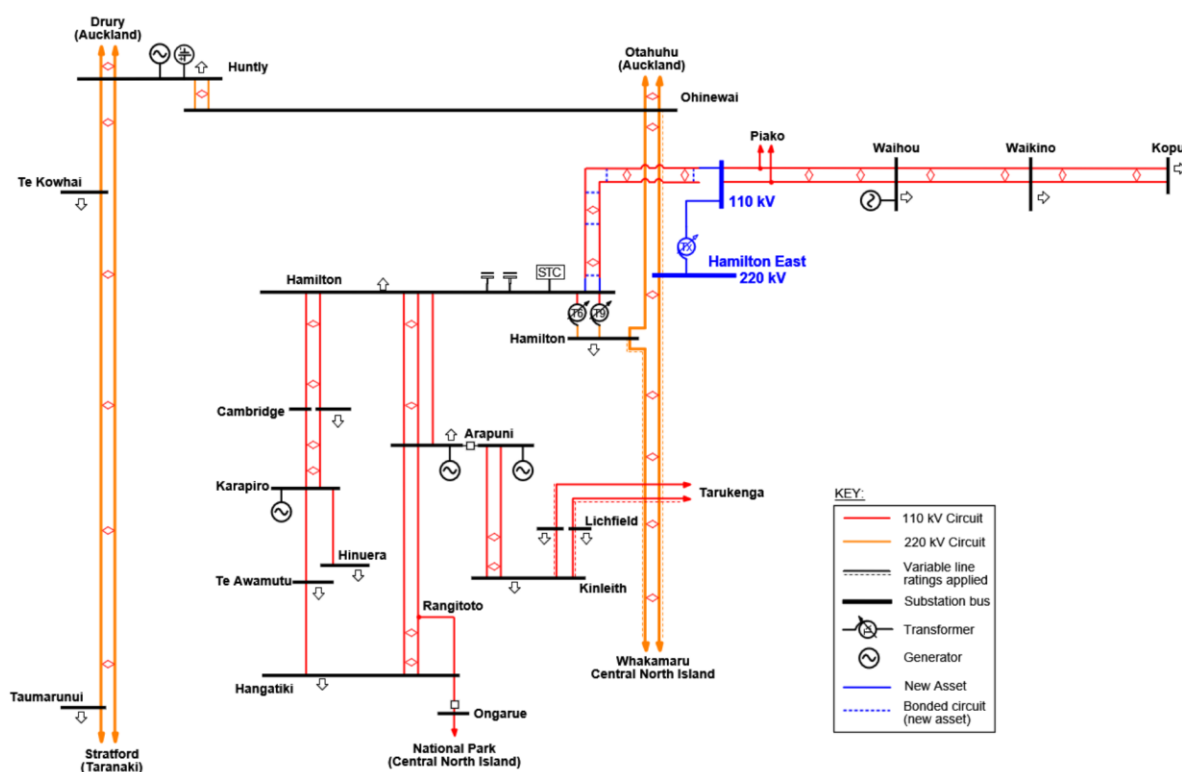


Figure 3: Schematic of shortlist Option 2 (Hamilton East)

4.3 Option 3: Ōtorohanga

The Ōtorohanga option involves establishing a new 220/110 kV connection at a greenfield site near Ōtorohanga, with loop-in, loop-out connections to the 220 kV Huntly–Stratford A circuit and the 110 kV Hangatiki–Te Awamutu circuit. This investment would increase interconnection capacity into the Waikato 110 kV network, diversify supply away from Hamilton, and improve transmission security during maintenance and contingency events. The option also relieves loading on key 110 kV corridors and defers the need for several future transmission line upgrades in the South Waikato.

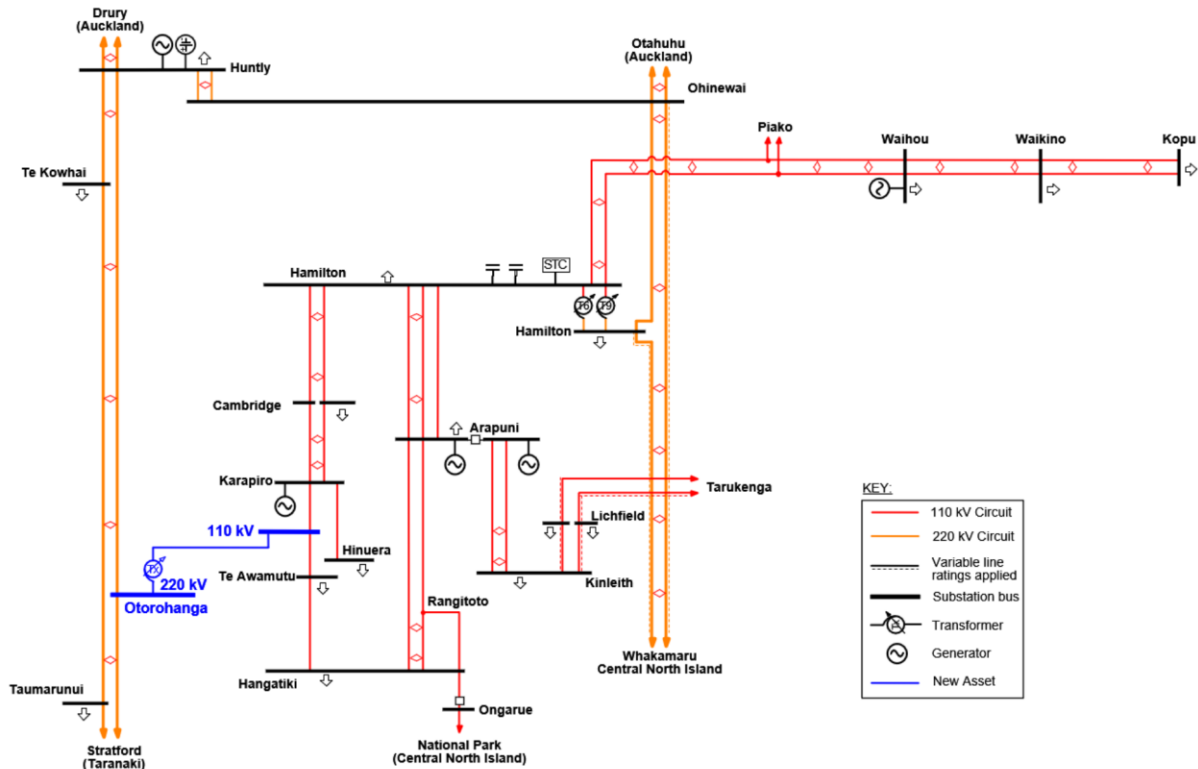


Figure 4: Schematic of shortlist Option 3 (Ōtorohanga)

4.4 Suitability of the shortlist

The investment need requires additional firm capacity to support the Waikato 110 kV network. This could be provided by a transmission investment or by sufficiently firm generation, battery storage, demand response, or another non-transmission solution. As shown in Table 2, new generation, demand response, and battery storage remain shortlisted solution categories. We will invite proposals through the non-transmission solutions process and assess any credible and sufficiently defined proposals alongside the transmission investment options.

A new 220/110 kV connection is an appropriate transmission technology because it directly addresses the investment need, can meet the Grid Reliability Standards, and improves regional resilience and security during maintenance outages. A third transformer at Hamilton (Option C1) was initially shortlisted but was removed following further assessment of its significant constructability and delivery risks and its continued reliance on Hamilton as a single point of vulnerability. Hamilton East and Ōtorohanga therefore form an appropriately focused set of transmission investment options: both are practicable, while their different locations provide sufficiently distinct wider network, resilience, and future flexibility benefits for economic comparison. As shown in Table 3, the defined shortlisted assessment cases comprise Option 1, the counterfactual used as the economic comparison case, and the two transmission investment options: Option 2, Hamilton East, and Option 3, Ōtorohanga.

4.5 Modelled projects

Modelled projects are future 110 kV network upgrades that are expected to be required in the counterfactual, where no additional interconnection capacity investment is undertaken. The indicative need dates and costs of these projects are provided in the table below. An investment option may defer, reduce, or eliminate the need for some of these upgrades. The resulting reduction in future network expenditure is reflected in the economic assessment as a benefit of the investment option.

Table 4: Modelled projects

Project	Cost (2026 \$m)	Need date ⁶	Need / Description of project
Hamilton–Waihou New Line	51.6	2034	Valley Spur static voltage stability limit (N-1). 43.1 km of GoatAC @ 80°C.
Hamilton–Morrinsville–Waihou Special Protection Scheme	0.8	2030	Thermal capacity limit of the Hamilton–Morrinsville circuit (N-1). We assume the installation of a Hamilton–Morrinsville–Waihou special protection scheme to manage post-contingency thermal and low voltage issues.
Cambridge Special Protection Scheme	0.8	2040	Thermal capacity limit of the Hamilton–Cambridge circuits (N-1). Modify Cambridge special protection scheme to monitor loading of Hamilton–Cambridge circuits.
Tactical thermal upgrade of Karapiro–Te Awamutu line	6.8	2048	Thermal capacity limit of the Karapiro–Te Awamutu circuit (N-1). Tactical thermal upgrade of the Karapiro–Te Awamutu line from Wolf-GZ 50°C to 75°C.
Reconductoring of the Arapuni–Hangatiki line and Arapuni–Rangitoto tee line Tactical thermal upgrade of parts of the Arapuni–Hangatiki line and Hangatiki–Rangitoto tee line	20.2	2053	Thermal capacity limit of the Arapuni–Hangatiki and Arapuni–Rangitoto tee–Hangatiki circuits (N-1). Reconductoring of the Arapuni–Hangatiki line and Arapuni–Rangitoto tee line to Wolf-AC 75°C. Tactical thermal upgrade of parts of the Arapuni–Hangatiki line and Hangatiki–Rangitoto tee line to 75°C.

Q4. Do you agree with the shortlisted options and the reasons for why other options have not been progressed?

⁶ Need dates presented are those expected for the counterfactual option, under the Environmental scenario demand and generation assumptions.

