BOMBAY OTAHUHU REGIONAL MAJOR CAPEX PROJECT

MAJOR CAPEX PROPOSAL

Transpower New Zealand Limited

May 2020

Keeping the energy flowing

TRANSPOWER

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Glossary

Capex IM	Transpower Capital Expenditure Input Methodology Determination, New Zealand Commerce Commission[1].
Code	Electricity Industry Participation Code 2010.
Connection Asset	A grid asset that connects a customer to the interconnected transmission network.
Connection Charge	The sum of the annual asset, maintenance, operating and (injection for generation customers) cost components for a connection asset over that pricing year. The charge recovers part of Transpower's AC revenue.
Exempt Major Capex	The amount of the major capex allowance (MCA) to which the major capex incentive rate does not apply.
EDGS	Electricity Demand and Generation Scenarios.
GEIP	Good electricity industry practice.
GIP	Grid injection point.
Grid Reliability Standards	The Grid Reliability Standards (GRS) are a set of standards against which the reliability performance of the existing grid (or future developments to it) can be assessed.
GXP	Grid exit point.
Interconnection Charge	Recovers the remainder of Transpower's AC revenue and is based on a customer's contribution to Regional Coincident Peak Demand (RCPD).
Investment Test	The Capex Input defines the 'Investment Test' (IT), being the detailed economic assessment required for Major Capex Projects.
Long-list consultation	Transpower's consultation document entitled Bombay to Otahuhu Regional Study Investigation Long List Consultation December 2018.
Major Capex Incentive Rate	Major Capex Incentive Rate means 15% or an alternative rate specified by the Commission in respect of an approved major capex project.
MBIE	Ministry of Business, Innovation and Employment.
MCA	Major Capex Allowance, as defined by the Capex IM, being the maximum amount Transpower can recover from customers to deliver the grid outputs in relation to this project
MCP	Major Capex Proposal, as defined by the Capex IM.
MW	Megawatt, one million watts, being the power conveyed by a current of one ampère through the difference of potential of one volt.
MWh	Megawatt hour of electrical energy.
N-1	A security standard that ensures with all facilities in service Transpower's transmission system remains in a satisfactory state following a single fault (e.g. a circuit outage).
P50	Expected peak demand forecast. P50 is the 50th percentile of the peak demand forecast probability distribution.

[1] See https://comcom.govt.nz/regulated-industries/input-methodologies/transpower-ims

	Also, P50 means the estimated aggregate project costs where the probability of the actual project cost being lower than that estimated is 50%
Present Value	Future costs discounted to a present value using a discount rate specified in the CapexIM.
Prudent forecast	Prudent peak demand forecast. P90 is the 90th percentile of our peak demand forecast for the first seven years, then grows at the same rate as the expected for all remaining years in the analysis period.
RFI	Request for information.
RFP	Request for proposal.
Short-list consultation	Transpower's consultation document entitled Bombay to Otahuhu Regional Study Investigation Short-list Consultation December 2019.
SDDP	Stochastic dual dynamic programming – a market dispatch model used to determine the optimal dispatch of hydro, thermal and other renewable generation.
SRMC	Short run marginal cost
TPM	Transmission Pricing Methodology, defined in Schedule 12.4 of the Code.
Transpower	Transpower New Zealand Limited, owner and operator of New Zealand's high-voltage electricity network (the national grid).

Executive summary

The purpose of this document

This Major Capex Proposal (MCP) seeks approval to recover the costs of undertaking investment to maintain a reliable electricity supply in the Bombay-Otahuhu region of the upper North Island.

Proposal at a glance	
What:	Maintain a reliable electricity supply to the Bombay-Otahuhu region by: • Procuring, installing and commissioning two 150 MVA 220/110kV transformers at Transpower's Bombay substation. • Procuring, installing and commissioning a connection for these transformers to the 220kV Otahuhu-Huntly 1 and 2 circuits • Undertaking preparatory works, including additional investigation, consultation and design work, for reconductoring the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line[2].
When:	We are planning to fully commission these works by 30 June 2023.
How much [3]:	Major Capex Allowance: $36.0 million[4].
Incentive elements:	Major Capex Incentive Rate: 15% Exempt Major Capex: none
Approval expiry date:	31 December 2028[5]

[2] We will apply for an amendment to an approved major capex project output under clause 3.3.6(1)(c) of the Capex IM, for installation of a higher capacity conductor on the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line, once the investigation is complete and we can estimate a P50 cost with more accuracy.

[3] The major capex allowance is in nominal New Zealand dollars, excluding GST.

[4] Approximately $10.8 million of the proposed major capex allowance has already been approved by the Commerce Commission as base capex in RCP3. To ensure Transpower does not over-recover its capital expenditure associated with this major project, any RCP3 revenues coming from the already approved base capex will wash-up and be returned through prices in RCP4.

[5] We have proposed an approval expiry date of 31 December 2028, which is after the commissioning date assumption of 30 June 2023. We have proposed this extra period to allow for any delays in procurement and consenting. If this happens it will be efficient to have a reasonable window during which we will not have to re-apply for investment approval.

The Proposed Investment is to install two new 220/110kV transformers at our Bombay substation and connect these to the Otahuhu-Huntly A transmission line plus undertake preparatory work for reconductoring the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line . At a later stage, we will apply for a grid output amendment, to amend the scope of this MCP to include reconductoring the Bombay-Otahuhu A transmission line between Otahuhu and Wiri with a higher capacity conductor to support further demand growth and address asset condition issues. Once both the Proposed Investment and reconductoring work are commissioned the 19 km Bombay-Wiri section of the Bombay Otahuhu A line will be dismantled and at a later time, the 176 km of 110kV transmission lines south of Bombay as far as Hamilton.

Figure 1 below illustrates the proposed future transmission network configuration if the Proposed Investment is approved and once the project is complete. The assets affected are circled in blue.

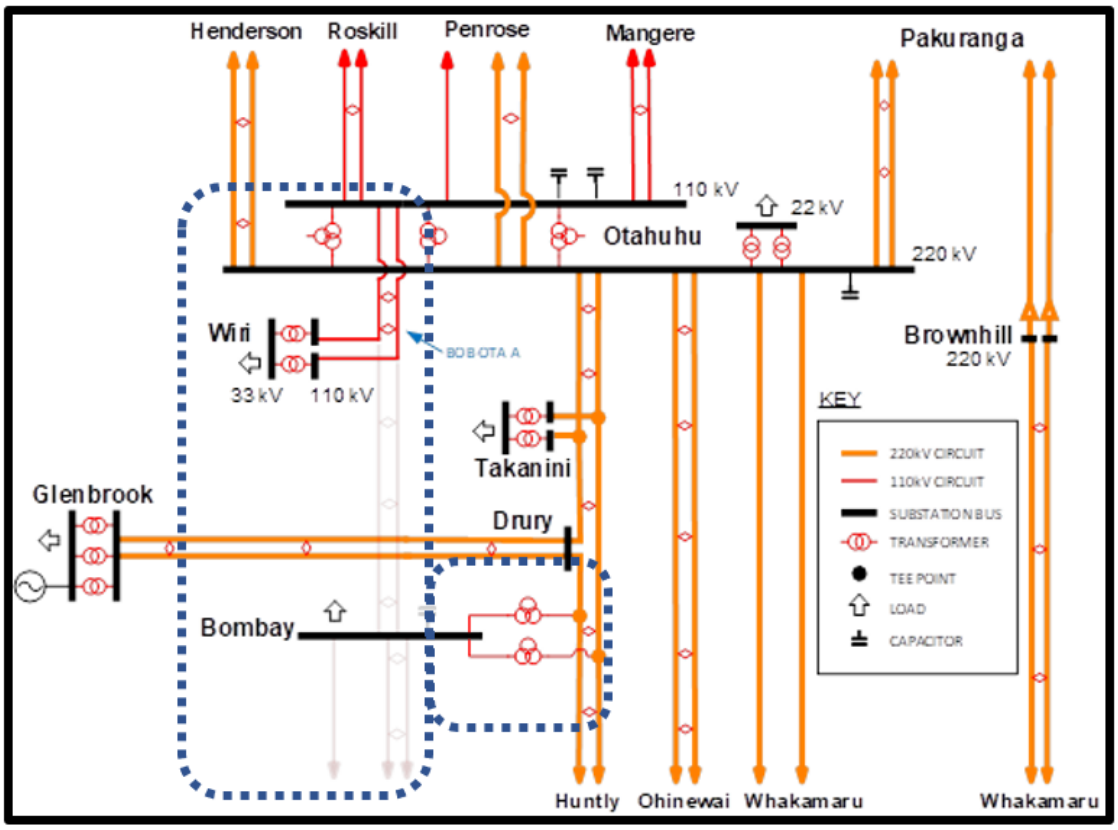

Figure 1: Single line diagram showing the proposed future configuration of the grid in the Bombay-Otahuhu region

The need for investment

The Proposed Investment is driven by the need to maintain a reliable electricity supply in the Bombay-Otahuhu region. There are two drivers: demand-driven, due to the electricity demand growth forecast in the region, and condition-driven, due to asset condition on our 110kV network in the region.

We have considered these issues simultaneously as there are synergies between them which enable a more beneficial solution overall compared to addressing the issues individually.

The COVID-19 pandemic is expected to suppress demand growth in the short term, but not the long term. The condition-driven need is not affected by COVID-19.

Option assessment

There are a variety of issues to be addressed in meeting the investment need.

Our approach first identified a long-list of components that, in different combinations, resolve the need. As well as considering potential non-transmission solutions, possibilities included new transformers, reconductoring existing transmission lines, new transmission lines, as well as dismantling existing transmission lines.

The long-list of components were reduced to a short-list using our short-listing criteria. The short-list of components were then used to compile a long-list of investment options, representing different development plans for the Bombay-Otahuhu region. We subsequently reduced the long-list of investment options to a short-list, to which the Investment Test has been applied.

Table 1 shows the key characteristics of the short-list of investment options we have applied the Investment Test to in this MCP.

These investment options include components (i.e. maintain and/or dismantle existing lines) which are not part of either this MCP or the intended grid output amendment. They are included in the investment options as they are relevant to assessing the costs and benefits of each option, however the costs of these components will be funded separately (not from the Major Capex Allowances for the Proposed Investment) – see Section 3.2.4.

Table 1 - Short-list of investment options - key characteristics and capacity increase

Short-list option	Key option characteristic	Location	Capacity increase compared to Base Case	Indicative length of overhead [1] lines dismantled
Option 1 **Base Case**	Reconductor OTA-WIR like-for-like Reconductor BOB-WIR like-for-like	Wiri Bombay	- -	0 km
Option 2	Reconductor OTA-WIR like-for-like New BOB 220kV connection	Wiri Bombay	- 35 MW	174 km
Option 3	Reconductor OTA-WIR like-for-like New DRY 220kV connection Reconductor BOB-DRY larger conductor	Wiri Bombay	- 25 MW	166 km
Option 4	Reconductor OTA-WIR larger conductor Reconductor BOB-WIR like-for-like	Wiri Bombay	50 MW 20 MW	0 km
Option 5	Reconductor OTA-WIR larger conductor New BOB 220kV connection	Wiri Bombay	65 MW 35 MW	174 km
Option 6	Reconductor OTA-WIR larger conductor New DRY 220kV connection Reconductor BOB-DRY larger conductor	Wiri Bombay	65 MW 25 MW	166 km
Option 7	Reconductor OTA-WIR larger conductor New BOB 220kV connection Reconductor BOB-WIR like-for-like	Wiri Bombay	110 MW 75 MW	149 km

[1] Overhead line length only and does not include underground cable sections

To assess net-benefits for each short-list option we have estimated the following quantifiable costs and benefits.

- Capital cost of developments at Wiri and Bombay
- Refurbishment costs for the 110kV lines south of Bombay
- Operating and maintenance costs
- Dismantling costs, where existing lines are dismantled
- Unserved energy costs, assessed where special protection schemes are used
- Overall dispatch cost differences (configuration of the grid differs between options)

In addition, we have assessed the following unquantifiable benefits

- Capacity benefits
- Operational benefits
- Community benefits.

Table 2 shows our combined quantified and unquantified assessment of the short-list options, used to identify our preferred option. Note that the net benefit is shown as $ million in present value terms.

Table 2: Quantitative and Qualitative ranking of options used to identify our preferred option

	Option 1 Base Case	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**	**Option 7**
Net-benefit	0.0	37.1	21.8	0.7	38.0	22.7	21.2
Unquantifiable benefits ranking	**5**	**3=**	**3=**	**4**	**1=**	**1=**	**2**
Overall ranking	**7**	**2**	**5**	**6**	**1**	**3**	**4**

The Investment Test recognises the inherent uncertainty in inputs to the cost-benefit analysis. Where the difference in net benefit between the option with the highest net benefit and another option is 10% or less of the aggregate project cost of the option with the highest net benefit, the options are considered “similar” and unquantified costs and benefits may be taken into account in order to identify a preferred option.

From our Investment Test analysis, we assess Option 5 to have the highest net benefit compared to the Base Case, with the net benefit of Option 2 being similar. After taking unquantified costs and benefits into account, Option 5 is our preferred option and therefore the Proposed Investment.

This conclusion is robust under sensitivity analysis.

The Proposed Investment is consistent with our Auckland Strategy[6].

[6] See our Auckland Strategy here.

Stakeholder consultation

We consulted on our draft long-list of components in December 2018[7]. In December 2019 we released our short-list consultation[8]. This described our short-listed components, short-listed investment options and our application of the Investment Test to identify a preferred option.

Since that time, we have considered feedback and continued to work on our analysis. In response to stakeholder feedback we have added an additional short-list option (Option 7), refined the capital costs of our short-list components, corrected a calculation error in our Investment Test analysis and developed our Major Capex Allowance calculation.

Implementing our preferred option

In order to meet the required commissioning dates for our preferred option, we have already commenced investigations and enabling works (such as consenting) for the installation of the Bombay works (two new transformers at Bombay). This has introduced some risk for Transpower if the Proposed Investment is not approved by the Commerce Commission, but is necessary for timely implementation. We will not commence any site works unless the Proposed Investment is approved by the Commerce Commission.

While the reconductoring of the Otahuhu-Wiri section of the Bombay-Otahuhu A transmission line is a part of our preferred option, we have not yet undertaken sufficient investigations to understand the cost to an appropriate accuracy for inclusion in this MCP. We have therefore included preparatory works only for this part of the project, in this MCP. The preparatory works will refine the scope and undertake further investigations in order to refine the P50 cost of this reconductoring with sufficient accuracy. Our intention is to apply for an amendment to an approved major capex project output under clause 3.3.6(1)(c) of the Capex IM at a later stage to amend the scope of this MCP to include delivery of the reconductoring.

The implementation schedule for the Proposed Investment is outlined in Table 3.

Table 3: Preferred option component implementation schedule

Component	Commission/complete
Install two new 220/110 kV transformers at Bombay	2023
Reconductor Otahuhu-Wiri section of Bombay-Otahuhu A 110kV transmission line with increased capacity	2024

[7] See our long-list consultation document here.

[8] See our short-list consultation document here.

1 The Proposal

This MCP concerns the need to maintain a reliable electricity supply in the Bombay-Otahuhu region.

The components in the blue box below are the grid outputs to be delivered in the Proposed Investment.

Grid Outputs

- Procure, install and commission two 150 MVA 220/110kV transformers at Transpower's Bombay substation.
- Procure, install and commission a connection for these transformers to the 220kV Otahuhu-Huntly 1 and 2 circuits.
- Undertake preparatory works, including additional investigation, consultation and design work, for reconductoring the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line

Once approval is received our intention is to complete the Bombay works and commission the new 220kV connection by 30 April 2023. We intend to complete the preparatory works for the Otahuhu-Wiri reconductoring by December 31, 2020.

We expect these works to cost $36.0 million once commissioned (based on a P50 estimate of cost). We are seeking Commerce Commission approval to recover the full costs associated with delivering these outputs, up to a total amount of $36.0 million.

2 The Need

2.1 Background

We have identified a series of forecast electricity demand growth and asset condition-based issues which are associated with Transpower's 110kV network in the geographical region around Bombay-Otahuhu.

Collectively, as presented in both our long-list and short-list consultation documents[9], these issues drive the need for investment, which is to maintain a reliable electricity supply in the Bombay-Otahuhu region of the upper North Island.

[9] Our consultation documents are available here.

We decided to investigate the issues simultaneously to exploit any synergies that might exist to create a more beneficial solution overall.

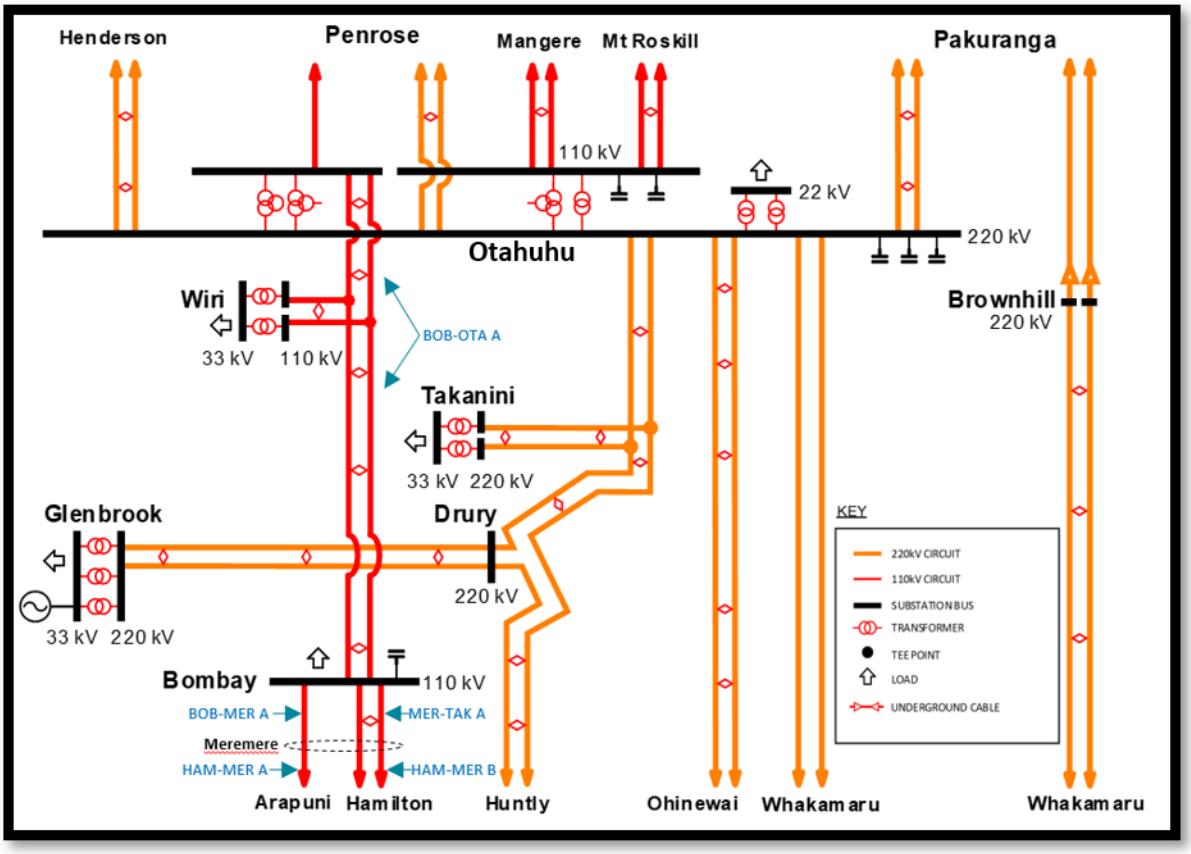

Figure 2: Single line diagram showing the existing configuration of the grid in the Bombay-Otahuhu region

2.1.1 Capacity of existing assets in the Bombay-Otahuhu region

The Bombay-Otahuhu region is growing quickly - both commercial and housing developments are underway and as a result, demand for electricity in the region continues to grow - particularly at our Wiri and Bombay substations.

Wiri is a Vector connection point that supplies the Manukau area. Bombay is the main point of supply for Counties Power, supplying Pukekohe, Papakura and surrounding areas.

Our Bombay–Otahuhu A 110kV double circuit line connects Wiri and Bombay grid exit points to Otahuhu, as illustrated in Figure 2. The capacity of each circuit is about 101 MVA between Otahuhu and Wiri, and 76 MVA between Wiri and Bombay, during winter. Wiri is supplied via a tee connection from the Bombay-Otahuhu A line.

Bombay is also connected to Waikato generation from the south, via the Hamilton-Meremere B, Meremere-Takanini A, Hamilton-Meremere A and Bombay Meremere A circuits. With low Waikato generation, power flows south from Wiri into Bombay, so that Bombay is supplied partly from Waikato and partly from Otahuhu. Under this condition, the Otahuhu–Wiri circuits

supply all the Wiri load plus some of the Bombay load. This could exceed the n-1 capacity of those circuits.

A summary of the existing line capacities is shown below in Table 4.

Table 4 Transmission line conductor ratings

Line	Circuit	Conductor	Conductor Rating		
			Summer	Shoulder	Winter
Bombay-Otahuhu A	Bombay-Wiri 1&2	Wolf 50º	62	69	76
Bombay-Otahuhu A	Otahuhu-Wiri 1&2	Wolf 75º	92[10]	97	101
Hamilton-Meremere B **Meremere-Takinini A**	Bombay-Hamilton 1&2	Copper 19/2.34 50º & Wolf 50º	51	57	62
Hamilton-Meremere A **Bombay-Meremere A**	Arapuni-Bombay	Copper 19/2.34 50º & Wolf 50º	51	57	62

Forecast demand growth means that the existing capacity of the Otahuhu–Wiri circuits, even with VLR implemented, will limit the ability to continue supplying Wiri and Bombay demand at n-1 security. We expect demand growth to be suppressed as a result of the COVID-19 pandemic in the short term, but to return to our forecast growth in the medium to longer term.

2.1.2 Future demand growth in the region

Our peak demand forecasts are updated annually as information is received, including actual peak demand observations, and details of expected demand growth from distribution companies and directly connected electricity consumers.

Forecasting electricity demand is inherently difficult and we are facing more future uncertainties in the longer term given the potential for electrification and investment in distributed energy resources.

As required by the Capex IM, our analysis uses the Ministry of Business, Innovation and Employment's (MBIE) Electricity Demand and Generation Scenarios (EDGS), as published in July 2019[11]. The objective of the scenarios is to explore a range of hypothetical futures, considering different demographic, economic, policy, and technology dimensions.

[10] VLR has increased the rating of the OTA-WIR circuits by approximately 12 MVA above this value.

[11] MBIE's Electricity Demand and Generation Scenarios are published here.

2.1.3 Asset condition

The conductors on some of the transmission lines in the Bombay-Otahuhu region are reaching end-of-life and some of the transmission towers require significant maintenance. The conductor on the Bombay-Otahuhu A line is at end-of-life and significant maintenance is forecast to be required on the Hamilton-Meremere B, Meremere-Takanini A, Hamilton-Meremere A and Bombay Meremere A circuits by 2030. The relevant lines are shown in Figure 2.

2.1.3.1 Condition of the conductor on the Bombay–Otahuhu A line

The Bombay – Otahuhu A line is a double circuit 110kV line approximately 29km long and strung predominantly with Wolf ACSR/GZ (Aluminium Clad Steel Reinforced with galvanised steel core wires) conductor. 10% of the line is strung with Goat ACSR/GZ - at the Bombay substation end of the line.

The line was commissioned in 1960 and the Wolf ACSR/GZ conductor was installed at this time, so has been in service for 59 years. The Goat ACSR/GZ spans were installed 10 years later in 1970 at the substation ends of the line, with most spans installed at the Bombay substation end. The line is double circuit, and the Wiri substation is served via a tee off these two circuits. The Wiri tee section consists of two single spans (approximately 90 m long), crossing the southern motorway to connect both circuits to Wiri substation. The line is described in two sections – Otahuhu-Wiri and Bombay-Wiri – throughout the remainder of this document.

The line is situated in a ‘severe’ corrosive environment due to airborne salts with over 80% of the line being within 5km from the coast.

Inspection and testing has identified widespread conductor corrosion, and numerous conductor defects beyond Transpower replacement criteria[12], and general conductor degradation is indicating that accelerated corrosion is occurring on the conductor. Corrosion defects have been identified on the conductor through both Cormon testing and close aerial surveys. This testing and inspection supports the conclusion that the conductor has reached replacement criteria and must be replaced to ensure continued safe operation.

2.1.3.2 Condition of the lines between Bombay and Hamilton

Four transmission lines – Bombay–Meremere A, Hamilton-Meremere A, Hamilton-Meremere B, and Meremere–Takanini A – carry three 110kV electrical circuits between Bombay and Hamilton (Arapuni–Bombay–1, and Bombay–Hamilton–1 and 2). These lines would all require significant maintenance expenditure within the next 30 years in order to retain the lines.

[12] The applicable Transpower replacement criteria is 20% loss of tensile strength or 15% section loss. Please see Attachment B – Condition Assessment Report.

They are relevant because they are currently used to supply Bombay and some of the investment options reflect retaining and maintaining these lines, whilst others reflect dismantling them. Where these lines are dismantled, Bombay is connected to the nearby Otahuhu – Huntly 220kV line and the future costs of maintaining the 110kV lines are avoided.

Bombay–Meremere A (*Arapuni–Bombay–1*)

The Bombay–Meremere A line is approximately 16km long and is predominantly strung with Wolf ACSR/GZ conductor. The line was commissioned in 1960 and the Wolf ACSR/GZ conductor was installed at this time, so has been in service for 59 years. Corrosion defects have been identified on the conductors on this line.

The line operates in a more benign environment than the Bombay – Otahuhu A line and modelling suggests that the conductor may need to be replaced. Significant maintenance would also be required including painting all transmission towers and replacing most of the insulators.

Hamilton-Meremere A (*Arapuni–Bombay–1*)

Near Meremere substation the Bombay-Meremere A line is redesignated as the Hamilton-Meremere A line. The Hamilton-Meremere A line was commissioned in 1927 and is a wooden pole line strung with Copper conductor. The line is approximately 67km long and runs through mostly rural farmland.

Significant maintenance would be required on this line, including the replacement of at least half of the wooden poles, crossarms and nearly all the insulators.

Hamilton-Meremere B and Meremere-Takanini A (*Bombay–Hamilton–1 and 2*)

The Hamilton–Meremere B and Meremere–Takanini A lines were commissioned in 1927, have been in service for 92 years and would require significant maintenance.

The Meremere–Takanini A line runs between Transpower's Bombay substation and the Meremere site, and is approximately 16km long. The Hamilton–Meremere B line runs between Meremere and Hamilton, and is approximately 62km long. Both lines are predominantly strung with Copper conductor.

Condition assessments and modelling for both lines have identified the need for extensive future maintenance expenditure including tower painting and insulator replacement as well as foundation refurbishments and the replacement of the conductors in the future.

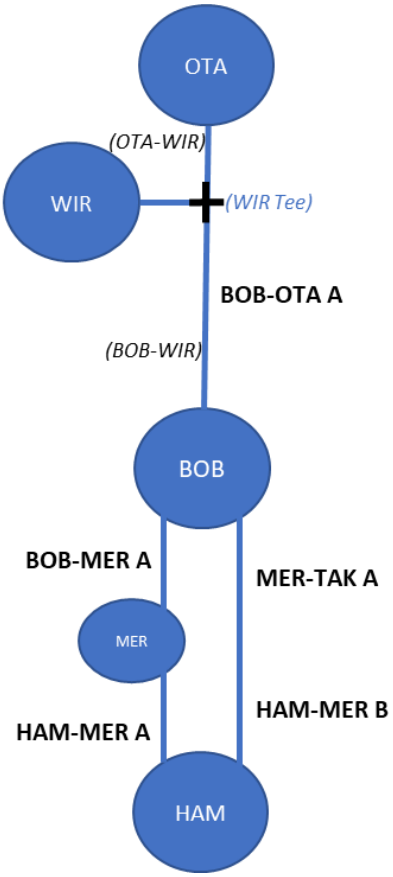

Figure 3: Diagram illustrating key assets

2.1.4 Grid reliability standards and good electricity industry practice

Good Electricity Industry Practice (GEIP) is defined in the Code as:

> "the exercise of that degree of skill, diligence, prudence, foresight and economic management, as determined by reference to good international practice, which would reasonably be expected from a skilled and experienced asset owner engaged in the management of a transmission network under conditions comparable to those applicable to the grid consistent with applicable law, safety and environmental protection. The determination is to take into account factors such as the relative size, duty, age and technological status of the relevant transmission network and the applicable law."

We consider our identification of the investment need, our identification of investment options to address the need (described in Section 3.2), our quantification of the costs and benefits of the investment options (described in Section 3.4) and the Proposed Investment to be consistent with GEIP.

We consider the Proposed Investment both meets the Grid Reliability Standards (GRS) in schedule 12.2 of the Code and provides a net electricity market benefit.

3 Identification and assessment of options

We consulted on our draft long-list of components in December 2018[13]. Our short-listed components, and the investment options we have developed to meet the need, were consulted on in December 2019[14]. Submitters were generally supportive of our intended approach to determining a preferred option[15].

3.1 Refinement since short-list consultation

In December 2019 we released our short-list consultation and this consultation closed on 21 February 2020. Since that time, we have considered feedback and continued to work on our analysis. This has resulted in us refining some of our work. In response to stakeholder feedback we have:

- added a short-list option, at Vector's request, that reconductors the Bombay Otahuhu A transmission line with like-for-like conductor, adds a new 220kV connection at Bombay and dismantles the 110kV lines south of Bombay. This retains the option of supplying Wiri from Bombay, should there be a double-circuit outage event (such as a tower failure) between Otahuhu and Wiri (Option 7)
- explained why Counties Power's option of building a bus at Bombay rather than a tee connection is not included in the short-list
- refined the capital costs of short-list components
- corrected a calculation error in our Investment Test analysis (this has not changed the relative rankings of the options, but has reduced the net benefit)
- refined our Major Capex Allowance calculations.

Additionally, we are submitting a non-staged MCP, rather than a two-stage MCP, as discussed in our short-list consultation.

This is for administrative efficiency. Following discussions with the Commerce Commission, it was felt that, given the circumstances for staging the MCP, exactly the same outcome could be achieved under a non-staged approach combined with an amendment to an approved major capex project output under clause 3.3.6(1)(c) of the Capex IM. Compared to using a staged MCP, this is a simpler, more efficient approach that is likely to require considerably less administrative effort from ourselves, submitters, and the Commission. This change is immaterial from the point of view of the short-list consultation.

[13] See our Long-list consultation document here.

[14] See our Short-list consultation document here.

[15] Refer to Attachment D – summary of submissions.

3.2 Identifying options

The identification of options to satisfy the Bombay-Otahuhu regional need was a four-step process, as shown in Figure 4. The numbered options included in the boxes in Figure 4 are for example only.

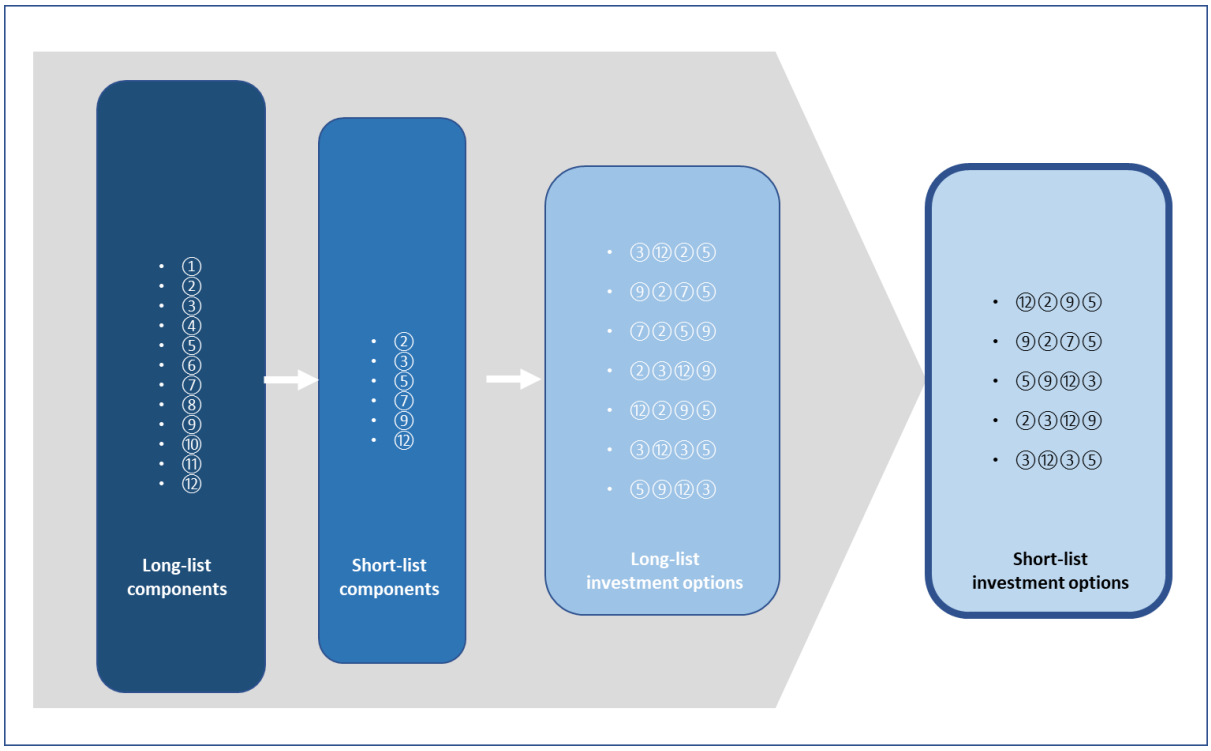

Figure 4 Derivation of short-list of development options (numbered components illustrative only)

3.2.1 Long-list of components

We initially developed a long-list of components. Each component addressed at least one aspect of the need, but the components were not coherently assembled into investment options to address the overall need. We consulted on our draft long-list of components in 2018.

Components in this long-list fell into three broad categories.

- Non-transmission solutions;
- Transmission solutions – new assets;
- Transmission solutions – existing assets: maintain, upgrade, enhance, or modify.

Most submitters agreed with our draft long-list of components, but we did receive some additional detail on components for us to consider in the long-list[16]. We subsequently incorporated feedback from this consultation to further refine our long-list of components.

We also received interest from proponents of non-transmission solutions (NTS) and therefore issued a RFP for NTS to economically defer or replace the transmission investment components.

For further detail on the long-list of components please refer to Attachment C - Options and Costing report.

3.2.2 Reducing our long-list of components to a short-list

Using our short-listing criteria[17], we reduced our long-list of components to a short-list of components[18]. Then, using the short-listed components as building blocks, a long-list of investment options was developed. Each investment option formed a forward development plan which overall ensured the need would be met.

Each investment option's indicative capital cost was determined, and the present value of the cost stream calculated. We then used these indicative capital costs to remove the most expensive investment options to form our short-list of investment options, which we then consulted on.

3.2.3 Short-list of investment options

This section summarises our short-list of investment options.

Option 1 maintains the status quo in terms of transmission line capacity by reconductoring the existing Bombay-Wiri-Otahuhu transmission line with the same capacity conductor as exists now, and is included as our Base Case. The existing capacity of assets in the region is maintained into the future and Special Protection Schemes (SPS) are installed as required to enable the load to exceed n-1 transmission limits. This option utilises the full capacity of our assets, but incurs the highest level of expected unserved energy.

Option 2 includes supplying Wiri from Otahuhu by reconductoring the existing transmission line with the same capacity conductor as exists now. The Bombay-Wiri section of the Bombay-Otahuhu line is removed. Future load growth at Wiri is met by installing a SPS to manage load post a contingency, allowing load to exceed the n-1 transmission limit pre-contingency. Bombay is supplied via two new 220/110 kV transformers connected to the adjacent Otahuhu-Huntly line.

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16 See our summary of submissions on our Long-list consultation document here.

17 For the short-listing criteria and more detail of the short-listing process see Attachment C – Options and Costing Report

18 See our Short-listing consultation document here.

Option 3 is similar to Option 2, but with the two new 220/110kV transformers being installed at the Drury switching station rather than at Bombay. The Bombay-Drury section of the Bombay-Wiri line is reconductored with higher capacity conductor to supply Bombay, and the Drury-Wiri section of that line is removed.

Option 4 is similar to Option 1 (the Base Case) except that the Otahuhu-Wiri transmission line is reconductored with a higher capacity conductor than exists now. This reduces the expected cost of unserved energy, with a SPS not required at Wiri, and only required at Bombay under a high load growth scenario.

Option 5 is similar to Option 2, except that the Otahuhu-Wiri transmission line is reconductored with a higher capacity conductor than exists now and consequently no SPS is required to meet future load growth.

Option 6 is similar to Option 5, except that the two 220/110kV transformers are installed at the Drury switching station rather than at Bombay. The Bombay-Drury section of the Bombay-Wiri line is reconductored with higher capacity conductor to supply Bombay, and the Drury-Wiri section of that line is removed.

Option 7 is similar to Option 2, reconductoring the Otahuhu-Wiri section of the Bombay-Otahuhu line with like-for-like conductor and installing two 220/110 kV transformers at Bombay. This option retains the option of supplying Wiri from Bombay, should there be a double-circuit outage event (such as a tower failure) between Otahuhu and Wiri.

Table 5 - Key short-list of investment options characteristics and capacity increase

Short-list option	Key option characteristic	Location	Capacity increase compared to Base Case	Indicative length of overhead[19] lines dismantled
Option 1	Reconductor OTA-WIR like-for-like	Wiri	-	0 km
Base Case	Reconductor BOB-WIR like-for-like	Bombay	-[20]	
Option 2	Reconductor OTA-WIR like-for-like	Wiri	-	174 km
	New BOB 220kV connection	Bombay	35 MW[21]	

[19] Overhead line length only and does not include underground cable sections

[20] Assumes high Waikato generation and a third interconnecting transformer is installed at Hamilton East

[21] Load limit at Bombay depends on the capacity of the transformers that are installed. The assumption here is a post contingency capacity of 188 MVA. Wiri limit is set by the capacity of the replacement conductor, assumed here to be Simplex Wolf at 75 ^{0}C

Short-list option	Key option characteristic	Location	Capacity increase compared to Base Case	Indicative length of overhead[19] lines dismantled
Option 3	Reconductor OTA-WIR like-for-like New DRY 220kV connection Reconductor BOB-DRY larger conductor	Wiri Bombay	- 25 MW[22]	166 km
Option 4	Reconductor OTA-WIR larger conductor Reconductor BOB-WIR like-for-like	Wiri Bombay	50 MW 20 MW[23]	0 km
Option 5	Reconductor OTA-WIR larger conductor New BOB 220kV connection	Wiri Bombay	65 MW 35 MW[24]	174 km
Option 6	Reconductor OTA-WIR larger conductor New DRY 220kV connection Reconductor BOB-DRY larger conductor	Wiri Bombay	65 MW 25 MW[25]	166 km
Option 7	Reconductor OTA-WIR larger conductor New BOB 220kV connection Reconductor BOB-WIR like-for-like	Wiri Bombay	110 MW 75 MW[26]	149 km

[22] The load limit at Bombay is set by the maximum upgrade for the 110 kV line between Drury and Bombay, which is assumed to be Simplex Goat at 80 ^{0}C. Wiri limit assumed here to be Simplex Wolf at 75 ^{0}C

[23] Limits depend on Auckland load and Waikato generation assumptions. We have assumed that Auckland load is 90% of peak and balanced Wiri and Bombay to get a maximum combined load.

[24] Bombay limit set by transformers (as described for Option 2), Wiri limit set by OTA-WIR conductor upgrade (Simplex Goat at 75 ^{0}C here).

[25] Bombay limit as described for option 3, Wiri as per Option 5.

[26] As per Option 3

Table 6 – Short list of investment options

Short-list option	Short-list components included in option
Option 1 Base Case	• Reconductor Otahuhu-Wiri line section (similar capacity) • Reconductor Bombay-Wiri line section (similar capacity) • Install post-contingency automatic load shedding at Wiri and/or Bombay • Maintain Hamilton-Meremere B and Meremere-Takanini A lines • Maintain Bombay-Meremere A and Hamilton-Meremere A lines
Option 2	• Reconductor Otahuhu-Wiri line section (similar capacity) • Install post-contingency automatic load shedding at Wiri • Install 2 x 220/110 kV transformers at Bombay and connect to Otahuhu-Huntly 220kV line (new Bombay 220kV connection) • Dismantle Bombay-Wiri line section • Dismantle Hamilton-Meremere B and Meremere-Takanini A lines • Dismantle Bombay-Meremere A and Hamilton-Meremere A lines • Install a new bus at Hamilton substation
Option 3	• Reconductor Otahuhu-Wiri line section (similar capacity) • Install post-contingency automatic load shedding at Wiri • Install 2 x 220/110 kV transformers at existing Drury switching station • Reconductor Bombay-Drury line section and connect at Drury (increased capacity) Dismantle Drury-Wiri line section. • Dismantle Hamilton-Meremere B and Meremere-Takanini A lines • Dismantle Bombay-Meremere A and Hamilton-Meremere A lines • Install a new bus at Hamilton substation
Option 4	• Reconductor Otahuhu-Wiri line section (increased capacity) • Reconductor Bombay-Wiri line section (similar capacity) • Install post-contingency automatic load shedding at Bombay • Maintain Hamilton-Meremere B and Meremere-Takanini A lines • Maintain Bombay-Meremere A and Hamilton-Meremere A lines
Option 5	• Reconductor Otahuhu-Wiri line section (increased capacity) • Install 2 x 220/110 kV transformers at Bombay and connect to Otahuhu-Huntly 220kV line (new Bombay 220kV connection) • Dismantle Bombay-Wiri line section • Dismantle Hamilton-Meremere B and Meremere-Takanini A lines • Dismantle Bombay-Meremere A and Hamilton-Meremere A lines • Install a new bus at Hamilton substation
Option 6	• Reconductor Otahuhu-Wiri line section (increased capacity) • Install 2 x 220/110 kV transformers at existing Drury switching station • Reconductor Bombay-Drury line section (increased capacity) • Dismantle Drury-Wiri line section • Dismantle Hamilton-Meremere B and Meremere-Takanini A lines • Dismantle Bombay-Meremere A and Hamilton-Meremere A lines • Install a new bus at Hamilton substation

Short-list option	Short-list components included in option
Option 7	• Reconductor Otahuhu-Wiri line section (increased capacity) • Install 2 x 220/110 kV transformers at Bombay and connect to Otahuhu-Huntly 220kV line (new Bombay 220kV connection) • Reconductor Bombay-Wiri line section (similar capacity) • Dismantle Hamilton-Meremere B and Meremere-Takanini A lines • Dismantle Bombay-Meremere A and Hamilton-Meremere A lines • Install a new bus at Hamilton substation

3.2.4 Modelled projects

Under the Capex IM each option is considered in the context of a longer-term grid development plan which may comprise 'modelled projects'. The modelled projects are future new assets or changes to existing assets that are not part of the option proposed, but could affect the options and the choice of the preferred option.

Our short-list of investment options considers options that would enable some 110kV transmission lines between Otahuhu and Hamilton to be dismantled in the future. If these transmission lines were dismantled, some bussing at the Hamilton substation would also be required.

We have treated the dismantling of these lines, and the bussing at the Hamilton substation, as if they were modelled projects for the purposes of applying the Investment Test for some investment options[27]. They are important to our economic analysis because although there is a cost to dismantling these lines, we would also save considerable future maintenance costs. An indicative schedule of when these lines would be dismantled is provided in Table 7.

Table 7: Indicative dismantling schedule

Component	Dismantle complete
Dismantling Bombay-Wiri section of Bombay-Otahuhu A 110kV transmission line	2025
Dismantling Bombay-Meremere A 110kV transmission line.	2026
Dismantling Hamilton-Meremere A 110kV transmission line.	2028
Dismantling Meremere-Takanini A 110kV transmission line	2032
Dismantling Hamilton-Meremere B 110kV transmission line	2032

[27] The definition of "modelled project" in the Capex IM does not include the dismantling of existing assets. Under the definition, the assets comprising the modelled project have to be likely to exist. In this case the situation is that certain assets are likely not to exist.

3.2.5 Changes from interconnection assets to connection assets

Some of our short-list of options result in grid reconfigurations which change how assets would be paid for under the Transmission Pricing Methodology (TPM). Some assets which are currently classified as interconnection assets would become connection assets.

The result of this change (under the current TPM) is that the charges associated with the new connection assets are reallocated from all New Zealand electricity consumers to those parties connected to the assets. Changes to the allocation of connection and interconnection charges across different parties are not considered in the Investment Test analysis, but an indicative description of the reallocated charges is included in Section **Error! Reference source not found.**..

3.3 Assess options

For each short-list option we have assessed the following quantified costs and benefits:

- Capital cost of developments at Wiri and Bombay
- Refurbishment costs for the 110kV lines south of Bombay
- Operating and maintenance costs
- Dismantling costs, where existing lines are dismantled
- Unserved energy costs, assessed where special protection schemes are used
- Overall dispatch cost differences (the configuration of the grid differs between options)

These are described in detail in the Options and Costing report.

3.3.1 Economic parameters

The Investment Test is a cost-benefit analysis and as such several parameters need to be defined. The parameters we have used are consistent with those defined in the Capex IM, as described in our long-list consultation and as supported by submissions. For more information please see Section 4 of the Options and Costing report:

- We use a 7% pre-tax real discount rate. Unless otherwise stated, all future costs and benefits have been discounted at this rate to a present value in 2019 dollars.
- Our generation assumptions and sensitivities are consistent with MBIE's 2019 EDGS[28].

[28] As prepared by the Ministry of Business, Innovation and Employment (MBIE) here.

- Our demand assumptions and sensitivities are our 2019 peak and expected forecasts which are based on the MBIE 2019 EDGS[29].
- To determine the cost of VoLL at specific GXPs, we use a VoLL of 26,400/MWh for Bombay and 27,800/MWh for Wiri (along with sensitivities at $13,000/MWh and $39,000/MWh). These values are based on our *2018 value of lost load study*[30]. We have used these values as we consider them a better representation of VoLL at these GXPs than $20,000/MWh. We note that our sensitivity range covers the default VoLL of $20,000/MWh described in the Capex IM.
- Our calculation period is 32 years, from 2019 until 2050. This was supported by consultation to capture the costs and benefits over the useful life of the proposed investments. We consider this an appropriate trade-off between assessing benefits over the economic life of the Proposed Investment and over-weighting future benefits with their inherent uncertainty.

[29] For more information including demand forecast graphs, please refer to section 4.1.1.4 of our Options and Costing Report

[30] See our VoLL study here..

3.4 Application of the Investment Test

Table 8 summarises the results of our quantified assessments of options. We present the net benefit of the options relative to the Base Case.

Table 8: Net-benefit test (present value 2019 $m)

		Option 1 Base Case	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
Capital cost	**A**	33.6	37.0	53.0	34.5	37.6	53.7	56.9
Refurbishing cost, lines south of Bombay	**B**	22.0	0.0	0.0	22.0	0.0	0.0	0.0
Operating and maintenance costs	**C**	4.7	0.7	0.9	4.7	0.7	0.9	1.3
Dismantling cost	**D**	0.0	6.4	5.5	0.0	6.4	5.5	3.4
Dispatch cost difference[31]	**E**	0.0	22.0	22.0	1.4	22.0	22.0	22.0
Estimated unserved energy costs[32]	**F**	0.5	1.6	1.6	0.3	0.0	0.0	0.0
Total cost	**A+B-C+D+E+F**	60.8	23.8	39.1	60.1	22.8	38.1	39.6
Net Benefit (relative to Base Case)		**0.0**	**37.1**	**21.8**	**0.7**	**38.0**	**22.7**	**21.2**

The Investment Test recognises the inherent uncertainty in inputs to the cost-benefit analysis. Where the difference in net benefit between the option with the highest net benefit and another option is 10% or less of the aggregate project cost of the option with the highest net benefit, the options are considered “similar” and unquantified costs and benefits may be taken into account in order to identify a preferred option.

Our Investment Test analysis shows that Option 5 has the highest net benefit compared to the Base Case, with the net benefit of Option 2 being similar.

[31] Dispatch cost difference is the present value of dispatch costs (the variable fuel costs of generation) as modelled across the different options.

[32] Estimated unserved energy costs are the present value of the economic cost of an interruption to electricity supply.

Option 2 includes supplying Wiri from Otahuhu by reconductoring the existing transmission line with the same capacity conductor as exists now. Future load growth at Wiri is met by accessing the full capacity of the transmission line and using a Special Protection Scheme (SPS) to manage unserved energy post a contingency.

Option 5 is the same, except that the Otahuhu-Wiri transmission line is reconductored with a higher capacity conductor than exists now and a SPS is not required to meet future load growth.

3.4.1 Sensitivity analysis

Table 9 shows our sensitivity analysis of the net benefit of the options to key economic variables and modelling assumptions. The option with the highest net benefit and options within 10% of this option are coloured in green.

Table 9: Sensitivity analysis (net-benefit, 2019 $m)

	Option 1 Base Case	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
Base Case	0.0	**37.1**	21.8	0.7	**38.0**	22.7	21.2
Discount rate 4%	0.0	**50.1**	33.2	1.4	**52.3**	35.4	33.6
Discount rate 10%	0.0	**26.9**	13.1	0.3	**27.2**	13.4	12.1
Upper range capital costs	0.0	**45.2**	22.2	0.3	**45.8**	22.9	20.6
Lower range capital costs	0.0	**29.0**	21.3	1.2	**30.2**	22.6	21.9
High Bombay regional demand	0.0	**37.1**	21.8	0.7	**38.0**	22.7	21.2
Low Bombay regional demand	0.0	**37.1**	21.8	0.7	**38.0**	22.7	21.2
+50% VoLL	0.0	**36.5**	21.2	0.8	**38.3**	23.0	21.5

The sensitivity analysis shows Options 2 and 5 have the highest net benefit under every sensitivity variation and are similar (as defined in the Capex IM) under every sensitivity variation. The conclusion that Option 5 has the highest net benefit and Option 2 is similar is robust under sensitivity analysis.

3.4.2 Unquantified benefits

We have also considered unquantified costs and benefits.

The Capex IM specifies that costs and benefits can be considered unquantified when they are not possible to quantify with a satisfactory level of accuracy, or when the investigation resource required to obtain a satisfactory level of accuracy is large relative to the size of the cost/benefit.

We have considered the following unquantified costs and benefits.

Electricity market benefits:

- **Capacity benefits**: options that provide greater transmission capacity for supply to Wiri and/or Bombay have more potential to be robust to future demand growth. As discussed, future electricity demand is uncertain due to the uncertainty of electrification and uptake of distributed energy resources. Higher capacity options could avoid the need for further investment if demand growth is higher than forecast.
- **Operational benefits**: options that provide greater transmission capacity may support a longer window of time during the year to take planned transmission or generation outages and may have other operational benefits such as managing high voltages during low load periods.

Non-electricity market benefits:

- **Community benefit:** options that benefit the community through the removal of existing transmission lines.

Table 10 evaluates the unquantified benefits identified above for each above using -, ✓, ✓✓, or ✓✓✓ where more ticks represents greater benefit.

Table 10: Unquantified assessment of benefits

	Option 1 Base Case	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**	**Option 7**
Capacity benefits	-	✓	✓	✓	✓✓	✓✓	✓✓
Operational benefits	-	✓	✓	-	✓✓	✓✓	✓✓
Community benefit	-	✓✓	✓✓	-	✓✓	✓✓	✓
Unquantified benefits ranking	**5**	**3=**	**3=**	**4**	**1=**	**1=**	**2**

The unquantified capacity benefits support options that provide a higher level of transfer capability into the Bombay-Otahuhu region. Option 5 has significantly higher capacity and operational benefits than Option 2 as it provides greater transfer capability into the Bombay region without relying on load shedding through an SPS as well as the removal of existing transmission lines.

4 Selecting the Proposed Investment

4.1 Preferred option

Our Investment Test analysis assessed Options 2 and 5 as having the highest net benefit and being similar in terms of the Capex IM.

Our sensitivity analysis confirms that Options 2 and 5 have the highest net benefit over all sensitivity scenarios and that the two options are similar over all sensitivity scenarios.

Options 2 and 5 only differ at Wiri.

Option 2 includes supplying Wiri from Otahuhu by reconductoring the existing transmission line with the same capacity conductor as exists now. Future load growth at Wiri is met by placing some load on N-security and the use of a Special Protection Scheme (SPS).

Option 5 is the same, except that the Otahuhu-Wiri transmission line is reconductored with a higher capacity conductor than exists now and a SPS is not required to meet future load growth.

When considering unquantified benefits, we consider that Option 5 has significantly higher capacity and operational benefits than Option 2.

In our view, the higher level of service provided to electricity consumers by Option 5, the extra flexibility it provides to deal with higher than expected load growth and the extra flexibility it provides in terms of maintaining the line, make it worth the higher cost.

Table 11: Quantitative and qualitative ranking of investment options

	Option 1 Base Case	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**	**Option 7**
Net-benefit	0.0	37.1	21.8	0.7	38.0	22.7	21.2
Unquantified benefits ranking	**5**	**3=**	**3=**	**4**	**1=**	**1=**	**2**
Overall ranking	**7**	**2**	**5**	**6**	**1**	**3**	**4**

Therefore, we conclude that Option 5 is the preferred option to meet the need to ensure ongoing reliability of electricity supply to the Bombay-Otahuhu region. Option 5 is the Proposed Investment.

5 Stakeholder engagement

Table 12 summarises our engagement with stakeholders.

Table 12: Stakeholder engagement to date

Date	Activity
July 2015	Integrated transmission plan published
November 2018	Integrated transmission plan published
December 2018	Long-list consultation and invitation for information on non-transmission solutions
June 2019	Request for Proposals (RFP) for non-transmission solutions (NTS)
December 2019	Consultation on short-list of options

5.1 Long-list Consultation

In December 2018, as part of our investigation, we published our Long-list consultation document[33] entitled *Bombay to Otahuhu Regional Investigation Long-list Consultation.*

This consultation document sought feedback from interested parties on our assessment of the need, our initial long-list of components (especially with regard to non-transmission solutions), some specific non-transmission solutions and the assumptions (including demand forecasts and generation scenarios) that we planned to use to identify a preferred solution. This consultation also included a Request for Information in relation to non-transmission solutions.

Submitters were supportive of the investment need. Most submitters agreed with, or did not comment on, the long-list of components presented. We did receive an additional long-list component that was subsequently short-listed (see 5.1.1 below).

We also received interest from proponents of non-transmission solutions.

5.1.1 Drury as a point of supply

Counties Power raised the potential for a new GXP at Drury being likely through our long-list consultation. Drury as point of supply has two potential development options:

[33] The *Long-list consultation* paper, the non-confidential submissions received on it and our *Summary of and response to submissions* are available at here.

1. Replace Bombay altogether and develop a substation at Drury – this has been considered in our long-list development options[34]

2. Counties Power elect to build an additional GXP at Drury. Bombay GXP will continue to supply some load to Counties Power but the remaining load will be shifted to the new Drury GXP.

Counties Power may request Transpower to build an additional GXP at Drury at some future time. Should this be the case, a portion of the electricity demand currently supplied from Bombay, will shift to be supplied from Drury. Our assessment is that this would not change the plans we have for Bombay as identified in this MCP. A smaller load at Bombay may mean we could install smaller transformers than we are currently anticipating, but in our view it would be economic to install the same size transformers in any case. The incremental cost difference between transformer sizes is small and would be offset by the extra operational flexibility gained from being able to service both the Drury and Bombay load from Bombay only.

5.2 RFP for Non-Transmission Solutions

As there was interest from proponents of non-transmission solutions, in June 2019 we issued an invitation for request for proposals (RFP) for transmission alternatives in our document[35] entitled *RFP for Non-transmission Solutions BOB-OTA Region*. The RFP requested proposals for NTS to address the load shortfall between the existing capacity of the Bombay-Otahuhu A line and the forecast load demand at Wiri GXP – or to economically defer the need for transmission investment at either Bombay or Wiri.

We had four respondent offers to the RFP, across a range of NTS solutions ranging from new embedded generation, assistance with developing a battery solution and demand-side management.

Our assessment of these offers found that they would either not be feasible physically, or would not be feasible economically to satisfy the shortfall between the existing line capacity and the forecasted load growth, or defer transmission investment.

5.3 Integrated Transmission Plan

The Bombay regional issues that together form the need for the Proposed Investment, and possible options for mitigating the need, were identified in the Transmission Planning Report of our most recent Integrated Transmission Plan[36]. The Proposed Investment and the investment need it addresses are consistent with this Integrated Transmission Plan.

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[34] This appears in our long-list of investment options 1.3, 2.3, 3.3, 4.3, 5.3 and 6.3.

[35] Our RFP for Non-transmission solutions can be found here.

[36] See section 5.3.2.1 of our Transmission Planning Report 2019 here.

5.4 Short-list consultation

In December 2019 we published our short-list consultation document[37] entitled *Bombay Otahuhu Regional Major Capex Project Investigation Short-list Consultation*.

This consultation document sought feedback from interested parties on our assessment of the need, our short-list of components, our approach to the Investment Test and the assumptions (including demand forecasts and generation scenarios) that we used to identify a preferred solution.

Counties Power, Vector Ltd and Mercury made submissions. Submitters generally agreed with our approach but there was concern from Vector regarding the reduced level of security resulting from the preferred option of dismantling of the Bombay 110kV circuits. Vector requested Transpower to include additional options to the short-list that maintained the existing level of security at Wiri, i.e. two separate transmission lines. We subsequently included a variant of Option 5 which retains the Bombay-Wiri section (Option 7). Reconductoring the Bombay-Wiri section retains the option of supplying Wiri from Bombay, should there be a double-circuit outage event (such as a tower failure) between Otahuhu and Wiri. The inclusion of Option 7 has not changed our choice of preferred option.

Counties Power and Vector also noted that there would be increases in their respective charges due to both Wiri and the 110kV bus at Bombay changing from interconnection assets to connection assets under the Proposed Investment. In addition, due to the currently proposed changes to the TPM, Vector requested that Transpower provide details on who the beneficiaries of the proposed investment would be. We discuss the pricing implications below in section 6.4.

Error! Reference source not found.. Application to the Commerce Commission

The Proposed Investment is a Major Capex Project under the Capex IM[38]. This means that we are required to submit MCPs to the Commerce Commission seeking approval to recover the expenditure for Proposed Investment.

6.1 Proposal

Transpower is seeking approval from the Commission to recover the full costs associated with the Proposed Investment, as outlined in the following table.

[37] See our short-list consultation document here.

[38] Capex IM as detailed in Transpower Individual Price-Quality Determination January 2020: see schedule C in here.

Table 13: Proposal at a glance

Proposal at a glance	
What:	Maintain a reliable electricity supply to the Bombay-Otahuhu region by: • Procuring, installing and commissioning two 150 MVA 220/110kV transformers at Transpower's Bombay substation. • Procuring, installing and commissioning a connection for these transformers to the 220kV Otahuhu-Huntly 1 and 2 circuits • Undertaking preparatory works, including additional investigation, consultation and design work, for reconductoring the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line[39].
When:	We are planning to fully commission these works by 30 June 2023.
How much [40]:	Major Capex Allowance: $36.0 million[41].
Incentive elements:	Major Capex Incentive Rate: 15% Exempt Major Capex: none
Approval expiry date:	31 December 2028[42]

In order to meet the required commissioning dates for our preferred option, we have already commenced investigations and enabling works (such as consenting) for the installation of the Bombay works (two new transformers at Bombay). This has introduced some risk for Transpower if the Proposed Investment is not approved by the Commerce Commission, but is necessary for timely implementation. We will not commence any site works unless the Proposed Investment is approved by the Commerce Commission.

While the reconductoring of the Otahuhu-Wiri section of the Bombay-Otahuhu A transmission line is a part of our preferred option, we have not yet undertaken sufficient

[39] We will apply for an amendment to an approved major capex project output under clause 3.3.6(1)(c) of the Capex IM, for installation of a higher capacity conductor on the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line, once the investigation is complete and we can estimate a P50 cost with more accuracy.

[40] The major capex allowance is in nominal New Zealand dollars, excluding GST.

[41] Approximately $10.8 million of the proposed major capex allowance has already been approved by the Commerce Commission as base capex in RCP3. To ensure Transpower does not over-recover its capital expenditure associated with this major project, any RCP3 revenues coming from the already approved base capex will wash-up and be returned through prices in RCP4.

[42] We have proposed an approval expiry date of 31 December 2028, which is after the commissioning date assumption of 30 April 2023. We have proposed this extra period to allow for any delays in procurement and consenting. If this happens it will be efficient to have a reasonable window during which we will not have to re-apply for investment approval.

investigations to understand the cost to an appropriate accuracy for inclusion in this MCP. We have therefore included preparatory works only for this part of the project, in this MCP. The preparatory works will refine the scope and undertake further investigations in order to refine the P50 cost of this reconductoring with more accuracy. Our intention is to apply for an amendment to an approved major capex project output under clause 3.3.6(1)(c) of the Capex IM, for installation of a higher capacity conductor on the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line, once the investigation is complete and we have a suitable P50.

6.2 Major Capex Allowance

If approved by the Commerce Commission, we can recover the actual costs of the Proposed Investment up to the Major Capex Allowance (MCA).

The Commerce Commission also approves an incentive rate for cost variances from the MCA. In this case we consider the standard incentive rate, which is 15%, to be appropriate. That means, if the project cost exceeds the MCA, we can only recover 85% of the cost in excess of the MCA.

The MCA we are seeking approval for is $36.0 million.

Table 14 shows our MCA calculation, including financing costs and inflation. This is our P50 estimate of the costs of the Proposed Investment – there is equal chance that the Proposed Investment could be delivered for more or could be delivered for less. As with any project, and consistent with the incentive regime, we intend to deliver the Proposed Investment as efficiently as possible. We assume the Proposed Investment is fully commissioned by 30 Junel 2023, based on the need and our current forecast of the delivery phase of the project.

Table 14: Major Capex Allowance (MCA)

Item	Capital cost ($000)
Capex – total risk adjusted (real 2020)	32,714
Inflation	1,219
Major Capex Allowance	**33,933**
Interest during construction (IDC)	2,013
Total Major Capex Allowance	**35,946**

The MCA is higher than the costs in Section 3.2.5 because it includes interest during construction, investigation costs, and inflation. Refer to the Options and Costing report for more detail on the calculation of the MCA.

$10.8 million of the proposed major capex allowance of $36.0 million has already been approved by the Commerce Commission as base capex in RCP3. However, to ensure Transpower does not over-recover its capital expenditure associated with this major project, any RCP3 revenues coming from the already approved base capex will wash-up and be

returned through prices in RCP4. To ensure the correct treatment when calculating incentive benefits under the base capex incentive mechanism, Transpower will remove the already approved amount from the base capex allowance consistent with the treatment prescribed in the CapexIM (through the use of the g term in Schedule B, Division 1).

6.3 Grid Outputs

The components in the blue box below are the grid outputs to be delivered by the Proposed Investment.

Grid Outputs

- Procure, install and commission two 150 MVA 220/110kV transformers at Transpower's Bombay substation.
- Procure, install and commission a connection for these transformers to the 220kV Otahuhu-Huntly 1 and 2 circuits.
- Undertake preparatory works, including additional investigation, consultation and design work, for reconductoring the Otahuhu-Wiri section of the Bombay-Otahuhu A 110kV transmission line

Anticipated duration of works

The anticipated duration of works for delivering the Proposed Investment is expected to be two to three years. We expect the Proposed Investment to be fully commissioned by 30 April 2023.

6.4 Pricing Implications

If the Commerce Commission approves this MCP and we undertake the Proposed Investment, transmission charges will increase under the existing TPM.

The proposed expenditure is our MCA of $36.0 million and this relates to works at our Bombay GXP and on our Bombay-Otahuhu 110kV transmission line.

Table 15 shows our estimated increase in both connection charges and interconnection revenue following the proposed commissioning of the new transformer at Bombay in 2023 and preparatory works for Otahuhu-Wiri reconductoring.

The most significant transmission charge impact of our preferred option will be that interconnection charges for Wiri and Bombay will become connection charges once the last line that connects Bombay to the 110kV network is dismantled. These pricing implications have been calculated assuming the work at Bombay is commissioned in 2023, but the lines south of Bombay are not dismantled until 2032. Transpower does not have a firm work programme to dismantle these 110kV lines, but they may be dismantled earlier than 2032.

From a pricing perspective (under the current TPM) the costs of the Proposed Investment will be recovered through interconnection charges until 2032 and partly through connection charges thereafter.

Further detail on our estimate of the transmission pricing implications, for both interconnection and connection charges, is provided in Attachment F.

Table 15 Estimated increase in Transpower's connection charges and interconnection revenue (nominal)

Pricing year	Increase in annual connection charge ($/kW)	Increase in annual connection charge (cents/kWh)	Increase in annual interconnection revenue ($/kW)	Increase in annual interconnection revenue (cents/kWh)
2023/24			0.29	0.0043
2024/25			0.29	0.0044
2025/26			0.30	0.0045
2026/27			0.40	0.0060
2027/28			0.41	0.0061
2028/29			0.41	0.0062
2029/30			0.42	0.0063
2030/31			0.43	0.0064
2031/32			0.40	0.0059
2032/33			0.40	0.0060
2033/34	na[1]	0.0061	0.00	0.0000
2034/35	na[1]	0.0060	0.01	0.0002
2035/36	na[1]	0.0058	0.03	0.0004

(1) $/kW for connection costs is not relevant as the rate is fixed in % of replacement cost.

A.1 Attachments

Further information supporting this major capex proposal is included in the following appendices:

Attachment A – Compliance requirements

This document provides a checklist as to how this major capex proposal meets the requirements to be approved by the Commerce Commission under the Capex IM.

Attachment B – Condition Assessment Report

This document provides condition assessment detail of the Bombay-Otahuhu A transmission one.

Attachment C – Options and costing report

This document describes:

- how the long-list of options was reduced to a short-list of options
- detail of how the short-list options were costed and how the Major Capex Allowance was derived
- detail of the Investment Test analysis used to identify benefits and hence the option which satisfies the requirements of the Investment Test

Attachment D – Summary of submissions

This document summarises the submissions received in our previous consultations and includes our responses to the points raised in those submissions.

Attachment E – CEO certification

This document includes the CEO certification as required by the Capex IM.

Attachment F – Indicative Pricing by GXP/GIP

This document contains indicative pricing implications by GXP and GIP should this MCP be approved, as required by the Capex IM.

Attachment G – Loss Modelling Report

This report contains the transmission loss modelling which was used in the analysis.