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KAIMAICASESTUDY

Version Final – 31 October 2023

1 Background

The Kaimai hydro scheme (Kaimai) dates back to the 1925 when the McLaren Falls power station was built by the Tauranga Borough Council to supply the Tauranga Borough and the newly created Tauranga Electric Power Board. Between 1972 and 1994 four additional stations were built with a capacity of 42 MW. With the commissioning of the Ruahihi Power Station, replacing McLaren Falls, the original power station was decommissioned. Kaimai was originally built to meet peak demand requirements for the Tauranga area and therefore has very reliable daily peaking capability.

Kaimai is connected to Powerco's network at Powerco's Greerton substation, which is about 700 m from Transpower's Tauranga substation. The generation from Kaimai connects via Greerton to TGA0331.

Figure 1 shows the local 110kV network in the Tauranga area showing the connection of Kaimai generation via CB2152 and CB2442 at Transpower's Tauranga substation.

The 110 kV circuits highlighted in yellow are connection assets under the Transmission Price Methodology (**TPM**) and those highlighted in blue are interconnection assets.

The lines between Tauranga and Kaitimako are reliant on Kaimai generation to operate at peak times to maintain N-1 security. An outage of either of the circuits connecting the Tauranga substation at peak times would result in loss of the entire Tauranga GXP if Kamai was at low generation levels.

2 Treatment of Tauranga circuits under GRS

The **grid reliability standards** require Transpower to invest to maintain N-1 security in the **core grid**.

The 110 kV Mt Maunganui to Tarukenga and 110 kV Tarukenga to Tauranga links are specified as part of the **core grid** in schedule 12.3 of the Code. However, when the **core grid** was defined Kaitimako substation did not exist with the lines constructed at 220 kV between Kaitimako and Tarukenga being operated at 110 kV. Transpower believe that with the commissioning of the Kaitimako interconnection substation the 110 kV network feeding Tauranga substation is no longer part of the core grid, and as a result is not subject to the requirement to design the grid to a N-1 standard and is only required to meet the requirement of clause 2(2)(a) but not 2(2)(b) of schedule 12.2 of the Code.

2 The grid reliability standards

(1) The purpose of the **grid reliability standards** is to provide a basis for **Transpower** and other parties to appraise opportunities for transmission investments and **transmission alternatives**.

(2) For the purpose of subclause (1), the **grid** satisfies the **grid reliability standards** if—

(a) the power system is reasonably expected to achieve a level of reliability at or above the level that would be achieved if all **economic reliability investments** were to be implemented; and

(b) with all **assets** that are reasonably expected to be in service, the power system would remain in a **satisfactory state** during and following a **single credible contingency event** occurring on the **core grid**.

(3) For the purpose of subclause (2)(a), the expected level of reliability of the power system must be assessed at each and every **grid exit point** and **grid injection point** (wherever located on the **grid**).

(4) For the purpose of subclause (2)(a) and (b), the expected level of reliability, and state, of the power system must be assessed using the range of relevant operating conditions that could reasonably be expected to occur.

Compare: Electricity Governance Rules 2003 clauses 3 to 6 schedule F3 part F

Box 1 - Clause 2 of Schedule 12.2 of the Code

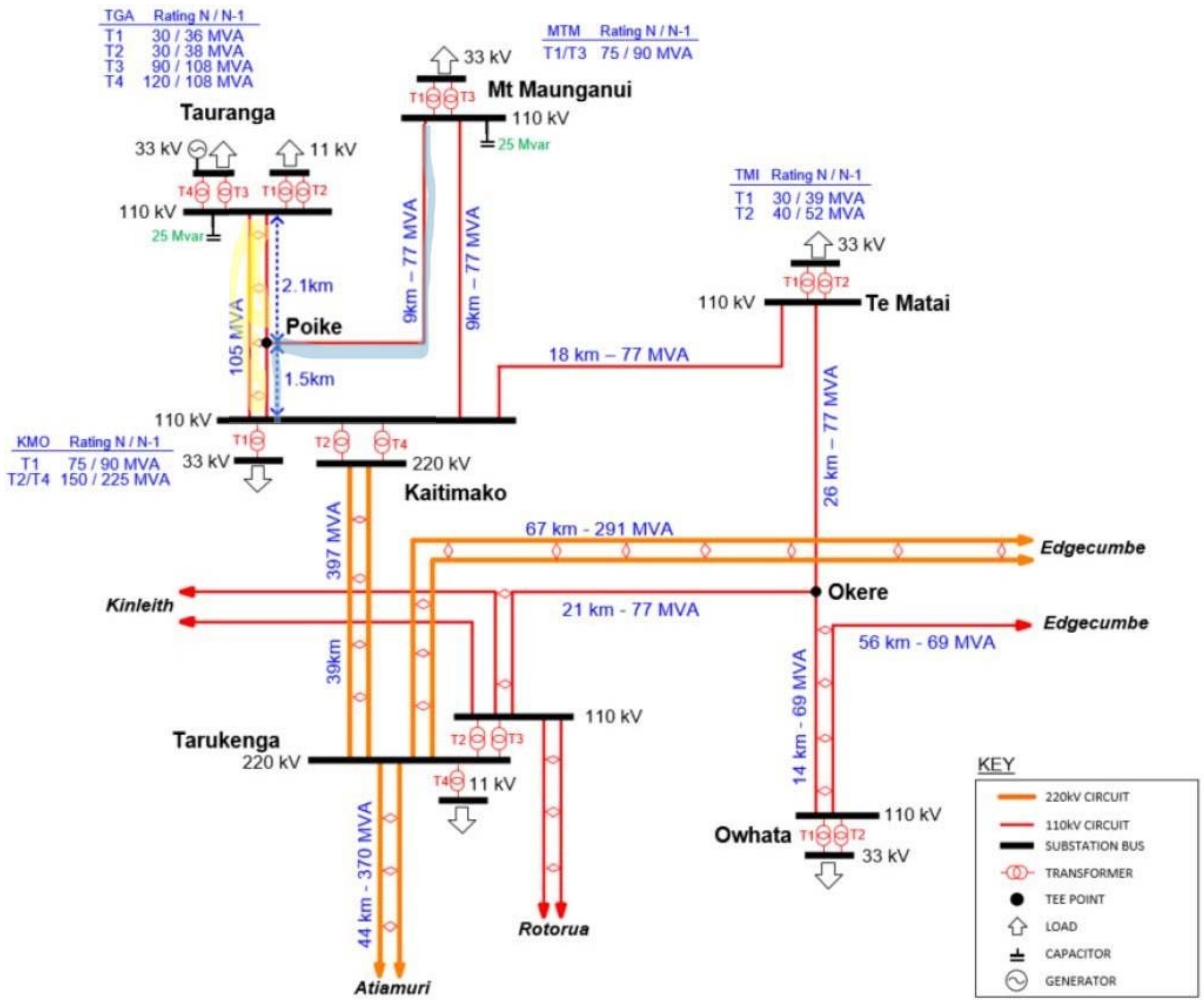

Figure 1 - Transpower Bay of Plenty Network

The **grid reliability standards** have not been amended, so it would be hard to argue that the 110 kV lines are still not part of the **core grid**. The original decision by the Electricity Commission in setting the **core grid** was to include links that provide N-1 for loads above 150 MW. With the addition of the Kaitimako interconnection, the risk of loss of supply has decreased and potentially trigger a review of the links included in the **core grid**. However the total gross load at Tauranga still exceeds 150 MW. In 2022 this occurred in 431 trading periods.

3 Responsibility for Tauranga Reliability

Given the mix of connection and interconnection assets in the lines feeding Tauranga substation I believe there is joint responsibility between Powerco and Transpower in maintaining reliability for Tauranga load customers.

Transpower is required to meet the **grid reliability standards** and Powerco must meet minimum service quality standards set by the Commerce Commission and detailed in schedule 3 of the Default Price-Quality Path Determination. The standards include the standard reliability measures of SAIDI and SAIFI. However, the measurement of SAIDI and SAIFI does not cover outages of Transpower's connection assets. Transpower required to meet the **grid reliability standards** in respect of connection assets but in practice is will not invest in new connection assets without a Transmission Works Agreement with the **customer**.

3.1 Grid Reliability Standards

Clause 12.36 of the Code requires the approval of the Authority if it proposed to operate below the **grid reliability standards** for a particular **grid injection point** or **grid exit point**.

4 Electricity Commission Core Grid Determination

4.1 Discussion Paper

In June 2005 the Electricity Commission published a discussion paper[1] on its proposed **core grid determination** as required under Part F of the EGRs.

This paper proposed that the N-1 test be limited to a loss of supply of 300 MW.

Box 2 describes how local generation is considered when determining the contribution to security of supply. The Tauranga GXP would be fit into the category 'Radial Feed with generation'. In this first iteration of the **core grid determination** the definition of Kaimai as 'Reliable Generation' or otherwise is irrelevant as the 300 MW limit was well above the load in the Tauranga/Mt Maunganui area with or without Kaimai generation.

The resulting proposed **core grid determination** did not include the lines feeding the Tauranga area from Tarukenga. It also did not include these lines when assessing under a 150 MW limit.

[1] https://ndhadeliver.natlib.govt.nz/webarchive/20091121182012/http://www.electricitycommission.govt.nz/consultation/coregrid

Table 5: Practical approach to assessing cascade failure objective

Transmission Link	Description	Core Grid Determination that would be consistent with cascade failure objective
Radial Feed	Radial transmission link feeding an area without generation.	Transmission link is part of Core Grid if peak load in the area is greater than A[8].
Radial Feed with generation	Radial transmission link feeding an area with generation.	Transmission link is part of Core Grid if peak load in the area, minus reliable generation[9], is greater than A.
Radial Generation	Radial transmission link providing a connection to generation.	Transmission link is part of Core Grid if loss of the generation in-feed would lead to loss of load greater than A.
Parallel Link	Transmission link running in parallel with other transmission links	Transmission link is part of Core Grid if loss of the link would lead to loss of load greater than A.
Meshed Link	Transmission link in a meshed part of the grid	If the load at a node minus the reliable generation at the node is greater than A, then there must be at least one Core Grid link connected to that node.
HVDC Link	HVDC transmission between the islands	HVDC is part of Core Grid if loss of the link would result in a loss of load greater than A.

Box 2 - Extract from Discussion Paper

[9] Reliable generation excluded intermittent generation such as wind and run-of-river hydro, except to the extent that diversity of supply would provide a reliable supply. Thermal power stations were assumed to have full fuel availability.

Box 3 - Definition of Reliable Generation

In the discussion paper the Electricity Commission concluded that there is no need for consistency between the definition of the **core grid** for the purposes of the **grid reliability standards** and the definition of **interconnection assets** for the purposes of determining transmission pricing. This implies that a **connection asset** such as the links highlight in yellow in Figure 1 could be defined as **core grid** and need to meet the N-1 standard, unless approved otherwise by the Authority.

4.2 Explanatory Paper

Following the receipt of submissions, the Electricity Commission published an explanatory paper on 24 August 2005.[2] This paper responding to those submissions.

The paper:

(a) reinforced the Electricity Commission's view that the Bay of Plenty was not a main load centre[3];

(b) suggested there is no need for consistency between the **core grid determination** and the definition of interconnection assets; and

(c) concluded that most submitters supported a wider definition of **core grid.**

As a result, the use of the 300 MW loss of supply test was not changed. There were some minor changes to the core grid links.

A short period of time was allowed for final comments from interested parties.

[2] https://ndhadeliver.natlib.govt.nz/webarchive/20091121182012/http://www.electricitycommission.govt.nz/opdev/transmis/gridreliability/

[3] para 3.8 of the Explanation Paper.

4.3 Second Round Consultation

The Electricity Commission published a second round of consultation on 21 October 2005[4].

In this consultation the Electricity Commission proposed to reduce the loss of load criterion to 150 MW, and revised the definition of 'reliable generation' as seen in Box 4. As a result the 110 kV lines from Tarukenga to Tauranga and Mt Maunganui were included in the new proposed **core grid determination**.

> [14] The methodology applied for this discussion paper is slightly different to that applied to the original discussion paper. Reliable generation excludes intermittent generation such as wind and run-of-river hydro, and in isolated regions with relatively limited diversity of generation sources, where it is unlikely that a stable post-contingent generation/load island would develop, it is assumed that no generation is available. Thermal power stations were assumed to have full fuel availability.

Box 4 - Revised Definition of reliable generation

4.4 Revised Explanatory Paper

The Electricity Commission published a revised explanatory paper in December 2005[5].

This paper summarised the submissions to the second-round consultation and confirmed the core grid as in that consultation, including the 110 kV lines into Tauranga would be included.

5 Situation Today

5.1 Grid Reliability Standards

The Code provisions for the **grid reliability standards** and the definition of the **core grid** have not changed since originally incorporated into the EGRs.

It is my view that both Kaitimako to Tauranga 110 kV links are **core** grid because:

(a) both links are still listed in Schedule 12.3 of the Code; and

(b) if the same rules that applied when the Electricity Commission originally determined the **core grid,** were re-applied the Tauranga grid exit point would still qualify as a result of the gross load now expected to be above 150 MW from 2025.

Figure 2 is taken from Transpower's 2022 Transmission Planning Report[6]. It shows the gross demand at Tauranga reaching 150 MW in about 2025.

[4] https://ndhadeliver.natlib.govt.nz/webarchive/20091121182012/http://www.electricitycommission.govt.nz/consultation/revcoregridoct05

[5] [Insert link to National Library]

[6] https://static.transpower.co.nz/public/uncontrolled_docs/2022%20Transmission%20Planning%20Report.pdf?VersionId=v6h_P0Vwhmys9BEpp3OGicM1aj4Fr_OZ

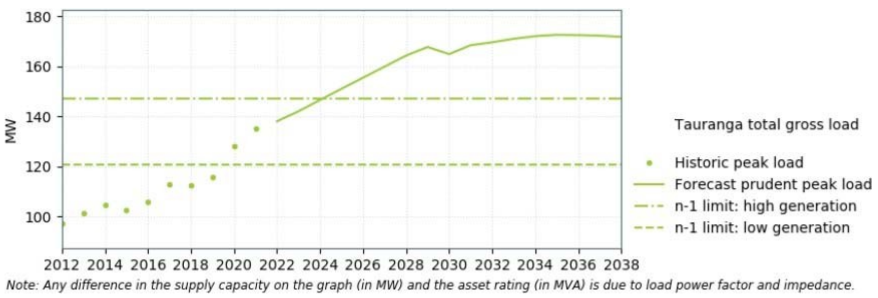

Figure 2 - Kaitemako-Tauranga transmissioncapacity

Actual gross demand at Tauranga GXP has actually reduced in the last two years. Figure 3 shows the peak gross demand at Tauranga and the number of trading periods where this exceeded N-1 security with no Kaimai generation. This peaked in 2021 when there were 474 trading periods where gross load exceeded 106 MW[7].

The reduction in the past two years has been caused by the transfer of load from Tauranga to Kaitimako 33 kV (approximately 20 MW increase at Kaitimako). Transpower's Western Pay of Plenty Development Plan: long-list consultation[8] suggests that this is not a long-term solution with load being transferred back to Tauranga GXP from 2027 as loads on Powerco's 33 kV network increase. In addition the peak load on the Tauranga 33 kV transformers is expected to exceed N-1 capacity even with full Kaimai Generation.

[7] The N-1 capability of the 110 kV lines supplying Tauranga GXP is 106 MW (winter capacity).

[8] https://static.transpower.co.nz/public/uncontrolled_docs/WBoP_Development_

Plan_MCP_long-list_consultation-Attachment-1.pdf?VersionId=hd641WbeKKuzfutqMswqwbd9BWMA_cDo

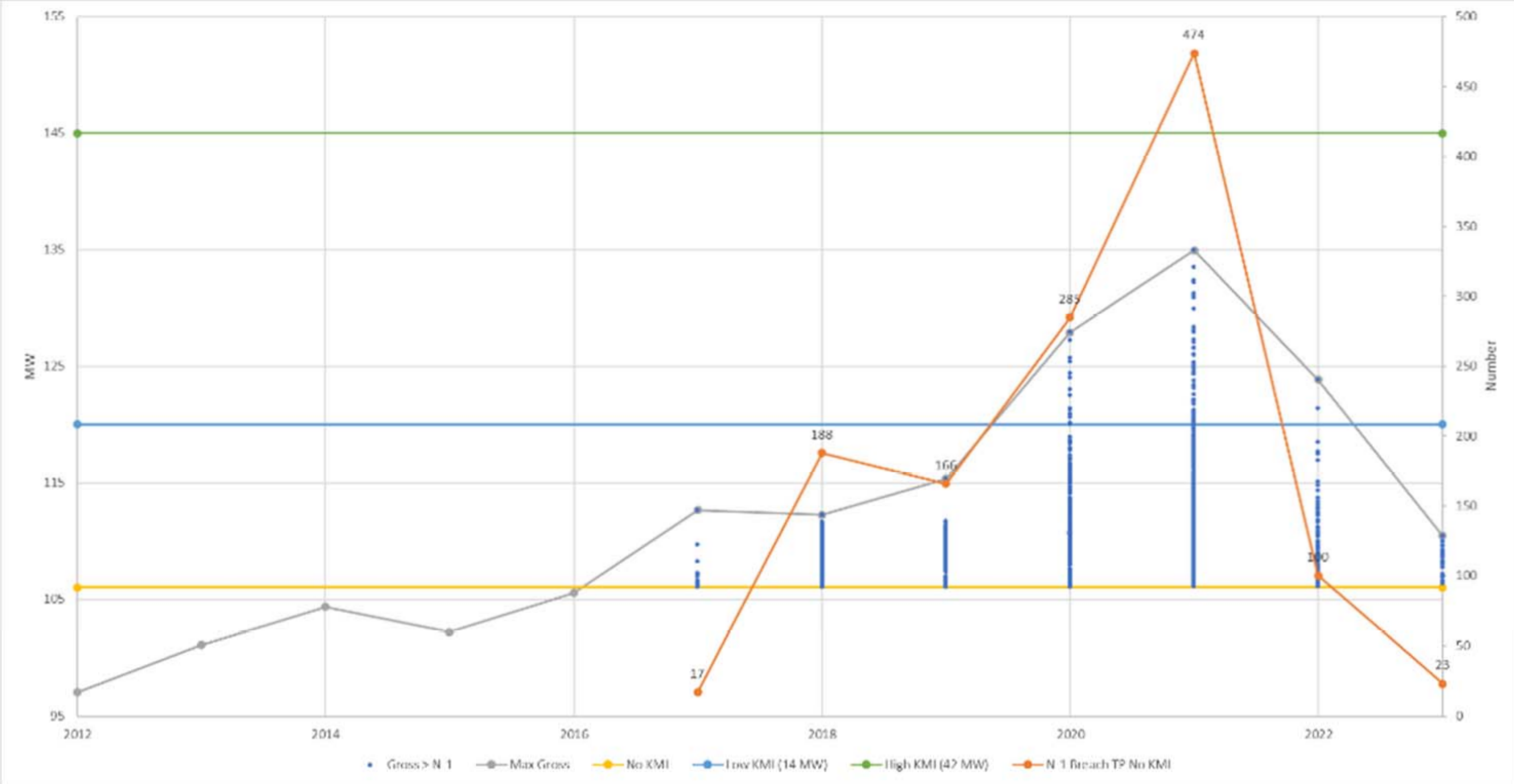

Figure 3 - Tauranga Substation N-1 exceedance

6 Transpower Major Capex Proposal

Transpower has begun consultation as required under the Commerce Commission's Major Capex process for investments over $20 million. It has published and received submissions on the long list of options.

The consultation paper argues that considerable investment is required over the next ten years with a step change in load at Tauranga GXP post 2025. Although the eventual transmission solution may negate the need for N-1 support from Kaimai, it is clear that Kaimai generation will have a key role to play in the period until new assets are built. Kaimai clearly will have an increasing role in supporting N-1 during this transition period.

7 Kaimai Support

Prior to the new TPM that came into effect from 1 April 2023 Kaimai was incentivised to generate at times of maximum demand in the Tauranga area through the payment of ACOT. Because Manawa was paid to support Tauranga and the wider area demand during peak demand periods Transpower could reasonably expect Kaimai to be generating at near to maximum capability during peak demand periods. This is no longer the case. Kaimai is only incentivised to generate to maximise spot energy revenue. In 2023, even though the average monthly generation over the peak demand winter period was higher than normal due to favourable hydrology conditions, the average generation during the maximum demand periods (greater than the N-1 limit of 105 MW) was lower than previous years.

Figure 4 is an example of the change in incentives for Kaimai operation under the previous TPM with RCPD signalling and the present incentives which is only to maximise spot revenue. Figure 4 shows in blue the top 100 RCPD periods for the Upper NI and in orange the actual generation from Kaimai during each trading period. In grey is the estimated generation from Kaimai during each of the top 100 RCPD periods if Kaimai was perfectly operated in the highest price trading periods on each day.

As can be seen there are a 18 periods where Kaimai would not have operated if only incentivised by price.

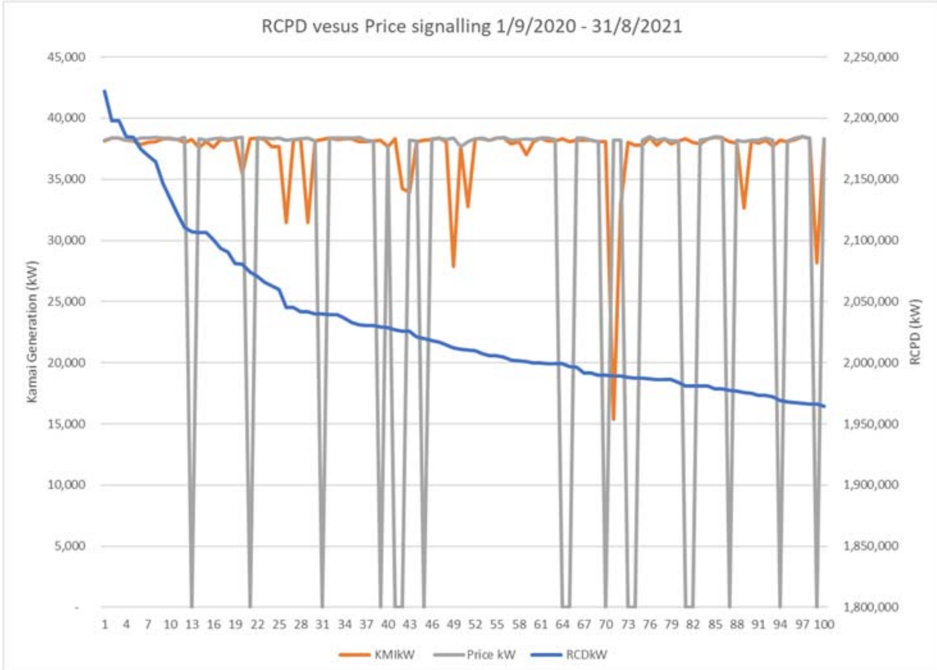

Figure 4 - Incentives on Kaimai Operation

8 Conclusions

With the lines feeding Tauranga from Kaitemako being a mixture of connection and interconnection assets there appears to be confusion as to whether Transpower, Powerco or both are responsible for the reliability of these assets.

Thus:

(a) there needs to be clarification of the responsibility of distributors and grid owners for reliability particularly where there is co-mingled assets;

(b) it should not be possible for a load centre the size of Tauranga to have a risk that neither network owner is accountable for reliability;

(c) as a minimum the regulators should agree the quality standards that apply on this set of assets; and

(d) more broadly the quality standards under price-quality path and the grid reliability standards (and associated definitions) may need to be reviewed to ensure they are fit for purpose.

This is an important first step to assessing whether networks companies are using non-network alternatives appropriately.

9 Glossary

Words in bold have the meaning in the Code.

Term	Definition
Authority	Electricity Authority
Code	Electricity Industry Participation Code
EGRs	Electricity Governance Rules 2003
TPM	Transmission Pricing Methodology in Schedule 12.4 of the Code