Powerco CPP application

Advice to MEUG for Commerce Commission submission

NZIER report to MEUG

22 September 2017

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Authorship

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Key points

Our estimated annual benefit to consumers of a more reliable network (based on the mean value of lost load (VoLL) for residential consumers and the median VoLL for business customers) is:

- negative for 2018 and the first four years (2019-2022) of the Customised Price Path (CPP)
- the peak annual 'reliability benefit' for the Asset Management Plan (AMP) forecast period (2027) is estimated $9 million – about one quarter of our estimate of the additional annual cost to consumers for the last year (2023) of the CPP of $31 million.

This gap between the estimated benefits and the estimated additional cost to consumers under the CPP is due to two factors:

- reducing unplanned outages is less valuable to consumers than the annual cost of the reduction
- Powerco's proposed increase in planned outages negates part of the benefit of the reduction in unplanned outages. (The estimated VoLL for customers for planned outages is only about two-thirds of the estimated VoLL for unplanned outages.)

The CPP and AMP are unclear about whether the increased capital (and operational) expenditure is a temporary 'catch-up' or whether expenditure will need to be maintained near CPP levels after 2027 (the end of the AMP).

However, the CPP and AMP do not deliver an across the board improvement in asset health by 2027 despite capital expenditure continuing at 86 percent of CPP levels over 2024 to 2027 – the gap between the end of the CPP and the AMP. Approximately half of the asset health indicators (AHI) listed in the CPP are forecast to be worse in 2027 than in 2016 for assets requiring replacement within 3 years and more than half of the AHI are forecast to be worse in 2027 than in 2016 for assets requiring replacement within 10 years. The lack of improvement in the AHI suggests that Powerco will have strong grounds to argue that the CPP level of capital expenditure and planned outages needs to be sustained after 2023 if the CPP expenditure reliability trade-off is approved by the Commerce Commission.

The Powerco CPP presents estimates of reliability gains and asset health at an aggregate network level and then detailed narrative on individual projects. This presentation does not highlight the differences between the two main networks – Eastern and Western.

The Western network has more severe fault problems than the Eastern network but this is not fully reflected in customer experience of outages as measured by the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI). The two networks also have markedly different asset age profiles and markedly different pricing plans for residential customers (the main source of revenue for both networks). Given these differences it is highly likely that customers in each network will face very different choices between price change and improved reliability.

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1. Quality measures

1.1. Proposed measures

A key rationale for the Powerco CPP is that capital investment is required to improve network reliability and safety. Powerco argues that network faults are tending upwards and this will lead to more frequent and longer outages that will be unacceptable to customers.

The main purpose of this section is to analyse the expected value of the improvement in network reliability under the customised price-quality path (CPP) compared to the default price quality path (DPP) and compare this benefit to the additional cost[1] to customers. The CPP provides an opportunity to analyse the cost of the service reliability trade-off that Powerco is offering its customers.

In addition, this section also discusses the recent history of faults across the Eastern and Western regions to consider where the investment is likely to be made. This will materially affect the price/reliability trade-off facing customers on each network. The Western network appears to have a materially higher rate of faults and more rapid deterioration in service provision than the Eastern network despite the two networks having similar numbers of customers and volumes of energy delivered.

1.2. Comparison of DPP and CPP

A key test for the Commerce Commission is that the electricity distribution businesses' (EDB) investment should be for the long term benefit of consumers. Cost benefit analysis could be used to assess the net benefit of the proposal by comparing the proposed investment with the next best alternative or 'what would happen' (the counterfactual). A cost benefit analysis would help to estimate the net value of the different benefits[2] from these two alternatives. A key element of the Powerco CPP is that the increase in capital and operating expenditure along with an increase in planned outages will deliver a more reliable network.

1.2.1. What is reliability worth to consumers?

The Powerco CPP application provides information on the expected difference in the length of outages (planned and unplanned) as measured by System Average Interruption Duration Index (SAIDI)[3] and the value of lost load for customers. We have presented a summary comparison in Table 1 with a supporting one (Table 9) in Appendix B that describe secondary assumptions and the calculation process in more detail.

1 The cost comparison is hindered by the absence of a full description of the DPP alternative to the Powerco CPP. Under the current process Powerco is not required to describe this alternative. We acknowledge that Powerco would need advice from the Commerce Commission to construct a meaningful DPP alternative.

2 A cost benefit analysis would normally cover the life of the project and consider the terminal value of project assets and liabilities at the end of the assessment period. The information in the Powerco CPP is focused on the period of the CPP 2018 to 2023 with some projections out to 2027.

3 Annual SAIDI is the total minutes of interruptions averaged per ICP over a year. Annual System Average Interruption Frequency Index (SAIFI) is the average number of interruptions per ICP over a year.

The Powerco CPP forecasts that the SAIDI for unplanned outages will be reduced by about 24 percent below the forecast DPP level by 2027 but also that planned SAIDI will increase over the CPP period by about 90 percent over the CPP (2019 – 2023). To calculate the value of this change in SAIDI we:

- converted the SAIDI measured in minutes[4] to a change in the quantity of energy delivered measured in mega-watt hours (MWh)
- multiplied the change in energy delivered (MWh) by the value of lost load (VoLL) measured in $/MWh[5] for residential (mean of $16,428 per MWh) and business (median[6] of $39,723 per MWh).

Our comparison indicates that the net effect of the forecast changes in planned and unplanned SAIDI is a small annual cost until the last year of CPP followed by a small but increasing benefit that reaches about $9 million per year by 2027.

Table 1 Value of additional reliability under CPP

Estimates for business and residential users of the benefit of reduced SAIDI

Year	Value of reduction in unplanned SAIDI ($m)		Value of increase in planned SAIDI ($m)		Value of net change in planned and unplanned SAIDI ($m)		
	Residential	Business	Residential	Business	Residential	Business	Total
2018	0.00	0.00	-0.46	-1.06	-0.46	-1.06	**-1.51**
2019	0.38	0.70	-1.33	-3.06	-0.96	-2.37	**-3.32**
2020	1.02	1.88	-1.58	-3.63	-0.56	-1.75	**-2.32**
2021	1.70	3.12	-1.95	-4.48	-0.25	-1.36	**-1.61**
2022	2.27	4.17	-2.25	-5.17	0.02	-0.99	**-0.98**
2023	2.96	5.45	-2.32	-5.34	0.64	0.11	**0.75**
2024	3.49	6.43	-1.29	-2.96	2.21	3.47	**5.67**
2025	4.02	7.40	-1.30	-2.98	2.73	4.42	**7.15**
2026	4.40	8.10	-1.31	-3.01	3.09	5.09	**8.18**
2027	4.57	8.41	-1.32	-3.04	3.25	5.37	**8.62**

Source: NZIER analysis of forecasts and customer consultation by Powerco

In making the above estimates we have used assumptions to replace missing data. In particular, Powerco did not provide forecasts for either planned SAIDI over the DPP or planned SAIDI under the CPP for the period 2024 to 2027.

4 We treated the change in SAIDI measured in minutes as a percentage of a year for which energy would not be supplied and then multiplied this percentage by the total amount of energy delivered in the year to estimate the lost load in MWh.

5 These estimates of the VoLL are included in Powerco's CPP application in the Customer Consultation Report and were calculated for Powerco by PwC based on surveys of residential and business customers.

6 We have used the median rather than the mean VoLL for business customers because we believe the median more accurately reflects the price quality trade-off facing most customers. A more detailed rationale for this position is presented in Appendix B.

As a working assumption for calculating the estimates in the table, we have set the planned SAIDI:

- under the DPP for the period 2018 to 2027 as 45.9 minutes which is the level of planned SAIDI for 2017 and is 1.2 minutes above the average level of planned SAIDI over the period 2008 to 2017
- under the CPP for the period 2024 to 2027 as 69.1 minutes or 86 percent of the average forecast planned SAIDI over the CPP period (2019 to 2023) as average capital expenditure over the period 2024 to 2027 is forecast to be 86 percent of average capital expenditure over the CPP period.

We note that as part of the CPP, Powerco has suggested that planned outages be given a zero (rather than a 50 percent weighting) for the assessment of performance against quality standards. We also note that while business and residential customers discount[7] the value of lost load (VoLL) of a planned outage – the VoLL for a planned outage is still more than 60 percent of the VoLL for an unplanned outage and therefore material to customers.

1.2.2. Does the CPP leave consumers 'better off'?

A key question for the Commerce Commission in assessing the CPP is whether the estimated value of the benefit exceeds the estimated cost. Our attempt to estimate the additional cost of the CPP relative to the DPP is hindered by the lack of DPP expenditure forecasts in the CPP for 2019 to 2023 and any Building Block Allowable Revenue (BBAR) forecasts beyond after 2023. The CPP does include SAIDI, capital expenditure and AHI forecasts out to 2027. (This is not a criticism of the Powerco as they are not required to provide DPP or post CPP BBAR forecasts as part of the CPP process.)

For our comparison of costs and benefits to the consumer we have:

- estimated a DPP revenue requirement for the period 2019 to 2023 based on a 2 percent annual compounding growth rate in the BBAR for 2019 – the first year of the CPP. Powerco pricing methodology reports[8] network indicate that network revenue grew at a compound annual growth rate of 1.48 percent over the period 2014 to 2017 and is forecast to reach $266.1 million in 2018 with a compound annual growth rate of 1.49 percent over the period 2014 to 2018
- estimated a BBAR path after the CPP based on a compound annual growth rate of 3.3 percent which is the average of our assumed 2 percent annual growth rate in the DPP BBAR and the actual compound annual growth rate of 4.67 percent for the CPP BBAR over the period 2019 to 2023.

7 For residential consumers, the mean VoLL for a planned outage is $10,622 per MWh compared to $16,428 per MWh for an unplanned outage. For business customers, the median VoLL for a planned outage is $32,067 per MWh compared with $32,067 per MWh for an unplanned outage.

8 We have used forecast revenue data from the Powerco pricing methodology reports for 2014 to 2018 rather than the actual data from Schedule 8 of the Commerce Commission Information disclosure because payments to Transpower are not reported separately from network revenue until 2017. The forecast total revenue form the pricing methodology reports is almost the same as the total revenue listed in Schedule 8 of the Information Disclosure.

The assumption we have used for the DPP BBAR forecast includes a deliberate upward bias compared to recent revenue growth which makes it more likely that we under-estimate the additional cost of the CPP and over-estimate the net benefit.

As shown in Table 2, the annual additional cost of the CPP is consistently higher than our estimate of the value of the improved reliability. (Our estimates are shown in italics and data from the CPP is shown in normal font.)

Table 2 Benefit and cost of CPP reliability gain

Annual benefits and costs in $million

Year	DPP BBAR	CPP BBAR	Additional CPP Cost (CPP BBAR less DPP BBAR)	Reliability Benefit	Net benefit (reliability benefit less additional CPP cost)
2018	266.1	266.1	*0.0*	*-1.5*	***-1.5***
2019	*266.4*	266.4	*0.0*	*-3.3*	***-3.3***
2020	*271.7*	288.6	*16.9*	*-2.3*	***-19.2***
2021	*277.2*	294.2	*17.0*	*-1.6*	***-18.6***
2022	*282.7*	307.0	*24.3*	*-1.0*	***-25.3***
2023	*288.4*	319.8	*31.4*	*0.7*	***-30.7***
2024	*294.1*	*330.5*	*36.3*	*5.7*	***-30.7***
2025	*300.0*	*341.5*	*41.5*	*7.1*	***-34.3***
2026	*306.0*	*352.9*	*46.9*	*8.2*	***-38.7***
2027	*312.1*	*364.7*	*52.5*	*8.6*	***-43.9***

Source: NZIER analysis of forecasts and customer consultation by Powerco

We estimate that the annual difference between the CPP period BBAR and the DPP[9] BBAR could be in the order of $20 t0 $30 million per year during the CPP and rise above this level after the end of the CPP. We have estimated CPP BBAR using the same 2 percent compound annual growth rate as the DPP BBAR after 2023 and this lowers the annual additional CPP cost by about $5 million per year over the period 2024 to 2027.

[9] The Powerco CPP does not include a counterfactual estimate of the DPP. As a rough proxy, we have estimated a DPP BBAR based on the CPP start value of $226.4 million increased at the rate of 2 percent per year. Based on data reported in Powerco pricing methodology (which unlike the Commerce Commission Information Disclosure reports separate Powerco revenue from transmission payments) the compound annual growth rate in network revenue over the period 2014 to 2018 was about 1.5 percent.

1.3. Does service quality vary?

A core argument of the Powerco CPP is that the network reliability will be compromised in future because:

- the number of network faults is rising rapidly
- network efficiency improvement measures that have mitigated the impact of faults in the past are almost fully deployed.

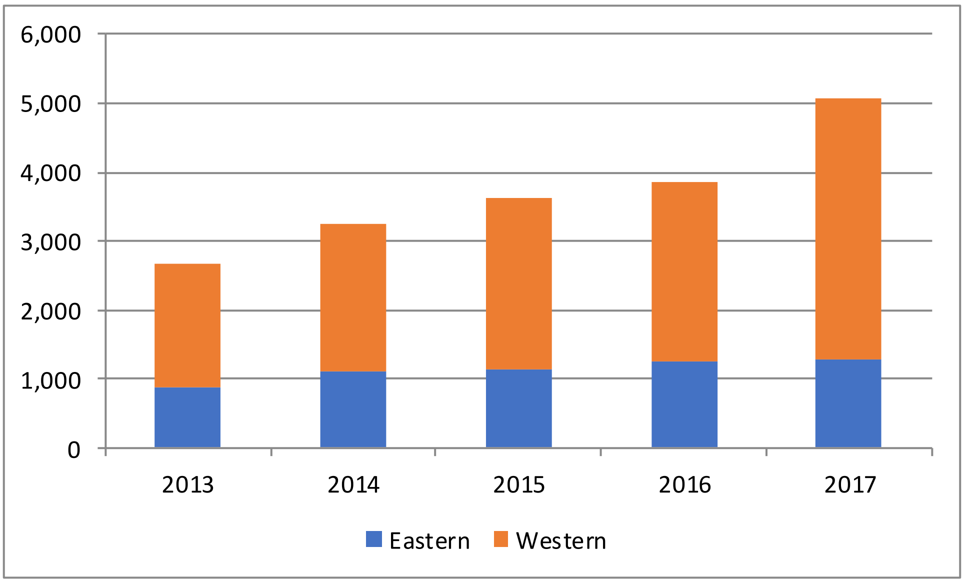
Powerco has presented this argument for the network in aggregate but the fault and SAIDI data suggests that Western and Eastern regions of the network have quite different experiences of faults and severity of outages. This difference suggests that customer experience of change in service levels and prices will be quite different under the CPP in the different regions as it is likely that the Western region will require a higher proportion of the initial capital expenditure to correct faults.

1.3.1. Different fault rates across the network

Figure 1 shows that the fault rate and rate of increase in the faults are markedly higher in the Western region than in the Eastern region. (This is not due to the different lengths of the networks as the measure ‘faults per km’ shows similar differences for the two regions.) However, Figure 2 shows a narrower gap between the impacts of faults on the two networks as measured by SAIDI.

Figure 1 Network faults

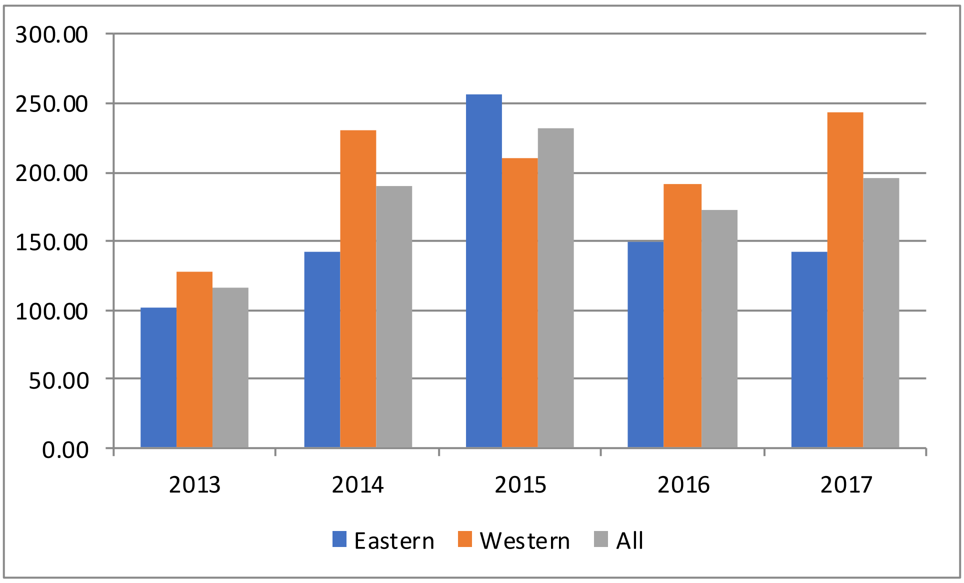
Number of faults on Powerco’s Eastern and Western networks



Source: NZIER analysis of Powerco Information Disclosure(s) to the Commerce Commission

Figure 2 Duration of unplanned outages

SAIDI measured in minutes per ICP per year Powerco's Eastern and Western networks[10]

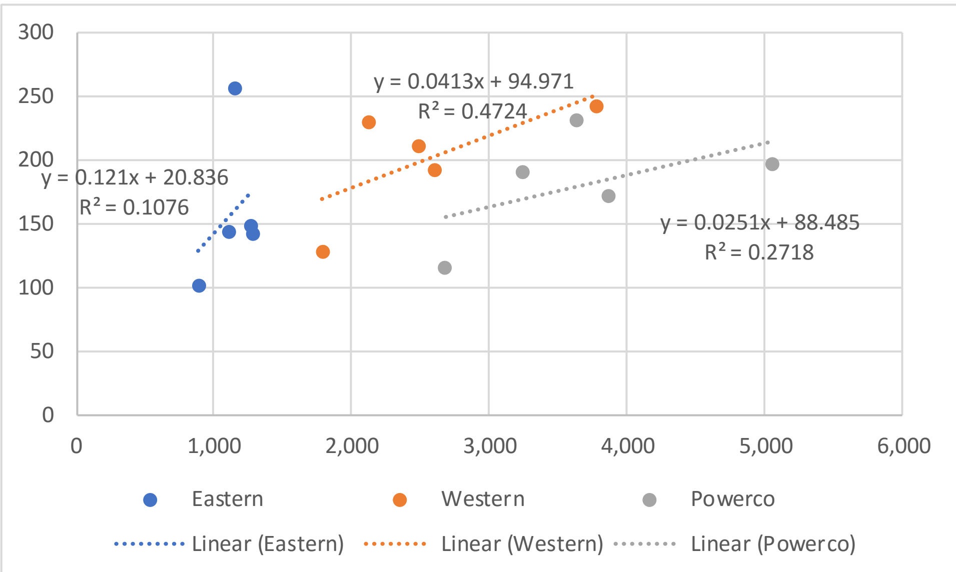


Source: NZIER analysis of Powerco Information Disclosure(s) to the Commerce Commission

Figure 3 and Figure 4 are intended to illustrate the difficulties of establishing a useable correlation between the number of faults and the impact of outages on customers as measured by either average duration (SAIDI) or average frequency (SAIFI).

Figure 3 Faults and duration of unplanned outages

'Correlation' between faults and average outage time per connection (SAIDI)



Source: NZIER analysis of Powerco Information Disclosure to the Commerce Commission

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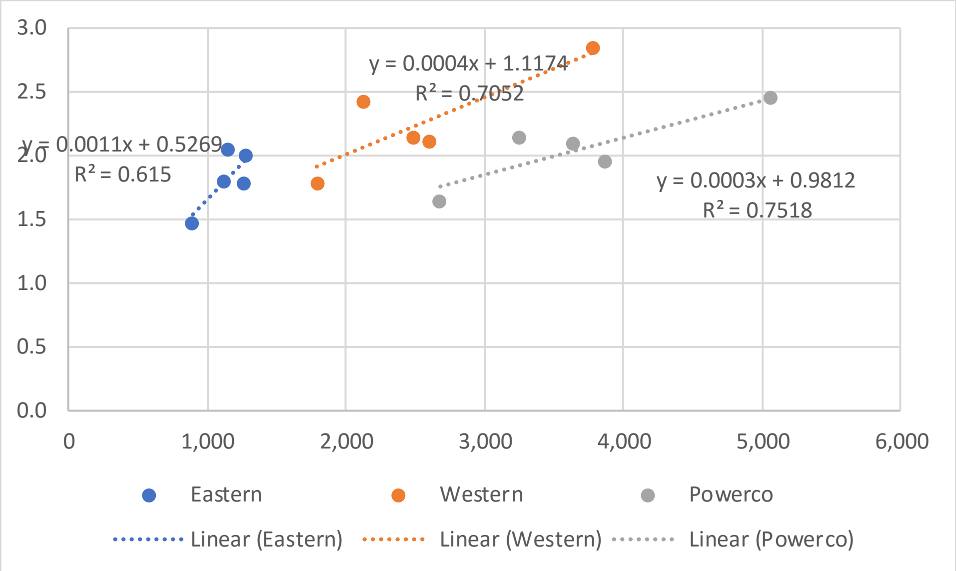
10 The observation of a SAIDI of 257 minutes for the Eastern region in 2015 is the value reported.

Figure 4 Faults and frequency of unplanned outages

'Correlation' between faults and number of outages per connection (SAIFI)



Source: NZIER analysis of Powerco Information Disclosure to the Commerce Commission

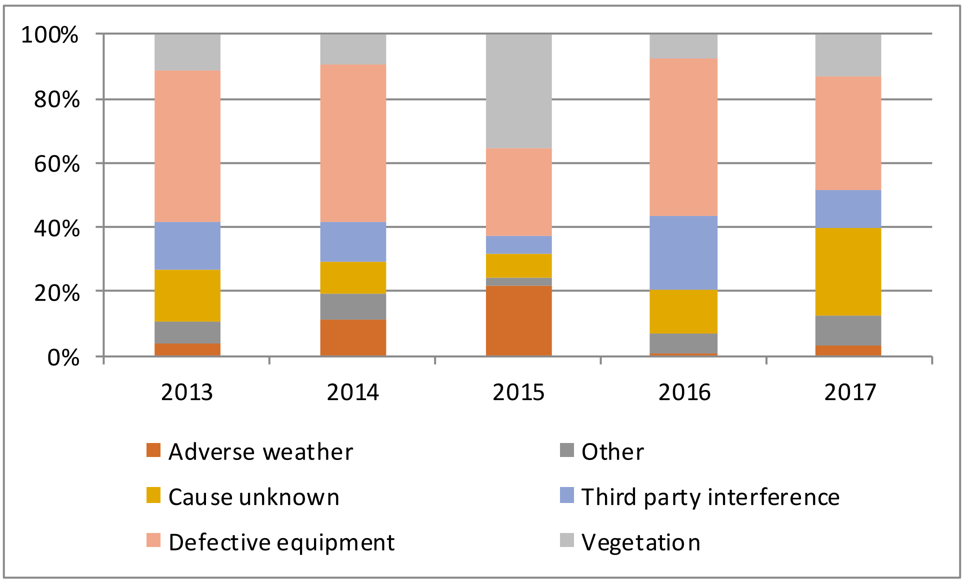
Caution is required when analysing the trend lines in Figure 3 and Figure 4 as they are fitted using only 5 years of data. (For the duration (SAIDI) chart, the measure of fit is poor for all the trend lines and the Eastern and Powerco trend lines are affected by the 2015 outlier for Eastern – due to bad weather and vegetation issues.) However, with this caution in mind the fitted trend lines indicate some unusual correlations:

- Eastern network reliability is more sensitive to faults than the Western network – in other words a fault on the Eastern network is likely to affect more connections and cause a longer outage than a fault on the Western network
- the combined sensitivity of the Eastern and Western networks' reliability to faults is lower than the sensitivity of the individual networks.

Finally, the cause of outages (number and duration) seems broadly similar for both networks despite the year-on-year variation as shown in Figure 5 and Figure 6. On average (over the period 2013 to 2017) defective equipment was responsible for about 42 percent of the outage duration for both the Eastern and Western networks. Also the share of outage duration attributed to defective equipment has fallen to about 35 percent for 2017.

Figure 5 Cause of duration of outage for the Eastern region

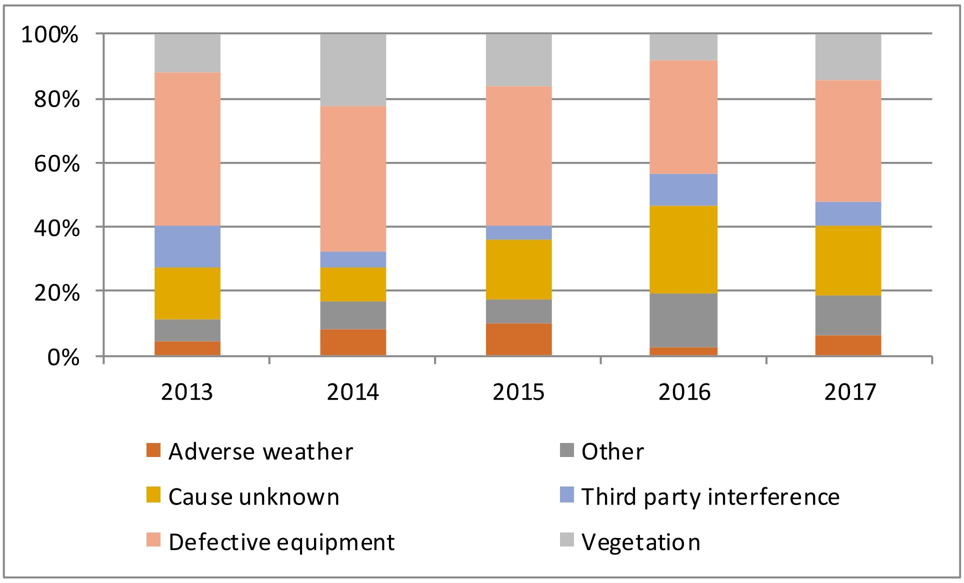
Percentage of outage duration due to each cause



Source: NZIER analysis of Powerco Information Disclosure(s) to the Commerce Commission

Figure 6 Cause of duration of outage for the Western region

Percentage of outage duration due to each cause



Source: NZIER analysis of Powerco Information Disclosure(s) to the Commerce Commission

1.4. Verifier comment on faults

The comments by the verifier question whether the Powerco CPP:

- under-estimates the reduction in unplanned outages that should be achieved by the CPP investment
- over-estimates the level and urgency for increased expenditure to lower fault rates to improve reliability.

A selection of the areas that the verifier suggested the Commerce Commission should investigate further is quoted in Table 3.

Table 3 Verifier's key issues for the Commission

Selected comments from 'Table 2 – Key issues for the Commission' of the verifier's report[11]

Forecast component	Why should the Commission investigate it?	Suggested additional information or line of inquiry
Quality standard variation	*Although Powerco's proposed increase in planned system average interruption frequency index (SAIDI) and system average interruption frequency index (SAIFI) appear reasonable given the proposed increase in planned works during the CPP period, its proposed targets for unplanned SAIDI and SAIFI do not appear to fully incorporate the likely improvement resulting from its proposed expenditure*	*The Commission may wish to undertake its own analysis of the likely reliability benefits arising from the proposed capex and opex programs, or engage with Powerco to have its models refined.*
Overhead conductors renewals capex	*Powerco has not proven that the risk associated with the current level of faults is unacceptable and needs to be reduced.*	*Undertake suitable investigation/analysis to assess the risks posed by distribution conductors failing, and hence the number of faults that can be expected on the network of a prudent EDB.*
Overhead structures renewals capex	*Powerco has not proven that the current fault rate is unacceptable and needs to be reduced. Additionally, Powerco's overhead structures survivor curves include 'green defects' which may overstate levels of expenditure required.*	*Construct new survivor curves excluding green defects. Revise the overhead structures forecast to reflect any changes to the overhead conductor renewals capex.*
Zone substation renewal capex	*With the information provided, we have identified five transformer replacements that could be deferred beyond of the CPP period, although Powerco has not yet had the opportunity to respond to this finding.*	*Confirm with Powerco that its proposed replacement of transformers is prudent in light of our findings.*
Growth and renewals capex	*Powerco does not currently have a probabilistic planning standard, which may lead to greater levels of expenditure necessary.*	*Assess the value of lost load associated with each of the major projects and a sample of the minor works.*
Reliability capex	*The level of expenditure proposed does not appear justified as the significant uplift in other capex appears sufficient to meet Powerco's aim to maintain unplanned reliability without the inclusion of a large reliability program.*	*Evaluate forecast reliability performance with the reliability program included to determine the level of expenditure required on reliability specific programs.*
Network evolution capex	*Information provided does not provide sufficient justification to verify the level of expenditure proposed.*	*Engage with Powerco on its business cases for its network evolution initiatives, including on whether the expected benefits of each initiative are likely to outweigh the costs and the alternative options available.*

Source: Powerco's Customised Price Path Application Final verification report for Powerco

[11] Source: 'Powerco's Customised Price Path Application Final verification report for Powerco - 7 June 2017', Farrier Swier Consulting, pages 19-20.

The detailed comments in the verifier's report on the issues listed in Table 3 are typically more critical of Powerco CPP and the suggested course of action more aggressive than the comments in Table 3.

Specifically:

- quality standard variations; Appendix E[12] of the verifier's report argues that the Powerco CPP forecast of unplanned outages ignores a long term declining trend in SAIDI and SAIFI and the forecasts start at a level that is too high. The trend-line for SAIDI in the verifier's report[13] forecasts a fall in SAIDI from about 150 minutes in 2017 to less than 40 minutes in 2028. In contrast the CPP forecasts SAIDI of 169 minutes in 2018 and SAIDI of 161 minutes in 2028 with a low of 158 minutes in 2024
- unverified capital expenditure of $95m: Section 3.3.1[14] of the verifier's report identifies up to about 11 percent of the forecast CPP capital expenditure as potentially overstated due to a combination of modelling approaches and asset replacement policies.

1.5. Consultation document comments

Powerco consulted extensively with its customers around the proposed CPP and three alternatives. The consultation included surveys of customer attitudes to Powerco services, price changes, willingness to pay to avoid outages and VoLL.

The final stage of the consultation sought customer feedback on four scenarios:[15] 'DPP Allowance', 'Must Do', 'Our CPP Proposal' and 'Enhance security and resilience'. These are summarised in Table 4.The consultation document also included advice to customers of the forecast unplanned and planned SAIDI in a single chart[16] and showed an almost flat trend in unplanned in SAIDI and an increase in planned SAIDI.

The description of the difference in reliability between 'DPP Allowance' and 'Our CPP Proposal' seems much more pronounced than is suggested by the forecast: 32 percent difference in unplanned SAIDI in 2027 based on Powerco forecasts. (The forecast difference in unplanned outages is not adjusted for the higher level of planned SAIDI under the CPP.)

Also the consultation does not compare the gain in reliability with the value of lost load to customers.

12 See: 'Powerco's Customised Price Path Application Final verification report for Powerco - 7 June 2017', Farrier Swier Consulting,, Appendix E pages 209 to 219.

13 See: 'Powerco's Customised Price Path Application Final verification report for Powerco - 7 June 2017', Farrier Swier Consulting,, Appendix E, Figure 35 page 215.

14 See: 'Powerco's Customised Price Path Application Final verification report for Powerco - 7 June 2017', Farrier Swier Consulting, pages 41 to 42.

15 See: 'Investing to ensure safety, security and resilience 2018 – 2023 Investment Proposal Have your say' – CPP Consultation: January 2017 pages 25-26.

16 See: 'Investing to ensure safety, security and resilience 2018 – 2023 Investment Proposal Have your say' – CPP Consultation: January 2017, Figure 4 page 14.

Table 4 Powerco CPP consultation scenarios

Extracts quoted from 'Have your say' pages 25 to 26

Option	Scenario	Revenue increase	Customer Outcome
DPP Allowance	*Set investments levels at the current regulatory allowance (Note that the DPP allowance is lower than our current spend.)*	*No change*	*Under this scenario minimum levels of safety cannot be maintained over the next five years. Risks to our staff and the public rise above the level allowed under industry safety regulations. The scenario is not considered viable or acceptable.*
Must Do	*Limit expenditure to safety critical items. Accept increasing numbers of assets failing in service.*	*5%*	*Immediate safety risks are managed over the next five years, however asset failure rates increase, and security margins erode below acceptable levels. Outages become noticeably more frequent for many, and replacement of assets is deferred or managed reactively. Current network architecture is maintained, and customers are restricted in their application of new energy solutions where these impact network outcomes. Customers are asked to fund the full cost of connection and connections of new load (e.g. business loads and EV loads) are restricted where capacity is not available. This scenario provides lower short term cost, but at the expense of resilience and security, and would require higher levels of investment (and prices) beyond the five year period.*
Our CPP Proposal	*We include investments that we believe will maintain safe, secure resilient networks, and minimise long term costs.*	*9%*	*Safety risks are managed for the longer term on a prudent basis to ensure the long term safety of our staff, service providers and the general public. Asset failure rates are stabilised, and network performance is maintained. Customer contributions are maintained at current levels, and new load is accommodated where it is economic to do so. New technology is evaluated and incorporated onto our networks to aid the connection of new energy solutions, and to moderate the long term cost of network operation. This scenario provides acceptable levels of resilience and security, and reduced long-term costs.*
Enhance security and resilience	*Includes all security investments currently considered 'best practice' and increased renewal programmes to minimise outages.*	*11%*	*We reposition our approach to reflect best practice in electricity distribution. Assets are replaced in a way that reduces unplanned outages to a minimum, security is lifted so that it is in accordance with internationally recognised standards, and new technologies are rolled out at scale to position our networks at the very forefront of technology development. This scenario provides the highest level of network security, resilience and flexibility, but is the highest cost.*

Source: Investing to ensure safety, security and resilience 2018 – 2023 Investment Proposal

1.6. Conclusion

Based on Powerco’s surveys of its customers, we estimate that the value to consumers of the increased network reliability under the CPP is considerably lower than our estimate of the increased cost to customers.

Powerco’s proposal to apply a zero rather than a 50 percent weighting to planned SAIDI and SAIFI for the Commerce Commission’s performance monitoring of Powerco compliance with its quality path is a material change to its performance incentives.

The verifier’s report raises doubts about whether the forecast improvement in SAIDI is understated in the CPP and the level of investment required to achieve the CPP reliability objectives is overstated.

2. Asset health and criticality

2.1. What is being measured

The purpose of this section is to review the change in asset health forecast under the CPP and consider whether this is consistent with the improvement in network reliability forecast in the CPP.

The CPP measures asset health using a 5-category scale based on Powerco's assessment of the remaining life of the asset based on several indicators including assets, age, condition and survival curves.

Table 5 Asset Health Indices (AHI)

Description of risk of asset failure and time limit for replacement

AHI	Asset quality	Replacement
H1	Asset has reached the end of its useful life	Within one year
H2	Material failure risk, short term replacement	Within 3 years
H3	Increasing failure-risk, medium term replacement	Between 3-10 years
H4	Normal deterioration, regular monitoring	Between 10-20 years
H5	As new condition, insignificant failure risk	Over 20 years

Source: Powerco CPP Main Application

The only readily available alternative indicator to the Powerco AHI is the age of the assets as listed in Powerco's Information disclosure. Although this indicator does not provide information on the current condition of the assets it is reported separately and therefore gives an indication of the difference in asset quality for the Eastern and Western networks. (The AHI is only reported for the network as a whole.)

2.2. Forecast change in asset health

The forecast change in asset health in the Powerco CPP compares the current AHI with forecast AHI in 2027 based on:

- the renewals planned under the CPP over the years 2019 to 2023 plus additional capital expenditure at about 86 percent of average CPP levels over the period 2024 to 2027[17]
- a 'do nothing' scenario with not asset renewals which is described by Powerco as:

  This isn't presented as a counterfactual (which would be the DPP) but rather as a useful illustration to understand the full potential health degradation over the forecast period. As we will always ensure our assets are safe and provide reasonable service 'do nothing is not a viable option.[18]

Powerco presents the AHI as a proxy for the risk of asset failure. If the CPP and AMP are to improve the reliability of the network then the proportion of assets needing rapid (within 3 years) replacement should be substantially lower at the end of the CPP and AMP than it is currently.[19] The forecast AHI does not provide evidence of an across the board substantial improvement in AHI by 2027 as shown in Table 6 and Table 7.

These two tables compare the change in AHI for the 'Current Health (FY16)' with 'Planned Renewals (FY27)' for assets with an AHI that would be require them to be replaced within three years (AHI of H1 and H2) and that would require them to be replaced within the next 10 years (AHI of H1, H2 and H3). The 'Change' column of the table equals the AHI for 'Current Health (FY16)' minus the AHI for 'Planned Renewals (FY27)'. A positive value in this column indicates an improvement in asset quality and a negative value is deterioration in asset quality. Negative change values are shaded in the tables.

For assets requiring replacement within three years (H1 and H2):

- eight out of 17 assets have a lower forecast AHI in 2027 than in 2016
- three of the 17 improve their AHI by less than 1 percentage point
- the assets that record the greatest improvement are 'distribution' (high voltage overhead lines and cables), 'ground mounted switchgear' and 'circuit breakers'.

For assets requiring replacement within ten years (H1, H2 and H3):

- ten out of 17 assets have a lower forecast AHI in 2027 than in 2016
- two of the 17 improve their AHI by less than 1 percentage point
- the assets that record the greatest improvement are 'indoor switchgear', 'ground mounted switchgear' and 'circuit breakers'.

17 The capital expenditure forecasts are listed in Powerco's Asset Management Plan. This comment refers to the capital expenditure forecasts in 2016 dollars.

18 See Powerco CPP Main Application, Box 11.1 Asset Health Indices (AHI), p82

19 The Powerco CPP does not provide AHI forecasts for the end of the CPP period and does not quantify the improvement in AHI required to deliver a reduction in the fault rate let alone an improvement in the SAIDI and SAIFI measures of network reliability.

The Powerco CPP does not describe the contribution of specific asset classes to network fault rates or the impact of those faults on customers (as measured by SAIDI and SAIFI). Therefore it is not possible for us to compare the change in AHI reported in the following tables with the CPP forecasts of reduction in faults, SAIDI and SAIFI.[20]

However the change in AHI based on the forecast increased capital expenditure does indicate that Powerco believes it needs to make a permanent increase in capital expenditure above historical DPP levels to maintain its network. In other words the proposed capital expenditure in the CPP is an indicator of Powerco's estimate of long term investment rather than a one-off catch-up.

[20] Also without AHI forecast for the end of the CPP period we cannot form a view on whether network reliability is likely to peak at the end of the CPP or remains stable or continues to improve during the period 2024 to 2027.

Table 6 Change in AHI for H1 and H2 assets

Proportion of assets classified with an AHI that require replacement within the next three years. A positive number for 'Change' is an improvement in AHI

Asset category from the Powerco CPP	Current Health (FY16)	Planned Renewals (FY27)	Change
'Figure 11.3 Wooden poles - current and projected asset health' on p86	25.90	20.72	5.18
Figure 11.4 Concrete poles - current and projected asset health' on p87	3.38	2.72	0.66
'Figure 11.5 Cross arm assets- current and projected asset health' on page 89	12.37	11.23	1.14
'Figure 11.9 Sub-transmission Aluminium conductor - current and projected asset health' on page 93	1.05	0.53	0.52
'Figure 11.13 Distribution - current and projected asset health' on page 96	16.71	4.76	11.95
'Figure 11.14 Low Voltage conductor - current and projected asset health' on page 98	1.74	5.18	-3.44
'Figure 11.16 Sub-transmission cable - current and projected asset health' on page 101	8.72	8.77	-0.05
'Figure 11.17 Distribution cable - current and projected asset health' on page 101	8.72	8.77	-0.05
'Figure 11.19 Power transformer - asset health' on page 105	2.58	0.59	1.98
'Figure 11.20 Indoor switchgear- current and projected asset health' on page 107	3.26	3.77	-0.51
'Figure 11.21 Outdoor switchgear- current and projected asset health' on page 108	2.33	7.36	-5.04
'Figure 11.23 Pole mounted distribution transformers - current and projected asset health' on page 113	4.24	3.87	0.37
'Figure 11.24 Ground mounted distribution transformers - current and projected asset health' on page 114	1.71	2.27	-0.56
'Figure 11.26 Ground mounted switchgear - current and projected asset health' on page 118	19.12	2.77	16.35
'Figure 11.27 Pole mounted fuses - current and projected asset health' on page 118	4.13	5.15	-1.02
'Figure 11.28 Pole mounted switches - current and projected asset health' on page 119	7.93	8.87	-0.94
'Figure 11.29 Circuit breakers - current and projected asset health' on page 119	57.28	0.00	57.28

Source: NZIER analysis of data used by Powero to draw the charts listed in the Powerco CPP Main Application

Table 7 Change in AHI for H1, H2 and H3 assets

Proportion of assets classified with an AHI that require replacement within the next three years. A positive number for 'Change' is an improvement in AHI

Asset category from the Powerco CPP	Current Health (FY16)	Planned Renewals (FY27)	Change
'Figure 11.3 Wooden poles - current and projected asset health' on p86	44.25	40.13	4.12
Figure 11.4 Concrete poles - current and projected asset health' on p87	6.52	6.40	0.13
'Figure 11.5 Cross arm assets- current and projected asset health' on page 89	25.44	25.94	-0.50
'Figure 11.9 Sub-transmission Aluminium conductor - current and projected asset health' on page 93	3.07	5.47	-2.40
'Figure 11.13 Distribution - current and projected asset health' on page 96	20.27	12.94	7.34
'Figure 11.14 Low Voltage conductor - current and projected asset health' on page 98	8.25	18.56	-10.32
'Figure 11.16 Sub-transmission cable - current and projected asset health' on page 101	9.92	15.90	-5.98
'Figure 11.17 Distribution cable - current and projected asset health' on page 101	9.92	15.90	-5.98
'Figure 11.19 Power transformer - asset health' on page 105	3.24	8.99	-5.75
'Figure 11.20 Indoor switchgear- current and projected asset health' on page 107	16.09	4.89	11.20
'Figure 11.21 Outdoor switchgear- current and projected asset health' on page 108	22.48	13.57	8.91
'Figure 11.23 Pole mounted distribution transformers - current and projected asset health' on page 113	11.73	12.50	-0.77
'Figure 11.24 Ground mounted distribution transformers - current and projected asset health' on page 114	6.45	8.24	-1.79
'Figure 11.26 Ground mounted switchgear - current and projected asset health' on page 118	24.97	8.80	16.17
'Figure 11.27 Pole mounted fuses - current and projected asset health' on page 118	14.12	17.94	-3.81
'Figure 11.28 Pole mounted switches - current and projected asset health' on page 119	19.13	20.50	-1.38
'Figure 11.29 Circuit breakers - current and projected asset health' on page 119	61.65	2.91	58.74

Source: NZIER analysis of data used by Powerco to draw the charts listed in the Powerco CPP Main Application

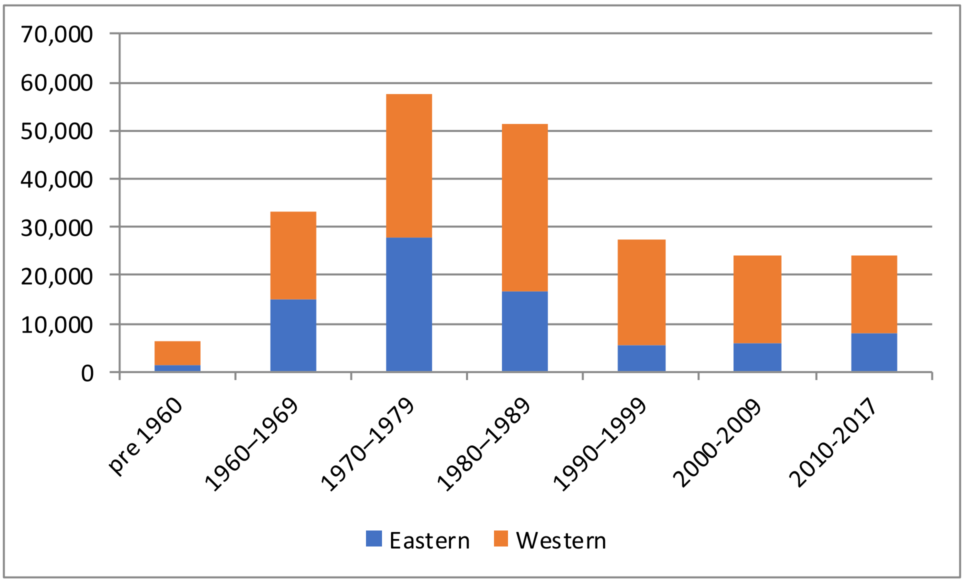
2.3. Asset age in the networks

The AHI reported in the Powerco CPP aggregates asset conditions in the Eastern and Western networks. The asset age profile for the Eastern and Western networks reported in Powerco's Information disclosure indicate that for the major asset categories (aside from concrete poles) the assets in the Western region are older and in some cases more fault prone (for example wooden poles). Also, in some instances the networks use quite different mixes of underground and overhead conductors.

Figure 7, Figure 8 and Figure 9 compare the age bands for the several of the major asset categories. (These categories are similar to the AHI categories used by Powerco in the CPP but unfortunately are not a 'one-to-one' match.)

Figure 7 Concrete pole age

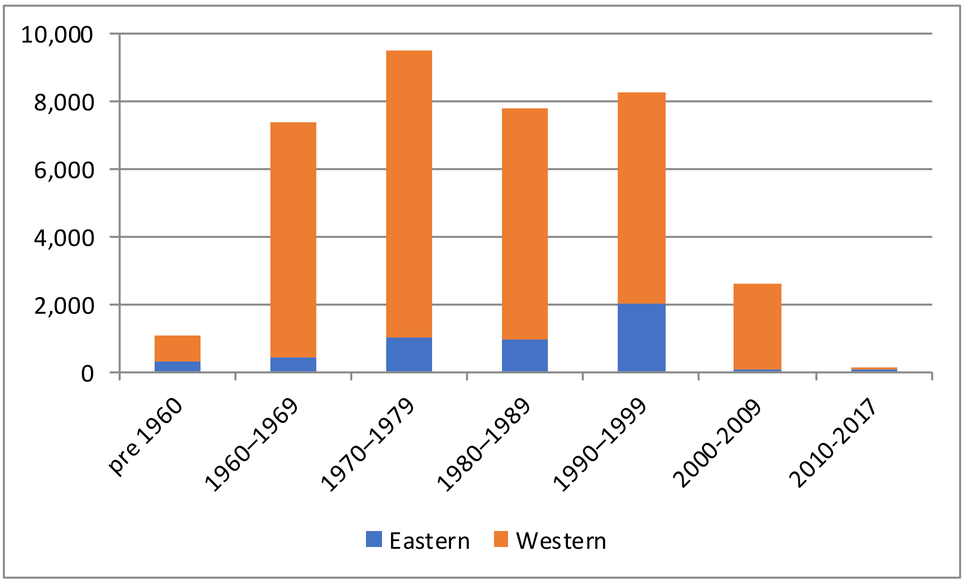
Number by installation year in 10 year bands for the Eastern and Western regions



Source: NZIER analysis of Powerco Information Disclosure

Figure 8 Wooden pole age

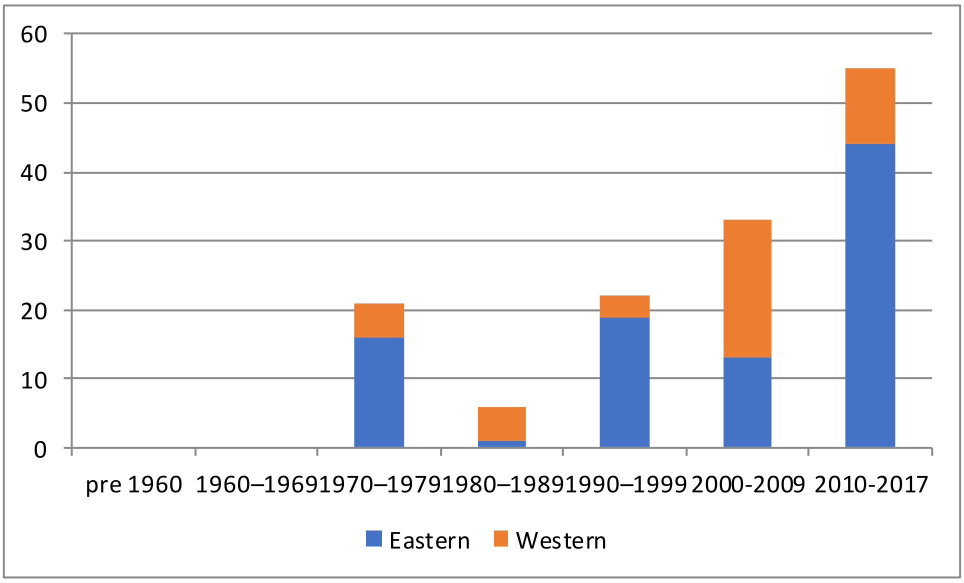
Number by installation year in 10-year bands for the Eastern and Western regions



Source: NZIER analysis of Powerco Information Disclosure

Figure 9 Underground sub-transmission cable age

Length in km by installation year in 10-year bands for the Eastern and Western regions



Source: NZIER analysis of Powerco Information Disclosure

2.4. Verifier comment

The verifier's report only has few comments on the AHI modelling approach used by Powerco, and most are related to the AHI models for some asset classes. The verifier does not appear to have made any comment about the change in AHI between 2016 and 2027 forecast by Powerco or the links between AHI, system reliability, and SAIDI and SAIFI. In the absence of this comment we do not have a complete independent network engineering assessment of the validity of the cost reliability trade-off that Powerco is offering through the CPP.

2.5. Consultation document comments

Most of the references to AHI in the consultation documents are qualitative descriptions of asset health and its importance to reliability. However, Powerco has provided AHI charts for the **current situation and all four scenarios**[21] for selected assets as follows:

- wooden poles, concrete poles and overhead assemblies (cross-arms and associated components) in 'Appendix 1 - Overhead structures renewals'
- distribution conductors and low voltage conductors in 'Appendix 2 - Overhead conductor renewals'. (Sub-transmission conductors and low voltage conductors are mentioned but a chart is not provided.)

The main observations on the charts[22] based on visual inspection rather than actual data are:

- wooden pole condition (proportion requiring replacement within 3 years) is forecast to be much worse in 2027 under the 'DPP' and 'Must do' options than under the CPP but the number of wooden poles requiring replacement is still high in 2027 even under the CPP
- cross-arm condition (proportion requiring replacement within 3 years) is slightly worse in 2027 under 'DPP' than it is 'now' (FY16) and slightly better under in 2027 under the 'Must Do' and 'CPP' than it is 'now' (FY16)
- concrete pole condition in 2027 (proportion requiring replacement within 3 years) is marginally worse in 2027 under 'DPP' than it is 'now' (FY16) and slightly better in 2027 under the 'Must Do' and 'CPP' than it is 'now' (FY16) but the proportion requiring replacement within 3 years seems to be less than 5 percent of the number of concrete poles
- distribution conductor condition in 2027 (proportion requiring replacement within 3 years) is marginally better in 2027 under 'DPP' and 'Must Do' than it is 'now' (FY16) and much better in 2027 under the 'CPP' than it is 'now' (FY16).

Overall the consultation documents do not provide a clear quantitative description of the link between asset health and reliability or the trade-off between reliability and investment.

21 See See: 'Investing to ensure safety, security and resilience 2018 – 2023 Investment Proposal Have your say', – CPP Consultation: January 2017, pages 32 to 37.

22 It is not clear if these charts are current were updated for the AMP.

2.6. Network demand

The AMP[23] included as part of the CPP, forecasts growth in energy delivered and peak demand of about the same amount over the period 2017 to 2022:

- compound annual growth in energy delivered of 0.91 percent
- an increase in peak network demand of 4.54 percent over the period.

In contrast over the period 2013 to 2017 the change in energy delivered increased much more slowly than the change in peak demand:

- energy delivered increased at an annual rate of 0.10 percent comprising:
  - annual growth in the Western region of 0.73 percent
  - annual decline in the Eastern region of 0.51 percent
- an increase in peak network demand over the period of 9.47 percent comprising:
  - an increase in peak demand for the Western region of 8.17 percent
  - an increase in peak demand for the Eastern region of 10.14 percent.

The forecast growth in energy delivered seems to be high in comparison to recent history. This is potentially challenging for Powerco's revenue outlook as about 52 percent of its revenue is from energy delivered charges that are collected almost entirely from residential consumers. The forecast for growth in peak demand is difficult to assess without comment on the gap between capacity and peak load.

2.7. Conclusion

The main CPP application does not include a comparison of asset health under the CPP and DPP. The information on AHI that is presented suggests that by 2027 AHI for individual asset classes is forecast to:

- improve for some assets but deteriorate for others
- change by widely varying amounts both in absolute terms and relative to the proportion of assets requiring replacement within 3 years (that are presumably most likely to fail).

The main CPP application does not quantify either the relative importance of the health of different asset classes to network faults or the link between network faults and consumer experience of outages (other than the sets of data points of AHIs and SAIDI/SAIFI in FY16 and 2027).

Faults, outages, asset replacement requirements (as indicated by age/type of asset) and growth rates differ markedly between the Eastern and Western regions which suggests consumers in these regions will face quite different price/reliability trade-offs.

[23] See: 'Investing for your energy future, Powerco, Electricity Asset Management Plan 2017, Supporting our Customised Price Quality Path Application' SCHEDULE 12C: REPORT ON FORECAST NETWORK DEMAND, page 305.

3. Powerco pricing

3.1. Introduction

We accept that the Commerce Commission may have limited interest in Powerco's consumer pricing as the CPP decision for the Commerce Commission is the approval of a 'revenue-quality' path rather than an expenditure plan. Also the efficiency of electricity pricing is a regulatory issue for the Electricity Authority rather than the Commerce Commission.

However in making its decision, the Commerce Commission does need to consider the price reliability trade-off likely to be presented to customers under the CPP and arguably should consider how customers might react to price changes. Also the different asset age and growth profile of the two networks suggests they will receive a different mix of investment. Therefore estimated change in average prices over all of Powerco's network are unlikely to be a good indicator of the price changes in the Eastern and Western regions – both sizeable networks in their own right compared to other EDB on regulated price-quality paths.

3.2. Comparing network revenue sources

Powerco receives most of its revenue in both the Eastern and Western networks from residential customers but they face quite different pricing structures. Overall the number of residential consumers rose by 3.4 percent over the period 2013 to 2017 but energy delivered fell by 1.9 percent.

Powerco's revenue discussed in this section includes transmission charges – a pass-through payment from EDB to Transpower for the use of the national grid which accounts for about 32 percent of Powerco's revenue and has increased by about 23 percent[24] over the period 2014 to 2018.

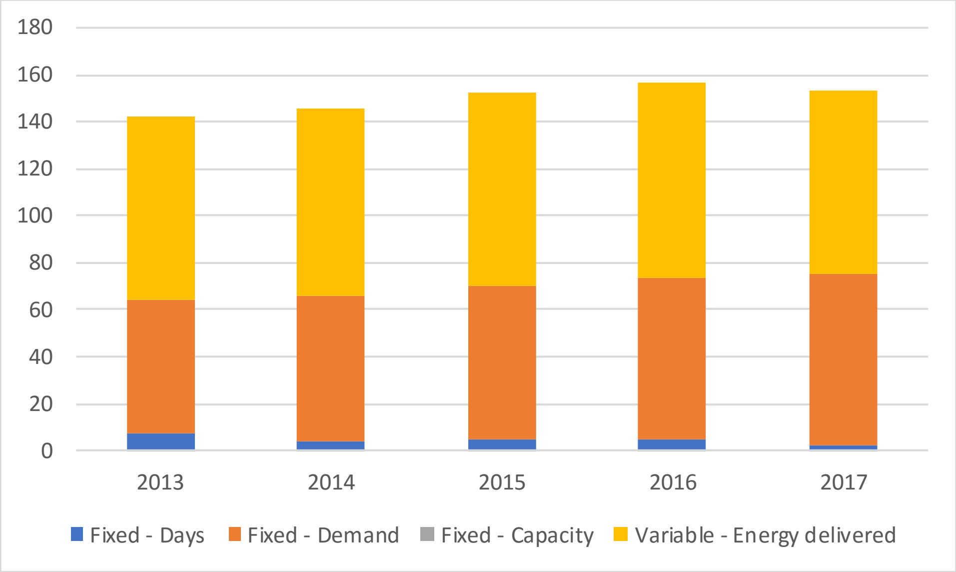
[24] This estimate is based on Powerco's pricing methodology reports.

3.2.1. Residential revenue

Western network residential revenue is almost evenly split between fixed demand (48 percent of 2017 residential revenue) and energy delivered charges (51 percent of 2017 residential revenue) as shown in Figure 10. Energy delivered to Western network residential consumers has fallen by about 4.3 percent over 2013 to 2017.

Figure 10 Western network residential revenue sources

Distribution and transmission revenue ($ million)



Source: NZIER analysis of Schedule 8 of Powerco's Information disclosure to the Commission

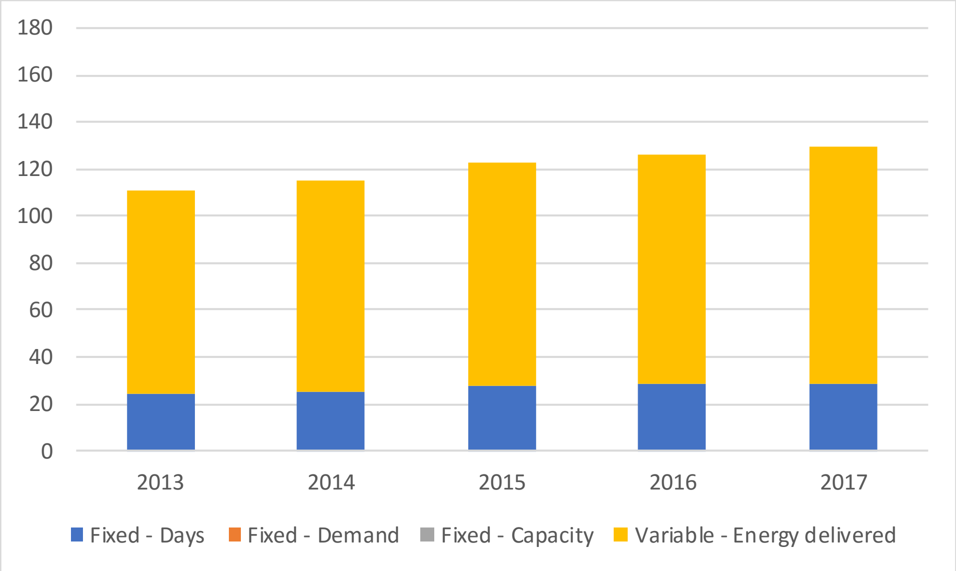
Eastern network residential revenue is mostly from energy delivered charges (78 percent of 2017 residential revenue) and fixed daily charges (22 percent of 2017 residential revenue) and is shown in Figure 11. Energy delivered to Eastern network residential consumers has increased by 1.2 percent over 2013 to 2017.

Our analysis of Powerco pricing methodology reports and tariff schedules indicates that residential consumers in the:

- Eastern network particularly Tauranga are switching rapidly from standard to low fixed charge plans – moving away from cost reflective pricing
- Western network are gradually switching from controlled to uncontrolled plans despite the additional fixed charge of $0.15 per day.

Figure 11 Eastern network residential revenue sources

Distribution and transmission revenue ($ million)



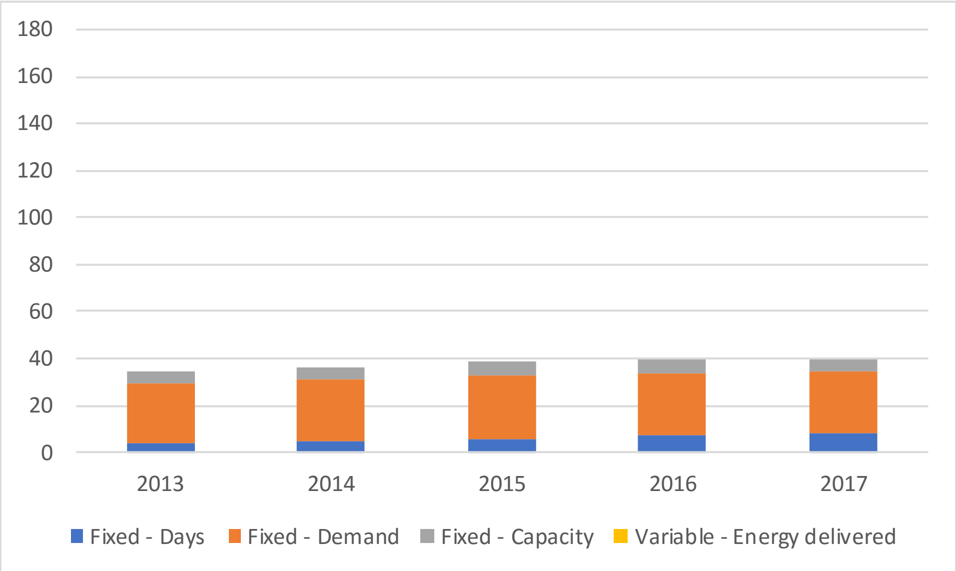
Source: NZIER analysis of Schedule 8 of Powerco's Information disclosure to the Commission

3.2.2. Commercial and industrial revenue

In contrast to residential revenue almost all the revenue from non-residential consumers (commercial to large industrial) is from fixed charges usually based on capacity or demand in both networks (except for 'medium' commercial consumers in the Eastern network) as shown in Figure 12 and Figure Figure 13.

Figure 12 Western network commercial/industrial revenue sources

Distribution and transmission revenue ($ million)

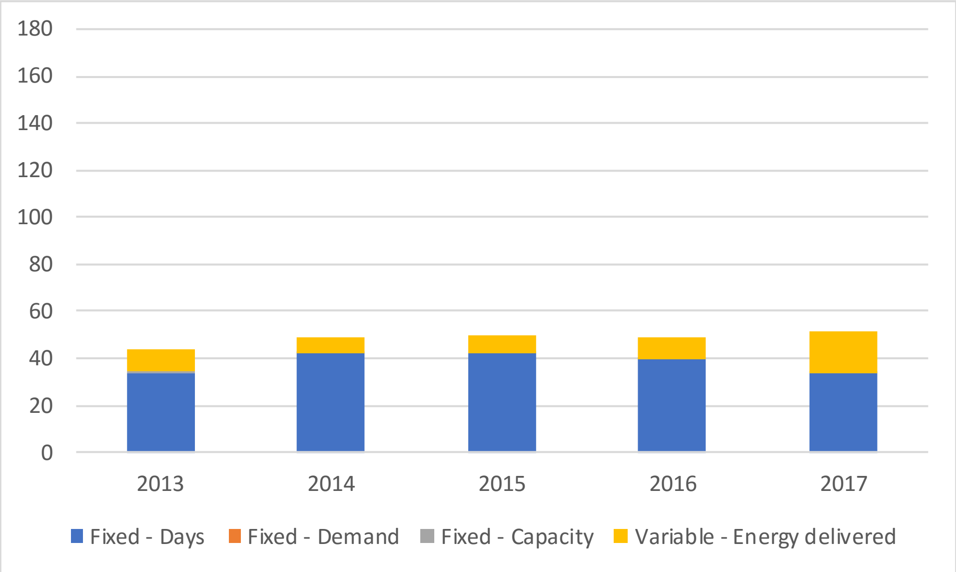


Source: NZIER analysis of Schedule 8 of Powerco's Information disclosure to the Commission

Most commercial/industrial revenue for the Western network is earned through a fixed demand charge while for the Eastern region most commercial/industrial revenue is earned through a fixed daily charge that is tiered based on consumer load. The increased share of energy delivered revenue in the Eastern network in 2017 occurred in the 'large commercial non-standard' group of consumers.

Figure 13 Eastern network commercial/industrial revenue sources

Distribution and transmission revenue ($ million)



Source: NZIER analysis of Schedule 8 of Powerco's Information disclosure to the Commission

For all consumers across both networks, transmission charges are allocated between 'residential', 'medium' and 'large' consumer groups using a weighted average of each groups' share of regional coincident peak demand (80% weighting) and share of the number of ICPs (20% weighting).

3.3. Price signals?

Economically efficient prices send[25] signals to consumers the additional cost of increased capacity and the increased cost of using the network when it is near capacity – an aspect of the cost of reliability. Some of Powerco's prices such as 'demand' and 'capacity' are much closer to being economically efficient than others such as 'energy delivered'. Powerco does not have an explicit plan in its CPP to standardise pricing signals and move to cost reflective pricing despite proposing a step increase in investment.

[25] We accept that these signals may be obscured by aggregated billing or price smoothing/bundling by energy retailers or that consumers may just not care about the marginal price difference – but this discussion is focused on the signal sent by EDB.

Appendix A Powerco networks

A.1 Network characteristics

The Eastern and Western regions have quite different structures and are on different growth paths as shown in the following table.

Table 8 Powerco network characteristics

Measure	Eastern	Western	Total
Overhead network length (km)	7,200	14,600	21,800
Underground circuit length (km	3,200	2,900	6,200
Zone substations	48	68	116
Peak demand (MW)	463	447	906
Energy throughput (GWh)	2380	2430	4810
Network revenue 2017 ($m)	120.9	137.3	258.2
Network revenue 2018 ($m)	122.5	143.6	266.1

Source: Powerco CPP Main proposal p7, Schedule Information disclosure, pricing methodology

Appendix B Quality data

B.1 Introduction

This section explains our argument for using the median rather than mean VoLL for business in calculating the value to consumers of reduced outages and provides detail on the steps in the calculation.

In 2017 Powerco had:

- 331,550 residential customers that paid $283 million ($80 million transmission[26] and $293 million distribution costs) equivalent to an average of $110 per MWh of which more than 60 percent was collected by Powerco as variable charges based on the amount of energy delivered
- 1,375 'commercial' customers that paid $23 million ($6 million transmission and $17 million distribution costs) equivalent to an average of $88 per MWh but collected by Powerco almost entirely as fixed charges based on connection capacity or maximum demand
- 618 'industrial' customers that paid $70 million ($33 million of transmission and $37 million distribution costs) equivalent to an average of $88 per MWh but collected by Powerco as fixed charges based on days connected, connection capacity or maximum demand.

B.2 Why use median VoLL for businesses

The PwC survey [27] estimated the median and mean VoLL for business customers of one outage lasting one hour at $39,273 and $521,929 per MWh, respectively. The difference between the median and mean VoLL indicates there is a small group of business users that attach an extremely high value to lost load in excess of the mean.

We have used the median estimate of VoLL $39,273 in our analysis for the following reasons:

- It is at the high-end of average VoLL for North Island non-residential consumers as estimated in a study by PwC for the Electricity Authority in 2015[28] which estimated average VoLL of:
  - commercial consumers – $37,151 per MWh
  - light Industrial $8,678 per MWh
  - heavy Industrial $19,451 per MWh
  - residential $15,877 per MWh
- if consumers had a VoLL in the order of hundreds of thousands of dollars we would expect that it would be feasible for them to have back-up power supply arrangements in place that would reduce their exposure to

26 Transmission costs are collected by Powerco on behalf of Transpower.

27 'See: 'Full results from consumer survey, Survey results for Powerco', PwC, April 2017, pages 77 and 78.

28 See: 'Estimates of North Island VoLLs – May 2015', PwC page 1.

unplanned outages and therefore reduce their benefit from improved network reliability below the mean VoLL.

B.3 Calculation of reliability benefits

Table 9 shows the data used to convert the change in unplanned SAIDI measured in minutes[29] to a change in the quantity of energy delivered measured in MWh for residential and business consumers – the first stage in the estimation of the value of reliability benefits. (The same forecast energy delivered was also applied to the forecast for planned SAIDI.)

SAIDI is measured in minutes. The change in SAIDI was divided by the total number of minutes in a year – the resulting percentage was multiplied by the actual and forecast energy delivered to residential and business consumers listed Table 9 to estimate the change in energy delivered to these consumer groups under the CPP and DPP forecasts of SAIDI. Energy delivered was forecast by multiplying energy delivered in 2017 by the growth in energy demand forecast in the AMP over the period 2019 to 2022 and an annual growth rate of 0.89 percent for the period 2023 to 2027.

Table 9 Forecast energy delivered

Estimate effect of difference between SAIDI under CPP and DPP on energy delivered (MWh)

Year	Growth rate	Total energy delivered		Increase in energy delivered under CPP	
		Residential	Business	Residential	Business
2017		2,572,926	1,957,940		
2018	0.93%	2,596,744	1,976,065	0	0
2019	0.92%	2,620,563	1,994,191	23	18
2020	0.91%	2,644,381	2,012,316	62	47
2021	0.88%	2,667,658	2,030,029	103	79
2022	0.89%	2,691,477	2,048,154	138	105
2023	0.89%	2,715,508	2,066,441	180	137
2024	0.89%	2,739,753	2,084,892	213	162
2025	0.89%	2,764,215	2,103,507	245	186
2026	0.89%	2,788,896	2,122,288	268	204
2027	0.89%	2,813,797	2,141,237	278	212

Source: NZIER

29 We treated the change in SAIDI measured in minutes as a percentage of the number of minutes in a year (525,600) for which energy would not be supplied and then multiplied this percentage by the total amount of energy delivered in the year to estimate the lost load in MWh.