Quality non-compliance Report

Unison Limited's non-compliance with the DPP quality standard for the 2017 and 2018 assessment periods

A report for
The Commerce Commission

November 2020

FINAL REPORT

Preface

Strata Energy Consulting Limited specialises in providing services relating to the energy industry and energy utilisation. The Company, which was established in 2003, provides advice to clients through its own resources and through a network of associate organisations. Strata Energy Consulting has completed work on a wide range of topics for clients in the energy sector in both New Zealand and overseas.

More information about Strata Energy Consulting can be found on www.strataenergy.co.nz

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Executive Summary

1. By exceeding SAIDI reliability assessment limits in both the 2017 and 2018 Assessment Periods (AP2017 and AP2018), Unison Networks Limited (Unison) breached Clause 9.1 of the DPP Quality Standard.
2. Unison's SAIDI data identifies that the factors contributing to the breach of the Quality Standards were:
    - the impact on SAIDI attributable to unplanned outages on one major event day in AP2017;
    - the impact on SAIDI attributable to unplanned outages at times other than major event days in AP2017;
    - the impact on SAIDI attributable to planned and unplanned outages on five major event days in AP2018; and
    - the impact on SAIDI attributable to planned and unplanned outages at times other than major event days in AP2018.
3. Our understanding of Unison's explanation for exceeding its Quality Standard Limits is that it had experienced:
    - a significant number of extreme weather events in AP2018;
    - an increase in planned outages as a result of changes to live line working practices;
    - increased fault restoration times due to changes in manual reclosing practices (primarily related to vegetation attributed faults);
    - significant increase in outages attributed to external influences; and
    - significant increase in outage events attributed to fall distance zone trees.
4. Following assessment of the available data and other information we concluded that:
    a) the five MEDs occurring in AP2018 made a material contribution of 22.705 SAIDI minutes to Unison's exceedance of its Quality Standard limit;
    b) evidence provided by Unison relating to the four SAIDI MEDs due to storms in AP2018 is supported by Metris analysis;
    c) the fifth MED caused by a chain type problem may have been avoidable had Unison identified this potential risk and undertaken network studies. The lack of information available for this MED has limited our ability to fully assess it; and
    d) SAIDI attributable to outages other than those on MEDs must also be considered as material contributors to Unison's non-compliance.
5. We agree with and accept Unison's explanation that changes to its live line processes were necessary from AP2015 to meet the revised Health and Safety requirements, and that it had taken appropriate actions to manage and mitigate implications for its reliability performance. We consider that Unison responded proactively to the revised requirements by initiating actions intended to reduce the impact of planned outages on electricity consumers.
6. In our opinion, Unison acted in accordance with good industry practice when addressing the changing health and safety requirements for live line working practices whilst at the same time taking steps to mitigate the adverse impact on network reliability.
7. We accept that changes to the Electrical Engineers' Association (EEA) Guidelines for Manual Re-closing of High Voltage Circuits Following a Fault will slow supply restoration in

some circumstances. We also accept that the changes are likely to have materially reduced the benefits that Unison would have otherwise realised from its smart grid investment programme. Conversely, the smart grid investments will have had other positive effects on network reliability and restoration times. In our opinion, the information and analysis supplied by Unison has been insufficient to support its claim that increased restoration times, due to its compliance with the revised EEA Guidelines, had a material impact on its non-compliance.

8. Unison's data supported its explanation that external influence related outages increased above historical levels in AP2017 and AP2018. Unison also provided information on research and analysis undertaken to determine the underlying causes for the increases. In addition, we consider it likely that Unison's investment in smart grid technologies, particularly the ability to sectionalise its network and use automated switching to reduce restoration time, will likely lessen the impact of external interference incidents on SAIDI. If this is the case, it is reasonable to expect that this benefit will continue to be seen in the future.

9. We agree with Unison that the fall distance zone (FDZ) tree related faults have been a major contributor to its vegetation related SAIDI. We also agree with Unison that the increase in FDZ faults in AP2017 and AP2018 materially contributed to its non-compliance. We also noted that the FDZ outages on MED days were not a main contributor to its non-compliance.

10. In our opinion, Unison has provided satisfactory evidence that it could not have materially reduced the FDZ tree outages by uplifting its vegetation management opex earlier than it did because:

    a. targeting and prioritising expenditure at FDZ tree management would have been challenging given the extent of Unison subtransmission lines located in forestry plantation and the difficulty in predicting which trees are the highest risk;

    b. there are limitations on Unison's rights to take tree cutting actions; and

    c. there is no evidence that Unison could have forecasted the increase in FDZ tree SAIDI in AP2017 and AP2018.

11. We agree with Unison that unless there is a significant change to the legislation, the management of FDZ trees will continue to be challenging.

12. Prior to 2017, Unison had developed and implemented a strategy to manage growth limit zone (GLZ) vegetation. We agree with Unison that GLZ associated outages were not material contributors to its non-compliance and that increasing its vegetation management expenditure for GLZ vegetation would not have improved performance to the extent that non-compliance would have been avoided.

13. On the contribution to SAIDI attributable to equipment failure, we agree with Unison that:

    - SAIDI attributed to equipment failure had been decreasing;
    - increased equipment failure numbers were not material towards its non-compliance;
    - capex applied to the network assets was sufficient given the age and condition profiles and was appropriately targeted at the poorer condition assets; and
    - underinvestment in the network had not occurred.

14. However, we found that whilst SAIDI related to equipment failure had been decreasing, since 2015, there has been an increase in the number of equipment failure related outages. We consider that Unison should take steps to understand and address this issue.

15. In its response to Strata's draft report, Unison noted the actions it undertakes proactively to better understand equipment failures and inform asset management decisions. Unison considers that this demonstrates that analysis of equipment failures is a feature of its

business allowing conscious decisions to be made about reliability performance and risk, and whether proactive replacement of assets is warranted.

16. We agree with Unison that it has developed strong risk-based prioritisation processes that are informed by continually improving asset data and related information. The issue we identified is specific to the increasing number of equipment failure outages since 2015. Whilst Unison reinforced information it had supplied on its overarching practices, it did not provide any information on analysis that it may have undertaken on the specific issue of increasing equipment failure numbers. In the absence of this information, we maintain our original point of view that this analysis should have been undertaken.

17. In addition, Unison has not provided evidence that supports its claim that appropriate post event reviews of the fifth MED attributed to a chain type issue and failure of protection. In our opinion, Unison's dismissal of the need for a post event review on the basis that a remedy for the specific incident had been initiated was inadequate and did not capture important lessons; it therefore falls below what is required to meet good industry practice standard.

18. We also found inconsistent descriptions and interpretations in supporting documentation supplied by Unison.

We have provided advice on four specific questions

19. The Commission asked Strata to consider whether:

- Unison had adequate processes to identify and mitigate risks that contributed to the failure to comply with AP2017 and AP2018, and whether they were responded to in accordance with good industry practice;
- Unison prioritised investment in its Smart Network Initiative over network maintenance and renewal in accordance with good industry practice, and the extent to which this contributed to the failure to comply with AP2017 and AP2018;
- Unison prioritised increased dividend payments over network maintenance and renewal in accordance with good industry practice, and the extent to which this contributed to the failure to comply with AP2017 and AP2018; and
- Unison's decision to deploy nine staff members for a period of 18 months to assist Aurora Energy Limited contributed to its failure to comply with AP2017 and AP2018, and if so, to what extent.

Unison's management of network risks

20. Unison informed the Commission that in March 2018 it became the first New Zealand organisation to attain certification to ISO: 55001 Asset Management Standard. Achievement of accreditation of ISO: 55001 is significant to the Commission's question because, amongst other things, it is the requirement for accredited organisations to have an integrated management system for risk and quality. Accreditation provides assurance that Unison now has a well documented industry practice asset management framework which must include management of network risks.

21. Regarding asset management practices prior to and during AP2017 and AP2018, we undertook analysis of information and data that Unison supplied to the Commission. We found that at 2015, Unison's network risk management would have been consistent with its peer EDBs in New Zealand. Since that time, it has accelerated the development of its network risk management framework, systems and practices to a level that, in our opinion, has established it as an industry leader.

22. We observed the introduction of systems and practices that are leading edge for EDBs. For example, Unison has implemented risk optimisation in its asset management practices

allowing it to prioritise its activities and investments to achieve the lowest overall risk position.

23. An important example of Unison's risk management practice is that, since at least 2012, it has been undertaking comprehensive post event reviews that meet a good industry practice benchmark and are more comprehensive than other EDBs we have reviewed for the Commission.

24. We concluded that Unison had adequate processes to identify and mitigate risks prior to AP2016/17; and since that time, has improved its practices considerably.

Prioritisation of smart grid investments

25. We can confirm that Unison did prioritise its smart grid investments over network renewal (capex) but not maintenance (opex). However, we found that it had done this by applying a managed risk strategy which involved the deferral of several lower risk renewal projects ($8.8M) and relocating budget provisions to smart grid investments.

26. In our opinion, Unison applied good industry practice when establishing, undertaking and operating its smart grid technology roll-out. Its use of deferred replacement capex was undertaken on a risk prioritised basis with good contingency planning. We found that Unison's business case studies, planning and risk management of its smart grid roll-out have set the benchmark for other EDBs when implementing a similar smart grid project.

27. We concluded that Unison did defer asset replacement capex to fund its smart grid project. We found that this was undertaken appropriately with associated risks managed in accordance with good industry practice.

Prioritisation of dividend payments over network investments

28. Unison provided evidence that it has not faced any capital constraints preventing it from investing appropriately in its network. Unison pointed out that it had:

    - paid out less in profits than had been earned on the network investment; and
    - maintained substantial capital headroom to make investments in the network (currently borrowing headroom of at least $140 million under Unison's banking covenants).

29. Unison supported its view that it had a sufficiently strong financial position and conservative dividend policy to have enabled it to fund its smart grid investments through debt if that had been necessary. There was also the potential to seek the Hawke's Bay Power Consumer's Trust (HBPC) agreement to defer some of the Overhead to Underground programme funded through its dividend payments.

30. Prior to 2014, Unison's dividend policy was based on 50% of Net Profit After Tax (NPAT). In 2014, a dividend pathway on a cents/share basis was established based on Unison's August 2012 dividend plus an annual CPI +1% increase. Essentially, this provided for a fixed dividend and did not allow for variations to extract funds that would otherwise be used for network investments. Unison demonstrated during on-site sessions that it had not made dividend payments to the HBPCT that were above the amounts allowed under its dividend policy.

31. We found no evidence to support a view that Unison had prioritised dividends over network capex and, in our opinion, Unison made an informed decision to fund its smart grid programme through other means.

Deployment of UCSL staff to Aurora

32. Unison provided documents relating to its subsidiary company Unison Contracting Services Limited's (UCSL) deployment of a project manager and nine line mechanics to undertake pole replacement work for Aurora Energy Limited.

33. In 2012, UCSL agreed with its Board that work under a strategic third party partnership or relationship development (such as the one with Aurora) would take priority over planned capex on the Unison network. Unison provided information demonstrating that, whilst the deployment of staff to the Aurora network was UCSL's commercial decision, Unison was engaged when the decision was made.

34. UCSL identified and informed Unison that deployment of the project manager and line crew staff to Aurora was a contributing factor to reduced capacity to undertake work in Hawke's Bay. At that time, Unison assessed that capital expenditure was down 21% against forecast and that this was directly attributable to underspend on planned projects.

35. In response to Unison's concerns, mitigation actions were applied by UCSL. The actions taken demonstrated that there was a reasonably high level of concern regarding the impact that staff deployment and other factors was having on UCSL's ability to complete planned capital works projects. The initiation of the actions indicated that Unison was involved in management of risks relating to UCSL's inability to complete some planned projects. Whilst Unison found no evidence that the staff deployment to Aurora caused actual asset failures and associated outages, it did identify that the risk of such events occurring was increased.

36. We concluded that:

    a) whilst UCSL's deployment of staff to Aurora did introduce quality performance risks for Unison, it had identified the risks;

    b) prior to the staff deployment, the risks had been assessed and accepted by UCSL and Unison and appropriate risk mitigation measures had been identified;

    c) the identified risk mitigation measures together with additional measures were implemented when issues with delivery of the capital works programme were raised by UCSL;

    d) the application of Unison's risk prioritisation method for determining its capital investment programme will have ensured that lower risk projects were deferred; and

    e) there is no evidence that the deferral of the lower risk projects contributed to Unison's SAIDI during 2017/18 and therefore would not have contributed to its non-compliance.

37. In our opinion, because of Unison and UCSL's sound management of the staff deployment to Aurora, including the management of potential resourcing risk, we do not consider that the deployment made any contribution to Unison's non-compliance.

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1. Introduction, scope and approach

1. The Commerce Commission (the Commission) engaged Strata Energy Consulting (Strata) to provide its expert opinion and advice in relation to Unison Networks Limited's (Unison) non-compliance with annual reliability assessments for the 2017 Assessment Period (AP2017) and the 2018 Assessment Period (AP2018).
2. Unison is subject to default price-quality path regulation under Part 4 of the Commerce Act 1986. The Commission set quality standards that apply to Unison from 1 April 2015 to 31 March 2020 in its Electricity Distribution Services Default Price-Quality Path Determination 2015 (2015 Determination).
3. Quality performance is measured by System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI). SAIDI measures interruption duration and is calculated as the average outage duration for each consumer connection in units of time. SAIFI measures interruption frequency and is calculated as the average number of interruptions that a consumer connection would experience over a year.
4. The Commission measures Unison's performance against the Quality Standards each Assessment Period which are 12 month periods commencing on 1 April.
5. Unison complies with the Quality Standard in respect of an Assessment Period if it either:
   a) complied with both of the annual reliability assessments (SAIDI & SAIFI) for the Assessment Period; or
   b) complied with both of the annual reliability assessments in the immediately preceding two Assessment Periods.
6. In AP2018, Unison reported[1] its non-compliance with the Quality Standard due to failing to comply with the annual reliability assessments for AP2017 and AP2018.

1.1. Qualifications and experience of the reviewers

7. The review was undertaken by William Alan Heaps, Strata Energy Consulting's Managing Director. Mr Heaps was assisted by Richard Heaps, Associate Consulting Analyst with Strata Energy Consulting.

William Alan Heaps

8. William Alan Heaps is Managing Director of Strata Energy Consulting Limited which is an independent consultancy business specialising in energy supply and energy management. He is a qualified electrical engineer and member of the Institution of Engineering and Technology (MIET) and a member of the New Zealand Institute of Directors (MoID).
9. Mr Heaps has experience in many aspects of the electricity supply chain and has held several senior executive and governance positions in the energy sector. He was Commercial Manager for CentralPower, an electricity distributor, and General Manager of Energy Brokers, an electricity retail company. He managed the Wairakei and Ohaaki geothermal power stations for Electricity Corporation New Zealand and Contact Energy Limited and was General Manager, Commercial Services, with Transpower New Zealand Limited.
10. He was a Director of Christchurch's electricity distributor, Orion Networks Limited and Chairman of the Retail, Wholesale Market, Transmission and Investment Advisory Groups for the Electricity Commission and Electricity Authority. He has also chaired several technical advisory groups for the electricity industry.

[1] Unison Energy 2018 Default Price-Quality Path Compliance Statement

11. As Managing Director of Strata Energy Consulting Limited, Mr Heaps provides advice and consultancy services on energy issues to a range of clients in New Zealand, Australia, Singapore and Malaysia. Strata's clients include the major electricity users, electricity generators, retailers, distributors, governments and energy regulators. Mr Heaps currently advises the Security and Reliability Council (SRC), an industry committee required under section 20 of the Electricity Act 2010 to advise the Electricity Authority on electricity supply security and reliability issues. He has advised the SRC on issues relating to the management of risk and on the development of a risk management framework.

12. Mr Heaps has undertaken lead technical consultant roles on several major regulatory reviews of SP Power Assets (Singapore distribution and transmission), Powerlink (Queensland transmission), ElectraNet (South Australia transmission), SPAusNet (Victoria transmission), and Transpower New Zealand Limited (New Zealand Transmission). For the Public Utilities Office in Western Australia, he reviewed the legislative and regulatory framework for energy safety. He has provided expert evidence relating to resource consent applications for New Zealand electricity generation plant and, for the Australian Government Solicitor, relating to solar power generation. Mr Heaps has advised the Electricity Authority on its investigation of a major substation fire and associated power outage that occurred on a Transpower substation in Auckland. He has also been technical advisor to the Authority on reviews of major incidents on the power system.

13. Mr Heaps has undertaken several reviews of electricity distribution businesses for the Commission. He has advised the Commission on developing its Input Methodologies relevant to electricity distribution price/quality regulation. He is familiar with the legislation and regulations that govern electricity supply arrangements in New Zealand, including those that apply to electricity distribution network businesses such as Unison.

1.2. Evidence-based opinions

14. The members of Strata's review team have read the High Court's Code of Conduct for Expert Witnesses and have agreed to comply with it when undertaking this review and forming opinions. The review team members have confirmed that unless stated otherwise in the body of this Quality Non-Compliance Report (this report), the areas reviewed are within the reviewers' expertise and experience.

15. In forming the opinions in this report, the review team has not omitted consideration of any material facts known to them that might alter or detract from the views expressed. The review team has specified in this report where the opinions expressed are based on limited or partial information and identified any assumptions made in forming opinions.

1.3. Information we have relied on

16. The information provided to Strata by the Commission and Unison has been relied upon for this review and when forming findings, opinions and recommendations. Where Strata has concerns regarding the reliability or quality of the information, this is stated with a consideration of the implications that this may have on the assessments and opinions contained in this report.

17. The information provided by the Commission includes all information forwarded by Unison to the Commission in response to the Commission's requests to Unison for further information.[2]

18. Where other information and data has been considered to be relevant or used to form findings, opinions and recommendations, a footnote reference identifying the source used has been provided.

[2] Draft Notice to supply information to the Commerce Commission Section 53zd of the Commerce Act 1986

1.4. The Commission's requirements describe the scope of this review

19. The Commission asked Strata to provide its expert opinion in relation to Unison's failure to comply with the annual reliability assessments for AP2017 and AP2018. The investigation scope included the following more specific requirement to provide opinions on three areas:

The validity of Unison's reasons for non-compliance

20. The Commission has asked Strata to provide opinions on the reasons given by Unison for its failure to comply with the annual reliability assessments for AP2017 and AP2018 including:

    a) whether those reasons were valid;

    b) whether those reasons arose as a result of a failure to act in accordance with good industry practice;

    c) how much of an impact those reasons had on SAIDI and SAIFI for AP2017 and AP2018; and

    d) claims by Unison that weather contributed to its failure to comply with the annual reliability assessments for AP2017 and AP2018 relative to the reference period, having regard to the 'Review of Weather Events for Non-Compliance with the DPP Quality Standard (2018)'.

Unison's adherence to Good Industry Practice (GIP)

21. The Commission has asked Strata to provide an opinion on whether Unison acted in accordance with good industry practice in areas of its network that relate to reliability performance for AP2017 and AP2018.

22. If we found that Unison had failed to act in accordance with good industry practice, the Commission required us to provide an opinion on the extent to which this had contributed to its failure to comply with the annual reliability assessments for AP2017 and AP2018.

23. The Commission also asked us to examine in particular any evidence that Unison:

    a) had adequate processes to identify and mitigate risks that contributed to the failure to comply in AP2017 and AP2018, and whether they were responded to in accordance with good industry practice;

    b) prioritised investment in its Smart Network Initiative over network maintenance and renewal in accordance with good industry practice, and the extent to which this contributed to the failure to comply in AP2017 and AP2018;

    c) prioritised increased dividend payments over network maintenance and renewal in accordance with good industry practice, and the extent to which this contributed to the failure to comply in AP2017 and AP2018; and

    d) contributed to the failure to comply in AP2017 and AP2018 by deciding to deploy nine staff members for a period of 18 months to assist Aurora Energy Limited.

24. To the extent that Unison has failed to act in accordance with good industry practice, the Commission asked us to identify any particular instance where the failure to act in accordance with good industry practice was substantial.

Actions Unison has undertaken to prevent future non-compliance

25. Strata has been asked to comment on the extent to which Unison has undertaken actions to prevent or mitigate further failures to comply with the annual reliability assessments in

the future, including a description of those actions, and an assessment of the likely efficacy of those actions.

The Commission's additional requirements

26. The Commission advised Strata that if it was unable to form an opinion on any of the matters listed, the Quality Non-compliance Report must include:

    a) Strata's preliminary findings in respect of that matter; and

    b) Strata's opinion on what further investigation or analysis would be required to conclude on that matter.

27. In considering whether Unison acted in accordance with good industry practice, the opinion should consider whether, in relation to any undertaking and any circumstances, Unison exercised that degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced operator engaged in the same type of undertaking under the same or similar circumstances.

28. The Commission requested that Strata's opinions and recommendations be set out in this report.

29. The Commission measures EDBs' Quality Performance against Assessment Period limits for the SAIDI and SAIFI. The Commission's definitions[3] relevant to SAIDI and SAIFI are:

SAIDI	means the average forced sustained interruption duration per connection point served per year, measured in minutes. Connection point numbers are to be the average for the disclosure year
SAIDI Values	means system average interruption duration index values based on Class B (planned interruptions on the network) and Class C (unplanned interruptions on the network)
SAIFI	means the average forced sustained interruption frequency per connection point served per year, measured in frequency per year. Connection point numbers are to be the average for the disclosure year
SAIFI Values	means system average interruption frequency index values based on Class B (planned interruptions on the network) and Class C (unplanned interruptions on the network)

Structure of this report is aligned with the scope

30. In forming our views and opinions, we have relied on Unison's information and data as primary sources.

31. In the Executive Summary of this report, we provide an overview of our findings and opinions on specific requirements from the scope for this investigation.

32. This report has three parts:

    A. **The reasons for non-compliance**

    Unison's non-compliance in the 2017 and 2018 Assessment Periods including an assessment of why Unison exceeded its annual reliability assessment limits in the 2017 and 2018 assessments and our opinion on the reasons given by Unison for its failure to comply;

[3] Electricity Distribution Information Disclosure Amendments Determination 2017

B. Validity of Unison's explanation for its non-compliance

Our assessment and opinions on whether the steps taken by Unison prior to its non-compliance met good industry practice including if we found evidence that it had not appropriately addressed network deterioration and/or increasing interruptions due to defective equipment. This section also includes a description of, and commentary on, the actions that Unison has undertaken to prevent or mitigate further non-compliance;

C. Our answers to the Commission's specific questions

Our assessment and opinions on the four specific areas that the Commission asked us to review.

1.5. Specific terms and values used in this report

33. A glossary of the terms and acronyms used in this report is provided in Appendix F.
34. Unison is responsible for the delivery of regulated services including meeting the Quality Standard. Accordingly, this investigation focused on Unison's responsibilities to ensure it did not contravene the Quality Standard.
35. When we refer to year, unless stated otherwise, we mean regulatory compliance Assessment Period. In the figures and charts provided in this report, unless stated otherwise, year is regulatory compliance Assessment Period.

1.6. Unison's submission on Strata's draft report

36. In September 2020, the Commission supplied a copy of Strata's draft report to Unison. The Commission invited Unison to make submissions on:
    - any factual errors that Unison considers exist in the draft report;
    - any conclusions reached in the draft report that Unison considers are not correct;
    - where Strata has stated that it cannot draw robust conclusions due to a lack of information provided by Unison, submit further information to aid Strata in drawing more robust conclusions on these points; and
    - any matters in the draft report that Unison considered to be confidential and should be redacted from a publicly released version of the report.
37. In a letter dated 15 October 2020, Unison provided its response to the Commission's invitation. Unison also supplied additional information supporting the points raised in its letter.
38. The Commission asked Strata to review Unison's response and make any appropriate changes to its draft report.

Strata found Unison's response to be constructive and useful

39. We have reviewed Unison's submission and reconsidered our conclusions and opinions. We have also revised our report to reflect consideration of Unison's submission.
40. We found Unison's submission to be constructive; it provided valuable additional information and insights on its views and practices. Below, we have reproduced a section from Unison's summary that we believe appropriately captures the content of Unison's submission.

> *For the most part, Unison is in agreement with the substantive conclusions reached in Strata's report. In this response we have sought to provide additional information on the non-weather MED and clarified Unison's*

approach to vegetation management and specifically fall distance trees associated with Unison's sub-transmission network, which appeared to be the two areas where Strata had concerns that Unison may not be meeting good industry practice.[4]

41. In particular, Unison requested that we consider the following:

- points of factual accuracy - two minor points of accuracy;
- vegetation management below GIP - a main point of difference is Strata's finding related to vegetation management; Unison provided additional information to support its view that it did everything possible to address FDZ vegetation prior to and during the periods contributing to non-compliance;
- MED related to protection issue - Unison has provided some additional information on points made in Strata's draft report concerning the protection related MED and the quality of asset data; the information relates to technical reviews and actions that it took prior to the MED;
- quality of asset information – Unison accepts issues raised in the draft report regarding the unusual changes in asset ages and provided additional information for Strata to consider;

42. In addition, Unison considers that it would be valuable if Strata's report contained advice to the Commission on the relativity of the contributing causes of Unison exceeding the reliability limits (i.e. network investment, higher than normal MEDs in RY2018, higher than average third party damage to the network, and the impact of changes in work practices due to the Health and Safety Act). We consider this a good suggestion; section 15 of this report now includes discussion of this point.

[4] 20201012 Unison response to Strata draft report, page 13

Findings and opinions on reasons why Unison was non-compliant

43. In Part A we:

a) set out that Unison was non-compliant;

b) assess why Unison exceeded its Quality Standards in AP2017 and AP2018;

c) provide the explanations given by Unison for its failure to comply;

d) provide our assessment of the validity of Unison's explanations; and

e) consider if there were other reasons for Unison's non-compliance.

2. Why Unison breached the Quality Standard

44. The DPP Clause 9.1 'Compliance with the Quality Standards' requires that:

45. A non-exempt EDB must, in respect of each Assessment Period, either:

- comply with the annual reliability assessment specified in clause 9.2 for that Assessment Period; or
- have complied with those annual reliability assessments for the two immediately preceding extant Assessment Periods.

46. Unison is a non-exempt EDB and must therefore comply with one of the above conditions.

2.1. Unison exceeded its SAIDI limit in APs 2017 and 2018

47. Unison's compliance performance record for the 2012 to 2018 Assessment Periods (see Table 1) shows that it exceeded its limit for SAIDI in AP2017 and in AP2018.

Table 1: Unison's quality performance record 2012 to 2019

Assessment Period	SAIDI Limit	Assessed SAIDI	SAIFI Limit	Assessed SAIFI
2011	147.8587	127.4921	2.7013	1.8284
2012	147.8587	160.6705	2.70	2.6162
2013	148.0942	89.2375	2.717	1.637
2014	148.0942	112.82	2.717	1.77
2015	148	115.26	2.725	1.972
2016	110.167	82.666	2.146	1.937
2017	110.167	124.641	2.146	2.017
2018	110.167	128.662	2.146	2.141
2019	110.167	103.8	2.146	1.865

Source: Unison Annual Compliance Statements 2013 to 2019

48. By exceeding SAIDI reliability assessment limits in both 2017 and 2018, Unison breached Clause 9.1 of the DPP Quality Standard.

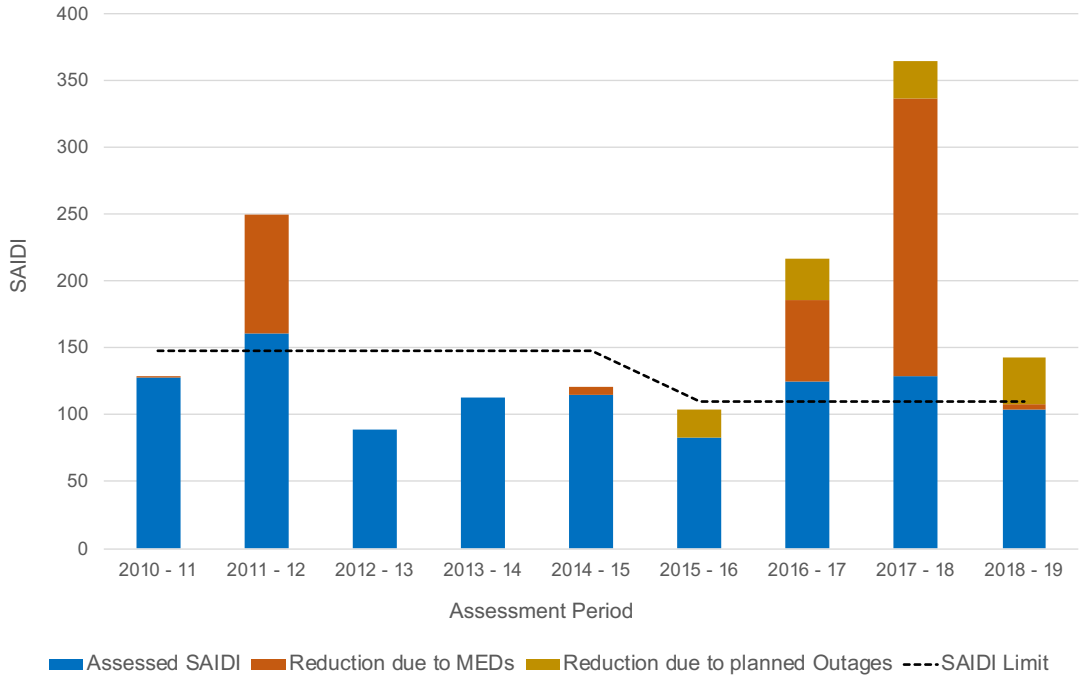
2.2. Unison adjusted its SAIDI and SAIFI due to MEDs and planned interruptions

49. In its Annual Compliance Statement for AP2017, Unison provided information on two MEDs. The first occurring on 16 August 2016 when it exceeded the SAIDI boundary value and the second on 14 November 2016 when it exceeded its SAIFI boundary value.

50. In its Annual Compliance Statement for AP2018, Unison provided information on six MEDs. For three of the MEDs (13 April 2017, 5 January 2018, and 27 March 2018) the SAIDI and SAIFI boundary values were exceeded. On 20 July 2017 and 4 January 2018 the SAIDI boundary value was exceeded, and on 17 July 2017 the SAIFI boundary value was exceeded.

51. Unison appropriately applied normalisation to each of these MEDs and also reduced its planned outages by 50% as allowed for in the DPP determination. The normalisation and planned outage adjustments are shown in Figure 1 for SAIDI and Figure 2 for SAIFI.

Figure 1 Normalisation of SAIDI due to planned interruptions and major event days

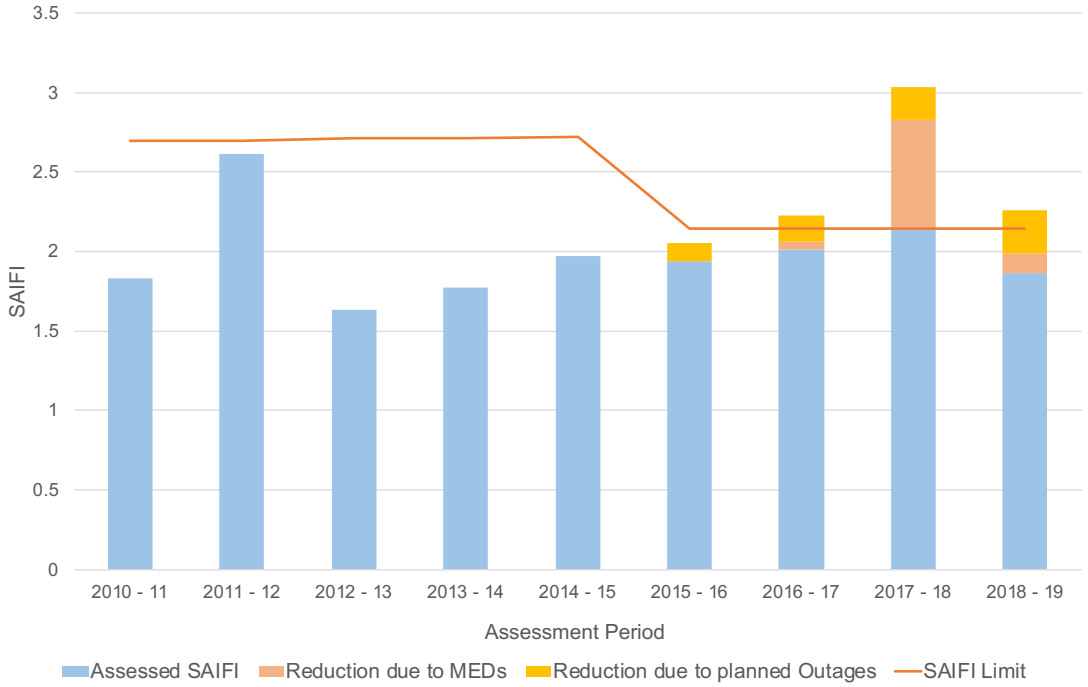


Source: Data from Unison Annual Compliance Statements

Notes:
1. SAIDI includes both planned and unplanned interruptions.
2. Adjustments are made to the raw data to reduce the impact of major event days.

52. Figures 1 and 2 show the changes to the Quality Standard limits that became effective from AP2016. When the revised limits came into effect, changes were also made to the calculation of boundary values (applying when adjustments from MEDs are made) and also for the inclusion of only 50% of planned SAIDI and SAIFI in the assessed SAIDI and SAIFI.

Figure 2 Normalisation of SAIFI due to planned interruptions and major event days



Source: Data from Unison Annual Compliance Statements

53. Figure 1 shows that following the adjustments, Unison still exceeded its Quality Standard SAIDI limit in AP2017 and AP2018. Figure 2 shows the adjustments made to SAIFI, and that in AP2018, at a marginal 0.2%, Unison was within its Quality Standard SAIFI limit.

54. In the following subsections, we focus primarily on SAIDI but, where relevant, include some discussion of SAIFI issues.

2.3. Summary of factors contributing to Unison's non-compliance

55. The SAIDI data supplied by Unison shows that the factors contributing to Unison's breach of the Quality Standards were:

- the impact on SAIDI attributable to unplanned outages on one major event day in AP2017;
- the impact on SAIDI attributable to unplanned outages at times other than major event days in AP2017;
- the impact on SAIDI attributable to planned and unplanned outages on five major event days in AP2018; and
- the impact on SAIDI attributable to planned and unplanned outages at times other than major event days in AP2018.

3. Unison's explanations for its non-compliance

56. For AP2017, Unison provided[5] four explanations for its non-compliance:

1. *A significant increase in planned outages as a result of the electricity supply industry developing a guideline for 'live' line work. The impact of the guideline is an increase in the number of tasks performed de-energised.*
2. *Increased restoration times for transient faults due to the EEA's Guide for Manual Re-closing of High Voltage Circuits Following a Fault. This requires waiting 15 minutes before any manual reclose attempts are made.*
3. *A substantial increase in the impact of external influence events such as motor vehicle accidents, vandalism and dig-ins.*
4. *Significant increase in the number of trees that Unison defines as 'Fall Distance Zone' trees. These are trees that are not in the Notice Zone or Growth Limit Zone of the overhead assets as defined by the Electricity (Hazards from Trees) Regulations 2003. Unison must negotiate with tree owners to remove these trees as there are no rights to address vegetation outside of the notice or growth limit zones defined by the regulations.*

57. For AP2018, Unison provided[6] the following four explanations for its non-compliance:

1. *Significant increase in the number extreme weather events compared to historic average. Unison encountered three storms with >140km/h winds that resulted in four (4) Major Event Days. The vast majority of these outages were caused by vegetation.*
2. *A significant increase in planned outages as a result of the electricity supply industry developing a guideline for 'live' line work. The impact of the guideline is an increase in the number of tasks performed de-energised.*
3. *Increased restoration times for transient faults due to the EEA's Guide for Manual Re-closing of High Voltage Circuits Following a Fault. This requires waiting 15 minutes before any manual reclose attempts are made.*
4. *A continued increase in the impact of external influence events such as motor vehicle accidents.*

58. Unison's conclusion, given to the Commission in its 2018 information request response was that:

> *Unison would have met the quality limits if:*
>
> *(1) Historical live work practices prevailed, or*
>
> *(2) External influences continued at historical rates, or*
>
> *(3) The number of maximum event days equalled the assumed 2.3 events underpinning the quality targets.*
>
> *In fact, Unison has experienced all three factors.*
>
> *…the excursions beyond the regulatory limit for SAIDI are driven by compliance requirements and external impacts that are beyond Unison's immediate influence.*

[5] Unison Annual Compliance Statement 2016-17, Appendix K
[6] Unison Annual Compliance Statement 2017-18, Appendix K

the causes of the excursions are not due to a lack of investment or resources available to restore supplies in a timely manner.

Unison's Smart Grid Strategy is demonstration of innovation focussed on delivering better outcomes for our consumers. The Smart Grid Strategy resulted in Unison investing in a Smart Network which included the deployment of numerous automated devices and sensors to optimally manage the balance between cost, risk and performance. [7]

59. In summary, our understanding of Unison's explanation for exceeding its Quality Standard Limits in APs 2017 and 2018, resulting in its non-compliance, was that it had experienced:

- a significant number of extreme weather events in AP2018;
- an increase in planned outages as a result of changes to live line working practices;
- increased fault restoration times due to changes in manual reclosing practices;
- significant increase in outages attributed to external influences; and
- significant increase in outage events attributed to fall distance zone trees.

60. Further detail on Unison's explanation for each of the above together with our opinions on the validity of each explanation is provided in the following section.

[7] Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, page 5

Validity of Unison's explanation for its non-compliance

4. Significant increase in the number of extreme weather events in AP2018

4.1. Unison's explanation included information and data on the MED

61. In its compliance Statement for AP2017, Unison also provided information on the two MEDs it experienced during AP2017:

> *6 August 2016*[8] *SAIDI and SAIFI MED*
>
> *A major snowstorm resulted in total loss of supply to Hawke's Bay and caused extensive damage to Unison's rural network that took four weeks to repair. The snowstorm caused approximately 200 poles to break, requiring mass replacements, particularly in the Taupo Plains area.*
>
> *14 November 2016 SAIFI only MED*
>
> *The Kaikoura earthquake caused multiple substations and feeders to lose supply as a result of line clashes.*

62. In its compliance Statement for AP2018 Unison also provided information on the six MEDs it experienced during AP2018. The single SAIFI only MED did not contribute to Unison's non-compliance.

> *13 April 2017 SAIDI and SAIFI MED*
>
> *Cyclone Cook battered the Hawke's Bay region with winds of up to 154km/h experienced on the network. This resulted in widespread outages across the region. Most outages were the result of airborne vegetation and debris.*
>
> *17 July 2017 SAIFI only MED*
>
> *An unplanned outage during planned switching resulted in the loss of supply to significant portions of the Napier area.*
>
> *20 July 2017 SAIDI only MED*
>
> *A storm struck Taupo and Rotorua resulting in large number of outages in rural areas. Winds of 144km/h were experienced on the network resulting in outages with the majority caused by toppled trees.*
>
> *4 January 2018 SAIDI only MED*
>
> *A storm hit all parts of the network with 146km/h winds encountered. Extensive damage was experienced across all regions.*
>
> *5 January 2018 SAIDI and SAIFI MED*

[8] We noted that there was a typographical error in Unison's 2018 Compliance Statement with August 2016 SAIDI MED being attributed to both the 16 August 2016 and 6 August 2016. Unison's database recorded that the MED occurred on the 6 August 2016.

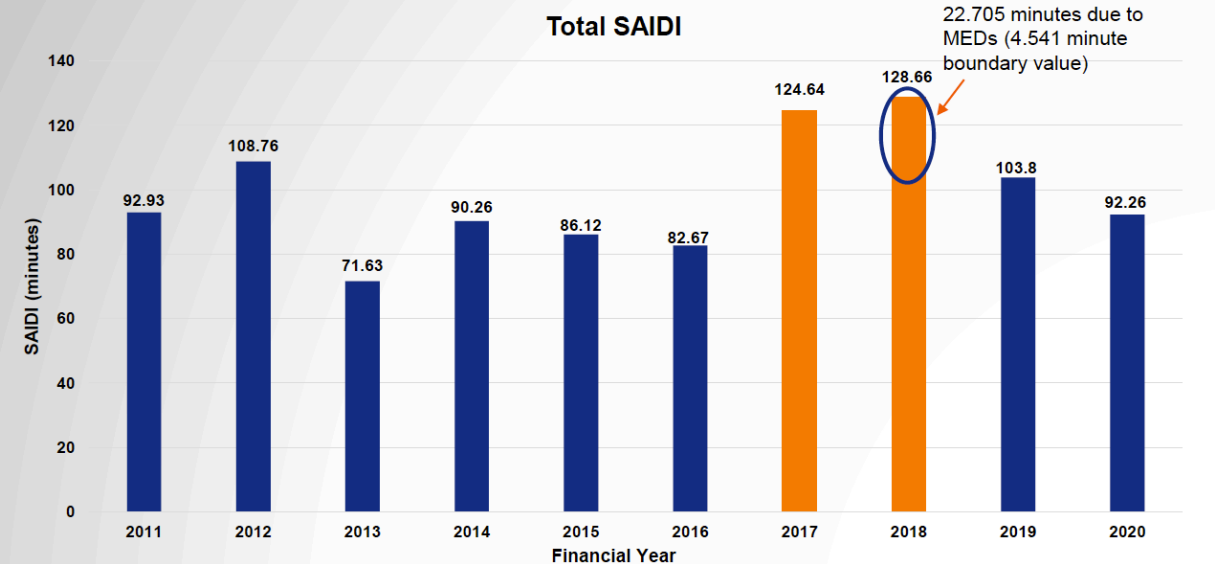
The storm from the previous day continued into today peaking at 10am. A storm hit all parts of the network with 146km/h winds encountered. Extensive damage was experienced across all regions.

27 March 2018 SAIDI and SAIFI MED

An unplanned outage resulting in loss of supply to significant portions of Napier started with a fault on one of Unison's feeders. This resulted in multi flow of energy caused by embedded generators on the network. It eventually ended with Unison's protection relays stepping in to protect the network from severe damage.

63. During our on-site sessions with Unison's management and staff we discussed the impact of the MED on its network performance and Unison provided evidence to support its descriptions of the exceptional nature of the events.

Figure 3: Unison's view of the impact due to MED



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 8

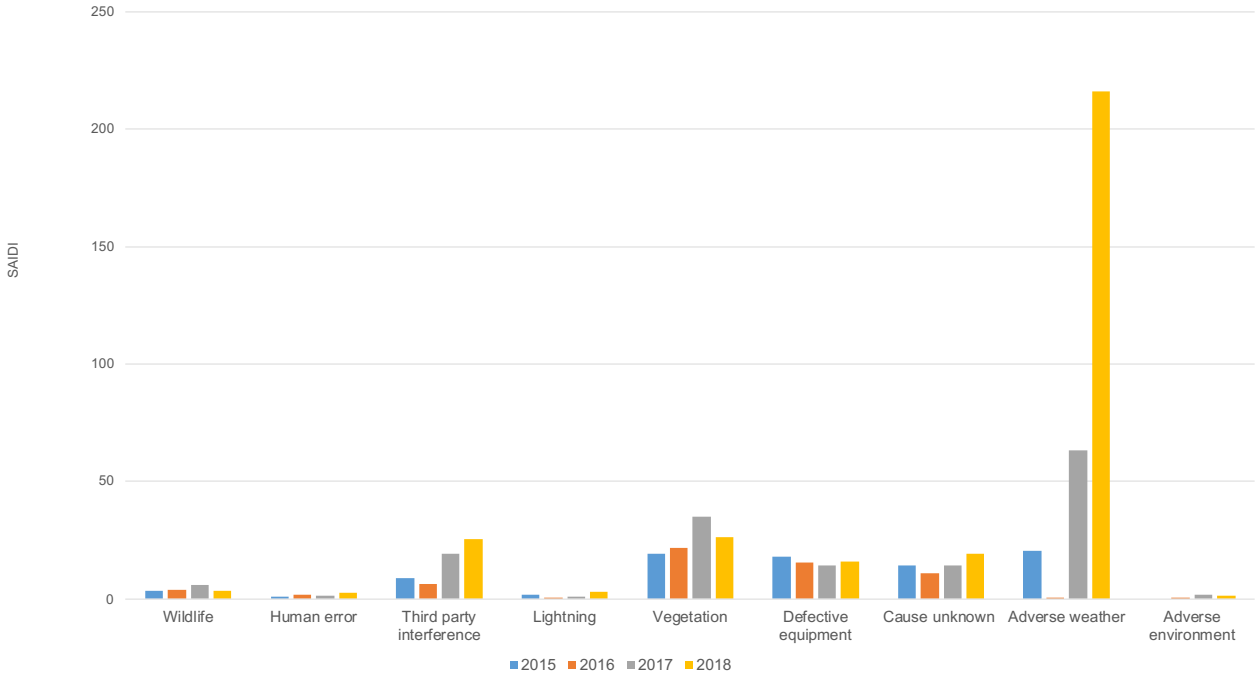
64. In Slide 8[9], Unison identified that the SAIDI associated with the five SAIDI MEDs in AP 2018 resulted in 22.705 SAIDI minutes after normalisation. Unison's view is that its SAIDI limit provided for a total of 2.3 SAIDI minutes for MEDs in AP2018, but in reality the AP2018 MEDs added a much greater 12.262 SAIDI. Unison concludes that, if the MEDs had been at 2.3, as predicted, it would have been compliant and therefore the high number of MEDs in AP2018 was the reason for its non-compliance.

4.2. Our assessment of Unison's explanation relating to increased MED in AP2018

65. The impact of MEDs in AP2018 can clearly be seen in Figure 4 which compares Raw SAIDI for four Assessment Periods. The severity of the adverse weather events during AP2018 supports Unison's statements that it represented a significant increase above the previous four years.

[9] Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 8

Figure 4: Unison's SAIDI (including MED) for AP 2015 to 2018



Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

66. We agree with Unison that the impact of five MEDs during AP2018 made a material contribution to its non-compliance. Unison's evidence on the severity of the adverse weather on four of the five MEDs in AP2018 demonstrated that these events caused major disruption to its network.

67. However, we disagree with Unison's conclusion that it would have met the quality limits if *the number of maximum event days equalled the assumed 2.3 events underpinning the quality targets*.[10]

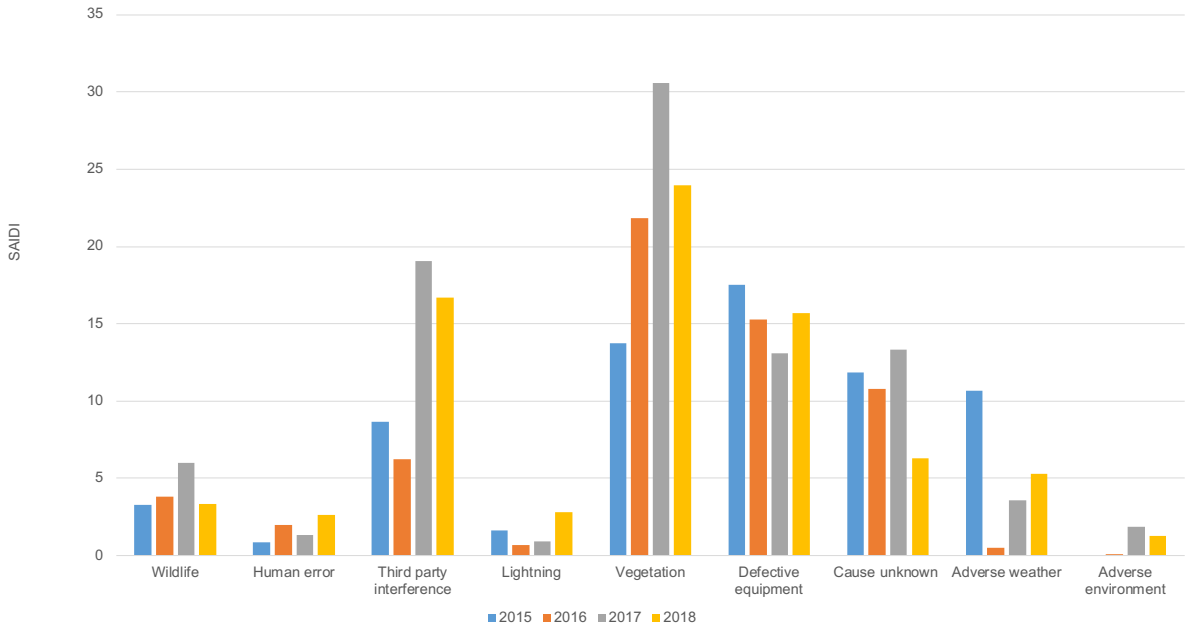
68. There was only one MED in AP2017, so Unison's point is not relevant for that Assessment Period.

69. In AP2018, Unison exceeded its SAIDI Quality Standard limit by 18.495 SAIDI minutes. The MED associated boundary SAIDI was 22.705 (4.541 x 5) minutes. Therefore taking away all MED SAIDI would put Unison 4.21 SAIDI below its limit. Adding a single MED at 4.541 would again put Unison over its limit. Adding 2.3 times the boundary limit would put Unison 4.872 SAIDI above its limit. Unison is incorrect in its statement that it would not have exceeded its limit in 2018 if the MEDs it experienced in that Assessment Period had equalled the assumed 2.3 events.

70. The above point is relevant because it means that causes of SAIDI, other than MEDs, are relevant to Unison's non-compliance. Figure 5 shows SAIDI for the four Assessment Periods excluding MED; this indicates that SAIDI attributed to adverse weather is relatively minor compared to other outage causes for days other than MED.

[10] 3 - Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, page 5

Figure 5: Unison's SAIDI (excluding MED) for AP 2015 to 2018



Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission
Note The dataset supplied by Unison included data for four Assessment Periods

71. The underlying SAIDI excluding MED indicates several contributing outage categories.

72. Unison's identification of increases due to third party and vegetation related SAIDI can be seen in Figure 5. However, defective equipment and unknown causes are also major contributors. The contributions from causes other than adverse weather are discussed in other sections of this report.

MEDs were not found to be materially abnormal but 2017 wind speeds were high

73. We reviewed the results of the study[11] completed by Metris Limited (Metris) for the Commission. In the study, Metris accessed weather data from a selection of NIWA weather stations and compared the results against a reference period. The objective of the Metris study was to investigate:

> *the assertion that the frequency of abnormal weather events (such as high-wind events, heavy rain events and heavy snowfall events that cause damage to power infrastructure) has increased in the two-year period 1 April 2016 to 31 March 2018.*[12]

74. The report covers AP2017 and AP2018 and weather stations relevant to the Unison network including Rotorua and Taupo airports and Turangi.

75. Metris' key findings are:

- During the first year of the investigation period, Wellington, Taupo and Rotorua Lakes and East Cape areas recorded a higher number of strong gusts than typically recorded during the reference years.

[11] Review of weather events for non-compliance with the DPP Quality Standard (2018), Metris Limited, 2019 draft report
[12] Ibid, page 1

- During the second year of the investigation period, Rotorua and East Cape also recorded a higher number of high wind events than recorded during the reference years but the other areas reverted to typical conditions.
- In Coastal Bay of Plenty and Central and Western North Island the wind strength measured in both investigation years was similar to the reference years, with the exception of the July 2017 storms.
- The July 2017 storms had strong winds and were among the highest recorded during the period of this study but were not without precedent in most areas.
- Using the supplied criteria, there is no evidence that wind speeds are trending upwards year-on-year.
- The duration or direction of the high wind events are not changing.
- The sub-regions are highly variable with respect to recorded sustained wind speed and gusts and single design parameter criteria may not be sufficient across all regions.
- Heavy rain events show no major differences across the investigation or reference years.
- Snow events are rare across most of the areas of this study. A heavy one-off event in August 2016 was unusual.

76. We aligned the MED with the weather data sourced by Metris and identified dates when MEDs featured in the top 20 of the 2005 to 2018 historical data:

Table 2: Wind ratings during MED

MED	Rotorua	Taupo	Turangi
06/8/2016			
13/4/2017	18th highest max sustained wind speed		16th highest max wind gust
20/7/2017	5th highest max wind gust 6th highest max sustained wind speed	6th highest max wind gust	
04/1/2018	2nd highest daily wind speed 8th highest max wind speed 2nd highest max sustained wind speed	18th highest max wind gust	
05/1/2018			

Source: Strata analysis of data from Metris Limited, 2019 draft report

77. Given the 5 January 2018 MED was adjacent to the 4 January 2018 MED which featured in three of the top twenty measures, we think that it is reasonable to consider these events related.

78. The Metris information and conclusions provide an additional point of reference to the information given by Unison. However, the locations and limited number of weather stations

available to Metris provides only general guidance on the adverse weather experienced on the exposed sections of the Unison network.

79. The Metris report does confirm that the 4 and 5 January 2018 MED, which Unison attributed to adverse weather, is in the top 20 for the 12 year sample.

80. Given the alignment of the four weather related MEDs in AP2018 (see Table 2) with the Metris report and its conclusion, we consider that it supports Unison's claim that AP2018 was an exceptional period for adverse weather.

The 27 March MED was not weather related

81. Also, one MED occurring in AP2018 was not related to adverse weather but resulted from a fault on one of Unison's feeders attributed to the operation of embedded generators on its network.

82. The unplanned outage was triggered by a fault on one of Unison's feeders; this resulted in embedded generators creating energy flow levels on the network that caused the tripping of multiple protection relays. This lead to a significant loss of the network supplying Napier City. The Raw SAIDI for this MED was 8.4 which was normalised to a 4.45 minute contribution to Unison's assessed SAIDI for AP2018.

83. In discussions during our on-site session, Unison explained that the outage highlighted the complexity of protection systems where there is local generation on the network. However, Unison has not provided any further explanation of this MED other than that supplied in its AP2018 Compliance Statement (see paragraph 55). There is no discussion of this event and subsequent actions taken to prevent future similar events in subsequent AMPs. Also, Unison did not provide any post event review documentation for this MED.

84. In our draft report we observed that this event was an opportunity for Unison to capture important lessons but this appears to have been missed. In its response to Strata's draft report Unison supplied additional information on the steps that it had taken prior to the event, these were that:

- it had undertaken a network study which had identified the potential risk to the network associated with the protection on the Rangitane Road ZS - 33kV feeder;
- a project had been *signed off* on 27/9/2017 to address the issue (Unison supplied the project approval);
- applying its risk prioritisation assessment, the work had been scheduled to be completed in 2018; and
- the failure event occurred just prior to the scheduled completion date of 10 December 2018, which had been chosen to avoid coinciding with winter peak demand periods; and
- the work was completed on schedule.

85. Regarding a post event review, Unison supplied additional information on the review that had taken place:

> *our review of meeting minutes from Unison's weekly Reliability Committee meeting shows that the Committee reviewed the event and determined actions required to prevent recurrence, which included an assessment of bringing forward the intended project to remediate the identified issue. A detailed investigation was not considered necessary, as in the circumstances there was already a remediation plan in place, but it was overtaken by the event.*[13]

[13] 20201012 Unison response to Strata draft report, page 11

86. We reviewed the additional information supplied by Unison and found that:

    a. the project approval notice is a Project Scope Form which is specifically focused on the relay replacement process and does not identify the reason why the replacement was proposed nor the benefits that will be realised by completing the relay replacement;

    b. a relevant network study had not been supplied in Unison's response nor identified as having been previously supplied to the Commission;

    c. the financial approval section of the Project Approval Form was unsigned;

    d. the signatures dated 29/7/2017 related to the scope quality acceptance and not financial approval;

    e. no documents were provided to evidence the completion of a risk prioritisation supporting the intended completion date; and

    f. no documents were provided (or references given if already supplied) from the relevant Reliability Committee review.

87. The lack of supporting evidence provided by Unison together with the inconsistency between the Project Scope Form and the statements Unison has made about this document have reinforced our concerns that actions taken prior to the event could have been more effective.

88. In addition, we consider that Unison's claim that a post event review was inappropriate is not correct. Unison informed the Commission that:

> *A detailed investigation was not considered necessary, as in the circumstances there was already a remediation plan in place, but it was overtaken by the event*[14]

89. Our primary point is that a post event review was required in this instance to inform Unison of potential systemic issues that could apply in other situations. In particular, Unison's explanation of the event related to the interaction between installed distributed generation operation and the protection system. Understanding these types of issues is fundamental to future management of increasing levels of distributed generation connected to distribution networks.

90. In our opinion, dismissing the need for a post event review on the basis that a remedy for the specific incident had been initiated, is inadequate and does not capture important lessons therefore failing to meet a good industry practice standard.

4.3. Multiple MEDs in 2018 were material contributors to non-compliance

91. We have concluded that:

    a) the five MEDs occurring in AP2018 made a material contribution of 22.705 SAIDI minutes to Unison's exceedance of its Quality Standard limit;

    b) evidence provided by Unison relating to the four SAIDI MEDs due to storms in AP2018 is supported by Metris analysis;

    c) the fifth MED caused by a chain type problem may have been avoidable had Unison identified this potential risk and undertaken network studies. The lack of information available for this MED has limited our ability to fully assess it; and

[14] 20201012 Unison response to Strata draft report, page 11

d) SAIDI attributable to other outages other than those on MEDs must also be considered as material contributors to Unison's non-compliance.

92. In section 9 we discuss outages attributed to defective equipment; we also consider the possibility that weaknesses in the network had been exposed during the adverse weather related MEDs.

5. Changes in live line work practice

93. During the on-site sessions in January 2020, Unison discussed the significant increase in planned work that occurred and that this had constrained its ability to undertake live line work practices. Unison attributed the increase in planned SAIDI to the need to disconnect circuits more frequently when planned work was undertaken.

94. The change in work practices is attributable to revisions made in 2015 to the Health and Safety at Work Act. This issue has been noted in other recent reviews that we have undertaken and is well known to the Commission.

95. Unison quantified[15] the impact attributable to the changes it made to live line work practice:

a) 8.7 SAIDI minutes, which was 7% of assessed SAIDI in AP2017; and

b) 7.9 SAIDI minutes, which was 6% of assessed SAIDI in AP2018.

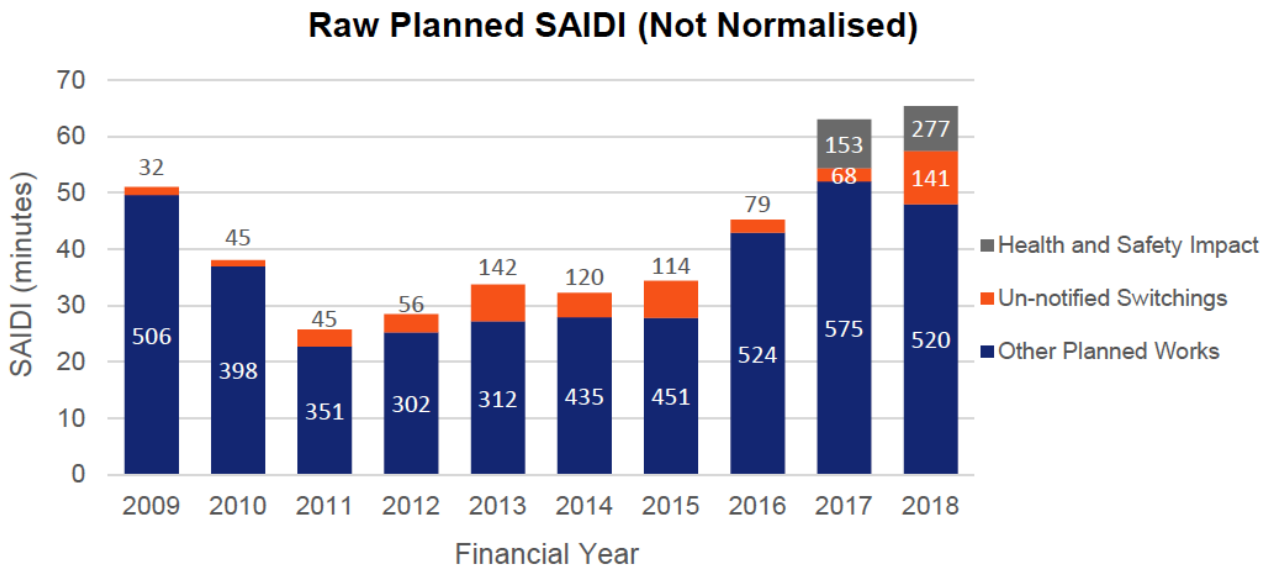
96. Unison linked its increased investment in network capital expenditure (capex) and operational expenditure (opex) over the last decade to the impact of reduced live line work on reliability performance:

> *Over the past ten years there has been a significant uplift in the investment on the network, both capital investment and maintenance. This includes an increasing level of replacement and renewal investment on existing infrastructure. This trend is expected to continue for the foreseeable future. With the change in Health and Safety legislation impacting on the proportion of work that can be undertaken using live line practices, this means that the contribution from planned works to total SAIDI has increased materially.*

97. Figure 6 reproduces Unison's analysis of the changing contribution to SAIDI of planned interruptions over the decade.

[15] Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 9

Figure 6: Unison's analysis of SAIDI related to changes in planned outages



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 8

98. Unison used Figure 6 to support its explanation that increased planned work on the network contributed to the increase in planned SAIDI, and that changes to live line working practices amplified this effect.

5.1. Unison anticipated impact due to changes in live line practice

99. Unison assessed the implication of the changes to live line working practices on its quality performance and its ability to comply with its Quality Standard limits:

> *Unison currently performs around 300 live line activities with an impact of around 25 minutes on average per year. Following the flowchart in the EEA guideline for one year's data showed just over half of these jobs would be selected to be done using live line techniques and the rest should be done de-energised. This equates to an impact of approximately 10 SAIDI minutes and 0.1 SAIFI interruptions per annum.*[16]

100. During Strata's January 2020 on-site sessions, Unison confirmed that it had followed the EEA Guideline for 30 months. Unison described and provided documents detailing its Live Line Decision Framework which its operational field management staff use to determine the practice to be applied to each work parcel.

101. The documents supplied by Unison provide evidence that it had carefully considered the implications of changes to live line working practices. Its decision making process when considering if work should be completed live is clear and aligned with the EEA Guidelines. We consider that the EEA Guidelines provide a good industry practice benchmark.

[16] Ibid, Page 3

5.2. Unison is planning to reduce the impact of future planned work

102. Unison gave information to the Commission on initiatives it was taking to improve the management of planned work and reduce the impact on electricity consumers. We discussed these initiatives with Unison during our on-site session.

103. The following extracts have been reproduced from information provided by Unison during the on-site sessions.[17]

Use of generators

104. Since November 2018, Unison increased the use of low voltage generators for planned outages. This resulted in a 30% reduction in the number of customers being affected by planned works.

105. Unison purchased and commissioned two generation units on its 11 kV Waimarama and Rotoma feeders in December 2018. It estimates that this has saved approximately 36 SAIDI minutes during unplanned and planned outages. Subsequently, a third generator has been purchased and installed.

Alignment of Unison's live line assessment criteria

106. Unison reviewed its live line assessment criteria and made changes; this has resulted in a 25% increase in the number of live line work requests being approved.

Realising project synergies

107. Unison has implemented initiatives intended to drive synergies from packaging planned work. This is particularly suited for work parcels performed on the same feeder. The initiative will reduce the impact on customers and produce cost savings through reducing the need for multiple outages.

Pole testing and replacement improvements

108. Unison has made changes to its pole testing and feeder inspection and replacement process to streamline and minimise SAIDI/SAIFI impact from this work.

Use of an outage calculator

109. Application of an outage calculator is being used to ensure a consistent approach to reducing the shutdown area for planned outages. The approach Unison applies considers the use of live line breaks, cable and line splitting using jumpers, and the use of temporary generation.

Contractor performance monitoring

110. To improve customer service, Unison is monitoring and reporting contractor performance on conformity to outage window information provided to customers.

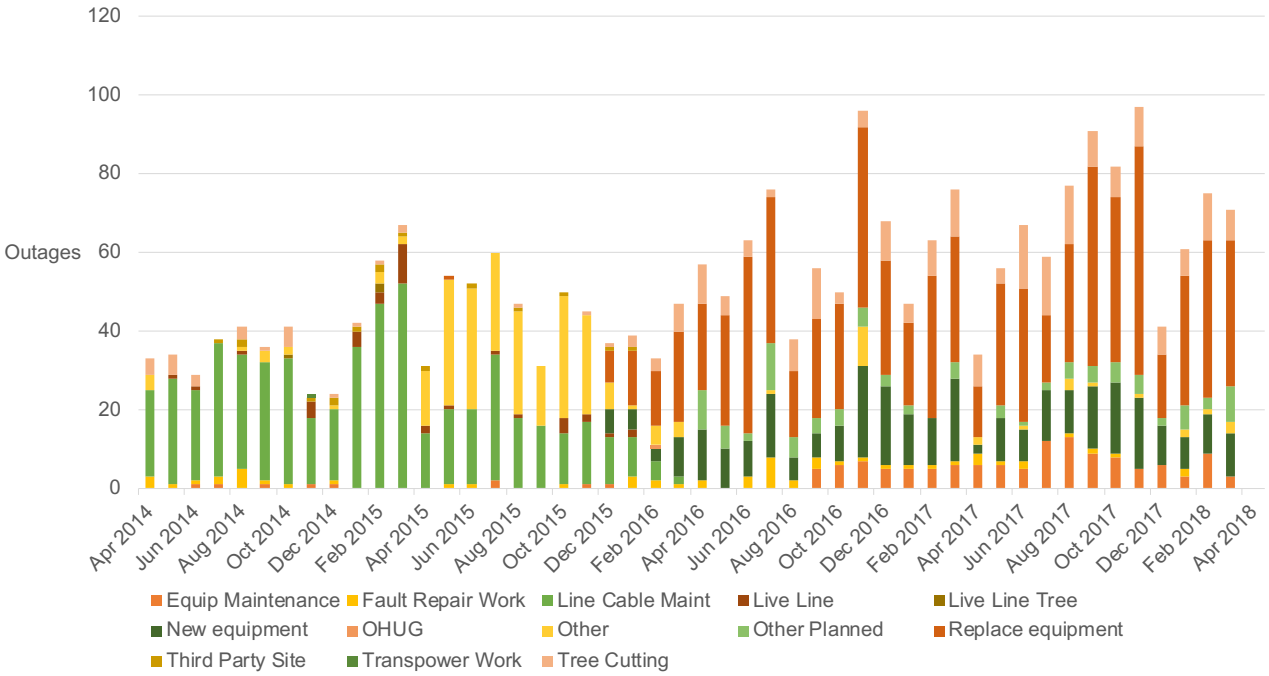
5.3. Our opinion on the contribution of changes to live line practices

111. Our analysis of the outage data given by Unison to the Commission indicates an increasing contribution from planned outages on SAIDI from 2015 (see Figure 7). A change in the types of planned work being carried out during the outages can also be seen with the contribution from line and cable maintenance decreasing whilst new and replaced equipment related outages significantly increase.

[17] 2018_Quality_Breach_ComComVisit_Jan2020_Final, slides 188 to 193

112. The reduction on 'other' planned outages at the beginning of 2016 appear to be due to improved categorisation of planned outages.

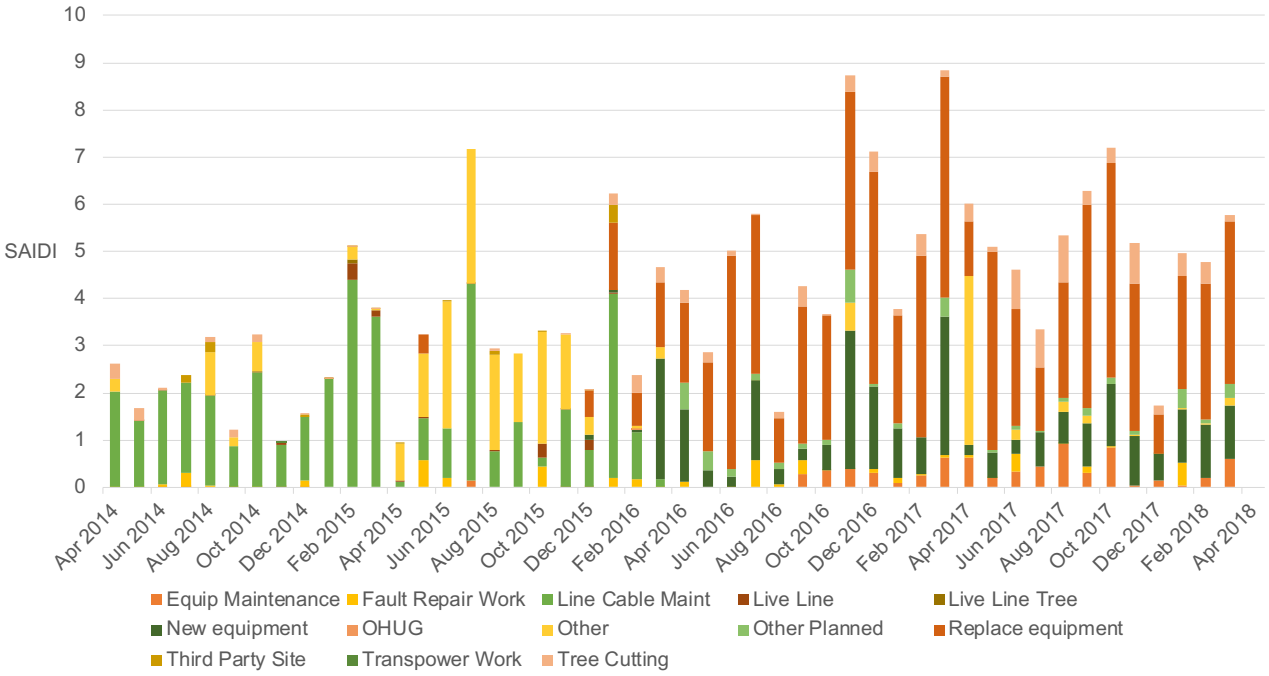
Figure 7: Causes of the number of planned outages



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 8

113. A similar trend can be seen in the impact of the planned outage categories on SAIDI (Figure 8).

Figure 8: Causes of the SAIDI for planned outages



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 8

114. Our analysis confirmed Unison's statements that changes to live line practices had increased the number and SAIDI of planned outages.

115. We reviewed Unison's Live Line Decision Framework[18] and found that it is appropriate and ensures that Unison is taking into consideration the implications for health and safety, electricity consumers, network reliability performance and cost. The framework includes consideration of switching/sectionalising and economic assessments of deployment of mobile generation plant.

116. Unison described how its smart grid roll out was enabling greater flexibility in its management of reliability performance on the network including reducing the impact of lower levels of live line working.

117. In our opinion, Unison has acted appropriately and in accordance with good industry practice in managing the changing health and safety requirements for live line work. When forming this view, we noted the following actions taken by Unison to reduce the implications for network performance:

    a) Unison had integrated the EEA Guidelines in its live line decision framework;

    b) the live line decision framework did not exclude all live line working;

    c) the decision criteria took into account reliability performance; and

    d) Unison had made provisions to lessen the impact of reduced live line working through the application of smart grid technologies, improved network switching capabilities and portable generation.

118. Accordingly, we agree with and accept Unison's explanation that changes to its live line processes were necessary to meet the revised Health and Safety requirements from AP 2015 and that it had taken appropriate actions to manage and mitigate implications for its reliability performance.

119. We consider that Unison's assumptions for and calculation of the impact on its annual reliability performance of 10 SAIDI minutes is reasonable. Changes to live line working were therefore material in Unison's exceedance of its Quality Standard Limits in both AP2017 and AP2018.

120. However, we do not agree with Unison's statement that it *would have met the quality limits if historical live work practices prevailed.*[19] In AP2017 Unison was 14.641 SAIDI above its limit, and in AP2018 it was 18.662 above its limit. Therefore, using Unison's 10 SAIDI minute estimate for live line impact, it would still have exceeded its limits in both Assessment Periods had live line practices remained unchanged.

121. We found that Unison has been responding proactively to the changes in live line practices with several initiatives being implemented to reduce the impact of planned outages on electricity consumers. In our opinion, Unison has demonstrated that it can respond appropriately to the changed requirements whilst taking steps to manage reliability and performance within the quality standards.

122. In our opinion, Unison has acted in accordance with good industry practice when addressing the changing health and safety requirements for live line working practices whilst at the same time taking steps to mitigate the adverse impact on network reliability.

[18] Unison provided the EEA Guideline decision flow chart and Unison's interpretation of the EEA Guideline criteria in Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, pages 37 and 38.
[19] 3 - Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, page 5

6. Increased fault restoration times

123. In its AP2018 Compliance Statement, Unison identified that *increased restoration times for transient faults* were material contributors to exceedance of its SAIDI limit in AP2018. In its Compliance Statement, Unison explained that the reason for the increase was its adherence to a new Electrical Engineers' Association (EEA) guideline for Manual Re-closing of High Voltage Circuits Following a Fault.

124. The issue was identified in Unison's 2018 AMP:

> *Increased restoration times for transient faults due to the EEA's Guide for Manual Re-closing of High Voltage Circuits Following a Fault. This requires waiting 15 minutes before any manual reclose attempts are made.*[20]

125. The Guide for the Manual Re-Closing of High Voltage Circuits Following a Fault was first published by the EEA in October 2001. The current revision was published in January 2014.

126. The EEA states that the Guide's purpose is to:

> *provide a nationally agreed document to help Electricity Network Companies and contractors managing networks to determine an appropriate policy with regard to the manual reclosing of a circuit following a tripping.*
>
> *the Guide substantially follows the approach given in the Safety, Health & Environment Committee of the Energy Networks Association Standard 06 titled Post Trip Manual Re-Closing of High Voltage Electrical Distribution Circuits, and the EEA acknowledges the ENA (UK) for permission to use their approach.*[21]

127. During discussions at the January 2020 on-site, Unison explained the need to identify the location and wait fifteen minutes for a visual inspection to take place before manually reclosing and restoring supply. We understood Unison's main concern was that the need for a manual inspection significantly reduced potential benefits from the remote switching capability installed under its smart grid investment programme.

128. We also consider that investments Unison had made since 2010 in its smart grid programme are likely to have delivered reliability benefits by enabling speedier restoration times; for example, through the improved ability to automatically sectionalise its network. This would be expected to reduce the negative impact on reliability from the introduction of the EEA Guidelines.

6.1. Our views and opinions on increased restoration times for transient faults

129. Our view is that Unison has not established that the changes to restoration times due to the revised EEA Guideline requirements have materially contributed to exceedance of its Quality Standards contributing to non-compliance. Unison provided no analysis quantifying the negative impact of delayed restoration, nor did it elaborate further on the basic claim that it made in its AMP and compliance statement.

130. We agree with Unison that changes to bring reclosing practice in line with the EEA Guidelines will have reduced Unison's potential to secure some of the benefits available from its smart grid investment programme. However, this will not have removed all the

[20] Unison 2018 AMP
[21] https://www.eea.co.nz/tools/products/details.aspx?SECT=publications&ITEM=2567

benefits, and as Unison points out in its letters to the Commission, the benefits actually achieved will have improved reliability.

131. In summary, we accept that the EEA changes will slow supply restoration in some circumstances. We also accept that the changes are likely to have materially reduced the benefits that Unison would have otherwise realised from its smart grid investment programme. Conversely, the smart grid investments will have had other positive effects on network reliability and restoration times. In our opinion, the information and analysis supplied by Unison has been insufficient to support its claim that increased restoration times, due to its compliance with the revised EEA Guidelines, had a material impact on its reliability performance.

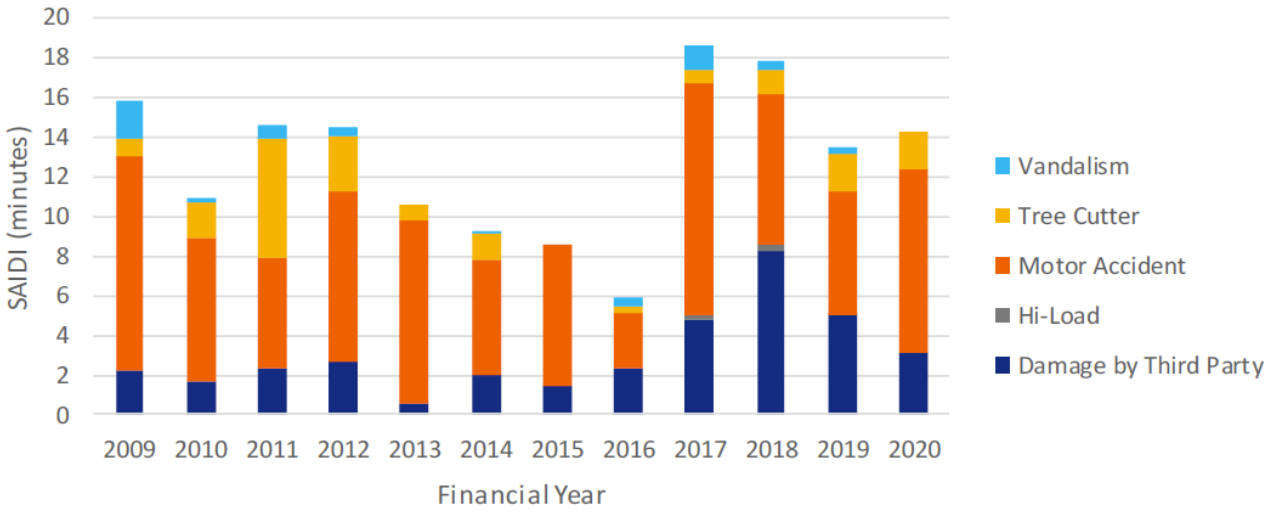
7. Impact of external influence events

132. Unison explained that:

> *…both SAIDI and SAIFI were showing a clear downwards trend up to and including the 2015/16 financial year. The 2016/17 and 2017/18 financial years saw a marked increase in external influence events, exceeding levels experienced in 2009 (the highest year in the historical data).*
>
> *…the increase in SAIDI is primarily attributed to the motor vehicle accidents in 2016/17 and damage by third parties in 2017/18. 2018/19 saw a decrease SAIDI impact in both subcategories relative to the preceding two years, however at the current rate of motor accidents on our network, the 2019/20 is forecast to see a similar level of impact from this cause to that in 2016/17.* [22]

133. To support its views, Unison provided the chart reproduced in Figure 9. This information showed that the two years contributing to non-compliance had the highest SAIDI recorded for these categories and especially for outages attributed to motor vehicles and damage by third parties.

Figure 9: External influence SAIDI effect



Source: Unison 20191119 Vegetation Equipment Failure and External Trends

134. Table 3 sets out the number of outages and SAIDI that Unison attributed to external influence events between AP 2015 and AP2018.

[22] 20191119 Vegetation Equipment Failure and External Trends

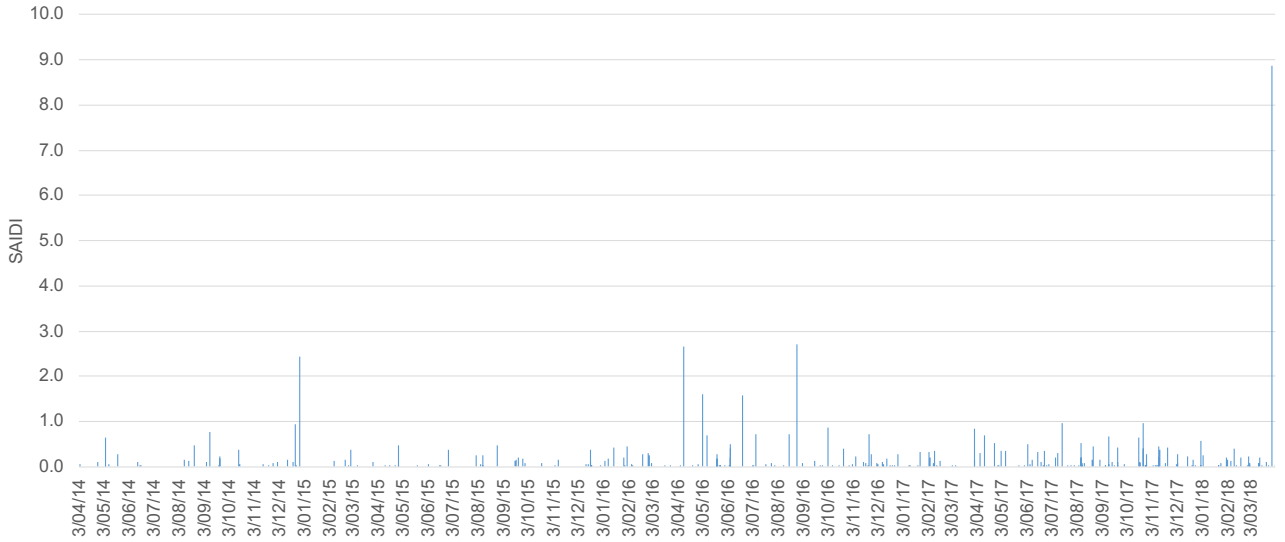
Table 3: Number and related SAIDI attributable to external influences (including MED)

	Including MED		Excluding MED	
Assessment Period	Number of outages	SAIDI	Number of outages	SAIDI
2015	34	8.64	34	8.64
2016	44	6.25	44	6.25
2017	68	19.08	68	19.08
2018	96	25.57	96	16.7

Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

135. For an external influence event to cause a MED, it must be substantial. In the four Assessment Periods for which Unison provided data, a single event on the 27 March 2018 caused a MED. The significance of this event can be seen in Figure 10.

Figure 10: SAIDI attributed to external influences AP 2015 to AP 2018



Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

136. This single event caused Unison to incur 8.87 SAIDI (the difference between the 2018 SAIDI values in Table 3) which was then normalised to its boundary limit of 4.541 SAIDI. This event is recorded in Unison's data base as:

> *Insulator flashed over at Gilligans (due to ext influence), Onekawa protection operated before Gilligans*[23]

137. We understand that this MED was initially caused by a faulty insulator on the subtransmission system; this led to multiple protection system operations which were compounded by the reaction of embedded generation plant on the network. The outage caused widespread loss of supply in Napier.

138. We consider that the data supports Unison's explanation that external influence related outages increased in AP2017 and AP2018 above historical levels. Unison provided information on the research and analysis undertaken to determine the underlying causes for the increases.

23

Unison's investigations on motor vehicle related incidents were inconclusive

139. Regarding motor vehicle accidents, Unison found no reasons for the increased motor vehicle incidents occurring in AP2017 and AP2018:

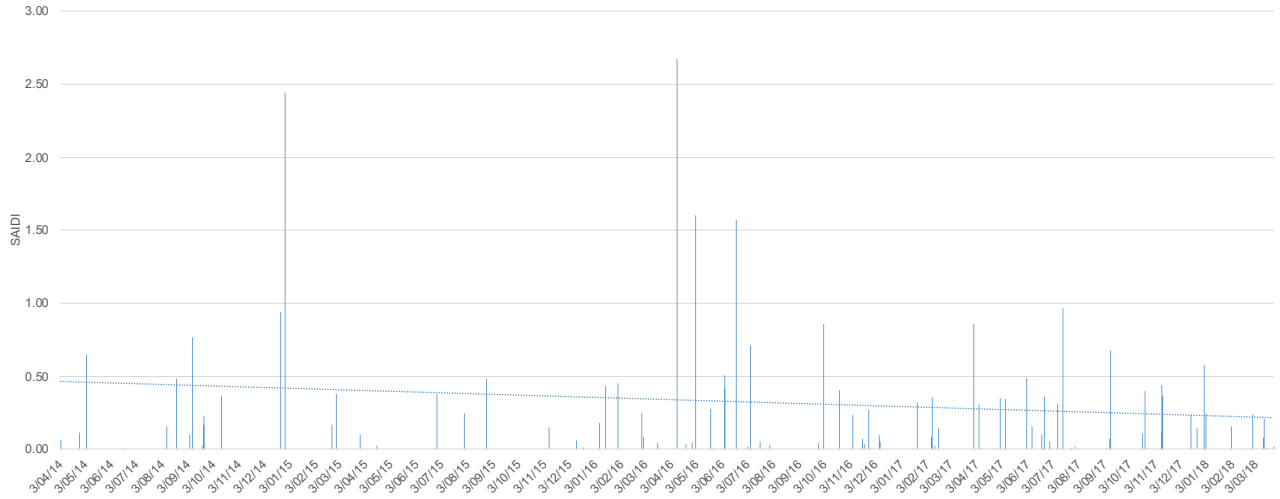
> *The increase in motor vehicle accidents has been analysed but with no clear trends. Not surprisingly, car vs pole incidents often occur on 80km – 100km arterial roads in rural areas. The lower design standards for rural roads combined with higher speed limits leads to a greater risk of drivers losing control. The network configuration, which inevitably comprises of long radial feeders in rural areas, leads to a significant SAIDI impact due to the inability to provide an alternative supply path to customers.*

140. Investigations Unison undertook did not identify any pattern attributable to its experienced motor vehicle accidents (e.g. particular pole locations etc.) that it could respond to with different asset management approaches.[24]

141. Our analysis of the outage dataset indicated that, despite higher incidents in AP2017 and AP2018, for the four years AP2015 to AP2018, SAIDI attributable to each motor accident event had trended downward (see Figure 11). So outages attributed to motor accidents increased in number but reduced in duration and impact on ICPs. However, the data is quite variable and subject to significant spikes when accidents cause longer duration interruptions or affect higher numbers of ICPs.

142. The trend line in Figure 11, combined with the annual figures, supports a conclusion that the SAIDI minutes per motor accident has been reducing. Although this appears to be a slight change in SAIDI it represents approximately 50% reduction over time. Had this not been occurring, the impact of motor accidents on Unison's reliability performance would have been worse.

Figure 11: SAIDI attributed to motor accidents with added trendline



Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

143. Table 4 supports Unison's explanation that the number of motor accident outages increased significantly in APs 2017 and 2018. However, the data does not support Unison's compliance statement claim that a material contributor to its non-compliance has been a substantial increase in the impact of external influence events such as motor vehicle accidents. This point is also highlighted in Table 4.

[24] 20201012 Unison response to Strata draft report, page 13

Table 4: Number and related SAIDI attributable to motor accidents

Assessment Period	Number of outages	SAIDI	Average SAIDI per outage
2015	17	7.17	0.422
2016	13	2.8	0.215
2017	28	11.8	0.421
2018	35	7.6	0.217

Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

144. Whilst the number of motor vehicle related outages increased in AP2017 and AP2018, the average SAIDI per outage was almost identical to the prior two Assessment Periods.

145. Accordingly, we agree with Unison that the number of motor vehicle related outages significantly increased in AP2017 and AP2018. However, the impact of motor vehicle accidents on SAIDI is not significantly higher than it was in previous periods. Therefore we cannot agree with Unison that increasing motor vehicle incidents made a material contribution to its non-compliance.

146. We consider that it is likely that Unison's investment in smart grid technologies, particularly its ability to sectionalise its network and use automated switching to reduce restoration time has reduced the impact of future incidents on SAIDI. If this is the case, it is reasonable to expect that this benefit will continue to be seen in the future.

8. Outages attributed to fall distance zone trees

147. Responsibilities and requirements for the management of vegetation adjacent to electricity networks are set out in the Electricity (Hazards from Trees) Regulations 2003 (Tree Regulations).[25] The Tree Regulations sets out its purpose as being to protect security of the supply of electricity and safety of the public by:

a) prescribing distances from electrical conductors within which trees must not encroach;

b) setting rules about who has responsibility for cutting or trimming trees that encroach on electrical conductors;

c) assigning liability if those rules are breached; and

d) providing an arbitration system to resolve disputes between works' owners and tree owners about the operation of the regulations.

148. The Tree Regulations set out Growth Limit Zones for trees encroaching overhead lines (2.5 metres for 33kV and 1.6 metres for 11kV). EDBs can notify tree owners when vegetation encroaches within one metre of the Growth Limit Zone. The Tree Regulations also stipulate which party is responsible for paying for the trimming/felling work.

149. Unison's explanation for its non-compliance relates to the Fall Distance Zone which is not defined in the Tree Regulations. We understand that the Fall Distance Zone is between the Growth Limit Zone (plus one metre) and the distance beyond which the tree would not

[25] Electricity (Hazards from Trees) Regulations 2003, Reprint as at 16 December 2013, amended 28 August 2017

connect with the overhead line assets if it were to fall. In a 2016 paper to its Board,[26] Unison management provided a summary of its historical vegetation management practices:

> *Based on historical performance, it was estimated that in order to maintain acceptable network performance, a minimum of approximately 18,000 trees annually would need to be removed from the immediate vicinity of Unison's network. This has proven to reasonably consistently, maintain the annual network performance impact from trees within the Growth Limit Zone (GLZ1) to acceptable levels. However, this does not address the impact of trees that are within falling distance of Unison's overhead lines. These trees are not covered by the current regulations or actively managed within Unison's existing programme.*

150. Figure 12 gives an example of a fault due to a Fall Distance Zone incident.

Figure 12: Fall Distance Zone incident

Source: Unison 20170801 CP6 - Introduction for external stakeholders

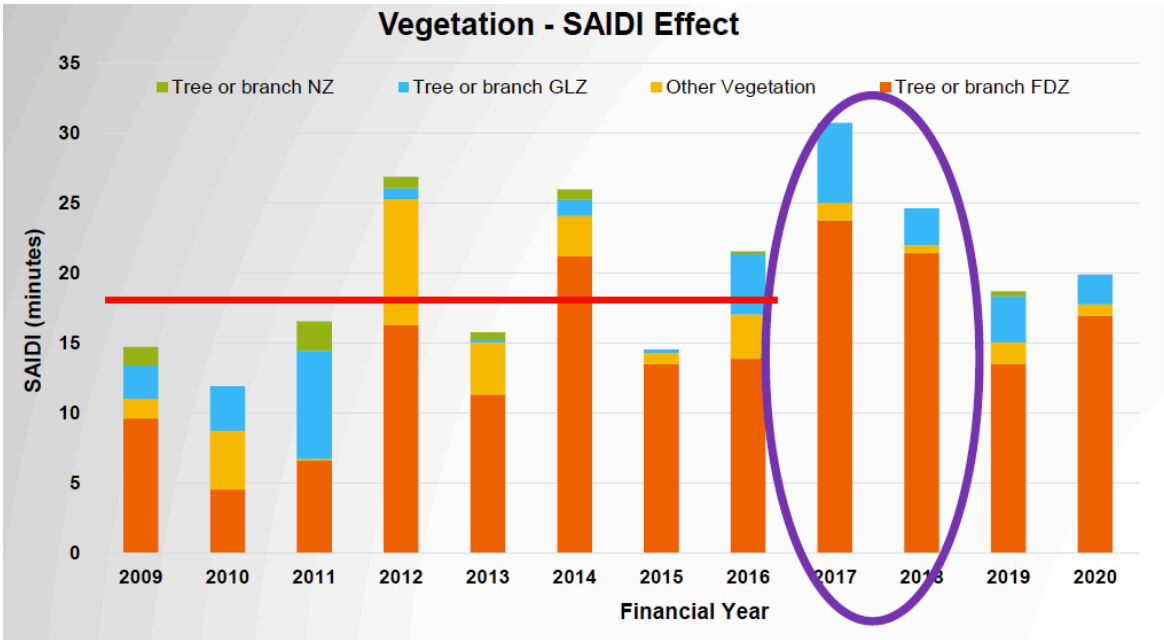
151. Unison noted that between 2012 and 2017 it had experienced 493 Fall Distance Zone related faults:

> *In 2016/17 fall distance tree-related faults led to an increase in SAIDI of 12.5 minutes above historical average and 6.4 minutes in 2017/18.*
>
> *Weather (rainfall, wind strength and direction) and maturing pine forests contributed to this impact.*[27]

152. Unison supported its explanation relating to Fall Distance Zone faults with outage data from 2009 to 2019 (see Figure 13). This data provides a clear indication that Fall Distance Zone faults became the largest contributor to vegetation related SAIDI from 2012.

[26] 20161216 Vegetation Management Programme Review_Board Report
[27] 2018_Quality_Breach_ComComVisit_Jan2020_Final, slide 12

Figure 13: SAIDI attributed to vegetation



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final

Note GLZ = growth limit zone, FDZ = fall distance zone

8.1. Unison's vegetation management practice has been changing

153. Our understanding based on the 2016 Board Paper is that between 2003 and 2016 Unison had focused its vegetation management expenditure on managing trees within the Growth Limit Zone. The trees outside the Growth Limit Zone had not been actively managed by Unison during that period:

> *This generally means any tree at a distance of more than 3.5m remains outside the scope of the Regulations and is not currently actively managed by Unison, except where it is identified there is a high likelihood a tree poses an imminent network risk.*[28]

154. In 2016 Unison summarised three concerns about trees in regard to its vegetation management practices at that time:

- the first is compliance with the tree regulations. Trees in lower risk areas of the network have the potential to grow into the GLZ without being effectively detected and addressed by the current approach;
- the second area of concern is fall distance trees. These are trees which are not covered by the existing tree regulations but far too regularly fall into Unison's lines. Unison is no longer willing to tolerate absorbing the high network performance impacts and associated remedial costs associated with fall distance trees; and
- there is no forecasted transfer of tree management costs to tree owners.[29]

[28] 20161216 Vegetation Management Programme Review_Board Report, page 8
[29] Ibid, page 7

155. The 2016 Board Paper also noted that in 2011 Unison had developed and implemented a decision support tool known as the Vegetation Prioritisation Tool (VPT) which had proven to be valuable in prioritising its vegetation management efforts.

156. In AP2018 Unison commenced trials into alternative approaches to vegetation management that would address the issues it had identified; Unison noted that:

> *The successful learnings from the various approaches will be incorporated in Unison's future Vegetation Management Strategy and Programme in order to achieve the desired Asset Management objectives and outcomes.*[30]

8.2. Unison has been monitoring its performance and implementing improvement strategies

157. Unison provided documents that demonstrated how it developed its current vegetation management strategy. The documents provide clear evidence that Unison applied considerable effort to gain an understanding of the limitations of its historical practices and current performance levels. In 2018, Unison recognised the contribution vegetation related incidents were making to its SAIDI and noted the increasing impact from Fall Distance Zone trees:

> *Throughout 2017/18, Unison has continued to deliver against the existing vegetation management programme. Even excluding storm related events, the impact that vegetation has on network performance is significant. Vegetation continues to contribute over 20% of the annual SAIDI and is responsible for approximately 25% of all extended outages experienced by customers.*
>
> *Whilst the Growth Limit Zone has been managed well and the impact has been minimised (average of 2 SAIDI minutes per year), vegetation within falling distance has had a sustained high impact (average of 25 SAIDI minutes per year). Over the past five years, there is an upward trend in the number of faults, and an increase in the impact of faults, from fall distance trees and those subject to the regulations*[31]

158. Unison also recognised the limitation of its current approaches:

> *Trees within falling distance have been managed reactively so far. This management approach had meant Unison experiences a high number of fall distance related faults every year and a high resulting impact.*[32]

159. To address the limitations, Unison undertook changes and made investments to improve its vegetation management performance. Unison described[33] its current vegetation management approach as:

- *a mix of proactive and reactive liaison with tree owners;*
- *using risk-based information to direct reactive liaison;*
- *using proactive liaison to address the backlog of liaison;*
- *resourcing at least three, two-man cutting crews per region;*
- *adopting electronic notices to reduce administration;*

[30] Ibid, 10
[31] 20180223 UNL Vegetation Management Strategy Paper, page 9
[32] Ibid, page 10
[33] [33] 20180223 UNL Vegetation Management Strategy Paper, page 9

- *developing more detailed data and reporting platforms to provide increased visibility;*
- *assessing the wider environment rather than just the regulated zones;*
- *creating efficiencies through use of electronic notices and coordination of outages and projects;*
- *maintaining closer relationship with between Unison and UCSL;*
- *improving accuracy of information and cause identification from tree related faults FDZ vs GLZ; and*
- *participating in an industry working group to lobby government for review of vegetation related regulation.*

160. During the on-site sessions, and in documentation, Unison demonstrated that it had implemented changes in its approach to Fall Distance Zone management and was applying new tools and systems.

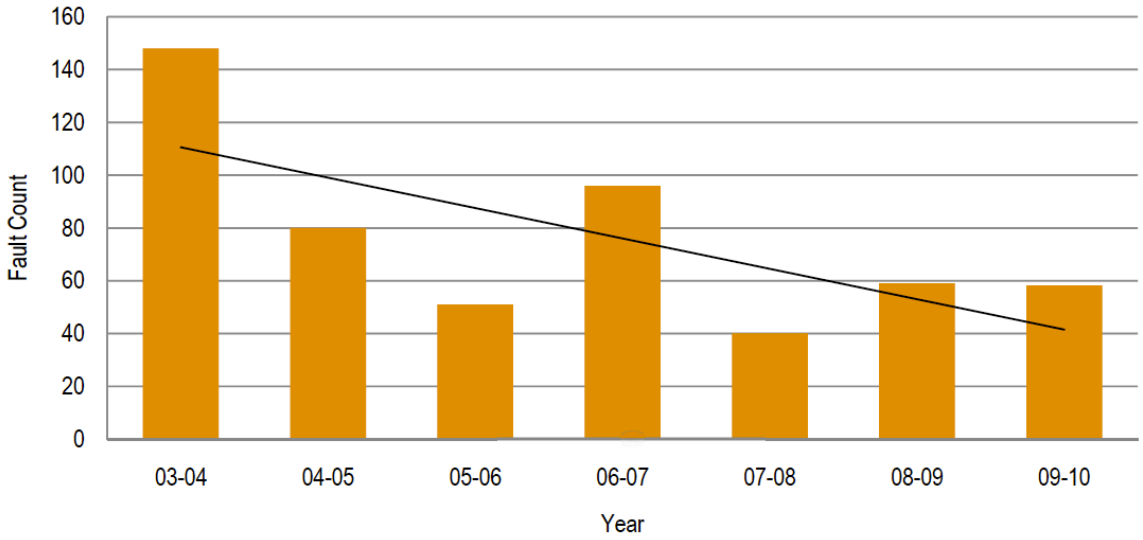
161. Unison also discussed a favourable high court ruling that it had gained to resolve an issue of repeated incidents with a forestry block concerning fall distance trees. Unison considered that this result set an important precedent for electricity networks regarding commercially grown trees (mainly forestry) located within falling distance of overhead electricity lines.

162. In our opinion, in taking legal action to support its efforts to address vegetation related reliability risks, Unison has demonstrated that it is creating incentives for tree owners to act responsibly. Unison's proactivity also indicates its willingness to take a leadership role in resolving current issues within the legal framework for tree management.

Between 2004 and 2010 Unison had reduced vegetation related faults

163. Figure 14 shows that between 2004 and 2010, Unison had reduced the outages related to vegetation. Whilst 2004 could be considered to be an outlier, the average fault count for the remaining years of around 60 per financial year/Assessment Period is low compared with performance in the following decade.

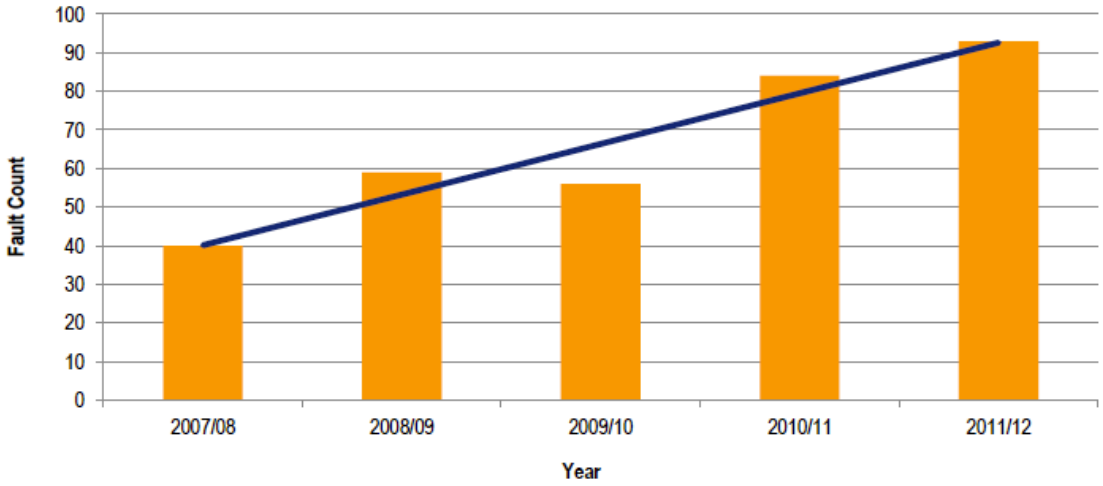
Figure 14: Vegetation related faults 2004 to 2010



Source: Unison 2010 AMP, page 6-29

164. Unfortunately, the apparent gains made in the 2000s were eroded in the following decade. The more than doubling of vegetation fault counts (Figure 15) was signalling a need for improved vegetation management activity and expenditure.

Figure 15: Vegetation related faults 2008 to 2012



Source: Unison 2013 AMP, Graph 6-7: Vegetation related faults

165. Unison noted in its 2013 AMP that the increase seen in 2011 and 2012 was transient and attributable to adverse weather in these years:

> *The apparent increasing trend of vegetation related faults, in the later two years……, is driven by the severe weather events that Unison experienced during 2010/11 and 2011/12. Adjusting for these events, and taking into account the benefits that have already been seen from implementing the network-wide first-cut strategy in 2012/13, this trend is expected to reverse. That is anticipated to be the case in the short-term for vegetation related faults due to incursion from within the clearance zone, however events due to fall-hazard trees are expected to take longer to influence and minimise.*[34]

166. It is interesting to compare the fault outages in Figures 14 and 15 with those in Table 5 which indicates that between AP2015 and AP2018, a significant increase in vegetation related faults occurred. It is important to note that the faults in Figure 15 are total vegetation related faults, and fault numbers in the first column in Table 5 include only those related to FDZ faults.

[34] Unison 2013 AMP, page 6-42

Table 5: Number and related SAIDI attributable to vegetation outages

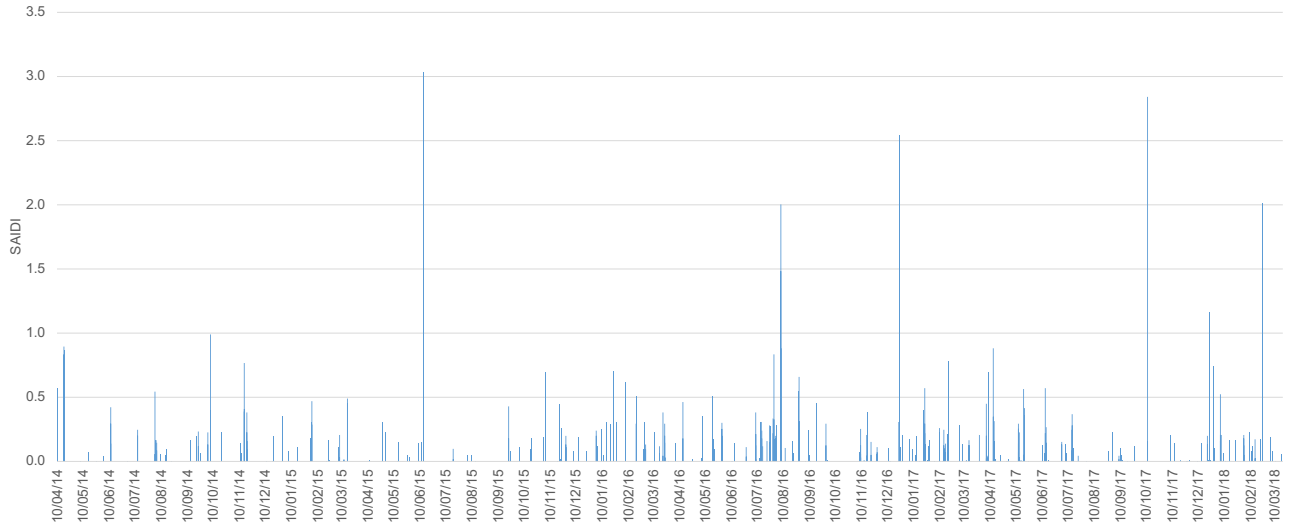
	FDZ only (excluding MED)		Total (including MED)		Total (excluding MED)	
Assessment Period	Number of outages	SAIDI	Number of outages	SAIDI	Number of outages	SAIDI
2015	64	13.24	82	19.31	74	13.75
2016	62	13.87	121	21.82	121	21.82
2017	146	23.45	199	35.04	195	30.59
2018	123	20.66	175	26.30	168	23.97

Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

167. The AMPs from at least 2010 were indicating a clear issue to be addressed regarding Fall Distance Zone trees. The issue became critical during AP2017 and AP2018. The high number of FDZ events in AP2018 is likely to have been due, to some extent, on the four adverse weather MEDs weakening trees which subsequently fell. However, even accounting for this, the data and analysis supports Unison's explanation that FDZ incidents are major contributors to vegetation related outages and, in AP2017 and AP2018, made a material contribution towards SAIDI and its non-compliance.

168. Figure 16 charts all FDZ outages including those occurring on MEDs. The analysis indicates that underlying FDZ incidents increased during AP2017 and AP2018 and that large events occurred more frequently in AP2018.

Figure 16: SAIDI (including MED) attributed to FDZ vegetation outages

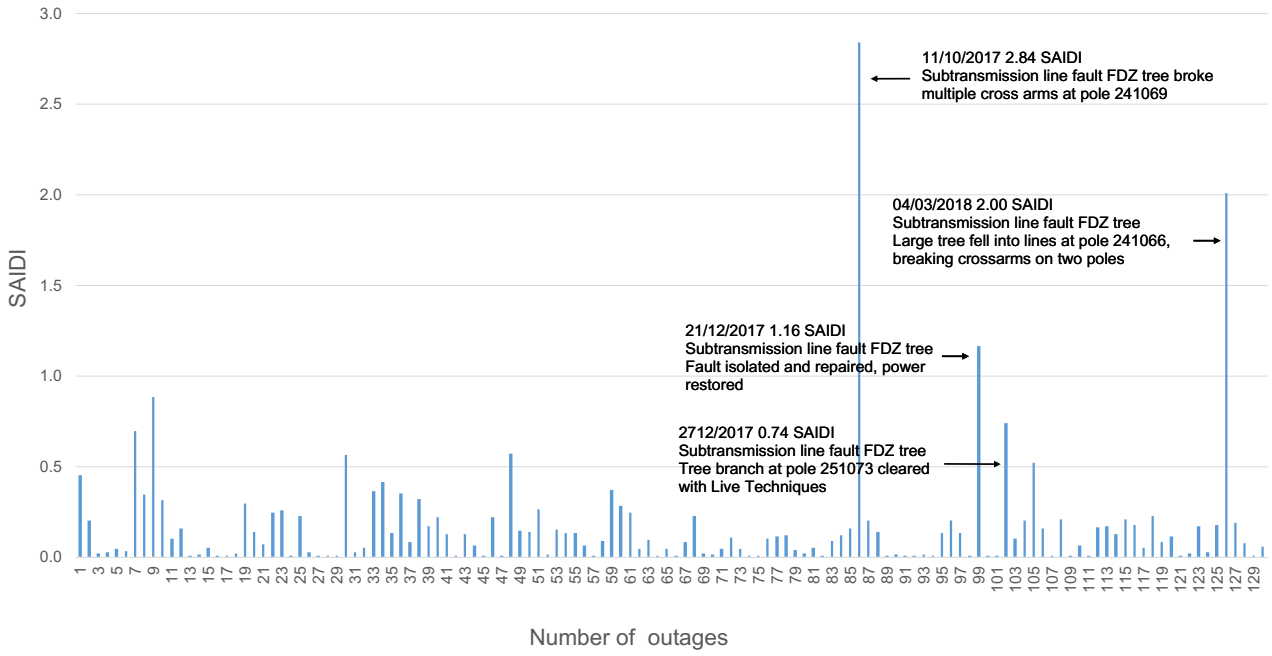


Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

169. In AP2018, there were six subtransmission outages related to FDZ trees. These six outages caused Unison to incur 7.25 SAIDI; three were attributed to FDZ trees falling, the others were attributed to branches on lines. Combined, the six outages contributed 27.6% of SAIDI attributed to all FDZ tree incidents.

170. Figure 17 shows the FDZ tree related outages occurring in AP2018. The causes of the four highest SAIDI events are noted, all of which are subtransmission line faults. Combined, these four events contributed 6.74 SAIDI which is 25.6% of SAIDI attributed to FDZ trees. None of these events occurred in months that included an adverse weather MED.

Figure 17: AP2018 SAIDI attributed to FDZ tree outages (includes MEDs)



Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

171. The outage data provided by Unison indicates that:

a) FDZ tree related outages were a material contributor to SAIDI in AP2017 and AP2018 and therefore relevant to Unison's non-compliance;

b) FDZ tree outages are not an MED issue because the majority are occurring on other dates;

c) a small number of incidents on the subtransmission lines were causing a disproportionately high contribution to SAIDI; and

d) Unison was aware of the issue it had with FDZ trees since at least 2009.

172. In its response to Strata's draft report Unison stated:

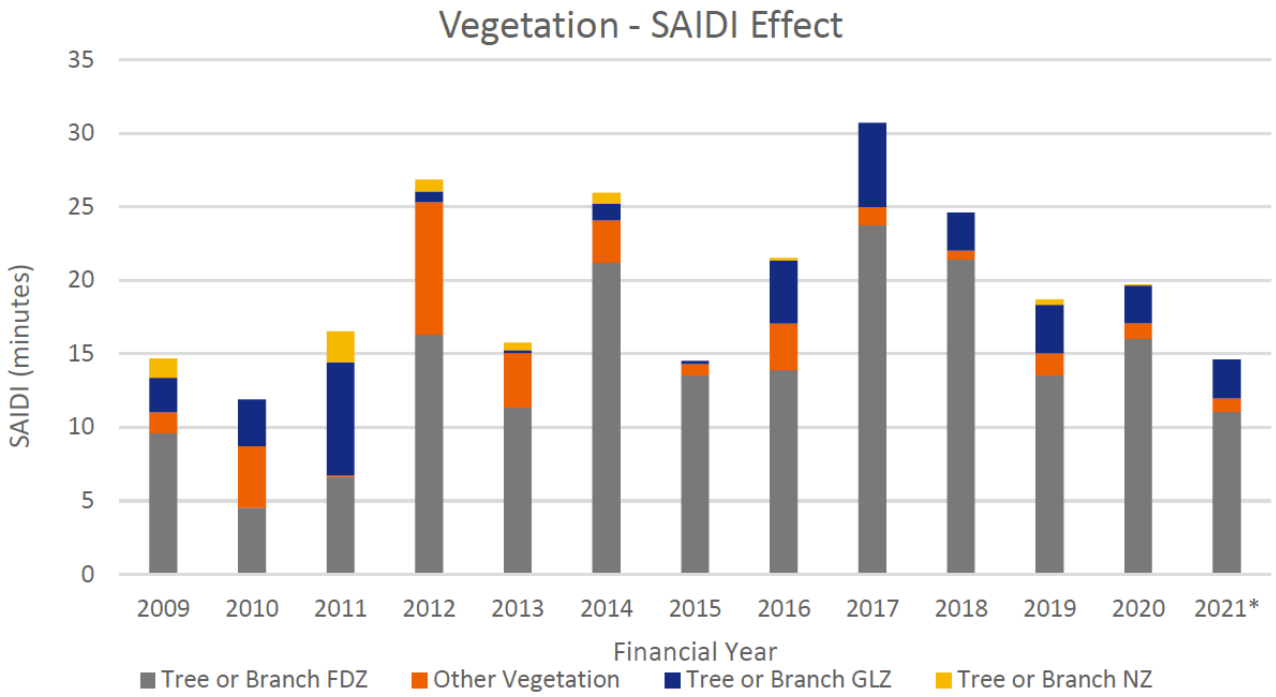
> *it is important to recognise that the impact of GLZ faults in the breach period was modest, contributing only 5.7 minutes in RY2017 and 2.6 minutes in RY201;*[35] and for FDZ
>
> *The 23.75 minutes incurred in 2017 and 21.2 minutes in 2018 were well above the historic average of 12.12 minutes and based on the commentary above, even in hindsight, Unison could have done no more to either foresee or prevent these FDZ impacts*

173. This statement is consistent with Unison's 2018 Vegetation Strategy paper discussed in paragraph 151. The strategy paper stated that vegetation within falling distance had had a high impact averaging 25 SAIDI minutes per year). The strategy paper also noted that over the most recent five years these faults had increased in number and impact.

174. Unison also provided a 12 year perspective of the tree fall events contribution to vegetation related faults. This is reproduced below.

[35] 20201012 Unison response to Strata draft report, page 5

Figure 18: SAIDI due to vegetation



Source: 20201012 Unison response to Strata draft report, page 6

175. Unison provided its view that the '*RY2017 and RY2018 years reflected statistical variation, not any change or diminution in practice in the period leading up to the limits being exceeded*.'[36] In our view, whilst statistical variation is likely to be a factor, the latter years of the decade appear to be indicating that FDZ vegetation interruptions had become more prevalent as a regular contributor to SAIDI.

176. Figure 18 also indicates that SAIDI attributed to GLZ incidents increased from 2016, whilst SAIDI attributable to other vegetation reduced.

177. The data confirms Unison's statements that FDZ incidents during AP2017 and AP2018 were major contributors to its vegetation related SAIDI.

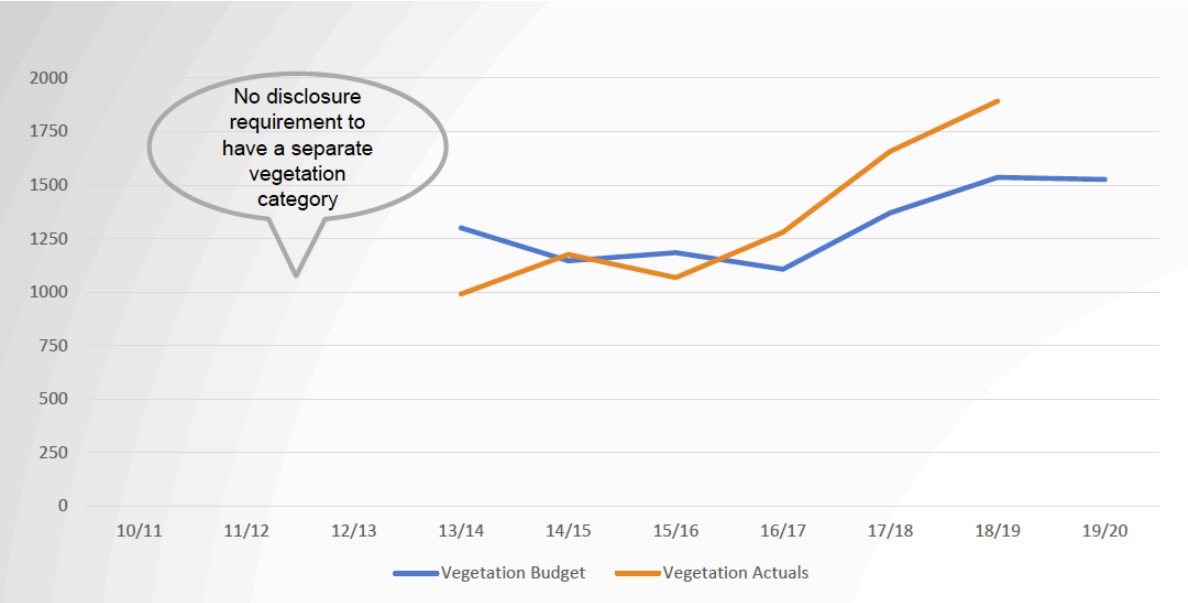
178. We will now consider if the vegetation management opex applied by Unison prior to AP2017 was appropriate.

Unison says that it increased vegetation management opex

179. In the information it gave to the Commission, Unison did not provide its historical vegetation management opex prior to AP2014. Figure 19 reproduces the information that Unison gave to support its explanation that vegetation opex had been increasing above budgeted levels. In its slide, Unison compares its actual vegetation management opex with budget.

[36] 20201012 Unison response to Strata draft report, page 6

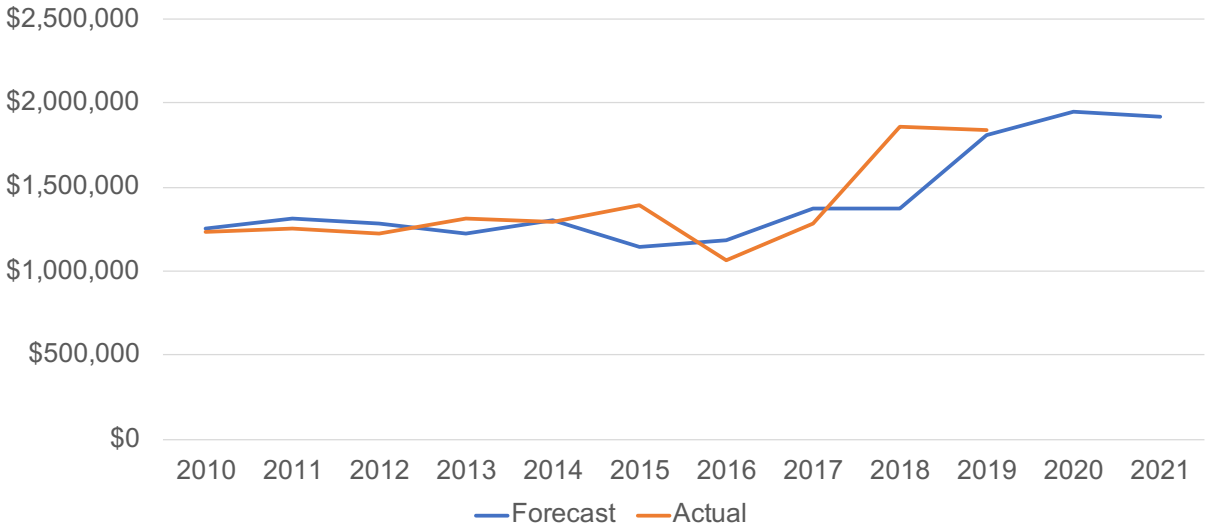
Figure 19: Unison's vegetation expenditure vs budget



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 153

180. To obtain a longer term view of the historical vegetation spend we plotted the actual vegetation management expenditure Unison disclosed in each of its AMPs against the forecast made for each period in the previous period's AMP. In other words, we compared the actual spend against the most recent forecast. Figure 20 presents the results of this analysis.

Figure 20: Vegetation expenditure vs budget from 2010 to 2019 AMPs



Source: Strata analysis of data in Unison AMPs from 2010 to 2018[37]

Note The AMP actual opex data between AP2010 and AP2013 included only period end forecasts produced in February. From AP2014, subsequent AMPs contained final actual opex. The actual opex for 2019 was sourced from the 2019 AMP and was a February forecast which is why it is lower than Unison's final value in Figure 18.

[37] Strata Excel workbook - Vegetation analysis from AMPs.xlsx

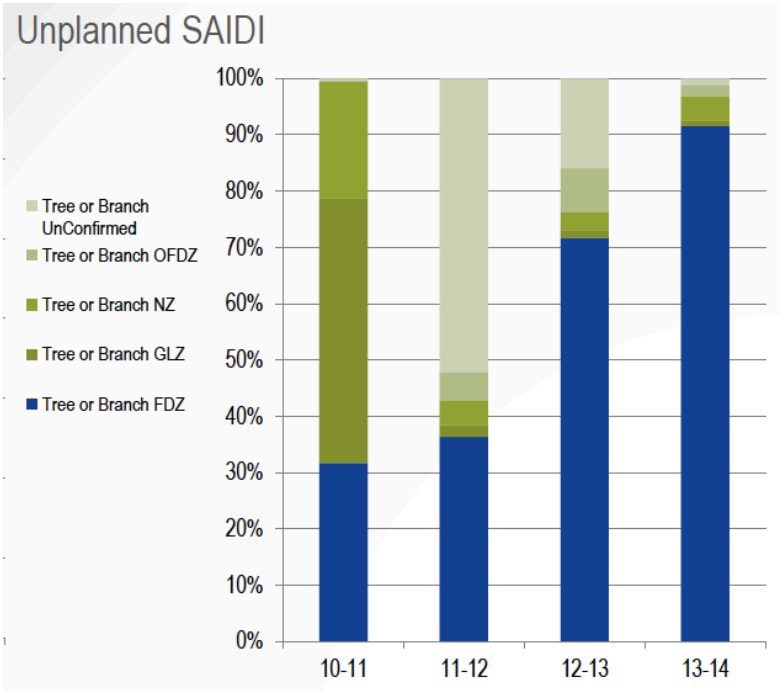
181. Unison's 2009 and 2010 AMPs provided evidence that it was aware of the condition of its vegetation related risks and had increased vegetation management opex:

> *Unison's strategy for vegetation control will result in a "first cut" for the whole network to be completed within the next three years. This has resulted in a considerable increase to operational costs in the short term, but it is expected that some recovery will be made in cutting costs by transferring the financial responsibility to the tree owner(s). The significant administration costs incurred to comply with the regulations will offset this benefit to some extent.*[38 and 39]

182. Unison's 2009 AMP indicated that it had applied increased levels of vegetation maintenance and this had impacted favourably on system performance.[40] The 2010 AMP noted that Unison's new prioritised feeder section Vegetation Maintenance strategy, which targets primary sections of feeders, had impacted favourably on system performance.[41]

183. In a December 2013 presentation[42] to the forestry industry, Unison identified that plantation vegetation incidents had contributed an increasing proportion of Unison's unplanned SAIDI attributable to vegetation. Figure 21 reproduces the chart Unison presented to the forestry industry. This chart clearly indicates emerging issues with FDZ trees and Unison's awareness of them.

Figure 21: The increasing FDZ tree related unplanned SAIDI



Source: Unison Forestry Presentation 06122013, slide 15

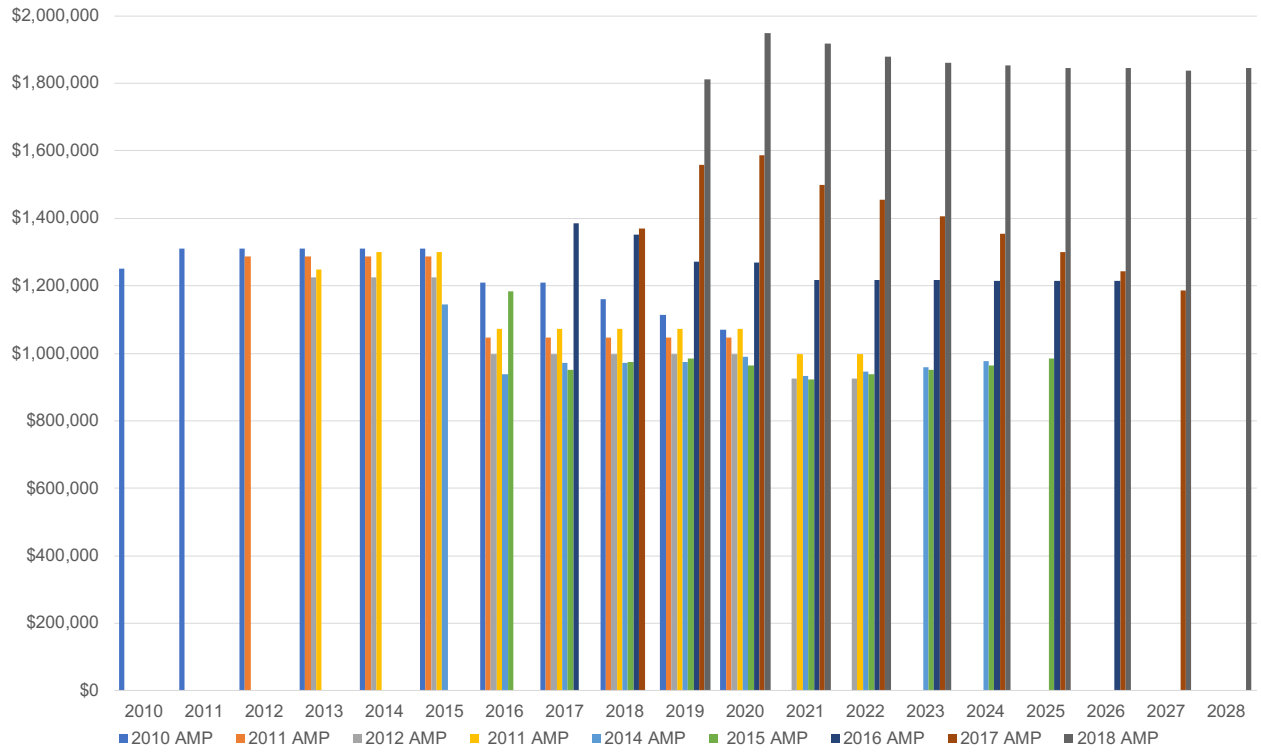
184. The progressive vegetation management opex forecasts provided in Unison's AMPs give an insight into its understanding of how vegetation issues had changed the level of expenditure it planned to make on vegetation management. Figure 21 shows the changing

[38] Unison 2009 AMP, page 6-27
[39] Unison 2010 AMP, page 6-28
[40] Unison 2009 AMP, page 3-22
[41] Unison 2010 AMP, page 6-24
[42] Unison Forestry Presentation 06122013

vegetation opex forecasts that were occurring between 2010 and 2018. The data has been taken from the forecasts Unison gave in its AMPs over that period. It is clear that Unison began to forecast a significant change in its vegetation management opex in the 2017 AMP and provided for a further uplift in its forecast in the 2018 AMP.

185. Prior to the 2016 AMP, Unison forecast a reduction from previous levels in vegetation management opex commencing at AP2015. Between the 2015 and 2018 AMPs, Unison actually doubled its forecast for AP2019 onwards.

Figure 22: Unison's changing vegetation management opex forecasts



Source: Unison AMPs from 2010 to 2018

186. Figure 22 indicates that Unison began to forecast a material increase in vegetation management opex from 2017, and a further material increase in the forecast vegetation opex in its 2018 AMP. The questions raised by this relatively recent increase in vegetation management opex are:

- Why did Unison forecast a reduction in vegetation management in its 2012 to 2015 AMPs?
- What has caused the material change in Unison's vegetation opex from 2017?
- What benefits is Unison forecasting that this will have in terms of improved reliability? and
- Had Unison applied this increase earlier, would it have avoided breaches to its SAIDI limits in AP2017 and AP2018, and therefore its noncompliance with the Quality Standard?

187. In its response to Strata's draft report, Unison supplied the following explanation for the expected reductions in vegetation management opex:

The 2010 review that prompted Unison to create an internal vegetation management function had identified that cutting methods and cut philosophy used by external vegetation managers was not aligned with

> *Unison's interests to ensure that cutting approaches directed regrowth away from powerlines, nor maximised the extent of felling. Unison submits that it was reasonable at the time for Unison to forecast that this would lead to a longer-term benefit of reduced tree management costs given the improved management approach.*[43]

188. Unison also explained why the expected benefits of the changes in its vegetation management practices had not been realised:

> *it subsequently transpired, the limitations of the Tree Regulations meant that the financial benefits of in-sourcing vegetation management were not as great as forecast. The Tree Regulations do not prevent consumers from receiving a free "first cut or trim" and then subsequently declaring "no interest" when regrowth occurs, leading to second rounds of tree trimming that EDBs must pay for. Furthermore, the Regulations do not prevent consumers from replanting new trees which are entitled to further free first cut or trims.*[44]

189. Unison's explanation aligns with the expectations stated in its 2009 and 2010 AMPS that future cost savings would be realised by transferring future trimming costs to tree owners. The explanation also addresses our initial observation when comparing the expectations set out in the 2009 and 2010 AMPs and the actual expenditure profile.

190. Unison noted that it had conducted a further review of its vegetation management programme in 2016. This resulted in the deployment of additional resources to increase capacity to manage GLZ trees. This aligns with uplift in the vegetation opex forecast seen in the 2016 AMP (see Figure 20). In its response to Strata's draft report, Unison acknowledged that increased vegetation management expenditure may have had a minor improvement effect on reducing GLZ vegetation related interruptions.

191. Unison also gave a reason for the further increase in vegetation management opex forecast from 2017:

> *The recent increase in vegetation management expenditure is focussed on growth limit zone trees, not on fall distance trees*[45]

192. Unison's information and explanations indicate that it has applied appropriate strategies to vegetation management and that these have evolved and changed over time in response to changing circumstances and improved information. The explanation also supports a conclusion that Unison's vegetation strategy has evolved since 2010 to improve its ability to prioritise and target its vegetation management operations and expenditure.

193. However, Unison also explains that since 2010, it has not targeted increased expenditure on FDZ trees. As Unison noted in its 2013 presentation to the forestry industry, FDZ vegetation issues are the primary contributor to SAIDI. A key question relative to Unison's non-compliance is whether an increase in vegetation opex to better manage FDZ trees would have enabled it to remain compliant. This question is addressed in the following section.

194. Accordingly, we have concluded that:

- the reduction in vegetation management forecast in its 2012 to 2015 AMPs was based on reasonable expectations of benefits associated with its vegetation control strategy to complete the first GLZ trim, and the assumption that the GLZ trimming costs would be passed on to tree owners;

[43] 20201012 Unison response to Strata draft report, page 4
[44] ibid
[45] ibid

- the change in Unison's vegetation opex from 2017 has been based on an appropriate strategy development which is largely due to the deployment of additional resources to increase capacity to manage issues related to GLZ trees;
- Unison's current vegetation management strategy is targeting benefits from an improvement to the management of GLZ vegetation; and
- had Unison applied this increase earlier, it is likely that some reliability improvement benefits would have been realised but that these would not have avoided breaches to its SAIDI limits in AP2017 and AP2018 as the interruptions attributed to FDZ vegetation would not have been reduced under the strategy.

195. The discussion above raises a further question regarding the adequacy of Unison's management and expenditure related to management of FDZ vegetation. We address this question in the following section.

8.3. Our views and opinions on outages attributed to fall distance zone trees

196. Whilst our analysis of Unison's outage data indicates that FDZ outages on MED days were not a main contributor to its non-compliance, we agree with Unison that the FDZ tree related faults have been a major contributor to its vegetation related SAIDI at times other than MED. We also agree with Unison that overall, the increase in FDZ faults in AP2017 and AP2018 materially contributed to its non-compliance.

197. In its response to Strata's draft report, Unison supplied further discussion and information on this issue. Unison informed the Commission that it had:

a. taken significant steps to improve management of FDZ vegetation from 2015 including applying a specific focus on its subtransmission lines;

b. been very aware of network vulnerabilities due to fall distance vegetation, particularly in relation to three specific radial sub-transmission circuits, namely the Esk, Fernleaf and Taupo Plains Feeders; and

c. implemented reinforcement solutions such as the installation of a diesel generator at the Rainbow Substation designed to support customers supplied by the Fernleaf 33kV Feeder. Unison noted that this installation was an attempt to limit the consequences of damage caused by FDZ trees, but in most circumstances, it is not efficient to build such back-up solutions.

198. In addition, Unison informed the Commission of the following actions that it had taken which, in its view, reflect good industry practice in vegetation management:

a. proactively identified the risks associated with fall distance trees through annual inspections of the sub-transmission network;

b. proactively engaged with tree-owners to seek improved forestry management around lines, and where there are clearly defective trees, address these to remove the risk;

c. where necessary, Unison issued tree-owners with Fall Distance Hazard Notices, formally notifying tree owners of the risks and putting them on Notice that Unison may seek recovery of damages;

d. periodically reviewed vegetation management practices and implemented improvements (e.g., formal reviews in 2010 and 2016, with other enhancements such as development of the vegetation prioritisation tool in 2012);

e. proactively taken a court case against a forest owner to clarify legal rights and responsibilities for damage caused by trees when negotiation efforts with tree-owners and lobbying efforts to gain improved Tree Regulations failed; and

f. *participated in industry forums and development of industry guidelines for managing trees, including latterly, actively contributing to MBIE's review of the Tree Regulations.* [46]

199. Concerning FDZ trees specifically, Unison expressed strong views that increasing vegetation management expenditure earlier than it did would have had little effect on it non-compliance because:

a. Unison has been very aware of network vulnerabilities due to fall distance vegetation, particularly in relation to three specific radial sub-transmission circuits, namely the Esk, Fernleaf and Taupo Plains Feeders which have large concentrations of predominantly commercial forestry plantations in very close proximity to Unison's assets;

b. the recent increase in vegetation management opex is not targeted at cutting FDZ trees but at management of GLZ trees that it historically prioritised as lower risk; and

c. there are significant legal limitations on its ability to compel owners of fall distance trees to remove them.

200. As a result of the above points Unison expects that periodically, it will have years where the combination of weather and ground conditions will lead to adverse reliability outcomes similar to that experienced in RY2014, RY2017 and RY2018.

201. The issues faced by Unison relating to FDZ trees is similar to that experienced by other EDBs that have assets, particularly subtransmission lines, that traverse forest plantations. We acknowledge that the legislation covering EDB rights to manage FDZ tree risks is limited and that managing these risks requires relationship management with the forestry industry and individual plantation owners.

202. There is clear evidence (e.g. the 2013 meeting with the forestry industry) that Unison has been proactive in providing information to, and building relationships with, the forestry industry. We have found that the information Unison has supplied indicates that it has understood the situation and has acted proactively to manage the challenges.

203. We also acknowledge that Unison has taken leadership roles in developing vegetation management practices.

204. In its 2020 AMP, Unison details the initiatives it has taken since 2018:

> *Unison is constantly reviewing and enhancing its vegetation management processes in an effort to improve the efficiency of the cutting programme, and to mitigate the issues and impacts caused by vegetation both within and outside the corridors prescribed in the Tree Regulations.*
>
> *Significant improvements have been made over the last 12 months including:*
>
> - *consolidation of all vegetation related defects into a single database (Activa) which will be migrated to One Energy on its implementation*
> - *enhancement of internal processes for reporting of vegetation issues*
> - *enhancement of the risk framework to more accurately evaluate vegetation related risk*
> - *development of a vegetation dashboard to aid with the visualisation, reporting and progress associated with vegetation management*

[46] 20201012 Unison response to Strata draft report, page 6 and 7

- *reduction in manual handling of vegetation information by the implementation of electronic notices and associated mobility solutions, and*
- *improvement in scheduling and forward view of vegetation work.*[47]

205. We have concluded that actions Unison has taken are likely to achieve improvements in the management of FDZ trees and result in lower related SAIDI and SAIFI. However, given the limitations of EDB rights to undertake vegetation management unilaterally, and the uneconomic cost of such action, FDZ tree issues will continue to be challenging.

8.4. Our views and opinions on Unison's general vegetation management

206. In our opinion, the improvement initiatives Unison has taken since 2016 demonstrate that it has been applying good industry practice vegetation management since that time. The reasons we have reached this view include;

a) evidence of investigations and research that Unison undertook from AP2010 to improve its vegetation management practices;

b) development, implementation and ongoing improvement of its Vegetation Prioritisation Tool; and

c) the increase in vegetation related expenditure and expanding the number of crews from AP2017.

207. The reassessment of forecasts during AP2017 leading to a near 100% increase above earlier forecasts provides evidence that Unison had understood that its forecasting in earlier AMPs was too optimistic. Unison has provided a logical and supported explanation for the changes in its AMP forecasts and we accept that the revisions made were appropriate.

208. Given the significance of the FDZ events to Unison's non-compliance, we have considered the question; if Unison had acted more swiftly to increase its vegetation management opex, could FDZ and other vegetation related outages in AP2017 and AP2018 have been avoided? We have concluded that increased expenditure is unlikely to have avoided non-compliance because:

a. targeting and prioritising expenditure at FDZ tree management would have been challenging given the extent of Unison subtransmission lines located in forestry plantation and the difficulty in predicting which trees are the highest risk;

b. there are limitations on Unison's rights to take tree cutting actions; and

c. there is no evidence that Unison could have forecasted the increase in FDZ tree SAIDI in AP2017 and AP2018.

209. During the 2010 to 2016 period, Unison did undertake improvements to its vegetation management processes, for example:

a) it was an early adaptor of new technologies and applications to improve its knowledge and management of vegetation;

b) it had implemented a proactive approach to tree owner relationships from AP2010 and continued to develop and improve this;

c) the Vegetation Prioritisation Tool applied a risk-based approach to management of vegetation;

[47] Unison 2020 AM), section 5.5

d) it undertook post event reviews that included capturing areas where improvements could be made; and

e) it took steps such as High Court action to establish a precedent for tree owner responsibilities.

210. In our opinion, Unison has provided satisfactory evidence that it could not have materially reduced the FDZ tree outages by uplifting its vegetation management opex earlier than it did.

211. Looking forward, because of its adoption of technologies and applications, together with its plans to implement smart grid investments, Unison has grounds for optimism that its network performance related to vegetation interruptions will improve. However, we agree with Unison that unless there is a significant change to legislation, management of FDZ trees will continue to be challenging.

9. If defective equipment related faults were a contributing factor

212. In this section, we consider the validity of Unison's explanation that:

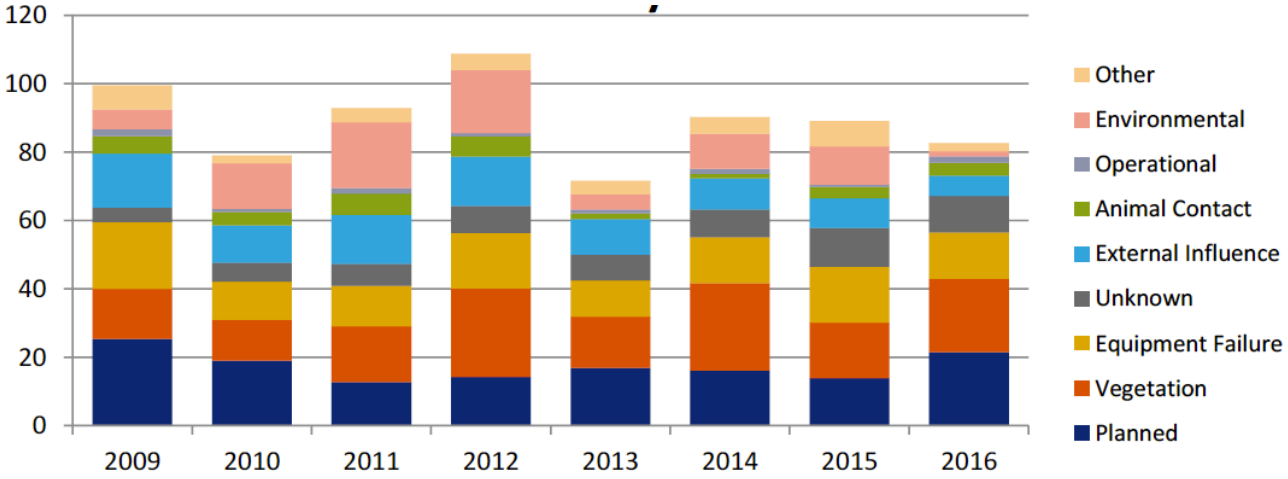
> *There has been a decrease in SAIDI from last year for the majority of causes, with the exception of planned work and vegetation-related outages. These fall within the natural variance expected from year to year, [48]*
>
> *…with reference to the SAIDI due to equipment failures, there remains a continued trend of the proportion of SAIDI contributed by equipment failures declining, such that it makes up less than 10% of SAIDI.[49]*

213. Unison noted[50] that it had experienced poor SAIFI performance of the 33kV overhead network.

214. Figure 23 presents Unison's analysis of the contributors to SAIDI over the decade preceding AP2017. The chart indicates several contributing causes with vegetation and equipment failure being the largest components of unplanned outages.

[48] Ibid, page 4
[49] Unison letter to the Commerce Commission 22 November 2019. Commerce Commission – Request for information – Unison Quality Breach, page 5.
[50] Ibid

Figure 23: Unison's May 2016 analysis of the causes of SAIDI

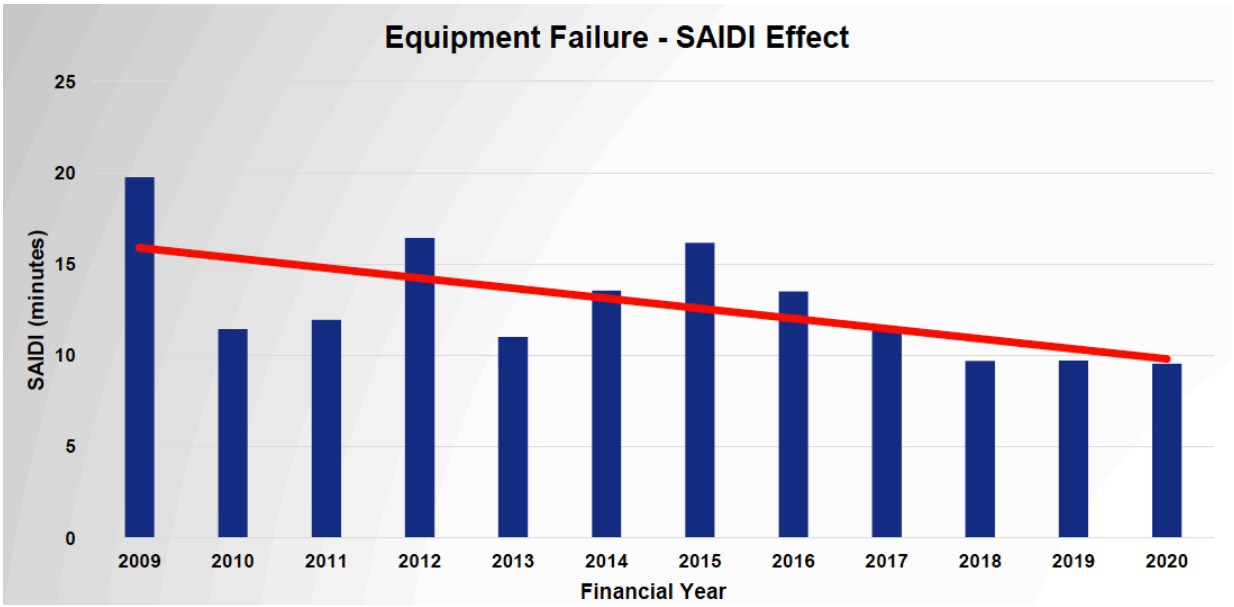


Source: Unison 20160520 Network Performance Board Report, page 4

Note The vertical axis is SAIDI

215. Unison provided the chart reproduced in Figure 24 to support its view that SAIDI attributable to equipment failures had been declining over the decade and that this decline was continuing. If this perspective is correct, then Unison's performance in reducing equipment failures would be impressive.

Figure 24: Unison's analysis of SAIDI attributed to defective equipment

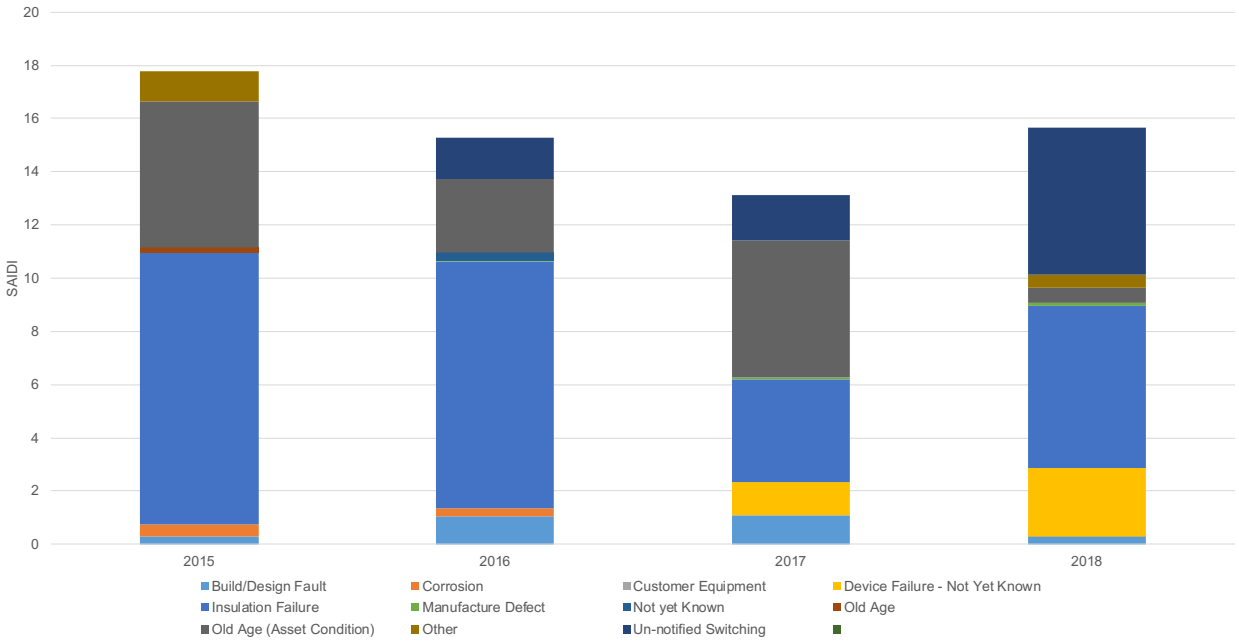


Source: Unison Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, page 5

216. To confirm the accuracy of Unison's view, we undertook analysis on the database of outages[51] that Unison had given to the Commission. This dataset included only outage data from AP2015. Figure 25 shows the profile of SAIDI (excluding MED) attributed by Unison to equipment failure.

[51] 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

Figure 25: Unplanned defective equipment SAIDI by AP (excluding MED)



Source: Strata analysis of Unison data[52]

217. We found a difference in SAIDI attributed to defective equipment between Unison's chart (Figure 24) and Strata's (Figure 25). Our chart has a higher number of SAIDI and a different trend line. We understand that both charts are drawn from the dataset Unison gave to the Commission.

218. We have concluded that the difference is due to Strata's inclusion of two additional subcategories (un-notified switching and other). Both of these subcategories are allocated to defective equipment in Unison's dataset.

219. Unison's definition of un-notified events was given in its 2018 response to the Commission:

> *Un-notified switching are instances where it is not possible to give customers 24 hours' notice. This urgent planned work arises due public safety risks being identified either by Unison's inspection programme or as a result of mechanical damage that has been caused to Unison assets by a third party. Examples of this include repairing overheating connections and replacing HV pole structures damaged by motor accidents. The number of these outages is volatile, as is the SAIDI and SAIFI impact.*[53]

220. Unison records un-notified switching outages and associated SAIDI and SAIFI for both planned and unplanned outages. Unison's fault classifications used in its Advanced Distribution Management System (ADMS)[54] provide the following requirements for un-notified switching:

    a) Planned (Un-notified Switching must be used if all customers are not given 24 hrs notice);

        a. includes tree cutting;

        b. new equipment;

[52] 4 - 14-15, 17-18 Dataset for submission to Commerce Commission
[53] - Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, page 19
[54] Ibid, Appendix A

c. equipment maintenance and replacement;

d. follow-up repair work - where customers have been notified; and

e. other planned work.

b) Un-notified Switching (counted as unplanned) - less than 24 hours' notice, or no notice, was given to all consumers affected by the interruption; e.g. tap change, follow-up repair work, isolation to remove branch, etc.

221. We found that un-notified switching events for unplanned work relate to equipment failures. A section of the dataset for un-notified switching events is shown in Figure 26. This clearly shows that the un-notified switching events are for undertaking work on broken or damaged equipment.

222. Unison provided data to the Commission for AP2015 to AP2018 only, so we are unable to validate other data in its chart (Figure 24). For AP2015 to AP2018, Unison's data will be compromised if it has omitted relevant equipment failure categories and its presentation of equipment failure trends.

223. The increase in unplanned un-notified switching under asset failure seen from AP2016 suggests either a change in the categorisation of these events or possibly the spillover effects of MED. By spillover effects, we mean the un-notified switching events on days adjacent to MED where the damage had been caused by the MED event. Unison did not advise that either of these issues had been experienced. In the absence of evidence from Unison to explain the increase in un-notified interruptions, the only conclusion we can draw is that increasing numbers of un-notified switching interruptions occurred since AP2015. This is confirmed in Figure 28.

Figure 26: Extract of interruptions dataset showing a sample of 'un-notified switching' events

FileType	Cause Description	Cause	**Asset Class**	Remedial Action
Unplanned	Defective equipment	Un-notified Switching	Distribution lines (excluding LV)	Fault isolated - power restored to rest of feeder
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Replace broken 11kV Fuse @ T225`
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Repair broken conductors
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	TXfr tap change. Tap change unable to be completed.
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Replace broken 11kv fuse & Xarm
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Isolate RMS 219 @ RMS 1796
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Repair 11kV lines at pole 262662
Unplanned	Defective equipment	Un-notified Switching	Distribution lines (excluding LV)	SP 135001297
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	repair Crossarm on Pole 238608 Broken
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Repair LV Fuse assy in Txfr 2264
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Replace crossarms pole 260390
Unplanned	Defective equipment	Un-notified Switching	Distribution lines (excluding LV)	Fault isolated and repaired, power restored
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Repairs to cable byd RMS s824
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Replace Txfr 3436
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	repair 11kV tail Txfr T2384
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Isolate to restand 11kV pole 761948
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	replace burning up fuse links s1515
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Un-notified emergency
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	pole 128138
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	Repair Fuses 4818
Unplanned	Defective equipment	Un-notified Switching	Distribution lines (excluding LV)	Replaced compressions on pole 112435
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	High Volts - performed tapchange
Unplanned	Defective equipment	Un-notified Switching	Distribution lines (excluding LV)	Repaired Jumper Pole 125984
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	To repair 11kV jumper at 11kv Fuses 4556
Unplanned	Defective equipment	Un-notified Switching	Distribution other (excluding LV)	LL replace faulty 11kV fuse s1718 toTxfr T3520

Source: Unison 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

224. We also found that the 'other' subcategory recorded under equipment failure in the dataset was also appropriately categorised as equipment failure (see Figure 18).

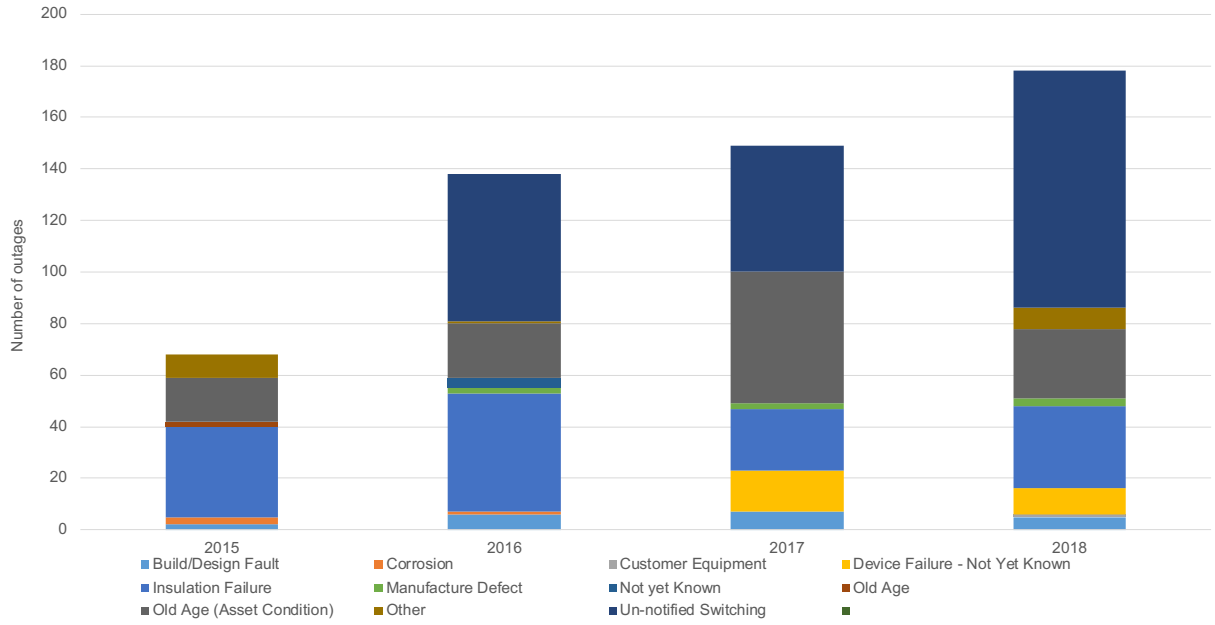
Figure 27: Extract of interruptions dataset showing a sample of 'other' equipment failure events

FileType	Cause Description	Cause	**Asset Class**	Remedial Action
Unplanned	Defective equipment	Other	Subtransmission lines	Back fed via 11kV
Unplanned	Defective equipment	Other	Subtransmission lines	Locate & repair, restore Tutira 33kv feeder
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	isolated and restored
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Repaired Line
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	repair line down & burnt wire at regulator
Unplanned	Defective equipment	Other	Subtransmission lines	Patrolled Nothing Found ABS 6607 Open Then Reclose
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Isolate & repair line connection
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Isolated & relivened
Unplanned	Defective equipment	Other	Distribution cables (excluding LV)	Cleaned HT insulators and relivened
Unplanned	Defective equipment	Other	Distribution other (excluding LV)	Sectionalised, replace T2079.
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Bolt came out of xarm repaired
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Tripped as a result of fault on Havelock 33kV and GFN maloperation
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Remote switch opened without command when comms restored. Closed remotely after field staff confirmation
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Agrekko Generator tripped while supplying Maraekakaho sub. Under investigation
Unplanned	Defective equipment	Other	Distribution cables (excluding LV)	Cable joint failed during a planned outage. Outage was scheduled to replace the section of cable including the joint after it was identified as an issue during scheduled inspection. Under investigation.
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	tripped while backfeeding due to slow fault indication from field devices
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	see INC 146023866, suspect R50 is faulty
Unplanned	Defective equipment	Other	Distribution lines (excluding LV)	Bypassed R50 as is suspected faulty

Source: Unison 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

225. Regardless of the issue with un-notified switching events, we can agree with Unison that between AP2015 and AP2017, there was a marked downward trend in SAIDI recorded for equipment failure outages related to insulator failures. However, when looked at from a number of outage perspectives, Unison's positive assessment of its equipment failure trend becomes difficult to accept at face value because, as Figure 28 indicates, the number of interruptions was increasing.

Figure 28: Unplanned defective equipment number of outages by Assessment Period (excluding MED)



Source: Strata analysis of Unison data[55]

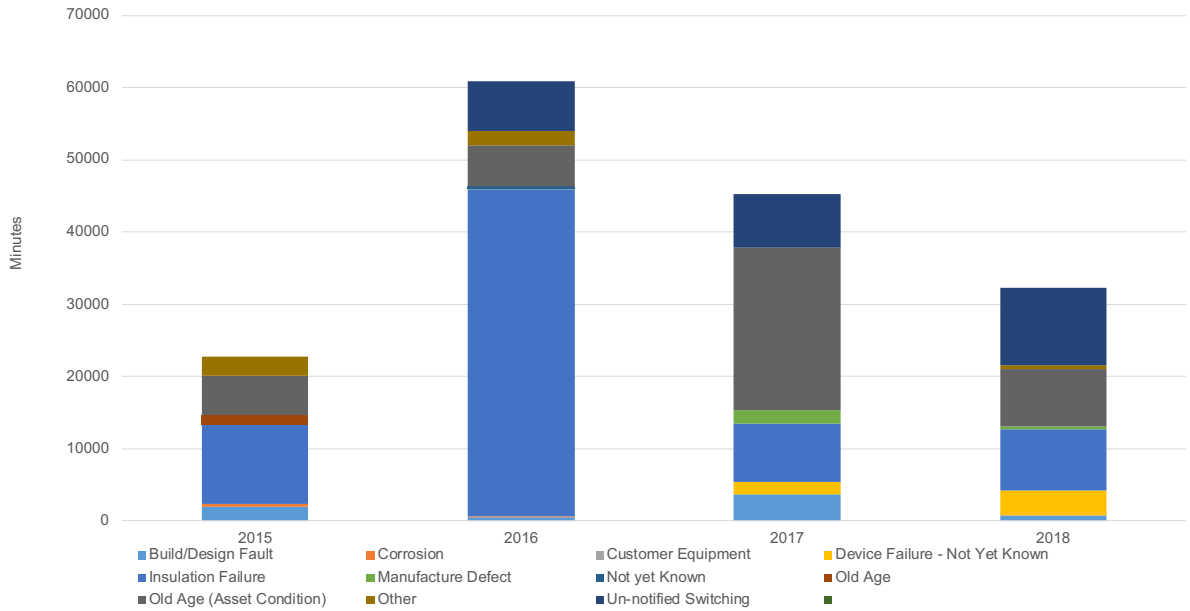
226. We examined Unison's interruption data further to establish if, rather than an improving condition/performance of the assets, changes in outage duration and/or the number of ICPs affected were driving the equipment failure trend.

227. Figures 29 and 30 provide charts from the relevant data.

228. Our analysis indicates that the improvement in equipment failure SAIDI between APs 2015 and 2018 was mainly due to the reducing duration of outages, particularly those for insulator failures. The reducing number of ICPs affected by outages also contributed to the downward trend in equipment failure related to unplanned SAIDI, particularly for insulator failures.

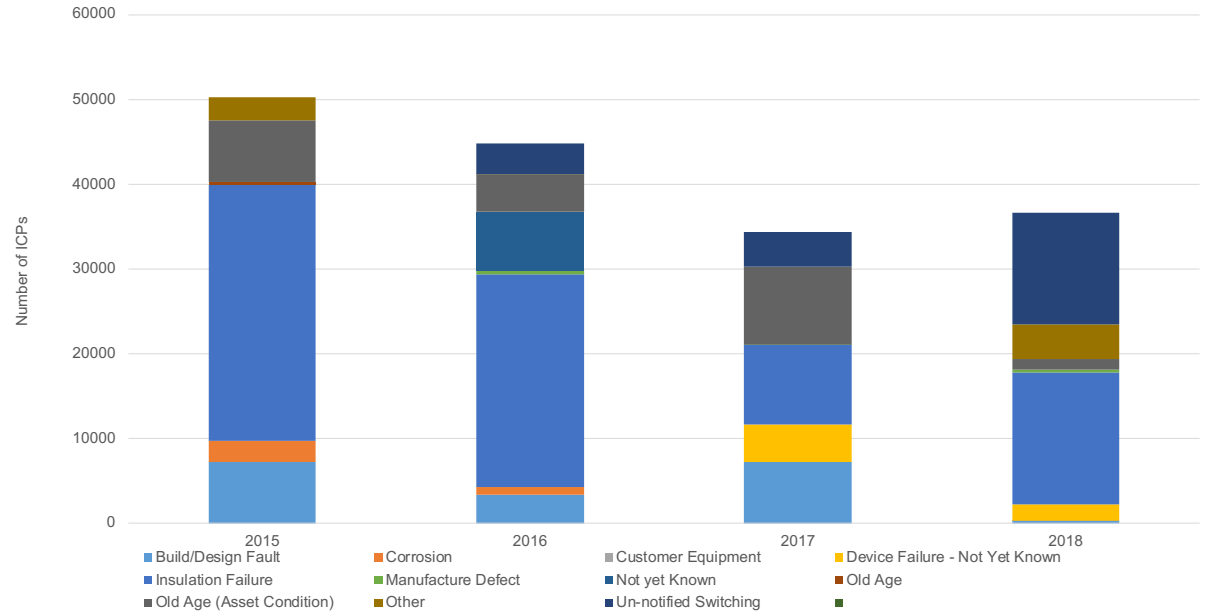
[55] 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

Figure 29: Unplanned defective equipment duration of outages by Assessment Period (excluding MED)



Source: Strata analysis of Unison data[56]

Figure 30: Unplanned defective equipment ICPs affected by outages by Assessment Period (excluding MED)



Source: Strata analysis of Unison data[57]

229. In our view, the reduction in equipment failure outage duration and number of ICPs affected is probably attributable to Unison's implementation of increased sectionalisation switching of its network and other steps, such as portable generation. Unison gained this capability through investment in a smart grid technology programme which commenced in 2009. This

[56] 4 - 14-15, 17-18 Dataset for submission to Commerce Commission
[57] Ibid

view is supported by Unison's documentation, discussions on-site and our observation of the network assets.

230. In summary, Unison's data recorded that the number of defective equipment related outages had not been trending downward as it claimed; the trend had actually been upward. The number of defective equipment related outages attributed to old age and poor asset condition had been increasing. Also, the number of un-notified switching had been increasing significantly between AP2016 and AP2018. This suggests that relatively small, easily fixed defects were becoming more common.

231. Whilst SAIDI related to equipment failure had been decreasing, we consider that the increase in number of equipment failure related outages since 2015 should be of concern and Unison should take steps to address this issue. Unison appears not to have identified and considered the increase in defective equipment related events. If this is the case, it is a departure from good industry practice.

232. In its response to Strata's draft report, Unison noted its proactivity to better understand equipment failures and inform its asset management decisions. Unison considers that this demonstrates how it applies analysis of equipment failures to support reliability performance and risk prioritisation when scheduling assets for replacement.

233. To support its point, Unison noted the following:

- *With respect to assessing equipment-related failures, Unison takes active steps to review all failures. This requirement is established in our asset management system (reference document AMS3012) and there are three different lenses/meetings where equipment failures are reviewed.*
- *Part of good practice Asset Management is balancing the cost, risk, and performance of the asset portfolio in a manner which best delivers value from the assets. Accordingly, it is efficient that some assets which carry low risk and low performance impact are not proactively addressed as this is not justifiable from a cost versus risk/performance perspective.*
- *Unison is proactively seeking to improve real-time knowledge and monitoring of its assets with an initiative to explore technologies that can anticipate faults by examining disturbances to waveforms on the network that are indicative of a deteriorating asset (e.g., cracked insulator) that may be at risk of short-term failure.*[58]

234. We agree with Unison that it has developed strong risk-based prioritisation processes that are informed by continually improving asset data and other information. However, the issue we identified is specific to the increasing number of equipment failure outages since 2015. Whilst Unison reinforced the information it had supplied on its overarching practices, it did not provide any information on analysis that it may have undertaken on the specific issue of increasing equipment failure numbers. In the absence of this information, we maintain our original point of view that this analysis should have been undertaken.

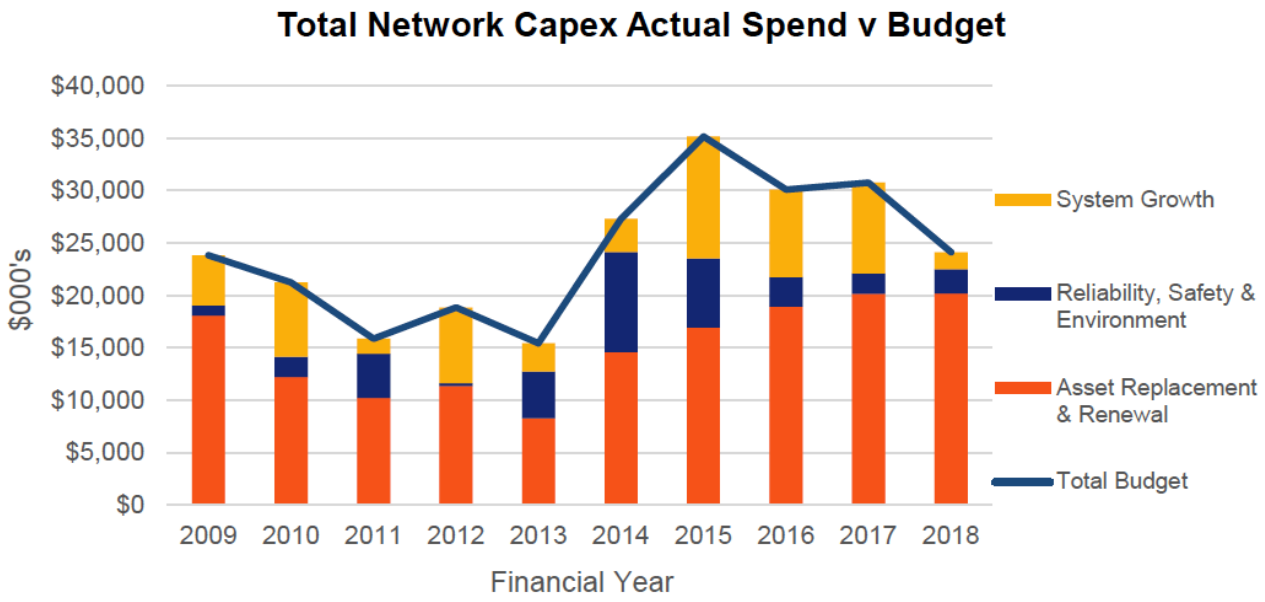
235. Because of the increasing number of equipment failure defects, and the lack of explanation for this from Unison (including in its response to Strata's draft report), we consider it valid to assess if the steps taken to maintain and invest in its network prior to AP2017 had been adequate.

[58] 20201012 Unison response to Strata draft report, page 11

9.1. Has Unison invested to maintain network performance?

236. Unison provided information in its letters to the Commission supporting its view that network capex had been appropriate. Figure 31 shows Unison's chart indicating that its network capex had increased substantially from AP2014.

Figure 31: Unison's analysis of network capex



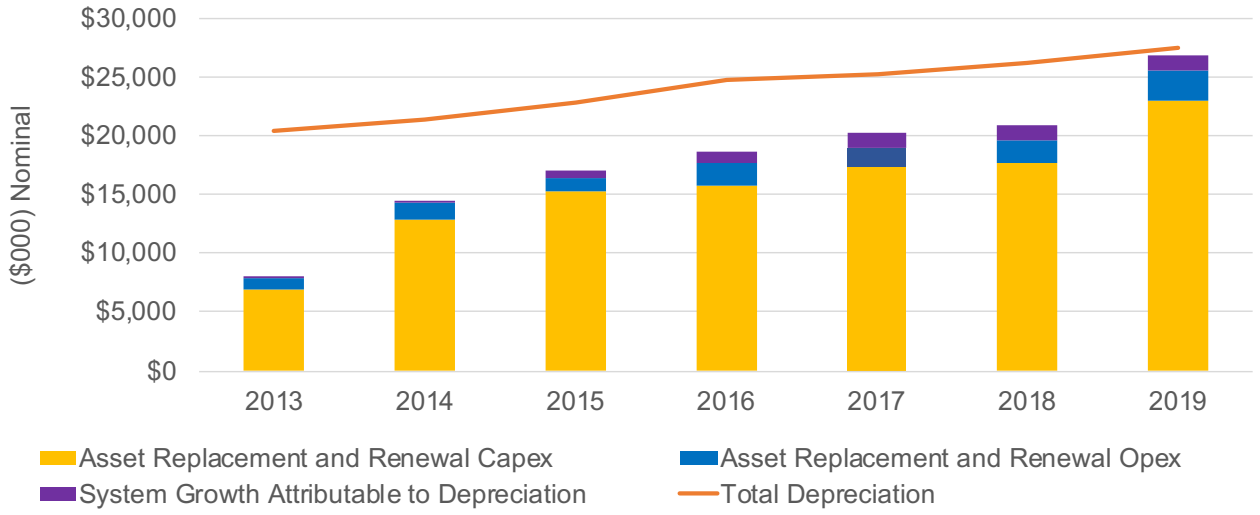
Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 8

237. Electricity distribution assets, particularly those exposed to corrosive coastal environments require ongoing investment to maintain and replace deteriorating assets. In information disclosures, EDBs publish data that can be useful in providing indications of the appropriateness of historical expenditure. Whilst Unison demonstrated that it increased investment in asset replacement and renewal, whether this was sufficient needs to be established.

238. One indicator is the level of capital expenditure (capex) related to asset replacement compared to the depreciation of network assets. It is important to note that this is an indicator only. There are several legitimate reasons why EDBs might not be investing at depreciation rates; for example, the network might, on average, be relatively new or generally performing well and in good health.

239. Figure 32 presents a view of the level of asset renewal and replacement related expenditure that Unison has applied compared to the annual depreciation of its network assets. The chart suggests that Unison's historical asset replacement expenditure has been higher than depreciation between AP2013 and AP2019.

Figure 32: Annual depreciation and asset replacement expenditure



Source: Strata analysis of Unison annual information disclosure data

240. To understand the reason why Unison's historical replacement capex has been higher than depreciation on assets, we undertook analysis of the condition assessments and age profiles for all its asset fleets.

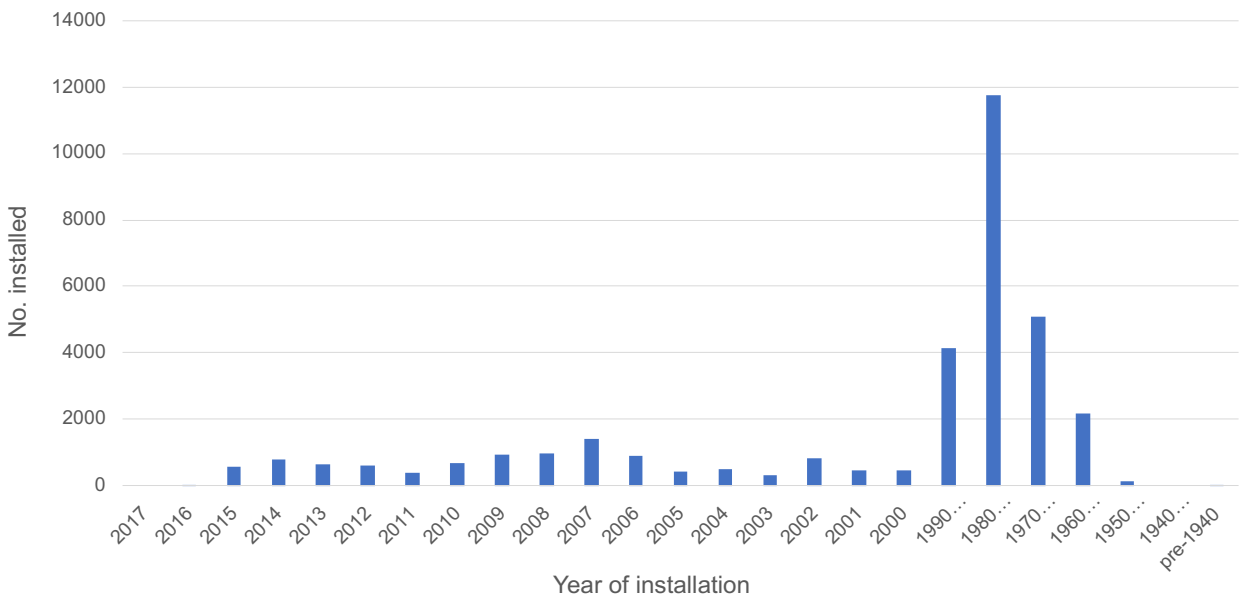
The age of Unison's assets is not unusual

241. Using Unison's annual information disclosure, we considered if the age profile of its major asset fleets suggested that asset replacement rates should have been greater. We then completed a similar study of Unison's condition assessments for each asset fleet.

242. Using the concrete pole asset fleet as an example, Figure 33 shows the age profile for concrete poles as it was in 2016. Concrete poles generally have a long life expectancy and the ages of sixty years or more is not uncommon. There is nothing in the age profile to suggest that replacement capex for concrete poles should have been advanced and/or increased.

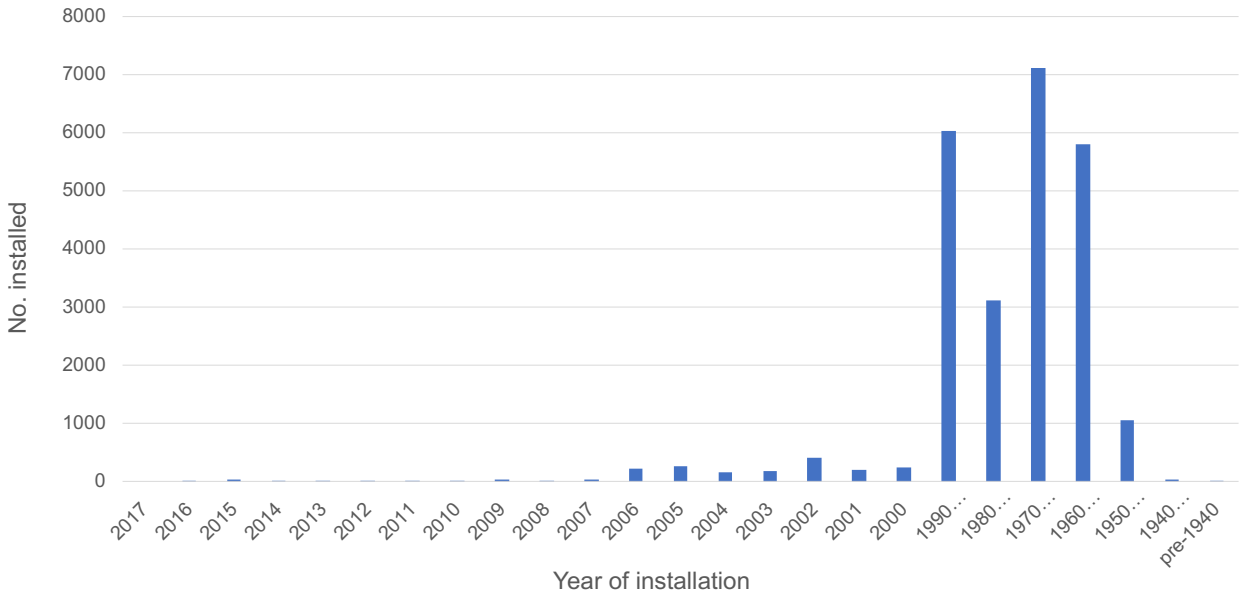
243. Figure 34 shows the age of Unison's wooden pole fleet at AP 2016. The age profile shows that the majority of Unison's wooden poles are between 16 and 60 years old. If condition assessment of these assets was positive, the age profile does not suggest that replacement rates should have been higher than it was.

Figure 33: Age profile of concrete poles at AP 2016



Source: Strata - Unison Asset Age Dashboard (Unison annual information disclosures)

Figure 34: Age profile of wooden poles at AP 2016



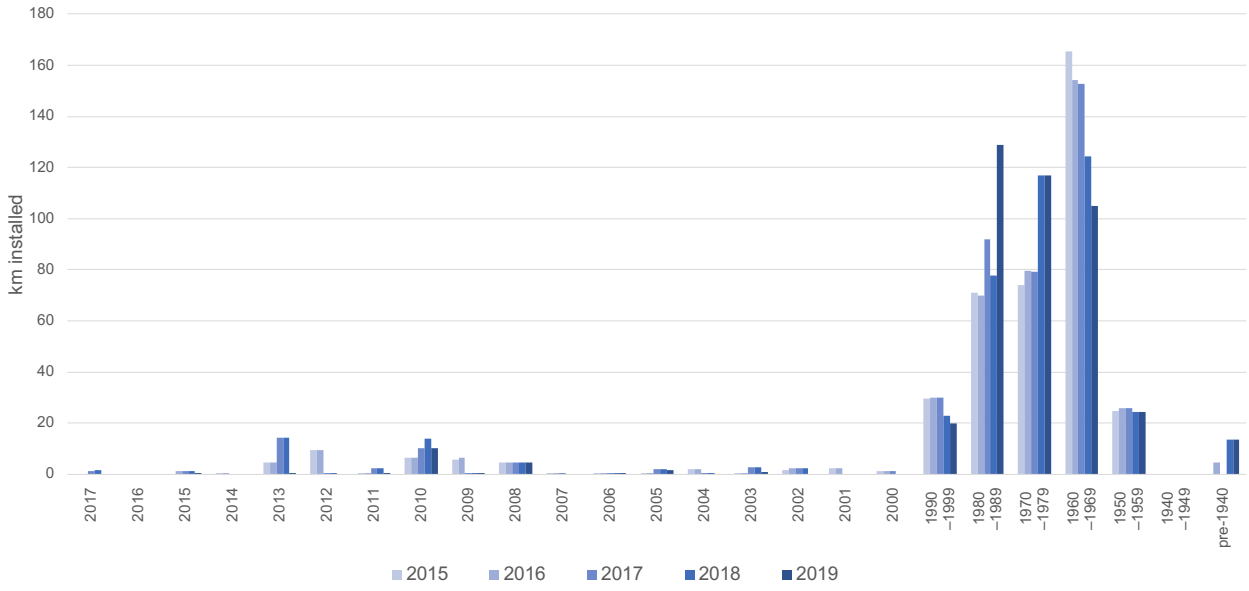
Source: Strata - Unison Asset Age Dashboard (Unison annual information disclosures)

244. As expected, we found that Unison's distribution conductor age profile is similar to its pole fleet. Increased replacement rates would not be needed unless condition assessments and/or failure rates suggested that they should be.

245. Unison's subtransmission conductors have a similar age profile to its distribution overhead conductors and therefore did not indicate that a higher replacement rate should have been undertaken. However, we found that Unison's information disclosures for this asset fleet over subsequent Assessment Periods had concerning inconsistencies.

246. Figure 35 shows the changes in subtransmission conductor installed dates between AP2015 and AP2019. Considerable variations can be seen in the lengths of subtransmission conductor installation dates.

Figure 35: Age profiles of subtransmission conductors between AP2015 and AP 2019



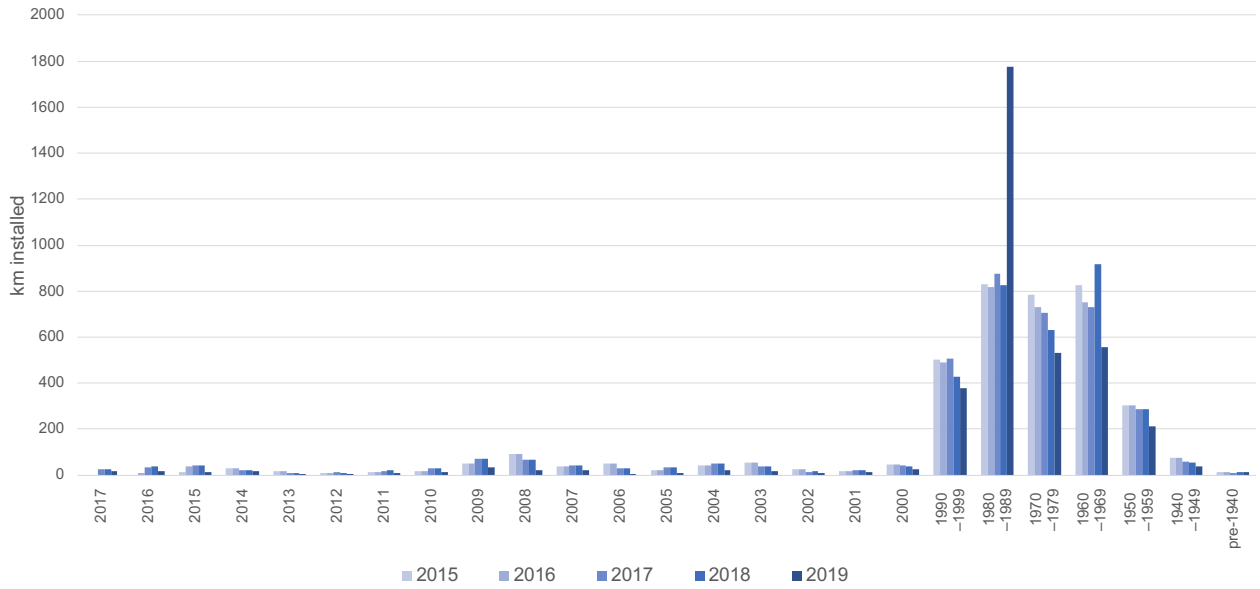
Source: Strata - Unison Asset Age Dashboard (Unison annual information disclosures)

247. We have been unable to identify a logical reason for this variation in installation dates for assets at the older end of the range. The variation is not due to a significant renewal programme because new conductors are not seen at the earlier end of the range. The variation is not due to significant increased length of subtransmission conductors. In 2013 there was 404km and in 2019, 425km.

248. It is possible that Unison progressively identified that a significant proportion of its subtransmission conductors had been installed much later than it had thought. In the absence of a logical explanation, the variation raises a potential concern regarding the reliability of Unison's asset data.

249. We also identified similar issues with Unison's more recent age data for distribution overhead conductors (see Figure 36). There is a clear error in the data for AP2019 where an additional 800km of 40 - 50 year old distribution conductors has been recorded. Notwithstanding this obvious data issue, the changing age profiles for older conductors is a concern and suggests that Unison has some asset data issues to resolve.

Figure 36: Age profiles of distribution overhead conductor between AP2015 and AP2019



Source: Strata - Unison Asset Age Dashboard (Unison annual information disclosures)

250. Progressive changes in asset age profiles have not led to increased asset age therefore we have no concerns that increased replacement capex should have been applied. However, the data issues we observed in Unison's information disclosures steers us towards placing more focus on asset condition data.

251. In addition, Unison's assessment of the reliability of its data (see Appendix E) indicates that prior to AP2015, it had an overly optimistic view of the quality of its age data for some asset classes. This means that its asset management decisions could have been compromised. However, on the basis that the recorded asset age for affected asset classes was generally pessimistic (i.e. older) than the current data indicates, there would have been the tendency to increase the replacement expenditure higher than was necessary on age alone. Whilst spending more on assets than is optimal is not good asset management practice, it will have tended to improve rather than reduce network performance.

252. In its response to Strata's draft report,[59] Unison acknowledged that it had experienced historical data issues. It also supplied information to reassure the Commission that it had implemented specific strategies to improve the quality of asset information.

253. Unison also noted its view that changes is asset data indicate that proactive improvements in data quality are being achieved. We agree with this point but consider that this does not explain the unusual movements in age profiles for subtransmission and distribution conductors between AP2015 and AP2019. Unison did not provide an explanation for this issue in its response to Strata's draft report.

Unison's condition assessments indicate that capex was sufficient

254. Figures 37, 38 and 39 provide a perspective on Unison's view of its asset condition and how this changed between AP2013 and AP2017. In these charts, Grade 1 represents the poorest asset condition.

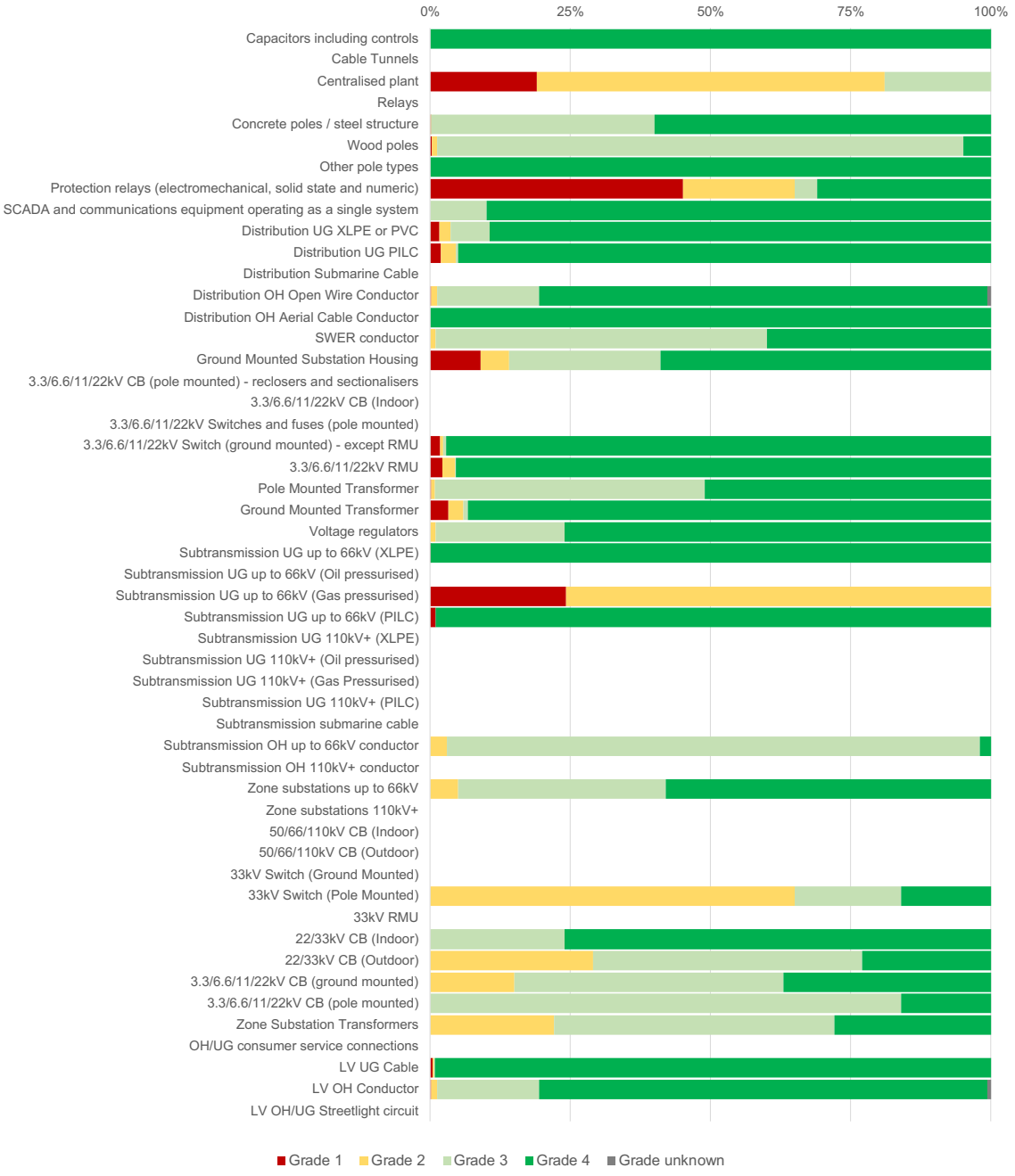
[59] 20201012 Unison response to Strata draft report, page 12

255. In AP2013, Unison assessed that it had condition related issues in its centralised plant, protection relays and underground subtransmission cables along with a small number of more minor condition issues.

256. The following charts are a collation of Unison's asset condition grades (based on the Commission's 1 - 4 grade) provided in its Information Disclosures for the relevant years.

257. Unison also provided asset health using its five point grading framework. This also included current and future asset health scores. Combined with asset age, fault history, maintenance strategies and risk, this data provides important inputs to Unison's Condition Based Risk Management (CBRM) and Investment Prioritisation Tool (IPT) through which it determines appropriate levels of asset replacement.

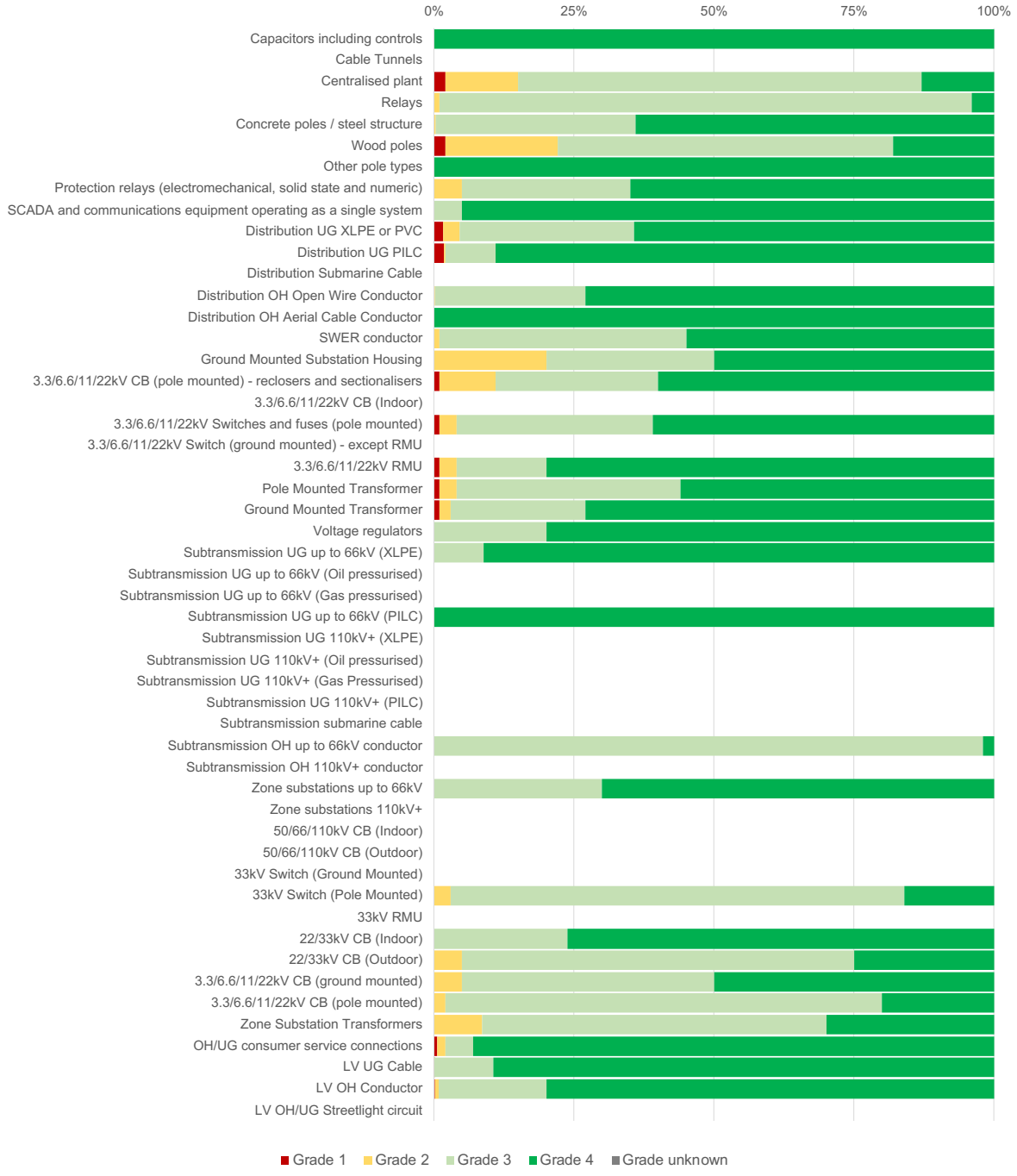
Figure 37: Unison's asset condition assessments at AP 2013



Source: Strata – EDB Asset Dashboard (2020 Unison Review)

Note The Asset Dashboard uses data from Unison's annual information disclosures

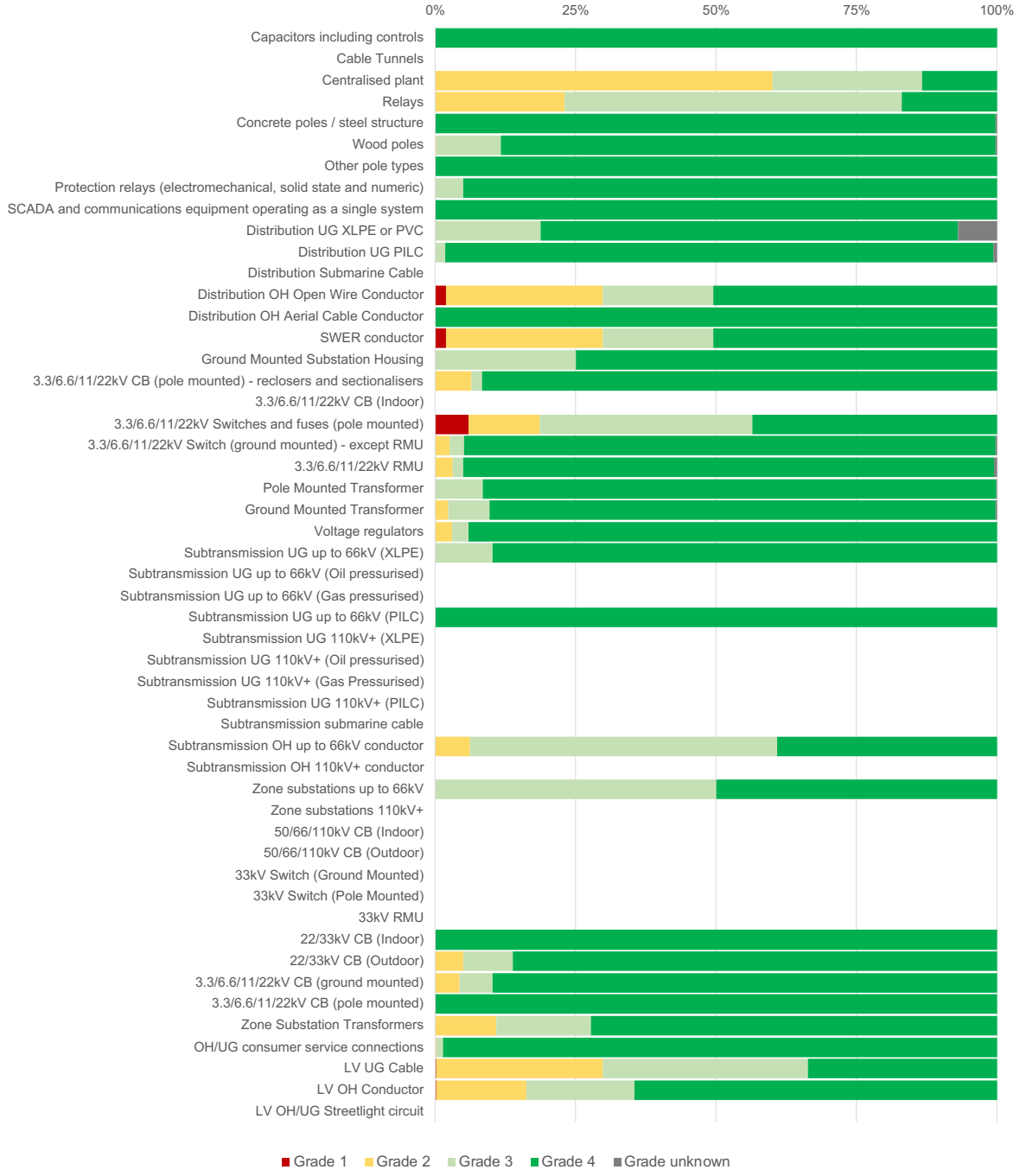
Figure 38: Unison's asset condition assessments at AP2017



Source: Strata – EDB Asset Dashboard (2020 Unison Review)

Note The Asset Dashboard uses data from Unison's annual information disclosures

Figure 39: Unison's asset condition assessments at AP 2019



Source: Strata – EDB Asset Dashboard (2020 Unison Review)

Note The Asset Dashboard uses data from Unison's annual information disclosures

258. We consider that the age and condition of Unison's assets as submitted in its annual information disclosures, and relied on when forming its asset management plan, support Unison's view that the capex applied to network assets was:

a) sufficient given the age profile of its assets; and

b) appropriately targeted at the poorer condition assets.

259. Taking into consideration issues identified with some asset age data, we have concluded that underinvestment in the network had not occurred.

260. We found that the number of equipment failure related outages has increased since 2015; this should be of concern to Unison, steps need to be taken to address the issue. We note that Unison has been increasing its asset replacement capex over this period and appears to be targeting this appropriately using asset health data and applying a risk optimisation approach. We consider that these improvements are above a good industry practice standard.

261. We have concerns regarding the reliability of Unison's asset age data but consider that the variations we observed are unlikely to have significantly affected Unison's asset replacement programmes.

9.2. Unison was optimistic about its future performance

262. At the end of AP2015, Unison was optimistic about its ability to perform under the revised limits and incentive scheme for AP2016 onwards:

> *Unison's good network performance over the past three years plus further benefits to be realised from smart networks and enhanced asset management practices, suggests the network is capable of performing within the incentives region of the scheme, with relative ease.*[60]

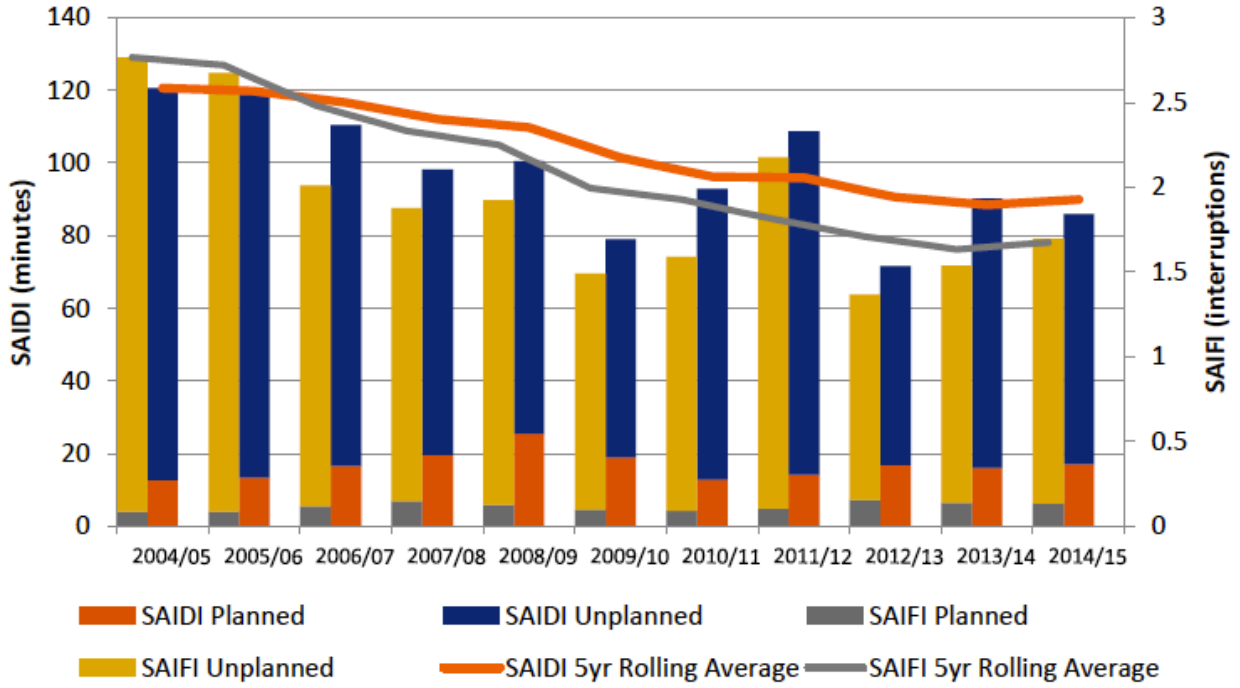
263. Unison had reason to be optimistic, as it noted in the 2015 Network Performance Report to its Board, SAIDI performance was 22% less than its target of 148 minutes and 6% better than the 123 minutes SCI target that it had set for itself. SAIFI performance was similar with 1.972 interruptions resulting in 28% lower SAIFI than Unison's limit of 2.725.

264. Unison also undertook benchmarking against the performance of what it considered to be similar EDBs. Based on a number of factors (including total customer base, consumer density, network circuit length and urban network proportion), Unison concluded[61] that it continued to outperform its peer EDBs. For faults per 100km (total system) Unison found that whilst the peer group EDBs' performance in this metric was beginning to trend upwards, Unison's was trending downwards.

265. Unison's view (see Figure 40) of its historical performance for SAIDI and SAIFI provided grounds for optimism.

[60] 20150522 Network Performance Board Report, page 3
[61] Ibid

Figure 40: Unison's analysis of its historical SAIDI and SAIFI performance



Source: Unison 20150522 Network Performance Board Report, page 6

Unison remained optimistic at the commencement of AP2017

266. In May 2016, Unison reported to its Board that the network was performing well and its investments in automated switching as part of its smart grid programme was reducing the frequency and duration of outages:

> *Unison's network continues to show excellent performance for the SAIDI metric. This has been driven by a reduction in the overall number of faults and a decrease in the average SAIDI impact of faults. The reduced impact has been facilitated by the use of automated switches, installed as part of the Smart Grid rollout, to isolate the fault and restore large numbers of customers quickly. SAIDI shows a long-term downward trend…..*[62]

267. As noted above, Unison was also optimistic that it could remain compliant under the Quality Standard limits for AP2015 to 2020.

268. Despite its optimism, Unison exceeded its SAIDI limits in AP2017 and AP2018 leading to its non-compliance with the Quality Standard in AP2018.

9.3. Unison's smart grid investments intended to reduce SAIDI?

269. Unison's roll-out of smart grid technologies was targeted at improving its reliability performance over time:

> *The rollout of reclosers and later advanced technologies as part of Unison's Smart Network deployment has enabled the company to steadily improve SAIDI on an annual basis from 2004 to 2016. The technology also played*

[62] 20160520 UNL Network Performance Board Report, Page 4

a key role in managing the impact on SAIFI, despite the increase in network interruptions.[63]

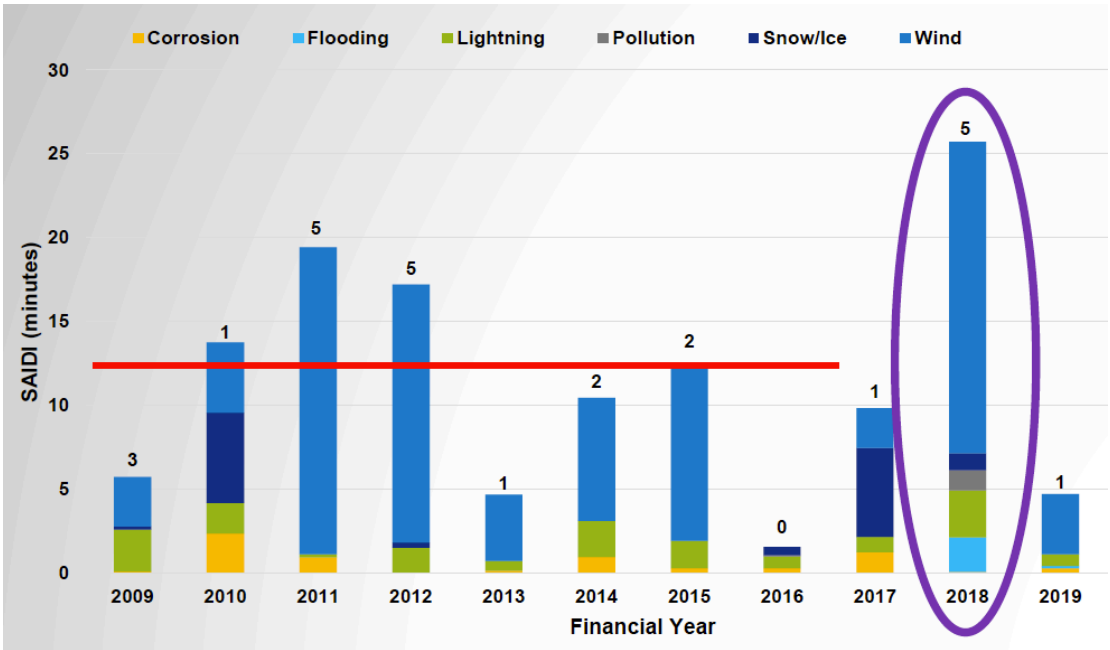
270. Unison pointed to actions it had taken to sectionalise its network and install automatic switching devices. It considered that these initiatives had mitigated the environmental impacts of its unplanned outages:

A notable exception to this overall trend was the large number of extreme weather events occurring 2017/18. This resulted in an additional 15 SAIDI minutes (when normalised) above the average since 2004/5. The number of outages (150% more than any other year) resulted in proportionately less disruption to supply than experienced previously due to the increased number of automated devices installed on the network. These minimised the areas affected and reduced restoration times.[64]

271. Unison explained that, additional automated switches on rural arterial roads had been installed to enable faster restoration of supply to customers following outages due to car accidents.[65]

272. Figure 41 is a reproduction of a chart that Unison provided to the Commission in its 2018 information request response. In our view, the chart does not provide convincing evidence on the extent to which automated switching had minimised the areas affected and reduced restoration times. It does demonstrate the variability of the outage cause sample that Unison had chosen for the chart.

Figure 41: Normalised SAIDI attributed to environmental effects



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 14

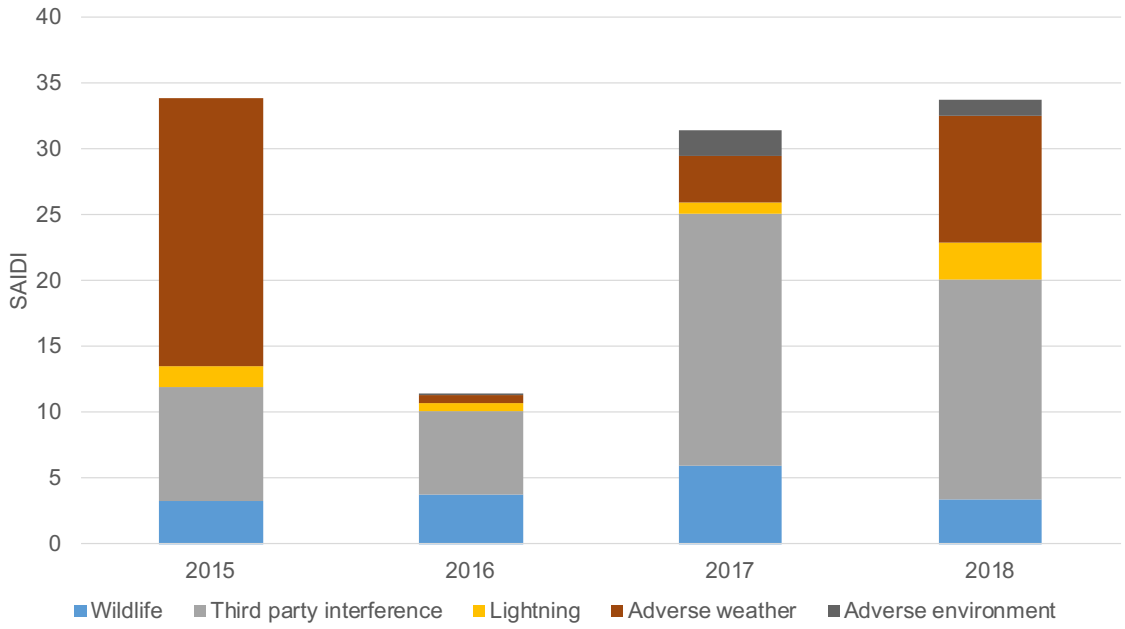
[63] Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, page 6
[64] Ibid, page 21
[65] Information Request Response to Commerce Commission Contravention of the Quality Standards for the 2018 Assessment Period, page 32

273. We undertook analysis of Unison's outage database to obtain a view of the potential impact of investment Unison had made in sectionalisation and automated switching on unplanned outages. We looked at outages Unison had attributed to wildlife, third party interference, lightning, adverse weather and adverse environment. We were looking to see if the data indicated that Unison has been able to reduce the impact on individual customers when outages occurred. We examined the data from the perspective of ICPs experiencing outages rather than reliability performance at a system level.

274. Figure 42 shows that for the two Assessment Periods contributing to Unison's non-compliance, third party interference was the most significant contributor to SAIDI of the selected outage categories. The SAIDI minutes contributed by third party interference is significant and we consider it to be material to Unison's non-compliance.

275. Third party interference has the widest range being the largest contributor to SAIDI in AP2017 and AP2018. This category includes; damage by third parties, hi-loads, motor accidents, tree cutters, vandalism, un-notified switching (related to third party damage) and other (third party related).

Figure 42: Unplanned SAIDI for wildlife, environmental and third party outage causes (excludes MED)



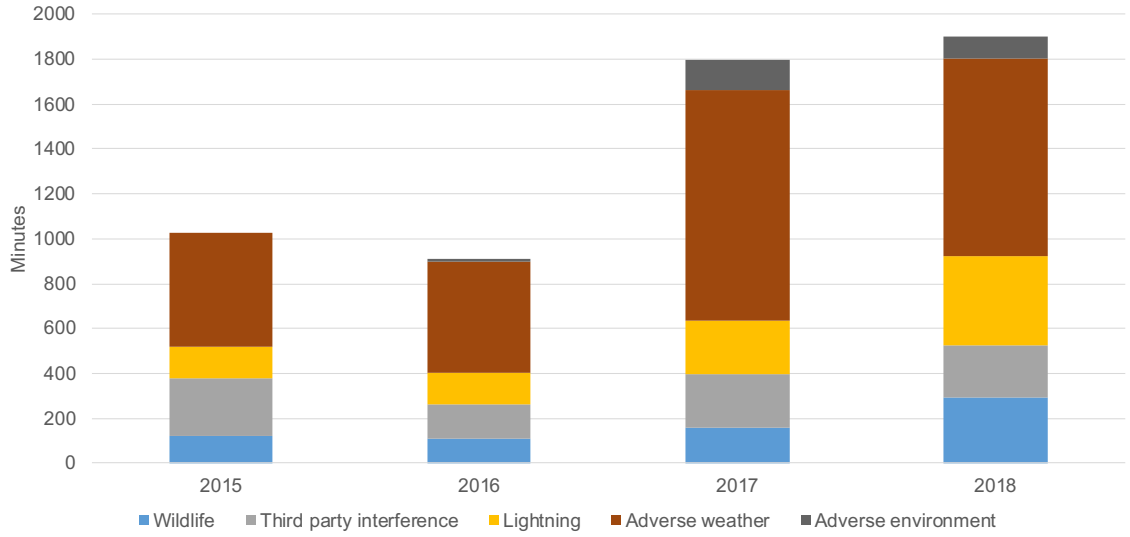
Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

276. The presence of potential benefits from automatic switching is not clear in Figure 42. This is possibly due to the analysis being at too high a level. To test this, we analysed if average outage times, for the ICPs that experienced outages, had changed. Sectionalising and automatic switching could be used to reduce this measure.

277. Figure 43 indicates that the reverse has occurred mainly due to the average outage duration time per affected ICP for adverse weather being much higher in AP2017 and AP2018. However, for third party damage, the average outage duration time was reasonably consistent across the four assessment periods. This result provided no evidence of benefits from sectionalisation and automated switching.

278. To assess this further, we considered the average total minutes that ICPs experienced when an outage occurred. To calculate this, we took the total customer minutes recorded against each outage and divided this by the total number of outages.

Figure 43: Average unplanned outage duration per affected ICP (excludes MED)

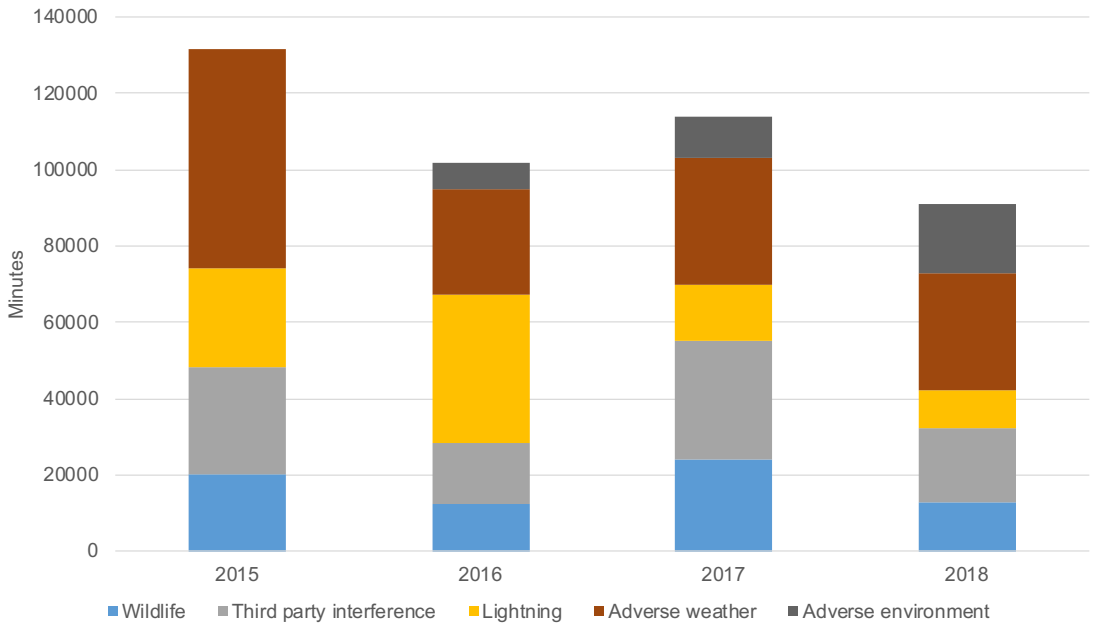


Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

Note To obtain the average outage time we divided the total outage duration by the number of ICPs affected by outages

279. The average total minutes for outages per ICP has fallen over the four Assessment Periods. However, the reason for this is not clear. On average, the ICPs affected by motor accident related outages have not seen material changes. Possibly lightning related outages have been mitigated by automatic switching.

Figure 44: Average total outage minutes experienced by ICPs affected by outages (excludes MED)



Source: Strata analysis of Unison data 4 - 14-15, 17-18 Dataset for submission to Commerce Commission

Note To produce this chart, for each Assessment Period, we divided ICP minutes by the number of outages. This gives the average minutes experienced by ICPs per outage.

280. We agree with Unison that the investment must be delivering reliability benefits. However, the data Unison gave to the Commission was insufficient to develop firm conclusions that the investments in sectionalising and automatic switching improved reliability, either at a system or ICP level.

281. Potential indications of emerging smart grid benefits may be driving relatively recent reductions in outage minutes for ICPs particularly affected by outages, reductions in defective equipment, and external influence related outages. However, we have insufficient data and information to confirm that this is the case.

282. Unison gave the Commission information on quantification of benefits from its Advanced Distribution Management System (ADMS) investment.

283. In its 8 May 2018 ADMS Business Case Review[66] to Unison's Risk Management Committee, Unison management provided an evaluation of realised benefits from the smart grid deployment. In this paper, Unison identified $670,000 of annual benefits derived from:

a) lower outage duration;

b) automated switching instructions;

c) increased efficiency; and

d) lower audit costs.

284. Unison summarised the operational benefits as being attributable to its investment in the ADMS:

> *The ADMS has introduced a step change in how the electrical network is managed on a day to day basis for planned and unplanned outages. It has enabled the Network Operations Centre (NOC) to create knowledge from raw data that is generated by sensors and smart assets installed as part of the Smart Network rollout. This includes the implementation of fast transfer schemes and auto-changeover schemes.*

285. Given the benefits that Unison quantified, we were interested in understanding why it had exceeded its SAIDI limits in AP2017 and AP2018. Unison's explanation was that the smart grid investments, including its ADMS, had reduced the impact of adverse weather related MEDs but no benefit was seen in its assessed SAIDI due to the application of its boundary value during normalisation.

286. In its ADMS Business Case Review, Unison provided the following assessment of how the ADMS worked during the January AP2018 MEDs:

> *ADMS was a vital part of the fault response to ensure up-to-date information was readily available for different stakeholders. UCSL is responsible for sectionalising and undertaking repairs. UNL Management oversee the operational response and strategic deployment of resources. The Customer Relations Team manages customer expectations through a variety of mediums, including social media. They also provide direct feedback of safety issues. The Civil Defence liaison provides updates to Civil Defence to ensure they are able to manage any local or regional emergencies. The information provided by ADMS is vital for these parties to undertake their roles and responsibilities.*[67]

287. Unison's smart grid project has three phases:

a) implementation phase (2011/2015)

[66] 20180525 ARC ADMS Business Case Review Report
[67] Ibid

b) optimisation phase (2016/2020)

c) integration phase (beyond 2020).

288. Given that the smart grid project is now into phase 3, we expected to see evidence of Unison reporting in detail on the realisation of benefits. This would include quantified comparisons with benefits identified in its smart grid business case. We expected that improvements in SAIDI and SAIFI would be clearly visible and quantifiable at the end of the optimisation phase. Documents supplied by Unison to the Commission presented only the quantified benefits of ADMS and not the broader smart grid programme.

289. Unison informed us that it is using an adapted version of a Smart Grid Computational Tool (SGCT) developed by the US Department of Energy to estimate the benefits of smart grid projects, and that:

To date the accrual of SG benefits has met Unison's expectations.[68]

290. In its presentation during on-site sessions, Unison included charts showing its record of cumulative reliability benefits.[69] The charts indicated that by AP2017, smart grid investment saved approximately 125 SAIDI minutes; and by AP2018, 150 SAIDI minutes. These reductions are significant considering the actual SAIDI recorded during these assessment periods.

291. Unfortunately, we have been unable to assess the validity of these values from the information Unison provided to the Commission. This information would be valuable to understand the likelihood of Unison remaining compliant with its Quality Standards in the future.

292. If the savings are independently verified, then the reliability benefits from Unison's smart grid investments are outstanding at 200 cumulative SAIDI minutes since AP2010. This is equivalent to just under two years of Unison's SAIDI limit. Therefore reductions in SAIDI of around 20% are achievable.

293. In our opinion, Unison's early adoption of smart grid technologies has been well managed and based on well researched estimates of quantified benefits. Unison states that it has quantified the expected network reliability benefits and has taken steps, including the adoption of the SGCT, to monitor and assess the level of delivered benefits. Due to information and data limitations, we have been unable to validate the realised benefits that Unison says it has achieved. This information is valuable in assessing the likely future reliability performance of the network and the success with which Unison is able to optimise its asset management expenditure.

10. A summary of our views on the validity of Unison's explanations

294. In this section, we address the Commission's questions relating to Unison's explanation for its non-compliance, specifically:

- whether those reasons were valid;
- how much of an impact those reasons had on SAIDI for AP2017 and AP2018; and
- the extent to which non-compliance was attributable to Unison not acting in accordance with good industry practice.

295. A summary of our findings and opinions is provided below.

[68] 2018_Quality_Breach_ComComVisit_Jan2020_Final, slide 192
[69] iBid

10.1. The number of extreme weather events in AP2018

296. On the impact of MED in AP2017, we agree with Unison that:

a) the five MEDs occurring in AP2018 made a material contribution of 22.705 SAIDI minutes to the exceedance of its Quality Standard limit; and

b) evidence relating to the four SAIDI MEDs due to storms in AP2018 is supported by Metris analysis.

297. In addition, we consider that:

a) the fifth MED caused by a multifactorial problem may have been avoided had Unison identified potential risks and undertaken network studies; the lack of information available for this MED has limited our ability to fully assess the event; and

b) SAIDI attributable to outages other than those on MEDs were also material contributors to Unison's non-compliance.

10.2. The impact of changes to live line working practices

298. On the impact of increased live line working, we agree with Unison that:

a) it made changes to its live line processes to meet the revised Health and Safety requirements from AP2015;

b) Unison's assumptions for, and calculation of, the impact on its annual reliability performance of 10 SAIDI minutes is reasonable; and

c) changes to live line working were therefore material in Unison's exceedance of its Quality Standard Limits in both AP2017 and AP2018.

299. We do not agree with Unison that:

a) it would have met the quality limits if historical live work practices prevailed.

300. In addition, concerning live line working practices, we found that Unison:

a) has been responding proactively to the changes in live line practices with several initiatives being implemented to reduce the impact of planned outages on electricity consumers;

b) has demonstrated that it can respond appropriately to the changed requirements whilst at the same time taking steps to manage reliability and performance within the quality standards; and

c) has acted in accordance with good industry practice when addressing the changing health and safety requirements for live line working practices whilst at the same time taking steps to mitigate the adverse impact on network reliability.

10.3. The impact of changes in manual reclosing practices

301. We agree with Unison that:

a) the changes to bring reclosing practice in line with the EEA Guidelines will have reduced Unison's potential to secure some of the benefits available from its smart grid investment programme; and

b) as this will not have removed all the benefits, the residual benefits actually achieved will have improved reliability performance.

302. We consider that Unison has not established that changes to restoration times due to revised EEA Guideline requirements have materially contributed to exceedance of Quality Standards contributing to non-compliance.

303. In our opinion, Unison's claim that increased restoration times caused by compliance with revised EEA Guidelines had a material impact on its reliability performance is not supported by the evidence it has provided.

10.4. Increase in outages attributed to external influences

304. We agree with Unison that:

a) external influence related outages increased in AP2017 and AP2019 above historical levels; and

b) the number of motor vehicle related outages significantly increased in AP2017 and AP2018; however, the data we have is limited.

305. In addition, we consider that Unison's investment in smart grid technologies, in particular its ability to sectionalise its network and use automated switching to reduce restorations times, should reduce the impact of future incidents on SAIDI. However, we have not seen evidence from Unison that this is actually being achieved.

10.5. The increase in outage events attributed to fall distance zone trees.

306. We agree with Unison that:

a) FDZ tree related faults have been a major contributor to its SAIDI attributed to vegetation; and

b) the increase in FDZ faults in AP2017 and AP2018 contributed materially to its non-compliance.

307. In our opinion, Unison has provided satisfactory evidence that it could not have materially reduced the FDZ tree outages by uplifting its vegetation management opex earlier than it did because:

a. targeting and prioritising expenditure at FDZ tree management would have been challenging given the extent of Unison's subtransmission lines located in forestry plantations and the difficulty in predicting which trees are the highest risk;

b. there are limitations on Unison's rights to take tree cutting actions; and

c. there is no evidence that Unison could have forecasted the increase in FDZ tree SAIDI in AP2017 and AP2018.

308. We agree with Unison that unless there is significant change to legislation, the management of FDZ trees will continue to be challenging.

10.6. Increase in outages attributed to equipment failures

309. We agree with Unison that:

a) SAIDI attributed to equipment failure had been decreasing;

b) increased equipment failure numbers were not material towards its non-compliance;

c) capex applied to network assets was sufficient given the age and condition profiles and was appropriately targeted at poorer condition assets; and

d) underinvestment in the network had not occurred.

310. Whilst SAIDI related to equipment failure had been decreasing, we consider that the increase in number of equipment failure related outages since 2015 should have been identified and assessed by Unison. Based on the information provided by Unison we concluded that it had overlooked or not considered the increase in defective equipment related events. If this is the case, it is a departure from good industry practice.

Whilst Unison reinforced the information it had initially supplied on its overarching practices, it did not provided any analysis on the specific issue relating to increasing equipment failure numbers. In the absence of this information, our view is that this analysis should have been undertaken.

311. We also identified some issues with Unison's asset age data but consider that the variations we observed are unlikely to have significantly affected its asset replacement programmes. Unison concurred that the identified discrepancies existed but did not provide an assessment of potential implications arising from them.

Our answers to the Commission's specific questions

312. The Commission asked Strata to consider whether:

- Unison had adequate processes to identify and mitigate risks that contributed to the failure to comply with AP2017 and AP2018, and whether they were responded to in accordance with good industry practice;
- Unison prioritised investment in its Smart Network Initiative over network maintenance and renewal in accordance with good industry practice, and the extent to which this contributed to the failure to comply with AP2017 and AP2018;
- Unison prioritised increased dividend payments over network maintenance and renewal in accordance with good industry practice, and the extent to which this contributed to the failure to comply with AP2017 and AP2018; and
- Unison's decision to deploy nine staff members for a period of 18 months to assist Aurora Energy Limited contributed to its failure to comply with AP2017 and AP2018; and if so, to what extent.

313. We have covered some areas related to the above questions in previous sections of this report. In the following sections, we address the specific requirement of each of the above questions and provide conclusions and opinions particular to topics identified in the questions.

11. Unison's management of network risks

314. Unison informed the Commission that in March 2018 it became the first New Zealand organisation to attain certification to ISO: 55001 Asset Management Standard. This was the culmination of a decade long strategy to align its asset management with recognised international standards and its decision in 2015 to seek accreditation.

315. Unison's achievement of accreditation of ISO: 55001 is significant to the Commission's question because, amongst other things, it is a requirement that the business has an integrated management system for risk and quality. Unison's accreditation of ISO:55001 should give the Commission assurance that it has adopted a good industry practice asset management framework.

316. However, the Commission's question requires us to consider Unison's asset management practices prior to and during AP2017 and AP2018 which is the period when Unison was strengthening its asset management framework in order to achieve ISO:55001 accreditation.

317. When assessing Unison's asset management systems and processes prior to AP2017 and AP2018 we considered the risk-based approach that it applies when making network investment decisions. Central to this approach is the use of risk analysis to determine a prioritised list of capital projects for inclusion in the annual capital works plan. Unison explained that it establishes the cut off point for projects on the basis of risk criteria intended to meet its risk appetite. Accordingly, the risk prioritised projects that form the annual capital plan would need to be completed to achieve Unison's desired level of risk at the end of the period.

318. Unison described how risk management is a core activity required in its asset management principles:

> *Asset Management is "the coordinated activities of an organisation to realise value from its assets"*

The objective of good asset management is to "extract maximum value from assets"

This is achieved by striking an optimum balance between cost, risks and performance, over the life of the asset.

319. Unison's AMPs set out its approach to and management of network risk. The 2016 AMP provides the following description:

High Impact-Low Probability (HILP) network related risks have the potential to significantly impact on public safety and the reliability and security of Unison's network. There could also be large cost implications and the risk of reputational damage to the Unison brand.

Unison's Networks & Operations Functional Area operates three risk sub-committees, (strategic, operational, and incident) to ensure effective risk management and oversight is undertaken and achieved at all levels of asset management.

The Strategic Sub-committee meets biannually to ensure that risks aggregated to the enterprise level are current, correct, and align with Unison's strategy and overall risk management objectives.

The Operational Sub-committee meets quarterly to assess and review network operational risks. SWIFT1, and Cause and Effect methodologies are employed to identify and assess network risks.

The Incident Sub-committee meets monthly to review and discuss any network incidents that have occurred over the previous month.

320. In documents submitted and presentations made during our on-site visit, Unison explained the development journey it had taken in respect of its network risk management processes and systems:

Between 2007 and 2017

The Decision Support Tools it had developed in 2007 were utilised, these included its:

- Augmentation Envelope
- Renewal Envelope (RE)
- Investment Prioritisation Tool (IPT)
- Condition Based Risk Management (CBRM) initiation, development and roll-out.

Since 2017

Unison undertook further development of its risk-based approach to prioritise risk and mitigations including:

- Asset Management Planning Framework
- AMP Tool
- AMP Risk Schema.

Continuing development

Unison continues to work on:

- further development and maturity of its CBRM and Risk-Based Approach
- transition to new Enterprise Asset Management System (EAMS).

321. We have reviewed Unison's approach, practices and systems for management of network risk and consider that it is at or beyond good industry practice. We observed the introduction of systems and practices that, in our experience, are leading edge for EDBs. For example, Unison has implemented risk optimisation in its asset management practices allowing it to prioritise its activities and investments to achieve the lowest overall risk position.

322. We consider that at 2015, Unison's network risk management would have been consistent with that of its peer EDBs in New Zealand. Since that time, it has accelerated the

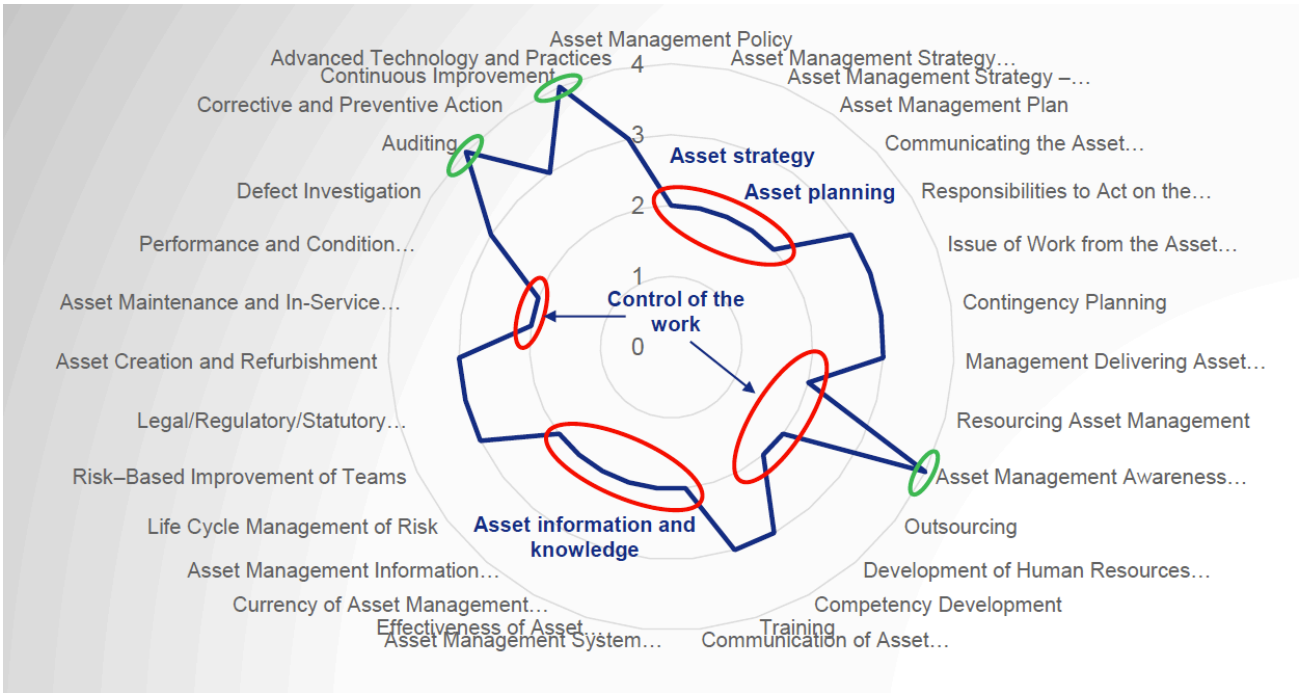
development of its network risk management framework, systems and practices to a level that, in our opinion, has established it as an industry leader.

11.1. Unison's overall asset management practices have been improving

323. The annual Asset Management Maturity Assessment Tool (AMMAT) results, which are undertaken by independent assessors, provide a window into the quality of the EDB's asset management systems and practices. Looking at sequential annual results provides an insight into the EDB's strengths and weaknesses in asset management, and where it had applied focus for improvement.

324. Figure 45 provides Unison's 2015 AMMAT result undertaken by Covaris. This result supported Unison's 2015 conclusion that there were important areas requiring improvement and that ISO 55001 would be an appropriate framework to support the organisation.[70]

Figure 45: Unison's December 2015 AMMAT undertaken by Covaris



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 42

325. The red hoops in Figure 45 indicate the areas Unison identified for improvement. The critical areas were asset strategy and planning, and asset information and knowledge.

326. In section 9, we raised a question regarding the level of capex Unison applied to replacement of its network assets; was higher replacement capex more appropriate because of the reliability of its asset condition data, age profile of its assets, and level of replacement investment compared to network asset depreciation levels?

327. To provide an answer to this question, the Commission sought information from Unison on, amongst other things, how it had managed risk on its network. In response, Unison supplied documents describing the approach it developed and applied to establish an appropriate level of asset replacement capex. This information added to that provided in Unison's annual AMPs and to the presentations and discussions during the on-site session.

[70] Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 42

328. The documents describe Unison's development of its approach to asset replacement strategies and expenditure decisions since 2010. At the core of Unison's approach has been the development and application of its Investment Prioritisation Tool (IPT).

329. The IPT was developed on an Excel spreadsheet to achieve the following objectives:

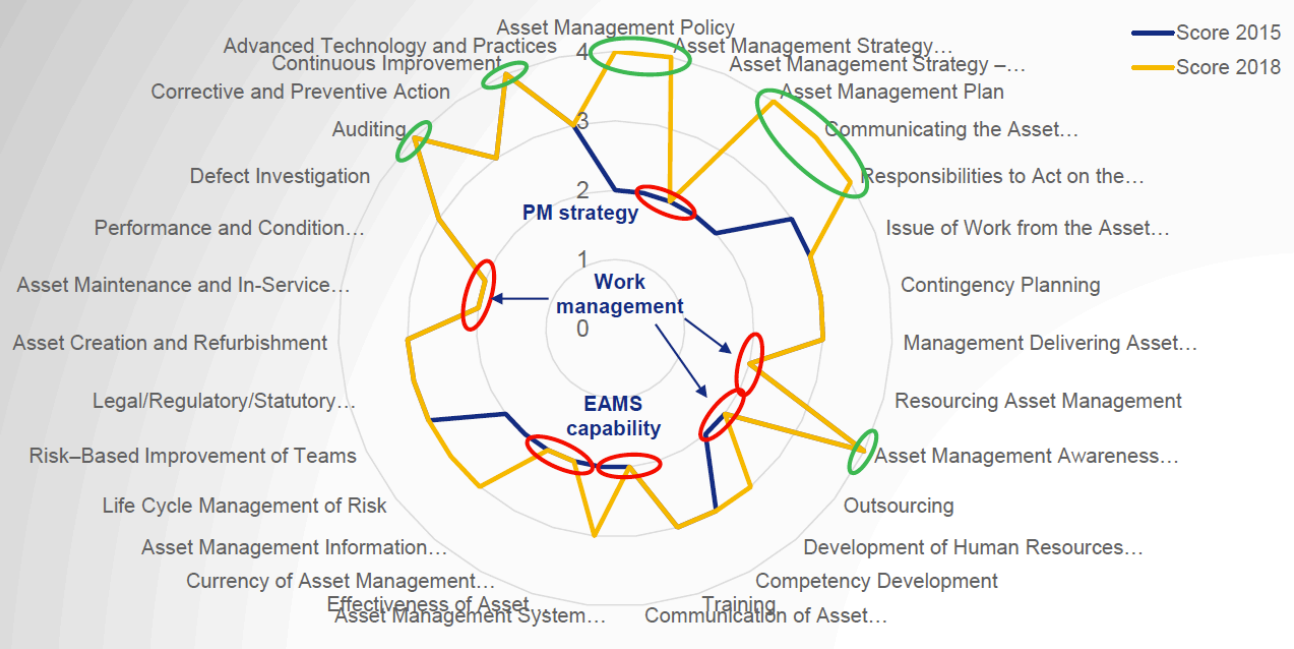
a) prioritise projects according to a set of business criteria (drivers); and

b) provide a systematic and transparent way to justify decision making aligned with business objectives.

330. We have reviewed the IPT and consider that it is an appropriate tool for establishing a risk-based prioritisation. However, the IPT and other asset management decision tools can only work effectively if the data used is reliable. Unison's 2015 AMMAT result and the issues we identified in its information disclosures for asset ages suggest that this is a key area for improvement.

331. Figure 46 shows Unison's AMMAT result in 2018 together with a comparison to its 2015 result. Unison highlighted that it had achieved step change improvements in its asset management practices, asset management strategy policy and planning, and asset lifecycle risk management. It had improved its maturity in the asset management information area, which is consistent with the movement we observed in its information disclosure data on asset ages.

Figure 46: Unison's December 2018 AMMAT undertaken by Covaris



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 60

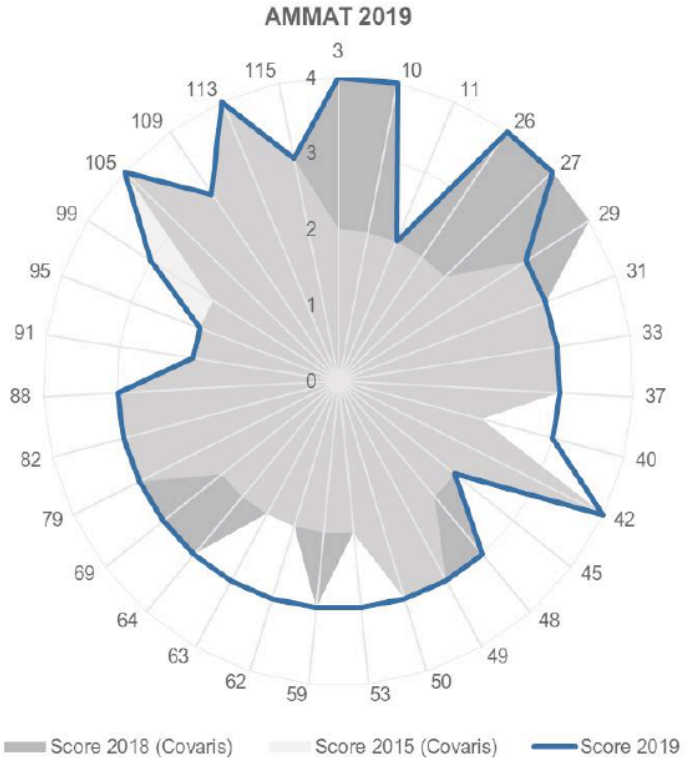
332. Unison recognised that the 2018 AMMAT result highlighted the need for it to work on improvements in three areas:

Unison is undertaking improvement work in works delivery, maintenance strategy and information systems[71]

[71] Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 60

333. The 2019 AMMAT result (Figure 47) demonstrates the significant improvement that Unison made between 2015 and 2019. This will have taken considerable effort and strong leadership from its management team.

Figure 47: Unison's 2019 AMMAT undertaken by 2019 Gatland Consulting



Source: Unison 2018_Quality_Breach_ComComVisit_Jan2020_Final, Slide 61

11.2. Post event reviews are part of risk management

334. To operate at good industry practice, we consider it important that EDBs undertake appropriate post event reviews to ensure that lessons from major interruption experiences are gained and, if relevant, shared with other EDBs. In recent reviews undertaken for the Commission, we found that EDBs have not been meeting good industry practice by failing to undertake appropriate post event reviews. Generally, the EDBs have agreed with our opinion.

335. Unison provided several examples of its post event reviews. We found that the review documentation exemplified good industry practice by including scope, content, information included, improvements to practices and improvements to processes.

336. In our opinion, from a New Zealand EDB perspective, Unison has met best industry practice in the quality of its post event reviews. The following is an example of a post event review by Unison.

2012 Omahu Road wooden pole failure

337. The Omahu Road incident occurred in December 2012 when six hardwood power poles (five 11kV and one 400V) collapsed into the road. Unison provided documents recording the post event investigation and reporting.

338. The investigation report[72] is comprehensive containing all the aspects we would expect to see in a post event report at good industry practice. The report included:

a) a comprehensive 34 page investigation report including detailed explanation of the failure and implications for the wooden pole fleet;

b) work practices assessment;

c) technical reports, findings and analysis;

   a. determination of direct and indirect causes

   b. identification of the root cause

   c. key issues

d) recommendations;

   a. design requirements

   b. reducing issues related to pole damage from parked vehicles

   c. scope for capital works

   d. reviews of safety management and asset renewal process

   e. amendments to asset inspection practices

   f. improvements to pole testing

e) action plan and audit requirements;

   a. recommendation

   b. action definition

   c. assignment of responsibility

   d. target date for completion.

339. Three months following the incident, Unison management reported the findings and outcomes from the incident review to its Board.

11.3. Unison demonstrated it had consistently undertaken post event reviews

340. Unison also provided its post event review reports[73] of the major storm events that occurred in AP2017 and AP2018. These reports were well structured and contained assessments of the damage, restoration performance and recommendations for managing future events. The documents record the scope and process of the post event reviews. The following is the approach Unison took in its review of the April 2017 storm associated with Ex-tropical Cyclone Cook:

> *Our approach was to obtain and then analyse insights and observations from staff directly involved in the:*
>
> • *initial storm response, and*
>
> • *proceeding network restoration.*

[72] 20121201 CONFIDENTIAL Omahu Rd Incident Investigation Report FINAL
[73] 20161122 Taupo Snow Storm Debrief Final Report, 20170501 Cyclone Cook Storm Debrief Report

Information and insights were gathered from each Business Unit involved in the response and / or restoration. Each of these Business Units undertaking a debrief immediately after network restoration was completed with those staff directly involved. The following Business Units provided debrief summary reports:

- *Network and Operations (Control Room)*
- *UCSL*
- *Commercial, and*
- *Business Assurance (Civil Defence Emergence Management (CDEM))*

The outputs from each of these debriefs were then collated into one document.

A further business wide debrief was then undertaken with a representative from each of the above Business Units and a representative from:

- *Corporate Services (Finance and Procurement), and*
- *IMG*

Unison also learnt from others

341. Included in the information Unison provided to the Commission were examples of how it had reviewed reports from its own experience and from those experienced by others. This provided additional opportunities for Unison to extract lessons that it could use to mitigate risks on its network. An example of this is a board paper following release of the Electricity Authority's investigation of the Penrose substation fire.[74]

Unison has set the benchmark for post event reviews

342. In our opinion, Unison has provided evidence that since at least 2012, it has been undertaking comprehensive post event reviews as part of its network risk management practices that, in our opinion, meet a good industry practice benchmark and are substantially better than those of other EDBs we have reviewed for the Commission.

12. Prioritisation of smart grid investments

343. During our on-site session, Unison explained that when developing and implementing its Smart Grid it had targeted the realisation of benefits in the following areas:

a) network reliability benefits (deployment of Self-Healing, Hendrix, GFN, Automation technologies);

b) asset protection benefits(use of differential protection);

c) asset utilisation benefits (from application of dynamic line ratings, DTS, fast transfer schemes); and

d) asset life extension (enabled through improved asset condition monitoring capability).

344. Unison installed an Advanced Distribution Management System (ADMS) together with fibre and mesh radio communication networks. These investments were needed to ensure that benefits from smart grid technologies could be realised.

[74] 20160318 UNL Penrose Substation Fire

12.1. Unison did substitute replacement capex to enable smart grid investment

345. Unison identified two strategies it could have adopted for funding smart grid investments, these were:

- a conservative risk strategy rolling out the advanced technologies over time; and
- a managed risk strategy which involved the deferral of several lower risk renewal projects ($8.8M) plus the substitution of budget provisions.

346. Unison provided the following breakdown for how it sourced funding for its smart grid project:

> *Total expenditure of $27.3M was originally approved for the deployment of smart grid.*
>
> *The Smart Grid was funded through:*
>
> - *Deferral of identified lower risk renewal projects ($8.8M)*
> - *Substitution of Renewal budget provisions ($15.2M)*
> - *Substitution of System growth budgets provisions. ($3.3M)*
>
> *Of the $15.2M of renewal substitutions, $11.3M was spent on asset replacements as part of the rollout of advanced technologies.*[75]

347. Therefore, we can confirm that Unison did prioritise its smart grid investments over network renewal (capex) but not maintenance (opex).

12.2. Unison implemented a risk mitigation strategy to manage substitution risks

348. Unison provided evidence in its 2010/11 and 2011/12 Business Plans[76] for the smart grid project. These documents describe Unison's consideration of the following:

a) the risks to the network caused by capex deferrals;

b) regulatory risk (i.e. compliance with Quality Standards);

c) sustainability of the contracting market;

d) availability of the required skillsets; and

e) financial risk.[77]

349. In the Business Plan documents, Unison sets out its strategies for managing risks associated with the deferral of low risk renewal projects; the strategies included:

a) increased inspection frequency;

b) an additional budget provision of $1M for reactive renewals; and

c) the implementation of online condition monitoring.

[75] 2018_Quality_Breach_ComComVisit_Jan2020_Final, slide 27
[76] 20091110 Smart Grid Technologies , and 20110515 Project Management Plan_Smart Grid Concept and Strategy
[77] 20091110 Smart Grid Technologies, section 4.3

350. Unison provided a case study demonstrating how it applied the risk mitigation strategies in practice. The case study was for the deferral of power transformer replacement at the Flaxmere zone substation. Key points made by Unison[78] are:

a) power transformers were identified to be replaced in 2010;

b) replacement of the transformers was deferred for two years as part of the smart grid managed strategy; and

c) to mitigate in service failure of the transformers during the deferral period, smart technologies were used to manage risk in real-time.

351. As part of its risk mitigation, Unison installed and used smart devices to monitor and manage the condition of the power transformers. Unison also held a spare transformer as a contingency in case an early failure occurred within the two year deferral period.

352. At the end of 2014 one of the transformers failed in service, due to vibrations caused by construction work on foundations for the new substation. Unison was able to use the spare transformer held to mitigate such an event.

353. In our opinion, Unison applied good industry practice when establishing, undertaking and operating its smart grid technology roll-out. Its use of deferred replacement capex was undertaken on a risk prioritised basis with good contingency planning.

354. We consider that Unison's business case studies, planning and risk management of its smart grid roll-out have set the benchmark for other EDBs to measure themselves against when implementing a similar smart grid project.

355. In conclusion, we can confirm that Unison did defer asset replacement capex to fund its smart grid project. We found that this was undertaken appropriately with associated risks managed in accordance with good industry practice.

13. Prioritisation of dividend payments over network investments

356. The Commission asked us to consider if Unison had prioritised the payment of dividends to its shareholder above investment in its network assets.

357. Unison informed the Commission that:

> *Unison's dividend yield (even expressed as a percentage of network assets, not Group assets) has only reached 4.6% in 2019, well below the return on equity provided for in the WACC, and has averaged only 3.9% per annum in the regulatory period to date. In addition, Group debt has been stable.*
>
> *Unison can attest that at no point has Unison faced capital constraints:*
>
> - Unison has paid out less in profits than has been earned on the network investment; and
> - Unison has maintained substantial capital headroom to make investments in the network (currently borrowing headroom of at least $140 million under Unison's banking covenants).

358. In its November 2019 letter to the Commission, Unison provided a table which excluded profits from its subsidiary companies whilst recognising all debt recorded against the distribution network business. Unison considered that this was an approach that illustrated

[78] 2018_Quality_Breach_ComComVisit_Jan2020_Final, slide 30

the Company's strong financial position and conservative dividend policy. The table is reproduced in Appendix D.

359. During on-site discussions, we verified Unison's position on this issue, we also considered:

- information and explanation that Unison provided to the Commission;
- Unison's dividend policies since 2010;
- dividend payments made to Unison's shareholders;
- documents containing relevant discussions with Unison shareholders on network investment requirements;
- potential reasons and opportunities that Unison might have had to prioritise dividends over network investments; and
- any evidence of prioritisation taking place.

13.1. Unison has a standard dividend policy

360. Unison's current dividend policy was established in 2014. The previous dividend policy was based on 50% of NPAT. In 2014, a dividend pathway on a cents/share basis was established based on Unison's August 2012 dividend plus an annual CPI +1% increase.

361. When the change was made to the dividend calculation, Unison and Hawke's Bay Power Consumers Trust (HBPCT) considered information on how the new method would impact on the long term financial sustainability of the Company including the sustainability of its capital development programme.[79]

362. At the time of implementing the change in dividend calculation, Unison identified the following reasons for the change:

- the previous dividend calculation method year to year variations was driven by fluctuating capital contributions received by Unison and other variable cashflows;
- changes to tax rules removing previous advantages; and
- under the previous dividend, 50% of all capital contributions was paid as dividend when its primary purpose was to fund otherwise uneconomic customer driven capex which drove up borrowings over time.[80]

363. The Commission has not asked us to review the merits of the change in dividend policy nor the appropriateness of the current dividend calculation. However, we consider that the documents given to the Commission demonstrate that the process through which the change was made was transparent.

364. In our view, the objectives of changing the methodology in 2014 were clear and included maintaining the sustainability of Unison's ongoing network capex.

13.2. Unison did not prioritise dividends over capex

365. Unison demonstrated during our on-site sessions that it had not made dividend payments to the HBPCT that were above the amounts allowed under its dividend policy.

366. Unison also noted that, had it been required, it could have raised funding for its smart grid investments through debt. We confirmed that Unison had ample capacity to raise this debt funding. There was also the potential to seek the HBPCT's agreement to defer some of the Overhead to Underground programme funded through its dividend payments.

[79] 2014 presentation on change to dividend payment methodology, slide 2
[80] Ibid

367. Neither of the above options was required because Unison established a strong business case for its smart grid network based on the targeted deferment of some replacement capex projects.

368. We found no evidence to support a view that Unison had prioritised dividends over network capex and, in our opinion, Unison made an informed decision to fund its smart grid programme through other means.

14. Deployment of UCSL staff to Aurora

369. Unison provided documents relating to its subsidiary company Unison Contracting Services Limited's (UCSL) deployment of a project manager and nine line mechanics to undertake pole replacement work for Aurora. Unison's management of this and the potential impact on its network performance due to reduced staff availability were discussed during our visit to Unison's offices.

14.1. Unison was aware of the value and risk trade-off

370. In its letter to the Commission, Unison identified that the decision to contract for work on the Dunedin network was UCSL's. UCSL had legitimate commercial objectives for the deployment; there were also benefits to Aurora having access to more skilled line crews during its accelerated pole replacement programme. Unison informed us that it is also seeing benefits from UCSL's expanded business due to its ability to engage and retain staff, economy of scale opportunities and increased capability.

371. UCSL was successful in winning the contract to fast track Aurora's pole replacement programme in January 2017. UCSL attributed *significant value, both reputationally and financially for the Unison Group*[81] from securing the Aurora work. It also noted the commitment under the contract to provide a project manager and nine line mechanics to rotate continually to Dunedin.

372. For our review, we have focused on determining how Unison managed the implications of reduced line staff availability rather than how its contractor UCSL made and managed the deployment decision. As the Commission required, our focus has been on potential implications of the deployment on the performance of the Unison network during relevant Assessment Periods.

373. Unison provided information demonstrating that, whilst deployment of staff to the Aurora network was UCSL's commercial decision, Unison was engaged when the decision was made:

> *UCSL in conjunction with Unison assessed the impact on Unison's work programme and determined that with the ability to backfill resources as well as defer some non-critical works (for example, OHUG programme), UCSL would be able to provide some assistance to Aurora as fore-runner to establishing a permanent operation with dedicated resources.*[82]

374. In 2012 UCSL agreed with its Board that work under a strategic third party partnership or relationship development (such as the one with Aurora) would take priority over planned capex on the Unison network.[83] The prioritisation matrix used by UCSL is reproduced in Appendix B.

[81] 20170804 Memorandum HB Planned Capex Update, 4 August 2017, page 6
[82] 3676989_20191122 Unison cover letter response to information request, page 4
[83] 20170804 Memorandum HB Planned Capex Update, 4 August 2017, page 6

14.2. The deployment of staff did impact on UCSL's capacity in Hawke's Bay

375. Following staff deployment to Aurora, UCSL identified that it was having problems completing planned capital works. In its August 2019 memorandum to Unison's GM Network and Operations, UCSL's CEO and Service Delivery Manager identified that the planned 2017/18 construction programme in Hawke's Bay would not be fully completed:

> *CS has analysed the full year programme of work in Hawke's Bay and unfortunately it indicates that a number of UCSL managed capex projects will not be fully constructed in 2017/18…… Essentially the work required to be completed by HB line mechanics materially exceeds the available capacity. CS estimates this delta for the remaining of 2017/18 to be 7,500 hours or equivalent to an additional 8 to 10 line mechanics FTE's.* [84]

376. The August 2017 memorandum also identified that the total capex value of the projects at risk of being underdelivered was $2.9m. The memorandum identified the specific projects that were at risk of not being completed during 2017/18. It also identified all factors that were impacting on UCSL's ability to complete these projects. The factors identified were:

1. customer work exceeding budget;
2. reactive and remedial work;
3. resourcing estimation and scope change;
4. weather;
5. Aurora contract; and
6. reduction of Hawke's Bay resources.

377. In a memorandum, UCSL identified and informed Unison that deployment of the project manager and line crew staff to Aurora was a contributing factor to the reduced capacity to undertake work in Hawke's Bay:

> *The impact of this crew deployment has impacted capacity across all regions, but especially HB line mechanics. These crews would have been doing planned capex work if not deployed to Dunedin.*[85]

378. In August 2017, Unison assessed[86] that capital expenditure was down 21% against forecast and this was directly attributable to underspend on planned projects. Unison was clearly involved in management of risks relating to UCSL's inability to complete some planned projects:

> *There is no doubt that UCSL's deployment to Aurora (exacerbated by tightness in the labour market for lines workers) did lead to UNL's work programme not being completed as first intended during the deployment period. Unison did have to look very closely at works that had been proposed to be deferred by UCSL to ensure that risks were appropriately managed during the deployment, and it would have been Unison's preference that UCSL did not undertake the deployment.*[87]

379. Supporting Unison's explanation that risks were considered and managed appropriately, UCSL described the following mitigation undertaken to address factors affecting delivery of capex projects. Note UCSL is CS (contracting services) and N&O is Unison network and operations. The mitigations were:

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[84] Ibid, page 1
[85] Ibid, page 6
[86] 20170811 Work Management Meeting Briefing Note, 2
[87] 3676989_20191122 Unison cover letter response to information request, page 5

- *CS requested N&O provide a priority of work to help with planning. N&O have prioritised this work and CS will aim to complete in the order requested. It is understood that Priority 2 and 3 projects generate less risk to network reliability if not completed in 2017/18.*
- *The design team have rescheduled their design flow to focus on priority 1 project completion.*
- *CS have reduced the HB contingent of line mechanics rotating to Aurora in Dunedin. More central region and Centralines staff have been used recently.*
- *CS recognised that rotating HB project managers to Dunedin can impact the continuity of project completion. CS has commenced outsourcing the project manager role where possible, to retain HB PM's to ensure continuity of projects.*
- *CS has been utilising Centralines resources on several planned jobs in the HB to ensure completion.*
- *CS has engaged Northpower to supply 2 x (3 man) crews in HB from August through to November to work specifically on planned Network capex. Northpower will also provide a supervisor for these two crews.*
- *CS have entered into discussions with Electrix, who may have line mechanic capacity.*
- *HB will not submit a crew in the annual lines competition. Whilst the competition is only for a week, there is a significant amount of pre-training and time commitment for this crew. Only a central region crew will be submitted.*
- *CS continues to ask contracting peers if they have spare capacity. Note that there appears to be limited capacity in the North Island. Centralines, Horizon, Eastlands and Downers have also advised they have no spare capacity.*
- *CS will continue to advertise and interview for the qualified line mechanic vacancies.*[88]

380. The mitigation applied by UCSL clearly demonstrates that there was a reasonably high level of concern regarding the impact that staff deployment and other factors was having on UCSL's ability to complete planned capital works projects. Similarly, Unison noted that:

> *During the period, non-UCSL contractors were used to backfill some UCSL resources, to reduce the consequential impact on UNL's work programme.*[89]

381. Unison also noted that:

> *In regard to the impact on planned work, Unison's work programme is a risk-based programme. Any adjustment to the programme, whether caused by the Aurora deployment, or disruptive major events, results in a risk-based reassessment of the work to be completed in the annual programme…..*

14.3. Unison assessed the risk impact of deferred work

[88] 20170804 Memorandum HB Planned Capex Update, page 2, note that CS is Unison Contracting Services also referred to as Unison Contracting Services Limited (UCSL)
[89] 3676989_20191122 Unison cover letter response to information request, page 5

382. We understand that when UCSL identified that some projects could not be completed, Unison undertook a risk-based assessment to determine which projects should be deferred. Whilst the projects were at the lower end of the risk scale (of those originally included in the plan), deferral would logically mean that Unison was taking higher risk on its network. Unison would have preferred not to have done this but considered that the additional risk was manageable given the mitigation that could be taken.

383. Unison also identified that, perhaps ironically, reducing planned work on the network was likely to reduce planned outages which would have a positive impact on SAIDI during the 2017/18 Assessment Period:

> *If anything, the deployment to Aurora reduced the amount of work done deenergised on Unison's network leading to lower planned SAIDI during the deployment period than if UCSL had not provided the resources.* [90]

14.4. Unison's analysis indicates that compliance was not compromised by the staff deployment

384. To address the Commission's specific question regarding the potential impact on Unison's non-compliance through staff deployment to Aurora, it was necessary to consider if the deferral of the capital projects had a negative impact on Unison's SAIDI. Unison anticipated this question in its letter to the Commission and undertook this assessment:

> *As part of responding to this information request, we have undertaken an analysis of the projects deferred during the deployment by correlating faults records with deferred projects. This is not a perfect science, as it involves identifying asset numbers associated with faults and determining whether those assets were part of the deferred project, nevertheless, in our review we have not been able to identify any equipment failures associated with deferred projects, which is what we would expect as it was a risk-based assessment of projects eligible for deferral.*[91]

385. We have compared the project list with Unison's interruptions data and, whilst the assessment can't be conclusive, it does support Unison's finding that the listed assets did not contribute to Unison's SAIDI during the relevant Assessment Periods.

386. Unison also discussed the potential impact that the absent nine line crew members might have had during AP2017 and AP2018 MEDs. In its response to the Commission, Unison stated:

> *No fault-people or vegetation crews were deployed. At all times sufficient resources were available to respond to network faults, so there was no impact on unplanned SAIDI from the deployment.*[92]

387. During on-site sessions, we discussed the potential implications of reduced staffing levels during MED. Unison identified that during the two January 2018 MEDs, the crews were back in Hawke's Bay and could have been called upon:

> *We also observe that during the period, only one MED occurred where UCSL staff were in Dunedin. On 20 July, 2017 severe rain and gales struck the Central North Island resulting in a MED, with raw SAIDI of 10.17 minutes (boundary value of 4.5 minutes). One three-person crew from Central region was deployed to Aurora, but at the time UCSL had access to a three-person crew from GDF contracting to support Central region operations. The following contractors were engaged to support the*

[90] 3676989_20191122 Unison cover letter response to information request, page 5
[91] Ibid, page 6
[92] Ibid, page 5

restoration: GDF, Sefton Electrical, Aggreko, and NZ Traffic Management. In addition, UCSL also brought across two crews from Hawke's Bay to the Central North Island, which is an advantage of owning the two networks where resources can be brought across to support repair work following a major event. It is rare for a major event to affect both networks simultaneously.[93]

14.5. We agree that deployment did not compromise compliance but that there was a risk

388. Whilst Unison found no evidence that the staff deployment to Aurora caused actual asset failures and associated outages, it did identify that the risk of such events occurring was increased. The 4 August 2017 Memorandum from UCSL to Unison clearly identified that the deployment of staff to Aurora had contributed to its inability to complete planned work programmes, including asset replacements.

389. Information in the 4 August 2017 memorandum from UCSL to Unison described constraints present in the contractor resource market, including UCSL's difficulty at that time in retaining and recruiting qualified and experienced staff. This issue would have been increasing the risk that planned capital works would need to be deferred. Unison also recognised this point in its 22 November 2019 letter to the Commission.[94]

390. We found that:

a) whilst UCSL's deployment of staff to Aurora did introduce quality performance risks for Unison, it had identified the risks;

b) prior to the staff deployment, risks had been assessed and accepted by UCSL and Unison and appropriate risk mitigation measures had been identified;

c) the identified risk mitigation measures together with additional measures, were implemented when issues with delivery of the capital works programme were raised by UCSL;

d) the application of Unison's risk prioritisation method for determining its capital investment programme will have ensured that lower risk projects were deferred; and

e) there is no evidence that the deferral of the lower risk projects contributed to Unison's SAIDI during 2017/18 and therefore would not have contributed to its non-compliance.

391. We accept Unison's explanation that deployment of staff to Aurora will not have impacted on its ability to manage the restoration of supplies during the AP2018 MEDs. We also accept Unison and UCSL's points that there are strategic benefits to both organisations in developing UCSL's strategic partnerships and business development. We consider that there are likely to be benefits to Unison's consumers through its access to stronger and more experienced UCSL people and other resources. The presence of these potential benefits are likely to be greater than the potential probability weighted cost of the risks.

392. In our opinion, because of Unison and UCSL's sound management of the staff deployment to Aurora, including the management of potential resourcing risk, we do not consider that the deployment made any contribution to Unison's non-compliance.

[93] 3676989_20191122 Unison cover letter response to information request, page 5
[94] Ibid

15. Relativity of contributing causes of non-compliance

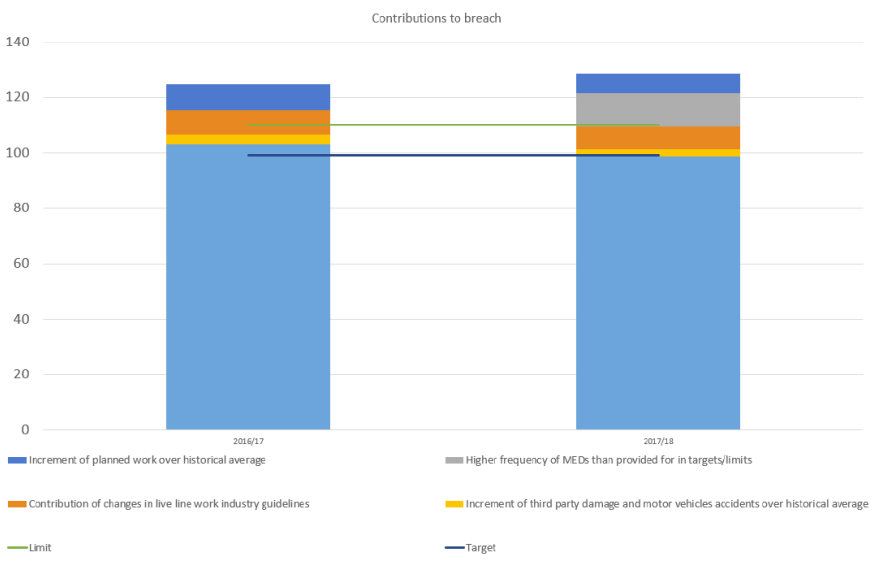
393. In its response to Strata's draft report, Unison raised the issue of the relativity of contributing causes of non-compliance:

> *While not part of the scope of Strata's report, we think it would be useful for Strata to highlight to the Commission that even setting aside whether or not Unison met GIP in managing fall distance trees, the combination of investing in the network, higher than normal MEDs in RY2018, higher than average third party damage to the network, and the impact of changes in work practices due to the Health and Safety Act (that were managed to GIP) were substantial causes of Unison exceeding the reliability limits. This would enable the Commission to draw the conclusion that Unison's reliability performance in RY2017 and RY2018 was not due to any failure on Unison's part to manage its network effectively.*[95]

394. The Commission asked Strata to consider inclusion of this point in its final report.

395. Unison demonstrated the relativity point in the diagram reproduced in Figure 48.

Figure 48: Contributions to SAIDI in RY2017 and RY2018



Source: 20201012 Unison response to Strata draft report, page 14

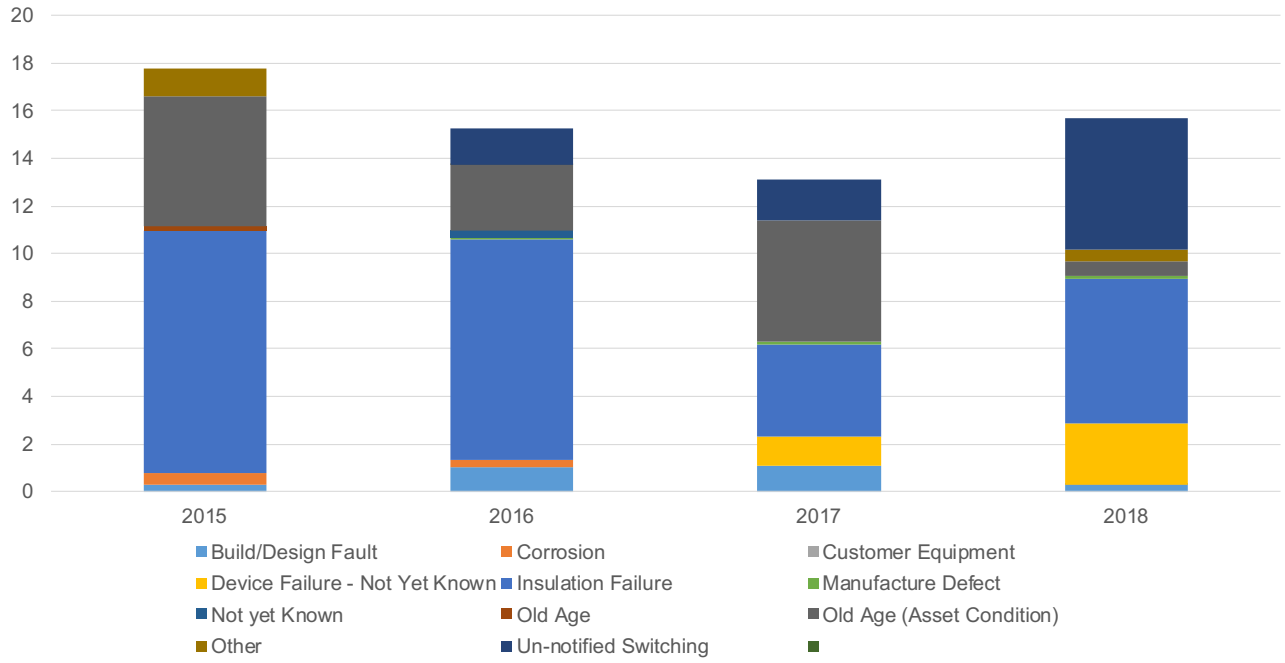
396. The point that Unison makes regarding the contribution of many events to SAIDI and SAIFI performance is relevant to consider. Strata considers this as part of its analysis of quality performance to identify if reasons given by EDB's in Annual Compliance statements are complete, or if other contributing causes exist.

397. Unison's chart reproduced in Figure 48 is one way of viewing the contributors to non-compliance. In Figure 48 Unison is highlighting what it considers to be contributors to its non-compliance. However, there are multiple contributors within the underlying light blue component of the column and the relativity of changes in all contributors needs to be considered.

[95] 20201012 Unison response to Strata draft report, page 13

398. Figure 49 highlights one of several areas that could be used to indicate that contributors to SAIDI are dynamic over periods and, for example, differed in AP2018 to earlier periods.

Figure 49: Unplanned SAIDI attributable to defective equipment (excluding MED)



Source: Strata analysis of Unison Outages_Detailed.xlsx

399. Other examples of the relativity of cause can be seen in Figure 5 and in the discussion of contributions to non-compliance provided in section 4 of this report.

400. The relativity of a specific cause is dependent on the position taken when looking at the data (i.e. which cause is placed at the top of the column). In our analysis, we looked at relativity from many perspectives to develop an understanding of the contributions of many causes and how these have changed over time.

401. Specific to Unison's non-compliance, our analysis has concluded that the contribution of MEDs, increase in planned outages, higher than average third party damage and changes in live line practices were relevant to its non-compliance. We concur with Unison that, had these increases not occurred, it would have been compliant with its quality standards.

402. However, there are several other contributors to non-compliance related SAIDI. Examples include the increase seen from 2016 in GLZ and FDZ vegetation related interruptions (see Figure 20), unnotified switching and cause unknown. So whilst we can agree with Unison that in the absence of the causes it has highlighted it would have remained compliant, the same can be said for combinations of other causes.

403. Essentially, achievement within a target and limit for SAIDI and SAIFI performance selected on the basis of historical performance will be highly dependent on the relative functioning of its components. During periods when several components perform worse than they have historically, the likelihood of non-compliance will be higher unless there is an offsetting effect of other components performing above historical levels.

404. In Unison's specific cases, the increases in SAIDI for the causes it has highlighted, and for the additional areas we have highlighted, were not off-set by decreases in other contributed causes.

405. As Unison has shown, the contributing causes to its non-compliance were those it considers as largely beyond its reasonable control.

406. Our analysis highlighted and subjected all relevant causes to assessment. Through this approach, the relative importance of individual causes was considered against the context of overall network reliability performance. Our analysis supports Unison's view that the combination of investing in the network, higher than normal MEDs in RY2018, higher than average third party damage to the network, and the impact of changes in work practices due to the Health and Safety Act (that were managed to GIP) were substantial causes of Unison exceeding the reliability limits. In addition, we consider that other causes that had higher than historical SAIDI were relevant contributors.

Appendix A Context and information on Unison Energy

A.1 Unison is owned by Hawke's Bay Power Consumers' Trust and is the fifth largest EDB in New Zealand servicing approximately 110,576 installation control points (ICPs) consuming approximately 1,700 GWh of electricity annually.

A.2 The Unison Group includes three subsidiaries that provide services to support its core network business:

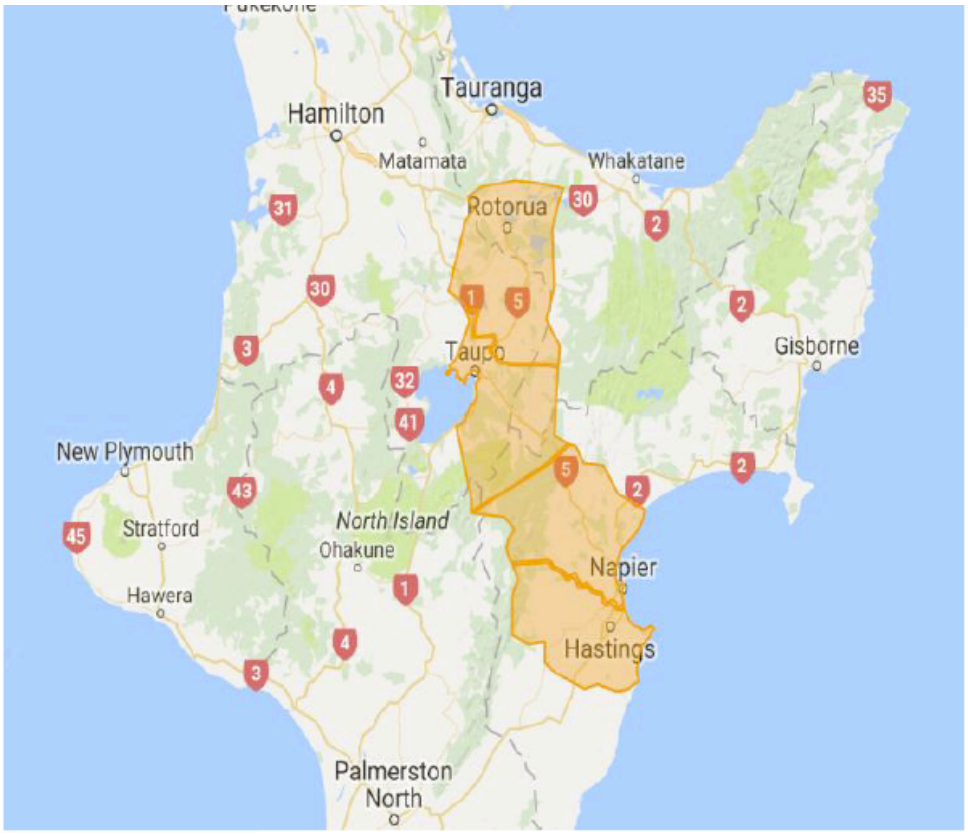
- Unison Contracting Services Limited – electrical, civil and vegetation management contracting services, as well as around the clock fault response;
- Unison Fibre Limited – fibre network services to enable Unison's Smart Grid;
- Unison Insurance Limited – captive insurance for critical assets; and
- ETEL Limited - supply chain partner, providing Unison with distribution transformers.

A.3 Unison's electricity networks distribute electricity to regional communities of Hawke's Bay, Taupo and Rotorua and to the main urban centres of Napier, Hastings, Taupo and Rotorua.

A.4 The total land area covered in Unison's electricity distribution areas is 12,181km^2.

A.5 **Unison's network area**

A.6 There are three network areas, Rotorua, Taupo and Hawke's Bay. These are shown in the map below.



A.7 The network extends into exposed backcountry areas where climatic conditions are highly variable, and through dense forestry areas where vegetation encroachment is a constant issue. Parts of the Central Region have high levels of corrosive compounds (H 2 S) in the air and soil, and areas of Hawke's Bay are susceptible to ocean salt spray.

A.8 Unison's network system length in AP2017 was 9,181km made up of:

- 498km 33kV subtransmission circuits;
- 4,699km 11kV distribution circuits; and
- 3,985km LV circuits.

A.9 In AP2017 69.7% of Unison's network was overhead.

Appendix B UCSL Work Prioritisation

B.1 The matrix below is used by Unison Contracting Services Limited to prioritise and schedule the work it undertakes for Unison. The prioritisation matrix was introduced in 2012.

Priority	Works element*	Justification
1	Faults and Emergency	First and second response to faults or urgent H&S issues. Restoration of power & comms to affected customers is the highest priority. This priority includes the restoration of the network to its original state. First and second response is also critically important to management of SAIDI and SAIFI, customer SLAs, and H&S issues on the network.
2	Critical defects	Restoration of communications to devices that is critical to operate the relevant network, i.e. radio communications, aerials, etc. This also includes the collection of data from field devices required for analysis of critical system faults.
3	Customer projects	The efficiency with which customer projects are delivered is indicative of the business' commitment to customer service. Customer projects must be seen to be given priority where possible. Includes third party work where: · a business commitment has already been made (e.g. work in progress); · that connection increases network capacity; or · there is a strategic third party partnership or relationship development projects agreed by the board.
4	Compliance projects	Compliance projects are initiated to rectify non-compliance with network standards, policies or legislation. Typical compliance projects are rectification of voltage issues and renewal of assets due to latent H&S risks. Non-compliance exposes Unison to a variety of risks, meaning that rapid rectification is desirable (note that if the non-compliance relates to urgent H&S issues, then it will be addressed under first and second response).
5	Asset maintenance	An enhanced and more proactive asset maintenance regime is a key mitigation technique for the deferral of network CAPEX under the Smart Grid initiative. The maintenance programme delivers asset managers the information they require to ensure that the network is performing as it should be during this time.
6	Proactive Initiatives, such as: Smart Grid projects	The installation of Smart Grid technologies on the network is essential to realising the benefits of the strategy. Ensuring that the rollout strategy is on schedule will minimise the period of time that the network is exposed to the risk of the project deferrals, and will maximise capture of the benefits.
7	Other CAPEX projects (renewals, OHUG, system growth and reliability)	Although essential to 'keep the lights on', these projects are less time-critical than the other projects that comprise this prioritisation framework. They should be given lowest priority for resource allocation.
8	Third Party Additional Revenue	Additional non-network revenue streams where resource availability can be identified to generate acceptable financial returns.

Source: 70804 Memorandum HB Planned Capex Update, Memorandum UCSL to Unison 4 August 2017

Appendix C Unison's interruption history compared to others

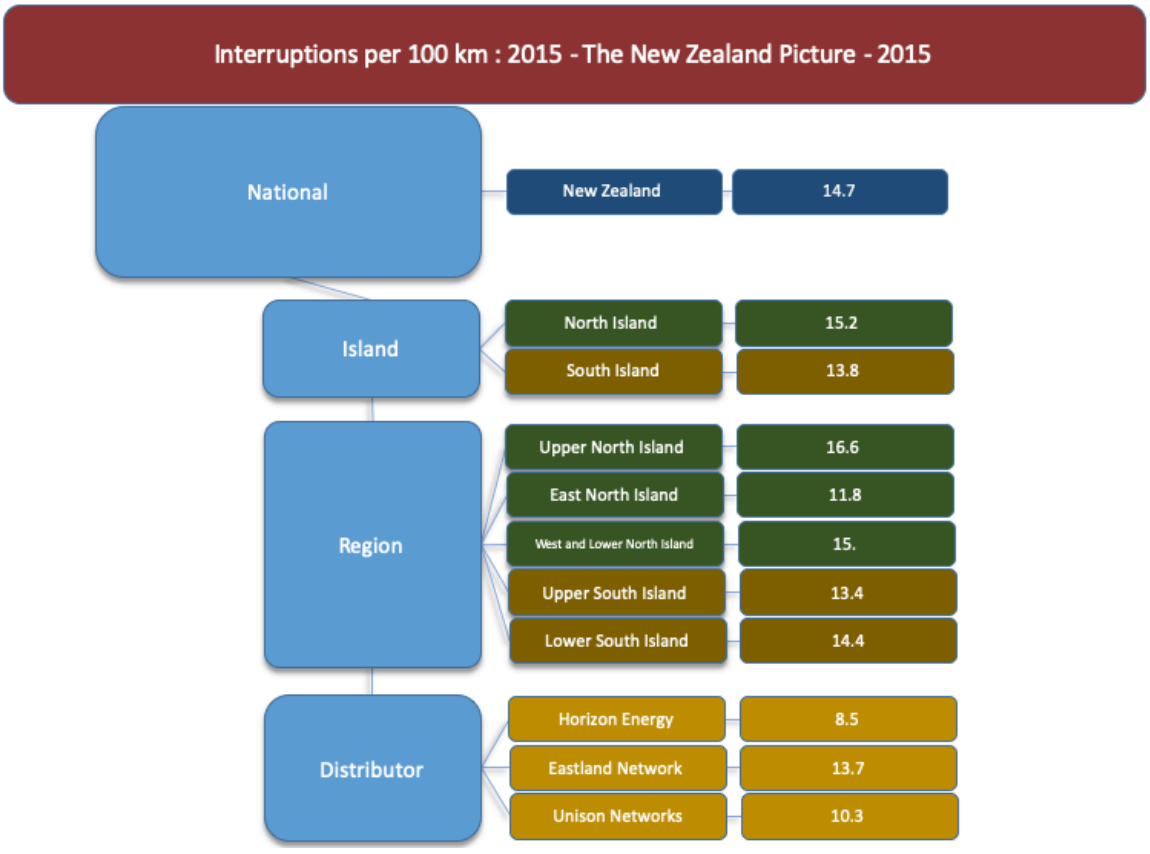
C.1 Comparison on an interruptions per 100 network km is relevant as it provides a view of the relative performances of networks across the country in the same years. Horizon Energy and Eastland Networks were selected for comparison as they are distribution networks located close to Unison's and are likely to have experienced a similar frequency of adverse weather events.

C.2 The following charts give the comparison for four years from 2015 to 2018. All charts are derived using Strata's EDB Dashboard which uses data sourced from distributor information disclosures available from the Commerce Commission website.

C.3 The sequence of charts show that Unison's performance on interruptions/100 network km in all assessment periods other than AP2018, was better than Eastland Network, Horizon Energy, national, North Island and East Coast of the North Island.

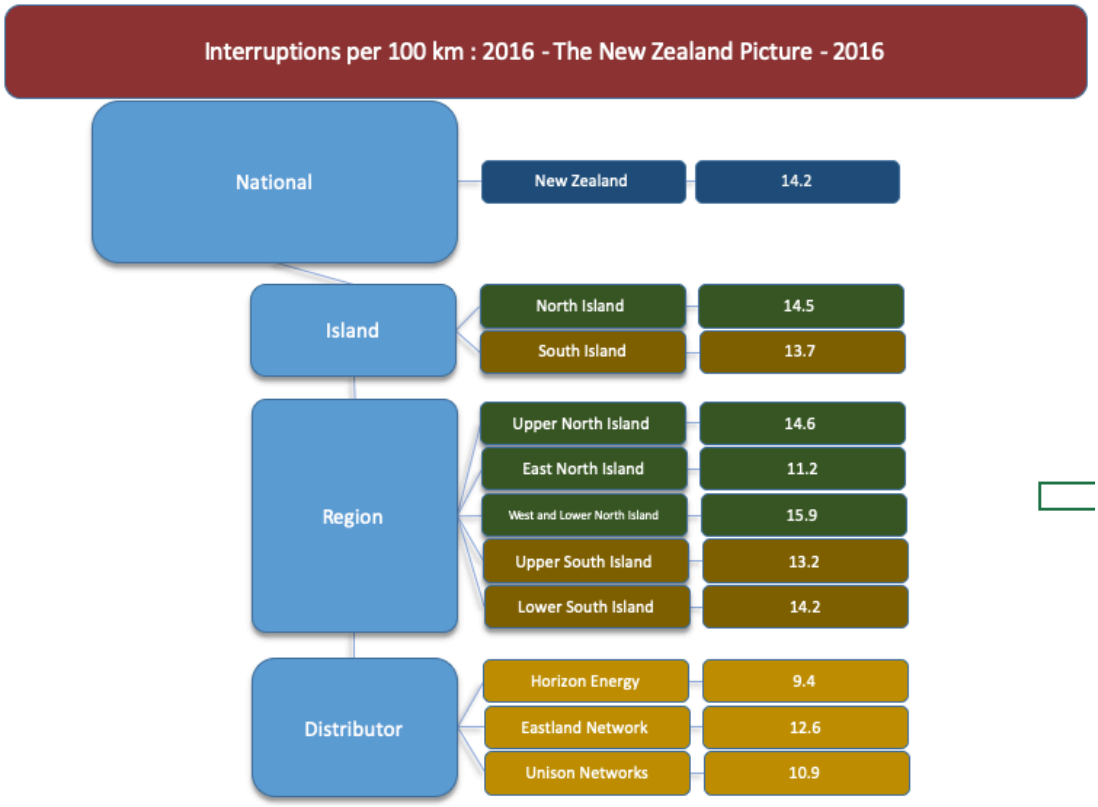
C.4 In AP2018, Unison's performance on this metric was higher than Eastland Network but still lower than Horizon Energy, the national, North Island and East Coast of the North Island interruptions/100 network km.

Appendix Figure 1: AP 2015 Interruptions per network km



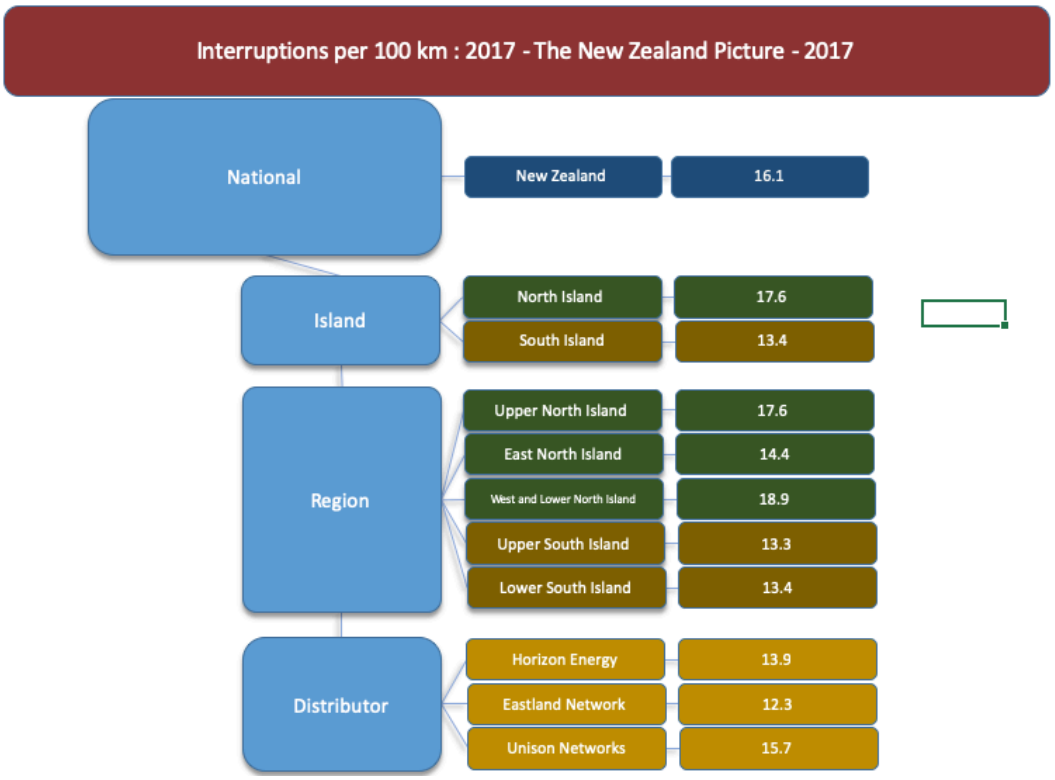
Source: Strata EDB Dashboard, data from Commerce Commission

Appendix Figure 2: AP 2016 Interruptions per network km



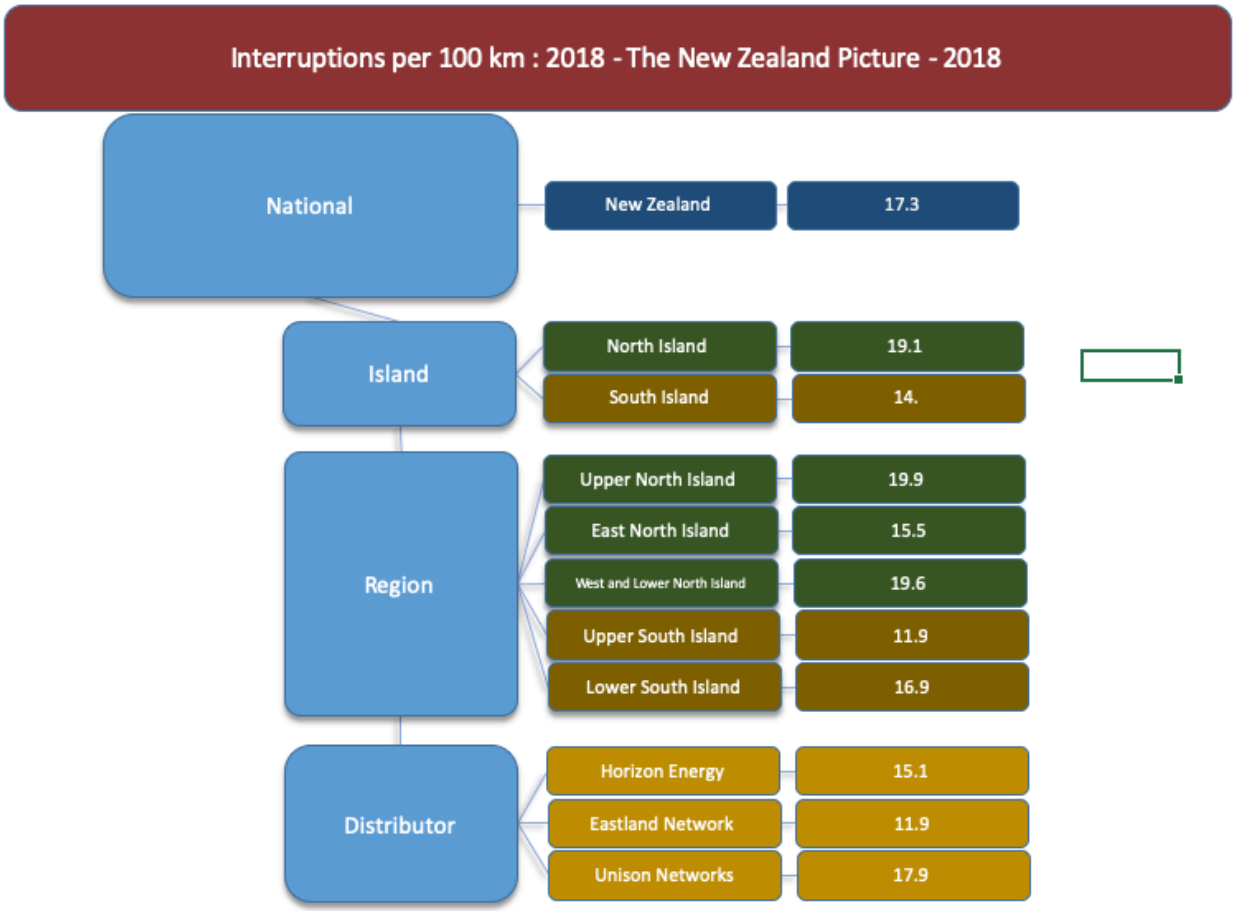
Source: Strata EDB Dashboard, data from Commerce Commission

Appendix Figure 3: AP2017 Interruptions per network km



Source: Strata EDB Dashboard, data from Commerce Commission

Appendix Figure 4: AP2018 Interruptions per network km



Source: Strata EDB Dashboard, data from Commerce Commission

Appendix D Unison summary of its financial position

D.1 The following table, which is prepared on a conservative basis by excluding profits from Unison's subsidiary companies, but recognising all debt against the network business, illustrates the Company's strong financial position and conservative dividend policy.

	2015	2016	2017	2018	2019	Comment
RAB value	538,909	547,998	581,135	586,195	620,045	
Implied "efficient" debt @44% of RAB	237,120	241,119	255,699	257,926	272,820	
Unison Group Debt (UNL, ETEL, UFL)	240,000	237,000	235,000	226,000	232,000	Unison's Group Debt is consistently below the Commission's implied efficient debt on network assets
Maximum borrowing capacity (ultra-conservative basis)	323,345	328,799	348,681	351,717	372,027	Ultra-conservative, as assumes can only borrow against electricity network assets. In reality, Unison could borrow up to $499m on total asset basis (2019).
Estimated borrowing headroom (ultra-conservative basis)	**83,345**	**91,799**	**113,681**	**125,717**	**140,027**	Unison's banking coventants permit borrowing to 60% of total assets (conservatively have just used RAB value)
Network profit @7.21% of 56% of RAB (allowed for under DPP)	21.8	22.1	23.5	23.7	25.0	7.21% RoE from 2014 cost of capital decision (ignores percentile so is conservative)
Dividend paid	9.6	9.7	12.7	12.7	15.8	
Retained network profits invested into business	**12.16**	**12.43**	**10.76**	**10.97**	**9.23**	Unison has paid less in Group dividends than the return on equity on network assets only
or most conservative basis, where RoE is net of revaluations						
Network profit @5.21% of 56% of RAB	15.7	16.0	17.0	17.1	18.1	RoE from 2014 cost of capital decision (Equity return reduced by revaluations due to CPI, reducing cash profits to 5.21%)
Dividend paid	9.6	9.7	12.7	12.7	15.8	
Retained network profits reinvested into business	**6.12**	**6.29**	**4.26**	**4.40**	**2.29**	Unison has paid less in Group dividends than the return on equity on network assets only (and assuming all revaluations are retained in the business)

Appendix E The reliability of Unison's data and information

Unison's assessment of its data quality

E.1 In its annual information disclosures Unison provides assessments of the quality of its disclosed data. The Commission's four point scale against which EDB assess their data quality is provided below.

Data Accuracy Score	Commerce Commission Interpretation
1	Good quality data is not available for any of the assets in the category and estimates are likely to contain significant error
2	Good quality data is available for some assets but not for others and the data provided includes estimates of uncounted assets within the category
3	Means that data is available for all assets but includes a level of estimation where there is understood to be some poor quality data for some of the assets within the category
4	Means that good quality data is available for all of the assets in the category

E.2 The tables below provide a collated summary of Unison's self-assessment of the data accuracy in its Information Disclosures.

Appendix Table 1: Asset register quality

	2013	2014	2015	2016	2017	2018	2019
Capacitors including controls	4	4	4	4	4	4	3
Cable Tunnels	4	4	4	4			
Centralised plant	4	4	4	4	4	3	3
Relays	2	2	2	2	2	2	2
Concrete poles / steel structure	3	3	3	3	3	4	4
Wood poles	3	3	3	3	3	4	4
Other pole types	4	4	4	4	4	4	4
Protection relays (electromechanical, solid state and numeric)	1	1	1	1	1	4	1
SCADA and communications equipment operating as a single system	3	3	4	4	4	4	1
Distribution UG XLPE or PVC	3	3	3	3	3	3	3
Distribution UG PILC	3	3	3	3	3	3	3
Distribution Submarine Cable							
Distribution OH Open Wire Conductor	3	3	3	3	3	2	2
Distribution OH Aerial Cable Conductor	3	3	3	3	3	2	2
SWER conductor	4	4	4	4	4	3	3
Ground Mounted Substation Housing	3	3	3	3	3	1	1
3.3/6.6/11/22kV CB (pole mounted) - reclosers and sectionalisers	4	4	4	4	4	3	3
3.3/6.6/11/22kV CB (Indoor)	4	4	4	4	4	3	
3.3/6.6/11/22kV Switches and fuses (pole mounted)	3	3	3	3	3	3	3
3.3/6.6/11/22kV Switch (ground mounted) - except RMU	4	4	4	4	4	4	4
3.3/6.6/11/22kV RMU	4	4	4	4	4	4	4
Pole Mounted Transformer	4	4	4	4	3	4	4
Ground Mounted Transformer	4	4	4	4	4	4	4
Voltage regulators	4	4	4	4	4	3	3
Subtransmission UG up to 66kV (XLPE)	4	4	4	4	4	3	3
Subtransmission UG up to 66kV (Oil pressurised)							
Subtransmission UG up to 66kV (Gas pressurised)	4	4	4	4	4		
Subtransmission UG up to 66kV (PILC)	4	4	4	4	4	3	3
Subtransmission UG 110kV+ (XLPE)							
Subtransmission UG 110kV+ (Oil pressurised)							
Subtransmission UG 110kV+ (Gas Pressurised)							
Subtransmission UG 110kV+ (PILC)							
Subtransmission submarine cable							
Subtransmission OH up to 66kV conductor	4	4	4	4	4	3	3
Subtransmission OH 110kV+ conductor							
Zone substations up to 66kV	4	4	4	4	4	3	3
Zone substations 110kV+							
50/66/110kV CB (Indoor)							
50/66/110kV CB (Outdoor)							
33kV Switch (Ground Mounted)							
33kV Switch (Pole Mounted)	4	4	4	4	4	4	4
33kV RMU							
22/33kV CB (Indoor)	4	4	4	4	4	4	4
22/33kV CB (Outdoor)	3	3	3	3	3	4	4
3.3/6.6/11/22kV CB (ground mounted)	3	3	3	3	3	4	4
3.3/6.6/11/22kV CB (pole mounted)	3	3	3	3	3	4	4
Zone Substation Transformers	3	3	4	4	4	4	4
OH/UG consumer service connections	3	3	3	3	3	3	3
LV UG Cable	3	3	3	3	3	2	2
LV OH Conductor	3	3	3	3	3	2	2
LV OH/UG Streetlight circuit	3	3	3	3	3	3	3

Source: Unison Information Disclosures (2014 to 2018)

Appendix Table 2: Asset age data quality

	2013	2014	2015	2016	2017	2018	2019
Capacitors including controls	4	4	4	4	4	4	3
Cable Tunnels	4	4	4	4	4		
Centralised plant	3	3	3	3	3	3	3
Relays	2	2	2	2	2	2	2
Concrete poles / steel structure	3	3	3	3	3	4	4
Wood poles	3	3	3	3	3	4	4
Other pole types	4	4	4	4	4	4	4
Protection relays (electromechanical, solid state and numeric)	1	1	1	1	1	4	1
SCADA and communications equipment operating as a single system	3	3	4	4	4	4	1
Distribution UG XLPE or PVC	3	3	3	3	3	3	3
Distribution UG PILC	3	3	3	3	3	3	3
Distribution Submarine Cable							
Distribution OH Open Wire Conductor	3	3	3	3	3	2	2
Distribution OH Aerial Cable Conductor	3	3	3	3	3	2	2
SWER conductor	3	3	3	3	3	2	2
Ground Mounted Substation Housing	3	3	3	3	3	1	1
3.3/6.6/11/22kV CB (pole mounted) - reclosers and sectionalisers	4	4	4	4	4	3	3
3.3/6.6/11/22kV CB (Indoor)	3	3	3	3	3	3	
3.3/6.6/11/22kV Switches and fuses (pole mounted)	3	3	3	3	3	3	3
3.3/6.6/11/22kV Switch (ground mounted) - except RMU	3	3	3	3	3	4	4
3.3/6.6/11/22kV RMU	3	3	3	3	3	4	4
Pole Mounted Transformer	3	3	3	3	3	4	4
Ground Mounted Transformer	3	3	3	3	3	4	4
Voltage regulators	4	4	4	4	4	3	3
Subtransmission UG up to 66kV (XLPE)	4	4	4	4	4	3	3
Subtransmission UG up to 66kV (Oil pressurised)							
Subtransmission UG up to 66kV (Gas pressurised)	4	4	4	4	4		
Subtransmission UG up to 66kV (PILC)	4	4	4	4	4	3	3
Subtransmission UG 110kV+ (XLPE)							
Subtransmission UG 110kV+ (Oil pressurised)							
Subtransmission UG 110kV+ (Gas Pressurised)							
Subtransmission UG 110kV+ (PILC)							
Subtransmission submarine cable							
Subtransmission OH up to 66kV conductor	4	4	4	4	4	3	3
Subtransmission OH 110kV+ conductor							
Zone substations up to 66kV	3	3	3	3	3	3	3
Zone substations 110kV+							
50/66/110kV CB (Indoor)							
50/66/110kV CB (Outdoor)							
33kV Switch (Ground Mounted)							
33kV Switch (Pole Mounted)	3	3	3	3	3	4	4
33kV RMU							
22/33kV CB (Indoor)	4	4	4	4	4	4	4
22/33kV CB (Outdoor)	4	4	4	4	4	4	4
3.3/6.6/11/22kV CB (ground mounted)	4	4	4	4	4	4	4
3.3/6.6/11/22kV CB (pole mounted)	4	4	4	4	4	4	4
Zone Substation Transformers	4	4	4	4	4	4	4
OH/UG consumer service connections	2	2	2	2	2	3	3
LV UG Cable	3	3	3	3	3	2	2
LV OH Conductor	3	3	3	3	3	2	2
LV OH/UG Streetlight circuit	3	3	3	3	3	2	2

Source: Unison Information Disclosures (2014 to 2018)

Appendix Table 3: Asset condition data quality

	2013	2014	2015	2016	2017	2018	2019
Capacitors including controls	3	3	4	4	4	3	3
Cable Tunnels							
Centralised plant	3	3	2	4	4	3	3
Relays		1	3	2	2	3	2
Concrete poles / steel structure	2	3	2	3	3	4	4
Wood poles	3	3	2	3	3	4	4
Other pole types	4	4	4	4	4	4	4
Protection relays (electromechanical, solid state and numeric)	3	3	3	3	3	1	1
SCADA and communications equipment operating as a single system	3	3	2	2	2	1	1
Distribution UG XLPE or PVC	3	3	2	2	2	3	3
Distribution UG PILC	3	3	2	2	2	3	3
Distribution Submarine Cable			4	4	4		
Distribution OH Open Wire Conductor	3	2	2	2	2	2	2
Distribution OH Aerial Cable Conductor	4	4	4	4	4	2	2
SWER conductor	3	3	2	2	2	2	2
Ground Mounted Substation Housing	3	3	2	2	2	1	1
3.3/6.6/11/22kV CB (pole mounted) - reclosers and sectionalisers		3	2	3	3	3	3
3.3/6.6/11/22kV CB (Indoor)		3	2				
3.3/6.6/11/22kV Switches and fuses (pole mounted)		3	2	2	2	3	3
3.3/6.6/11/22kV Switch (ground mounted) - except RMU	3		2			4	4
3.3/6.6/11/22kV RMU	3	3	2	4	4	4	4
Pole Mounted Transformer	2	3	2	3	3	4	4
Ground Mounted Transformer	3	3	2	4	4	4	4
Voltage regulators	3	3	2	4	4	3	3
Subtransmission UG up to 66kV (XLPE)	3	3	2	3	3	3	3
Subtransmission UG up to 66kV (Oil pressurised)						3	
Subtransmission UG up to 66kV (Gas pressurised)	3	3					
Subtransmission UG up to 66kV (PILC)	3	3	4	3	3	3	3
Subtransmission UG 110kV+ (XLPE)							
Subtransmission UG 110kV+ (Oil pressurised)							
Subtransmission UG 110kV+ (Gas Pressurised)							
Subtransmission UG 110kV+ (PILC)							
Subtransmission submarine cable							
Subtransmission OH up to 66kV conductor	3	3	2	3	3	3	3
Subtransmission OH 110kV+ conductor							
Zone substations up to 66kV	3	3	4	4	4	3	3
Zone substations 110kV+							
50/66/110kV CB (Indoor)							
50/66/110kV CB (Outdoor)							
33kV Switch (Ground Mounted)			2	2	2		
33kV Switch (Pole Mounted)	3	3	2	2	2		
33kV RMU			2				
22/33kV CB (Indoor)	3	3	4	4	4	4	4
22/33kV CB (Outdoor)	3	3	2	4	4	4	4
3.3/6.6/11/22kV CB (ground mounted)	3	3	4	4	4	4	4
3.3/6.6/11/22kV CB (pole mounted)	3	3	2	4	4	4	4
Zone Substation Transformers	3	3	4	4	4	4	4
OH/UG consumer service connections		1	2	2	2	3	3
LV UG Cable	3	2	2	2	2	2	2
LV OH Conductor	2	2	2	2	2	2	2
LV OH/UG Streetlight circuit	3	2	2	2	2	2	2

Source: Unison Information Disclosures (2014 to 2018)

Appendix F Glossary

Act	Part 4A of the Commerce Act 1986
AHI	Asset Health Index
AMMAT	Asset Management Maturity Assessment Tool
AMP	Asset Management Plan
AMS	Asset Management System
AMIP	Asset Management Improvement Programme
AP	Assessment Period
APR	Accelerated Pole Replacement Programme
Capex	Capital Expenditure
CBD	Central Business District
CBRM	Condition Based Risk Management
Commission	The Commerce Commission
CPP	Customised Price Path
DAMS	Distribution Asset Management System
DDO	Distribution drop-out fuse
DGA	Dissolved Gas Analysis
DPP	Default Price Path
EDB	Electricity Distribution Business
EEA	Electrical Engineers' Association
FMEA	Failure Mode Effects Analysis
GIP	Good Industry Practice
GWh	Gigawatt-hour, a unit of electrical energy
HBPCT	Hawke's Bay Power Consumer's Trust
HSWA	The Health and Safety at Work Act 2015
ICP	Installation Connection Point
ID	Information disclosure
IPT	Investment Prioritisation Tool

km	Kilometre
kmh	Kilometres per hour
kV	Kilovolts (= 1000 volts), a unit of electrical voltage
MPL	Maximum practicable life
MPT	Mechanical pole testing
MVA	Megavolt-ampere, a unit of electrical power
MW	Megawatt, a unit of electrical power
NPAT	Net profit after tax
OOU	Onset of unreliability
Opex	Operational expenditure
PILC	Paper insulated lead covered
RMU	Ring Main Unit
SCCP	SCADA communication control and protection
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAMP	Strategic asset management plan
Strata	Strata Energy Consulting Limited
TALC	Total Asset Lifecycle
Transpower	Transpower New Zealand Limited
UCSL	Unison Contracting Services Limited
Unison	Unison Energy Distribution Limited
WorkSafe	WorkSafe New Zealand
XLPE	Cross-linked polyethylene

Appendix G Defining and measuring Good Industry Practice asset management

G.1 The Commission asked that, when we form opinions on whether Unison acted in accordance with Good Industry Practice, we should consider whether Unison exercised a degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced operator engaged in the same type of undertaking under the same or similar circumstances.

G.2 Good Industry Practice can be determined through the requirements placed on electricity distributors through legislation, regulations, standards and guidelines.

Requirements of legislation and regulations

G.3 Electricity distributors are subject to a range of legislative instruments (legislation, regulations, standards, and codes of practice) of direct relevance to management of its assets as it imposes certain compliance obligations. These instruments include:

- Electricity Act (1992);
- Commerce Act Part 4;
- Electricity Distribution Information Disclosure Determination 2012;
- Electricity Distribution Services Default Price-Quality Path Determination 2015;
- Electricity Industry Participation Code (2010);
- Energy Companies Act 1993;
- Electricity Industry Act (2010);
- Public Works Act (1981);
- Electricity (Safety) Regulations (2010);
- Health and Safety at Work Act (2015);
- Electricity (Hazards from Trees) Regulations 2003;
- Health and Safety at Work Regulations (various); and
- Resource Management Act (1991).

Requirements of relevant industry standards

G.4 Good industry asset management practice is established with reference to a number of industry standards, including:

- AS/NZS – ISO55001 – which specifies requirements for asset management system;
- AS/NZS-ISO31001 – which specifies requirements for risk management;
- AS/NZS-ISO14001 – which specifies requirements for environmental management; and
- NZS 7901 – which specifies the requirements for safety management systems for public safety in the electricity and gas industries.

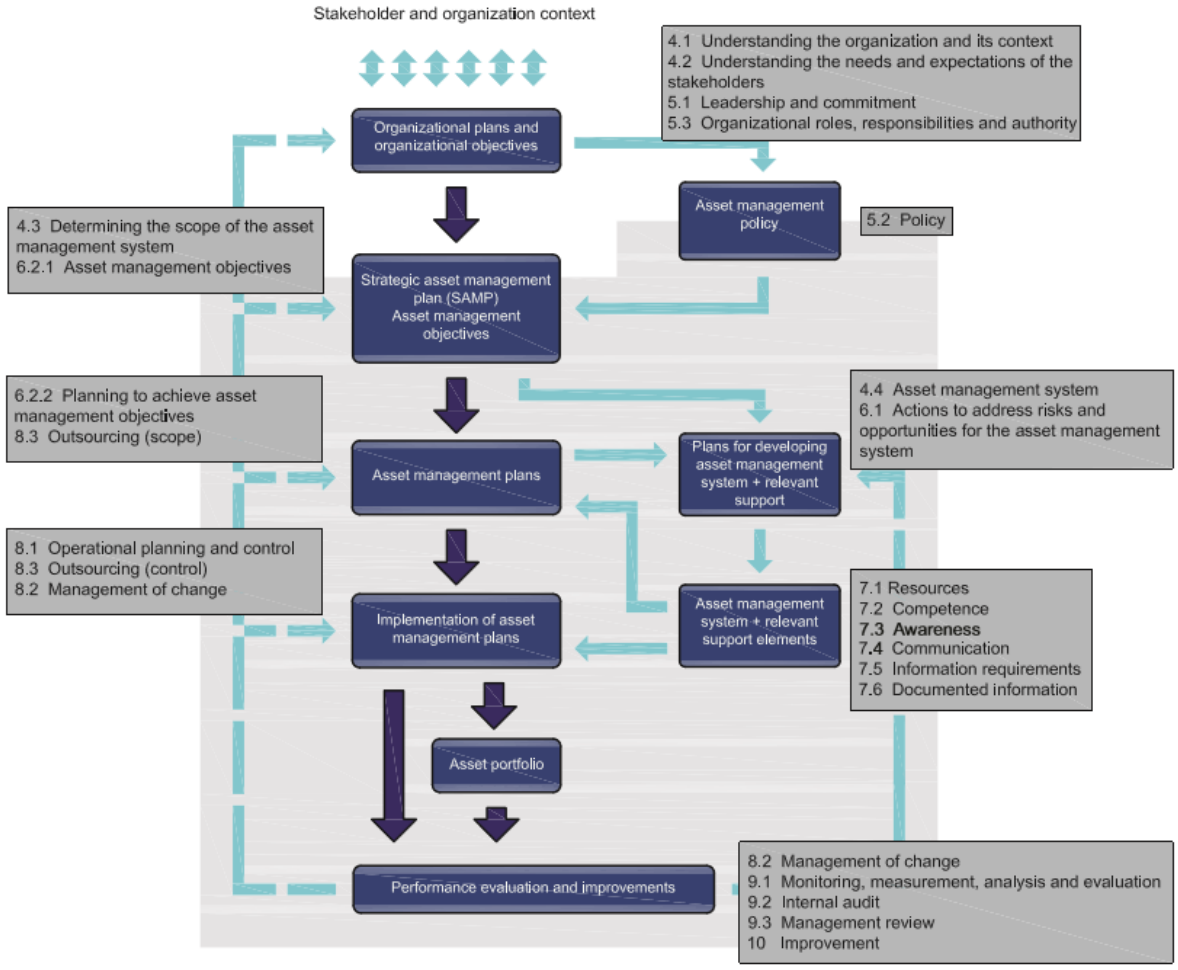
G.5 There are other standards that apply to specific asset classes, such as AS/NZS 7000 (for overhead line design) and AS/NZS 60076 (for power transformers).

Asset management system

G.6 The foundation of Good Industry Practice in asset management is the development of an asset management system (AMS) which provides '*a set of interrelated and interacting elements of an organisation, whose function is to establish the asset management policy and asset management objectives, and the processes, needed to achieve those*

objectives.[96] The diagram below shows the relationship between the key elements of an asset management system according to the internationally recognised ISO 55000 (Asset Management System) suite of standards.[97]

Appendix Figure 5: ISO 55000 – Asset management system key elements



Source: ISO 55000, section 2.5.1

G.7 Asset management plans (AMP) are a central element of the ISO 55000 asset management system. The Commission has recognised that AMP provide important information on how electricity network businesses intend to manage assets to meet consumer demands in the future. As part of its regulatory role, the Commission reviews AMPs to assess the extent to which they comply with the disclosure provisions of the Electricity Distribution (Information Disclosure) Determination 2012 (as amended in 2017).

Asset management objectives

G.8 Consistent with the principles in ISO 55000, asset management objectives for electricity utilities are typically based on delivering safe, reliable and efficient services to meet present and future needs of its customers at the least whole-of-life cost. The asset objectives must

[96] ISO 55000, section 2.5.1
[97] There are also internationally recognised guidelines to complement the ISO 55000 suite, such as the International Infrastructure Management Manual (IIMM)

be consistent with the organisational plans and objectives and the organisation's asset management policy.

Asset renewal decision methodologies

G.9 Good asset management decision making in the context of reliability performance is based on minimising asset life cycle cost by selecting appropriate action for an individual asset (or 'fleet' of assets). This requires reliable asset data and involves an economic choice between doing nothing and renewing (i.e. refurbishing[98] or replacing) the asset(s).

G.10 Justification for renewing individual assets or asset fleets[99] therefore requires demonstration that:

1. there is an impending need to refurbish or replace the asset(s) (e.g. due to its assessed condition or performance);
2. the prudent and efficient action (i.e. scope and cost) has been selected through options analysis, and is designated to occur at the economically optimum time; and
3. the proposed action (scope, timing, cost) is justified considering broader network plans and the capability of the EDB to deliver the work efficiently.

G.11 Depending on the specific circumstances, the three elements of the decision making process may be iterative.[100] The principles for establishing a bona fide case for the impending need to retire an asset or asset fleet include:

4. evidence that the asset condition monitoring and assessment is robust (i.e. not biased towards overstating the likelihood of asset failure); and
5. for cases in which pending asset obsolescence is cited as the trigger for action:
   - evidence from the manufacturer regarding the expected life, and of service and/or spare parts availability;
   - evidence that asset performance is declining (e.g. defect trends).

G.12 Leading industry practice is to quantify the risk of failure to enable comparison with the cost of the various options. This is typically referred to as condition-based risk management (CBRM), in which the risk calculation is based on combining the probability of failure[101] value with the consequences of failure.[102] Each consequence is given a monetary value. The risk-cost avoided by implementing the project is a benefit that is an input to the economic assessment model along with any additional quantifiable benefits and costs to determine the net present value (NPV) for the project.

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[98] This is essentially a life extension strategy and includes, for example, reinforcing wooden poles at the base or replacing components such as seals in switchgear.

[99] If the assessment is applied to an asset 'fleet', then there should be sufficient evidence that the condition assessment and assessment of risk of failure is applicable to the asset fleet.

[100] For example, an asset may be identified as no longer being fit for purpose, but after considering the broader plans for the network, asset replacement is not justified because the asset will no longer be required due to network reconfiguration (i.e. the asset can be retired without replacement or refurbishment).

[101] The probability of failure of an asset is modelled as a function of time and can be derived from industry experience rather than the organisation's asset history, although calibration of the industry statistics with the organisation's own data is good practice.

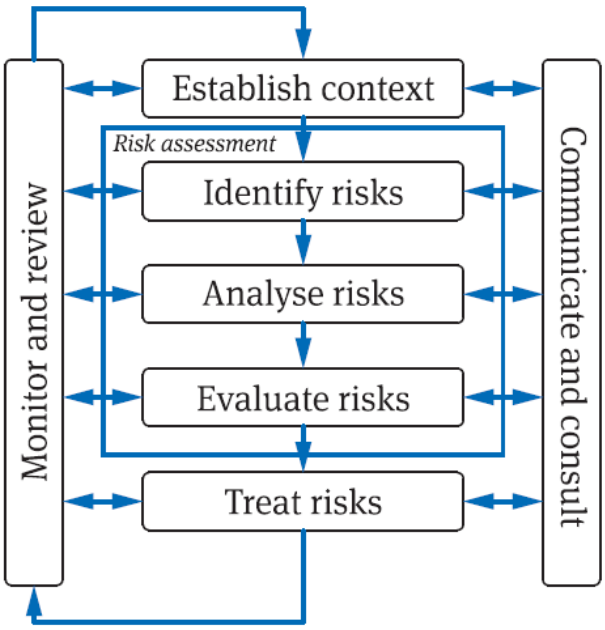
[102] The consequences of failure are defined in several categories, typically network performance, safety, financial and environmental and can be derived from industry-wide data rather than just the individual organisation's data.

G.13 The relative importance of individual assets can be accounted for by defining the 'criticality' of the asset separately in each of the categories. This allows all investment projects to be ranked on the basis of cost/benefit.

ISO 31000 – Risk management

G.14 A fundamental aspect of asset renewal (and network augmentation) decision making is risk assessment. The ISO 31000 international standard on risk management is widely consulted as the reference for Good Industry Practice providing a framework and process for managing risk.

Appendix Figure 6: ISO: 31000 Risk Management framework



Source: ISO: 31000 Risk Management

Asset Health Indices

G.15 AHI is an asset score which is designed to reflect or characterise asset condition and thus likely asset performance in terms of the asset's role. Different organisations apply different approaches, but a common requirement is a link between the available raw data (e.g. condition monitoring or asset history or maintenance and operational data) through to likely failure modes, or issues which will affect asset performance. The AHI should:

- provide a clear indication of the suitability of the asset for ongoing use; and
- contain objective and measurable characteristics of asset condition (with other factors such as age and location only used in the absence of direct measurable data).

Asset Management Plans

G.16 Asset strategy[103] and the needs identification, options analysis and option selection (scope, cost and timing) for each asset class is typically contained within AMPs (one for each asset

[103] For example, run-to-fail, proactive replacement based on condition, proactive replacement based on obsolescence

class). The asset management plans should identify the operational expenditure (opex) (e.g. maintenance activity) and capital expenditure capex (e.g. replace, refurbish) for each asset class or category.

G.17 AMPs need to be updated regularly to take into account new asset information and to respond to actual asset performance.

Portfolio optimisation

G.18 At an organisational level, the deliverability and affordability of the portfolio of work needs to be assured with adjustments made to the portfolio to ensure the appropriate balance between risk management, efficient delivery, and the impact on tariffs. This is usually undertaken as a 'top-down' challenge of the proposed 'bottom-up' work programme using a decision-support tool based on quantified risk reduction vs cost.

Implementation of asset management plans

G.19 Once the asset management plans are ratified, approved projects need to be delivered according to the agreed scope, time and cost. Good governance includes comprehensive monitoring and control with the organisation instigating appropriate corrective and/or preventive actions to ensure that the planned work is delivered.

Performance evaluation and improvements

G.20 Good asset management practice includes continuous evaluation of the effectiveness of asset management strategies, plans, and implementation in achieving the asset and organisational objectives.

G.21 A valuable source of feedback is post-incident reviews, with the emphasis on failure mode and effects analysis (FMEA).

G.22 From this analysis, and from comparison with Good Industry Practices, organisations should be able to demonstrate to stakeholders that they are investing prudently and efficiently in the network and/or continually improving their methods. This assessment is required across the whole asset life cycle.

AMMAT assessment areas and levels of maturity

G.23 The Commerce Commission requires EDBs to complete and disclose an Asset Management Maturity Assessment Tool (AMMAT) report each time they disclose a full AMP.[104] The AMMAT allows for assessment of an EDBs' asset management practices against recognised Good Industry Practice.

G.24 The AAMAT is a somewhat simplified assessment of the alignment of EDBs' asset management systems and practices against the requirements of the PAS 55 Asset Management Methodology[105] which was superseded in 2014 by the ISO 55000 suite.

G.25 The AMMAT consists of 31 questions for which assessment scores are assigned. The questions are designed to cover the full range of asset management activities, designated in Figure 55, via six assessment areas:

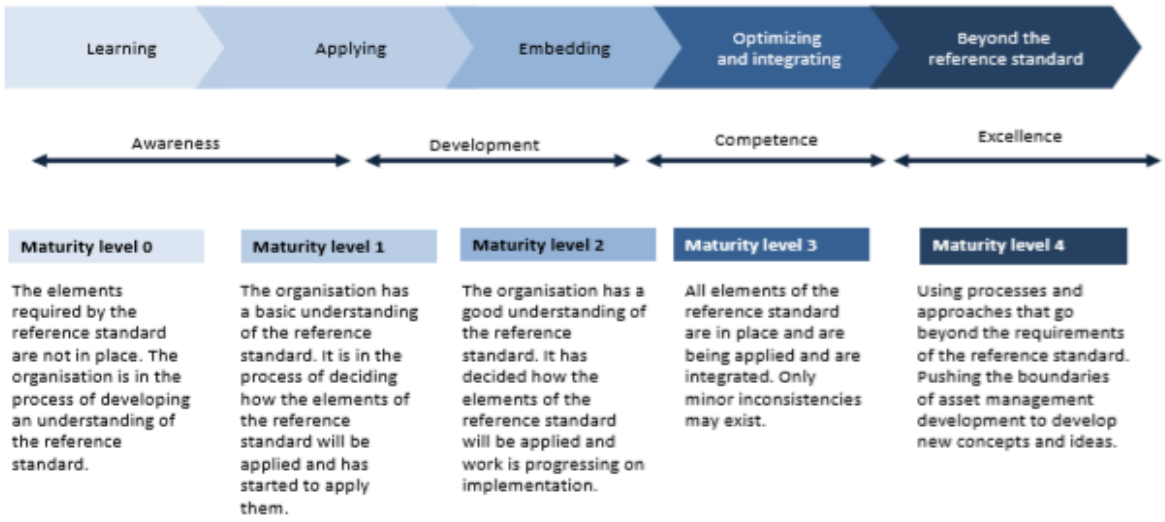
- asset strategy and delivery;

[104] Under Part 4 of the Commerce Act 1986
[105] Publicly Available Specification, published by the British Standards Institution in 2004

- documentation, controls, and review;
- systems, integration and information management;
- communication and participation;
- structure, capability and authority; and
- competency and training.

G.26 The diagram below shows the generic description of the different AMMAT maturity levels.

Appendix Figure 7: AMMAT asset maturity levels



Source: Commerce Commission, How mature are electricity distributors' asset management practices[106]

Assessing if GIP has been applied

G.27 GIP in asset management is not an absolute measurement; as the AMMAT demonstrates, an organisation can be considered to be applying GIP even if some of its practices are assessed as being relatively immature. GIP changes over time as technology, knowledge and systems development mature and improve. For example, whilst it is still possible for paper based asset records to be used effectively, the adoption of electronic capture, storage and analysis is becoming widely used and accepted as GIP.

G.28 When forming an opinion on whether GIP has been applied, it is necessary to consider all the above instruments, measures and scales alongside the practices of others that are considered to operate at GIP. An organisation that demonstrates GIP management in many areas may still be failing to apply GIP in others.

[106] Commerce Commission, *How mature are electricity distributors' asset management practices*, EEA Conference and Exhibition, 2013, page 3