# Quality non-compliance Report

# Alpine Energy Limited's non-compliance with the DPP quality standards for the 2016 assessment period

A report for
The Commerce Commission

6th November 2018

# 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

This report was prepared by:

William Heaps
Managing Director
Strata Energy Consulting Limited
Level 8, 342, Lambton Quay
Wellington Central 6011

PO Box 25157
Featherston Street
Wellington 6146
New Zealand

Phone: 04 471 0312
Mobile: 021 852 843
Email: bill.heaps@strataenergy.co.nz

# Executive summary

1) The Commerce Commission (Commission) engaged Strata Energy Consulting Limited (Strata) to undertake an investigation into the causes for the quality standard non-compliance of Alpine Energy Limited (Alpine) in the 2016 regulatory Assessment Period. Strata undertook the investigation during April and May 2018. The investigation included a desktop based study of the relevant documentation provided by Alpine in its regulatory disclosures and through its responses to the Commission's requests for additional information. Onsite discussions were held with Alpine in May 2018.

2) Alpine's performance against the Quality Standard limits for SAIDI and SAIFI are shown in the following table.

| | SAIDI | SAIFI | Compliance with Clause 9.1 |
|---|---|---|---|
| **2013 Assessment period** | Did not exceeded the limit | Did not exceeded the limit | Compliant |
| **2014 Assessment period** | Exceeded the limit | Exceeded the limit | Compliant |
| **2015 Assessment Period** | Did not exceeded the limit | Did not exceeded the limit | Compliant |
| **2016 Assessment Period** | Exceeded the limit | Did not exceeded the limit | Non-compliant in this period because of the exceedance of the quality limit in 2014 and 2016. |
| **2017 Assessment Period** | Did not exceeded the limit | Did not exceeded the limit | Compliant |

3) An electricity distribution business (EDB) is non-compliant with the quality standards set out in clause 9.1 of the Electricity Distribution Services Default Price-Quality Path Determination 2015 (clause 9.1) if the EBD exceeds its SAIDI or SAIFI limits in that year and also exceeds the SAIDI or SAIFI limits in at least one of the previous two years. Because Alpine exceeded the SAIDI and SAIFI limits in 2014 and the SAIDI limit in 2016, it was non-compliant with clause 9.1 in 2016.

4) The Commission asked that we identify the factors, failure events and trigger events that contributed to Alpine's non-compliance in 2016. To address this question, we initially identified the factors that made the most material contribution to Alpine's non-compliance, these were:

1. the impact on SAIDI due to unplanned outages on four major event days in the 2014 Assessment Period;

2. the impact on SAIDI due to unplanned outages at times other than major event days in the 2014 Assessment Period;

3. SAIFI performance on the Waimate feeder during the 2014 Assessment Period; and

4. the SAIDI performance on the Woodbury, Cave and Fairlie feeders during the 2016 Assessment Periods.

5) We identified that non-compliance was primarily attributable to unplanned supply interruptions and that planned outages needed to undertake maintenance work on the network were not material factors contributing to Alpine's non-compliance.

6) When considering the potential failure events, we studied Alpine's SAIDI and SAIFI performance in the 2014 Assessment Period and the 2016 Assessment Period. We found that in the 2014 Assessment Period, SAIDI and SAIFI issues were not confined to a single location but spread across several locations. For SAIFI, we found that the distribution system feeding the Waimate area had been particularly troublesome.

7) In the 2016 Assessment Period, Alpine exceeded its SAIDI limit by just 1 SAIDI minute. A single failure of the Fairlie 33kV distribution feeder was the most significant factor in Alpine's exceedance of the SAIDI limit in that period.

8) We studied the types of failure that had occurred during adverse weather events and at other times. We also considered the condition of the network and the level of expenditure that Alpine had applied to maintain its performance.

9) We concluded that the failure events contributing to Alpine's non-compliance were:

   1. weaknesses in some overhead line assets that made them prone to failure events during adverse weather;

   2. vegetation as a failure event that contributed to Alpine's non-compliance and could have been mitigated had Alpine increased investment in vegetation management earlier than it did; and

   3. third party interference which made a material contribution to Alpine's AP2014 SAIDI and again, mitigation could have avoided exceedance of the SAIDI limit in AP2016.

10) We found that occurrences of adverse weather were not failure events, we considered them trigger events that led to failure events. We concluded that the material trigger events that led to the failure events were; high wind and heavy snow occurring on MEDs and other days, failure of asset management to address issues with some overhead line assets, and insufficient investment in control of vegetation risks.

11) The Commission asked us to review the extent to which the concerns noted in Strata's 2012 report on Alpine's reliability performance have been addressed or contributed to the non-compliance. In 2012 Strata found that, beyond the short term, the achievement of good network performance would depend on Alpine's continued commitment to:

   1. development and implementation of a reliability performance improvement plan by Alpine, on the basis of the four action points, Strata also stated that it would be useful if AEL reported on progress on implementing the improvement plan in future AMPs and/or in Compliance Statements; and

   2. assurance that future Compliance Statements are accurate.

12) We found that whilst Alpine had not produced and published a specific implementation plan, it had continued to take steps to improve its asset management practices. This view is evidenced by the development and implementation of an integrated suite of asset management and operational systems and tools. We found that Alpine's asset management capability has increased markedly through the provision of these tools and the development of asset management human resources.

13) We have found that Strata's previous concerns on the collection of SAIDI and SAIFI data have been addressed. However we found that its information disclosures relating to asset condition had not accurately reflected its knowledge of the condition of conductors.

14) The Commission required that we provide opinion on whether or not, having regard to the relevant failure events and triggers, Alpine acted consistently with Good Industry Practice (GIP) for each relevant year. The Commission provided the following guidance on how GIP should be considered:

> *whether in relation to any undertaking and any circumstances, Alpine 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.*

15) Taking into account our assessment of the factors, failure events and trigger events, we identified the following four actions Alpine could and should have taken to prevent non-compliance. In our opinion, by not undertaking these actions Alpine did not act consistently with GIP:

1. investing sufficiently in overhead line assets identified as being old, below specification and/or prone to failure in adverse weather;

2. earlier and increased investment in vegetation management which could have reduced SAIDI and SAIFI due to vegetation impacting on overhead line assets;

3. formal and rigorous post event reviews and analysis of asset performance and condition which would have identified areas where Alpine performance during adverse weather events could be improved; and

4. taking some responsibility for actions that Alpine could take to mitigate both failure and trigger events that it currently considers are outside its ability to control.

16) We found that the network in 2018 is generally in good condition and we observed examples of Alpine's application of GIP in several areas of its asset management practices. However, we found that Alpine's practices prior to and during the Assessment Periods relevant to its non-compliance did not meet GIP in the actions identified above.

17) Had Alpine taken these actions, our opinion is that the failure events in the 2014 Assessment Period could have been reduced. Had Alpine taken these actions before 2015, we believe that the adverse impact on network performance due to failure events in the 2016 Assessment Period could have been reduced sufficiently to have prevented exceedance of the SAIDI quality standard limit for that period and therefore avoided non-compliance.

18) Whilst we found that Alpine has applied GIP in most aspects of its asset management practices and is continuing to implement improvements, it is our opinion that by failing to take the four actions we identified, Alpine did not act consistently with GIP.

19) This report sets out the approach we took to complete this investigation and provides our responses to specific questions asked by the Commission including information and evidence to support our opinions.

Strata ENERGY CONSULTING

# Contents

## Figures

# Tables

# 1. Introduction, scope and approach

1. The Commerce Commission (the Commission) has engaged Strata Energy Consulting (Strata) to provide its expert opinion and advice in relation to Alpine Energy Limited's (Alpine) failure to comply with the annual reliability assessment for the 2014 Assessment Period (AP2014) and the 2016 Assessment Period (AP2016).

2. 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.

3. The Commission measures Alpine's performance against the Quality Standards each Assessment Period which are 12 month periods commencing on the 1 April.

4. Alpine complies with the quality standard in respect of an Assessment Period if it either:

   a) complied with both of the annual reliability assessment (SAIDI & SAIFI) for the Assessment Period; or

   b) complied with both of the annual reliability assessment in the immediately preceding two Assessment Periods.

5. In 2016, Alpine reported its non-compliance with the quality standards due to failing to comply with the annual reliability assessments for AP2014 and AP2016.

## 1.1. Qualifications and experience of the reviewers

6. The people who undertook this review (the Reviewers) are:

   - William Alan Heaps – Managing Director of Strata Energy Consulting; and
   - George Richard Gibbons – Managing Director LineTech Consulting

7. The review panel 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.

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 Alpine.

## Richard Gibbons

14. Richard Gibbons has over 45 years of experience in the Electrical Power Industry and has recently retired from his position as General Manager of LineTech Consulting. Richard started his engineering career with the London Electricity Board completing an Honours Degree in Electrical and Electronic Engineering.

.

15. After a short time with the NZ Electricity Department and consultants KRTA Richard joined the Auckland Electric Power Board where he remained for 21 years holding several different positions, finally becoming Chief Engineering for the AEPB, then General Manager Network for Mercury Energy. More recently his roles have included General Manager Power and Communications with the United Group NZ and before joining Line Tech was consulting, both on his own and with SKM and PB Associates.

16. Richard has been a member of the Electrical Engineer's Association since 1983 and has been a regular contributor at regional engineering forums and EEA Conferences. He has continued over many years to contribute engineering, technical and engineering governance papers. In 1991 he was elected onto the EEA Board and was EEA President from 1997 to 1999.

17. Richard has an in depth understanding of the critical role Standards undertake in the electricity industry and has in the past contributed to the setting of national and international equipment and process standards. From 2003 to 2016 Richard has been a Government appointed Director of the Standards NZ Council.

## 1.2. Evidenced based opinions

18. 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 report, the areas reviewed are within the reviewer's expertise and experience.

19. 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. Our approach and information we have relied on

20. Our review was conducted in three stages.

21. The first stage was a desktop review of publicly available and specifically requested information. The information provided to Strata by the Commission and Alpine has been relied upon for this review and when forming findings, opinions and recommendations. Where we have concerns regarding the reliability or quality of the information, this is stated with an assessment of the implications that this may have on the assessments and opinions contained in this report.

22. The information provided to us by the Commission included all information forwarded by Alpine to the Commission in response to the Commission's request to Alpine for further information.[1] 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.

23. The second stage was an onsite review of Alpine's asset management practices.

24. The third stage was the development and review of this report. We provided the Commission with a draft report for its review and addressed comments and made revisions where we considered it appropriate to do so. A further draft report was provided to Alpine for it to identify any omissions and/or factual errors. Where we considered it to be appropriate, we revised the report to address Alpine's feedback. Following the review stage we produced this final version of our report for the Commission.

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

25. The Commission asked Strata to provide the following opinions and recommendations:

    1. an opinion on whether there is anything that Alpine could and should have done to prevent the non-compliance, including:

        a. a description of the factors which led to non-compliance;

---

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

b. a description of the failure events that contributed to Alpine failing to meet annual reliability assessment for each relevant year (being 2014 and 2016);

c. a description of the trigger events and/or other contributory factors to the failure events; and

d. an opinion on whether or not, having regard to the relevant failure events and triggers, Alpine acted consistently with GIP for each relevant year;

2. an opinion on the extent to which Alpine has undertaken actions to prevent or mitigate similar events in the future, including a description of those actions, and an assessment of the likely efficacy of those actions;
3. any recommendations on further action that Alpine could and should undertake to prevent or mitigate similar events in the future;
4. an opinion on the extent to which the concerns noted in Strata's 2012 report on Alpine's reliability performance:

a. have been addressed; or

b. contributed to the non-compliance; and

5. an opinion on whether any of the Supplier's findings indicate there is any cause for concern about:

a. Alpine’s adherence to;

b. Alpine's asset management practices;

c. the condition of Alpine's assets;

d. the appropriateness of Alpine's contractual relationship and dealings with Netcon Limited;

e. the quality of Alpine's asset data or information disclosed under our information disclosure requirements; or

f. Alpine's attitudes to asset management or its prioritisation of compliance with our regulatory 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:

1. Strata’s preliminary findings in respect of that matter; and
2. Strata’s opinion on what further investigation or analysis would be required to conclude on that matter.

27. The Commission required Strata to undertake evidence based assessments and provide opinions on specific questions to the level required for experts in High Court proceedings.

28. The Commission requested that Strata’s opinions and recommendations be set out in a Quality Non-compliance Report (this report).

## 1.5. Structure of this report is aligned with the scope

29. In forming our views and opinions, we have relied on Alpine's information and data as primary sources. In taking this approach, we were fully aware of Strata's findings relating to the reliability and quality of data and information identified in its 2013 investigation report.

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

31. The structure of this report takes a reader through a logically sequenced discovery of:

    a) a description of the health and performance of Alpine's network;

    b) how the network performed in adverse weather and in specific locations;

    c) why Alpine exceeded its Quality Standard limits in the relevant Assessment Periods; and

    d) our opinions and views on the questions the Commission asked us to address.

32. In appendices to the report we have provided Strata's record of observation made during its field visit and other background information.

33. Our findings and the opinions that the Commission has asked us to provide are found in the relevant sections.

## 1.6. Specific terms and values used in this report

34. A glossary of the terms and acronyms that we have used in this report is provided in Appendix A .

35. Alpine is responsible for the delivery of regulated services including compliance with the Quality Standards. Accordingly, this investigation focused on Alpine's responsibilities for ensuring compliance with the Quality Standards.

36. 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.

# 2. What Alpine could and should have done to prevent non-compliance

37. This section primarily addresses the Commission's requirement that we provide our opinion and advice regarding Alpine's non-compliance with the quality standards for AP2014 and AP2016. Alpine's exceedance of the Quality Standard limits in these Assessment Periods contributed to its non-compliance with clause 9.1 of the Commission's Electricity Distribution Services Default Price-Quality Path Determination 2015.[2]

38. Specifically, the Commission asked us to provide:

- a description of:
  - the factors which led to non-compliance;
  - the failure events that contributed to the non-compliance for each relevant year;
  - the trigger events and/or other contributory factors to the failure events; and
- an opinion on whether or not, having regard to the relevant failure events and triggers, Alpine acted consistently with for each relevant year.

39. This section describes our review and analysis of the non-compliance failure events and identifies what we consider were the triggers and other contributory factors that led to Alpine's non-compliance. The opinion draws from our investigation findings and the analysis set out in other sections of this report.

40. In the following discussion a 'failure event' is when a loss of supply is experienced by consumers due to a planned or unplanned outage on the high voltage network. The failure event is described by the direct cause of the outage e.g. a broken overhead line conductor, blown fuse or cable joint fault etc.

41. A trigger event is the primary incident that led to the failure event e.g. extreme wind conditions, heavy snow etc. that caused a network component to fail.

## 2.1. The factors that led to Alpine's non-compliance

42. The DPP Clause 9.1 'Compliance with the quality standards' requires that:

A Non-exempt EDB must, in respect of each Assessment Period, either:

(a) comply with the annual reliability assessment specified in clause 9.2 for that Assessment Period; or

(b) have complied with those annual reliability assessments for the two immediately preceding extant Assessment Periods.

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

[2] http://www.comcom.govt.nz/dmsdocument/13416

44. Alpine's compliance performance record for the 2013 to 2017 Assessment Periods (see table 1) shows that it exceeded its quality limits (for SAIDI and SAIFI) in the AP2014 and in the AP2016 (for SAIDI). The exceedance of the quality limits in these Assessment Periods means that Alpine did not meet the requirements of, and was non-compliant with, Clause 9.1(a) or 9.1(b) for AP2016.

**Table 1: Alpine's quality performance record 2013 to 2017**

| Assessment Period | SAIDI Limit | Assessed SAIDI | SAIFI Limit | Assessed SAIFI | Outcome |
|---|---|---|---|---|---|
| 2012 | 164 | 162 | 1.69 | 1.26 | Limits not exceeded |
| 2013 | 164 | 148 | 1.69 | 1.30 | Limits not exceeded |
| 2014 | 164 | 275 | 1.69 | 2.00 | Exceeded SAIDI and SAIFI limits |
| 2015 | 164 | 140 | 1.69 | 1.16 | Limits not exceeded |
| 2016 | 154 | 155 | 1.51 | 1.18 | Exceeded SAIDI limit |
| 2017 | 154 | 133 | 1.51 | 1.07 | Limits not exceeded |

Source: Alpine Annual Compliance Statements 2013 to 2017

45. Therefore the factors, failure events and trigger events that the Commission requires us to consider relate to AP2014 and AP2016 that contributed to Alpine's non-compliance with Clause 9.1.

## Factors related to the 2014 Assessment Period

46. In its Annual Compliance Statement for 2014[3] (2014 compliance statement), Alpine identified that it had exceeded its quality standard limit for both SAIDI and SAIFI.

47. Alpine's total unadjusted or 'raw' SAIDI for the AP2014 was 858.4 minutes. Alpine adjusted[4] its SAIDI for four major event days, this is referred to as 'normalisation'. The result of normalisation is provided in Table 2.

48. Alpine's SAIDI limit for the AP2014 was 164.22 minutes[5] and its calculated assessment of its SAIDI performance after normalisation was 274.77 minutes (858.4 – 583.63). Therefore, Alpine exceeded its SAIDI limit by 110.55 minutes.

49. If the total SAIDI occurring on the four major event days had been excluded, Alpine's SAIDI would have been 197.75 minutes (858.4 – 660.65 = 197.75). This means that had the AP2014 been a benign year with no MEDs (noting that MEDs are expected in an average year), Alpine would still have exceeded its SAIDI by 33.53 minutes (197.75 – 164.22) regardless of SAIDI on the major event days.

[3] Alpine Annual Compliance Statement for the Assessment Period ending 31st March 2014, Section 5.2
[4] Adjustments are required to be made to the 'raw' SAIDI and SAIFI data to reduce that actual SAIDI for major event days to a predetermined Boundary value.
[5] Alpine Annual Compliance Statement for the Assessment Period ending 31st March 2014, Appendix D

**Table 2 Normalisation of 2013/14 SAIDI due to the four major event days**

| | Raw SAIDI | Boundary Value | Adjustment in SAIDI due to normalisation |
|---|---|---|---|
| 20/06/13 | 41.61 | 19.26 | -22.36 |
| 03/07/13 | 45.27 | 19.26 | -26.01 |
| 10/09/13 | 503.14 | 19.26 | -483.88 |
| 14/10/13 | 70.63 | 19.26 | -51.37 |
| **Total** | 660.65 | | -583.63 |

Source: Alpine Annual Compliance Statement 2014, Appendix D

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.

50. Alpine's total unadjusted or 'raw' SAIFI for AP2014 was 2.2. Alpine calculated a normalised SAIFI against the four major event days. The result of normalisation is provided in Table 3.

**Table 3 Normalisation of 2013/14 SAIFI due to the four major event days**

| | Raw SAIFI | Boundary Value | Adjustment in SAIFI due to normalisation |
|---|---|---|---|
| 20/06/13 | 0.0419 | 0.1927 | 0 |
| 03/07/13 | 0.0706 | 0.1927 | 0 |
| 10/09/13 | 0.3905 | 0.1927 | -0.1978 |
| 14/10/13 | 0.1883 | 0.1927 | 0 |
| **Total** | 0.69 | | -0.1978 |

Source: Alpine Annual Compliance Statement 2014, Appendix D

51. Alpine's SAIFI limit for AP2014 was 1.69[6] and its calculated assessment of its SAIFI performance after normalisation was 1.999. Therefore, Alpine exceeded its SAIFI limit by 0.3.

52. Total normalised SAIFI due to the four major event days was 0.4922 which is 29% of Alpine's SAIFI limit. MEDs are therefore a factor contributing to Alpine's exceedance of its SAIFI limit.

53. Whilst the major event days must be considered as factors contributing to Alpine's exceedance of its SAIDI and SAIFI limits in AP2014, the fact that SAIDI would still have been exceeded indicates that other factors occurring outside the major event days must also be considered as factors contributing to the non-compliance in AP2016.

[6] Alpine Annual Compliance Statement for the Assessment Period ending 31st March 2014, Appendix D

## 2016 Assessment Period

54. In its Annual Compliance Statement for AP2016,[7] Alpine identified that it had exceeded its quality standard limit for SAIDI but not for SAIFI. Accordingly, the following discussion focuses on factors relating to the exceedance of SAIDI.

55. Alpine's total unadjusted SAIDI for AP2016 was 415.08 minutes. From AP2015, the Commission changed the adjustments made to normalise the raw SAIDI and SAIFI data; planned (Class B) and unplanned (Class C) SAIDI and SAIFI were treated separately and differently for normalisation.

56. Alpine's total raw Class B SAIDI for AP2016 was 57.854 minutes and this was reduced by 50% to 28.927 through normalisation. Alpine adjusted[8] its Class C SAIDI for four major event days, the result is provided in Table 4.

**Table 4 Normalisation of 2015/16 Class C SAIDI due to the four major event days**

| | Raw SAIDI | Boundary Value | Adjustment in SAIDI due to normalisation |
|---|---|---|---|
| 12/4/2015 | 13.172 | 9.18 | -4.00 |
| 18/6/2015 | 206.609 | 9.18 | -197.43 |
| 19/6/2015 | 28.860 | 9.18 | -19.69 |
| 4/10/2015 | 18.916 | 9.18 | -9.74 |
| **Total** | 267.56 | | -230.86 |

Source: Alpine Annual Compliance Statement 2014, Appendix F

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.

57. Alpine's SAIDI limit for AP2016 was 154.22 minutes[9] and its calculated assessment of its SAIDI performance (Class B and Class C) after normalisation was 155.292 minutes. Therefore Alpine exceeded its SAIDI limit by 1.14 minutes. Major event days, after normalisation, contributed 19.5% of SAIDI. This contribution was a material factor in Alpine's exceedance of the Quality Standard limit in AP2016.

## Spill-over effect not a factor in AP2014 and AP2016

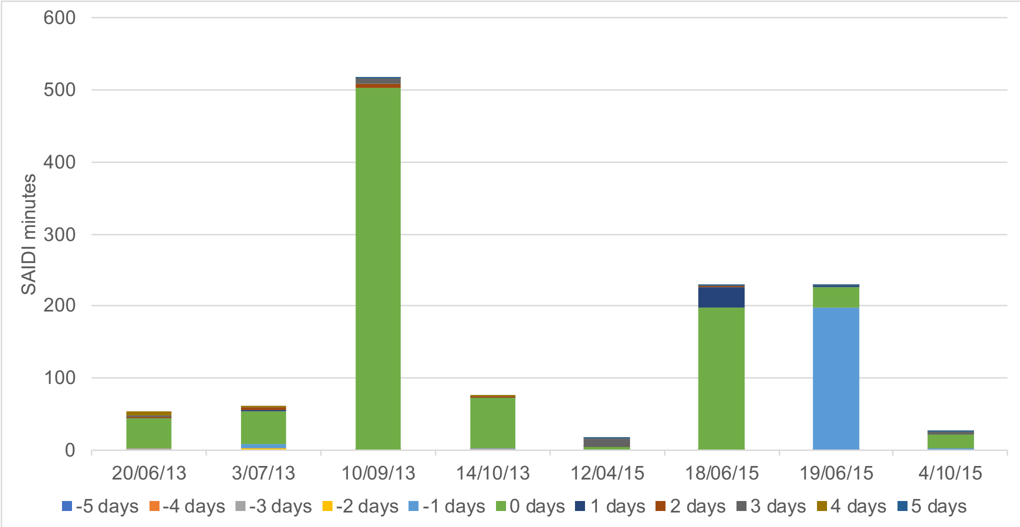
58. It is possible for the impact of extreme weather to 'spill over' into days following a MED. Such a spill-over may create high SAIDI and SAIFI either side of a MED as the weather builds and falls prior to and post the main event. We have tested the extent that this occurred for Alpine's MEDs in AP2014 and AP2016.

59. Figure 1 indicates that for SAIDI the spill-over from the MEDs relative to the size of the MEDs is minor. The spill over from 18 to the 19 June 2015 is the result of the prolonged

[7] Alpine Annual Compliance Statement for the Assessment Period ending 31st March 2016, Appendix F
[8] Adjustments can be made to the 'raw' SAIDI and SAIFI data to reduce that actual SAIDI for major event days to a predetermined Boundary value.
[9] Alpine Annual Compliance Statement for the Assessment Period ending 31st March 2016, Appendix F

storm and both days qualifying as MEDs (therefore both days would have been normalised). Other than for these days, the proportion of spill-over relative to the SAIDI on MEDs is small, even for the outstanding MED on 10 September 2013.

**Figure 1: SAIDI within 5 days of a Major Event Day**




Source: Alpine - 2.18 A to F Summary Outage workbooks 13-17.xlsx

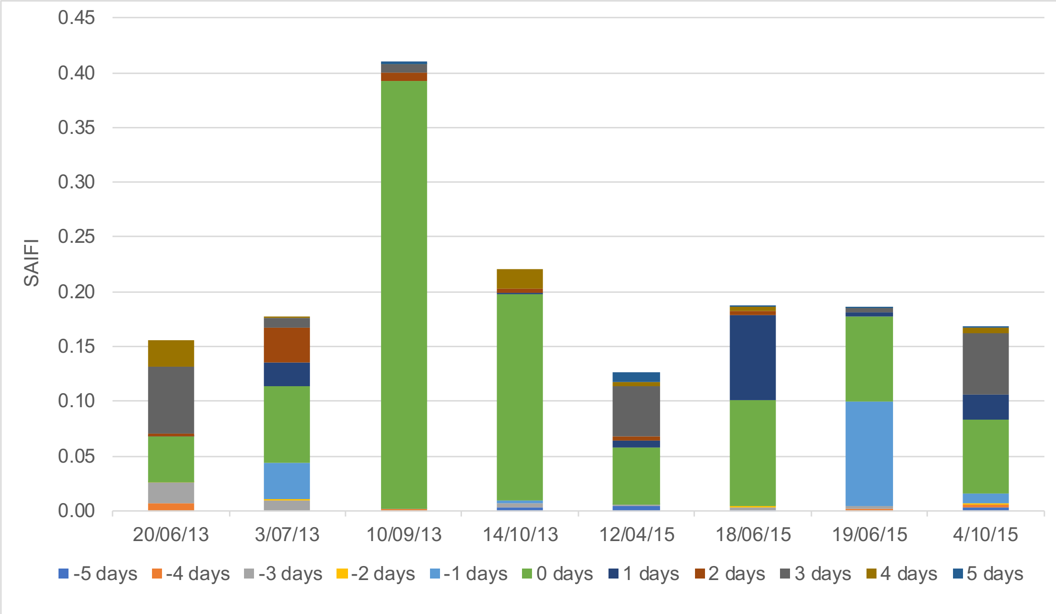
60. Taking the 5 day spill-over into non-MED days we have calculated that the additional annual SAIDI attributable to spill over to be 12.8% of the SAIDI limit in AP 2014 and 9.4% of the SAIDI limit in AP 2016. Removing the average expected SAIDI,[10] the additional SAIDI attributable to spill-over in AP 2014 will have contributed just under 8% of the actual SAIDI for that period. For AP 2016 SAIDI attributable to spill-over is just under 10% of the actual SAIDI for that period.

61. Spill-over is therefore a contributing factor to Alpine's exceedance of its SAIDI limit both these periods and therefore its non-compliance. However, at around 10% of actual SAIDI it is not the most significant contributor.

62. For SAIFI (see Figure 2) we have found that the spill over is more apparent. This is potentially due to more minor faults being found following the main event. For the largest MEDs, the spill over effect from SAIFI is not as great as others.

[10] The average daily SAIDI included in the SAIDI limits is removed as it is the underlying daily SAIDI.

**Figure 2: SAIFI within 5 days of a Major Event Day**




Source: Alpine - 2.18 A to F Summary Outage workbooks 13-17.xlsx

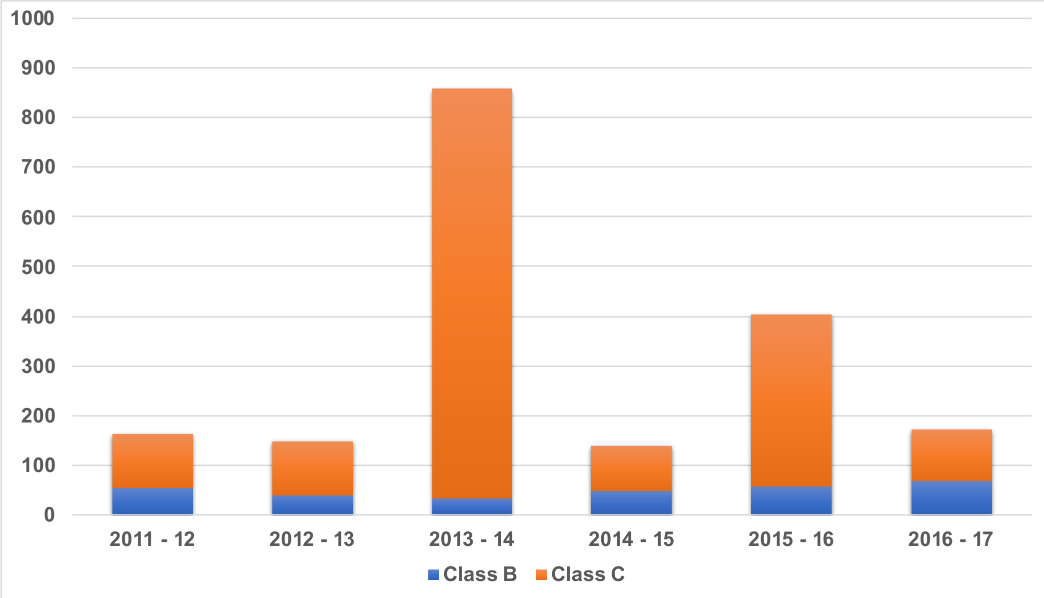
63. SAIFI spill-over effects are material and will have contributed to the exceedance of the SAIFI limit in AP2014.

64. Damage incurred during adverse weather events that is not an immediate cause of an interruption can cause failure weeks, months or years later. However, the period between the weather event and the potential fault provide the distributor with time to undertake post event inspections of the assets and the surrounding environment (e.g. vegetation damage). The post event assessment results can allow prioritisation of remedial work and support the need for increased expenditure.

## Planned interruptions not a factor in AP2014 and AP2016

65. Planned outages to conduct maintenance and repairs contributed to Alpine's performance against its SAIDI and SAIFI limits. Figure 3 shows Alpine's SAIDI for planned (class B) and unplanned (class C) supply interruptions.

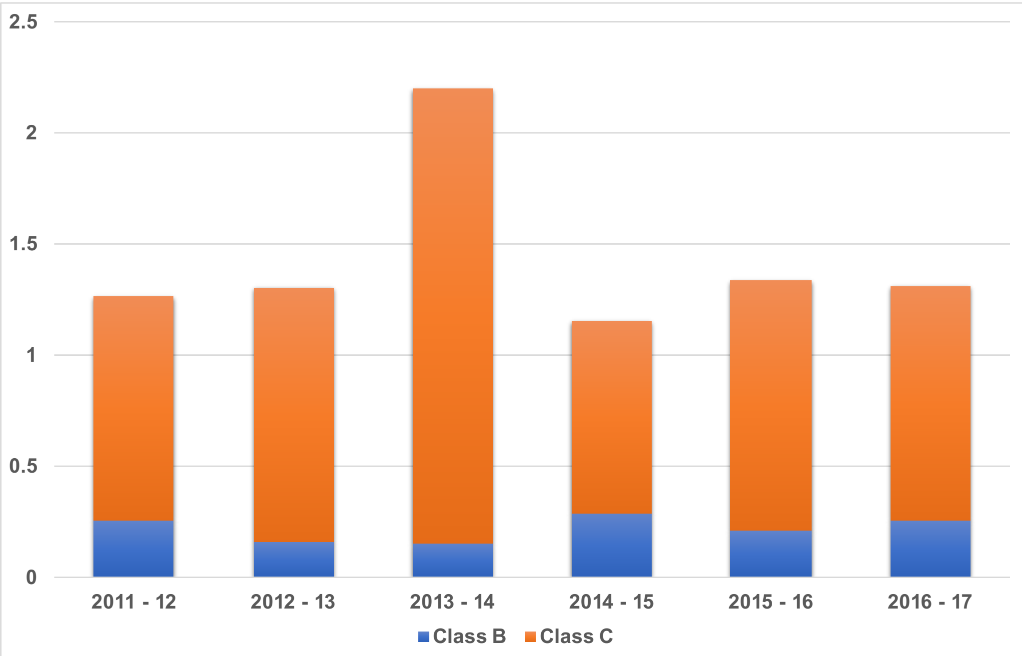
**Figure 3: Planned and unplanned SAIDI**




Source: Alpine - 2.18 E Summary Outage workbooks 13-17.xlsx

66. Figure 4 shows Alpine's SAIFI for planned (class B) and unplanned (class C) supply interruptions.

**Figure 4: Planned and unplanned SAIFI**




Source: Alpine - 2.18 E Summary Outage 13-14.xlsx

67. The low impact of planned outages on both SAIDI and SAIFI is consistent with the information provided to us by Alpine during the onsite sessions in May 2018. During the sessions, Alpine management confirmed that the Company was continuing with live line work activities and that its service provider NETcon had developed strong competencies in

undertaking this type of work. A feature of live line working is that it reduces the impact of outages due to planned maintenance and fault repair.

68. In AP2014, both class B SAIDI and SAIFI were lower than other years. For AP2016, class B SAIDI was at the average for the six years and SAIFI was the third lowest year. From this, we have concluded that increased outages due to planned work did not contribute to Alpine's exceedance of the quality standard limits in AP2014 and AP2016.

69. Accordingly, we have found that planned interruptions were not factors in Alpine's non-compliance.

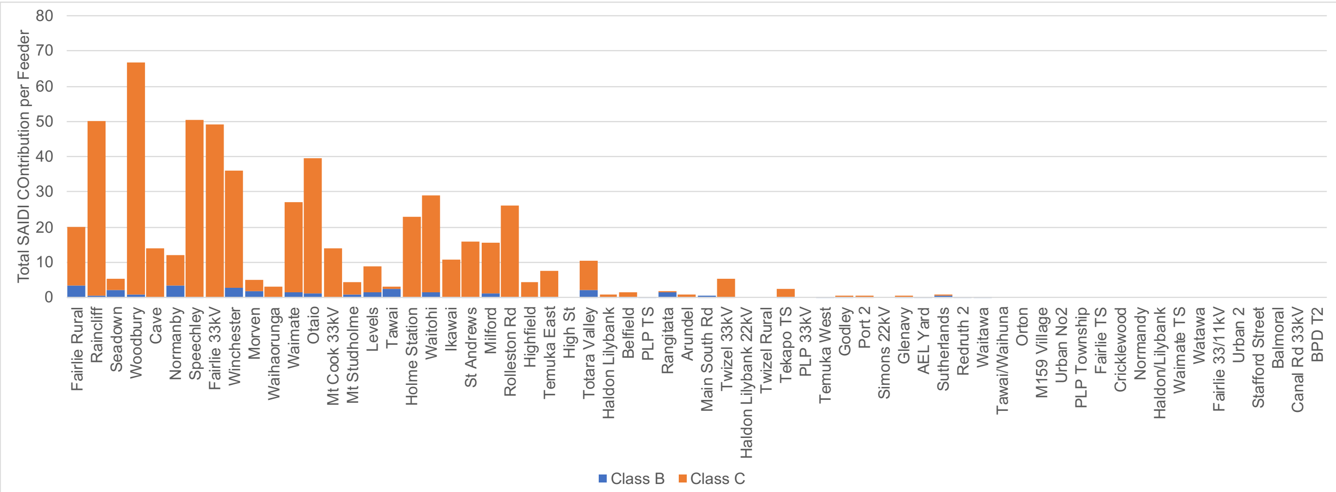
## Worst performing feeders as factors

70. The term 'feeder' is used to describe the high voltage overhead lines and underground cables that distribute electricity from zone substations to the broader supply area. The performance of the feeders contributes directly to SAIDI and SAIFI. Assessment of the contribution to SAIDI and SAIFI from each feeder can reveal the location of feeders that are experiencing the greatest number of failure events.

### ***Worst performing feeders in 2014***

71. Figure 5 shows the individual high voltage (HV) distribution feeder[11] performance for AP2014.

**Figure 5: SAIDI by feeder during the 2014 Assessment Period**




Source: Alpine - 2.18 E Summary Outage 13-14.xlsx

Notes: A larger format version of this chart is provided in Appendix F

72. It is clear that, in AP2014, the factors contributing to Alpine's exceedance of its SAIDI limit were not confined to a single feeder but spread across several feeders.

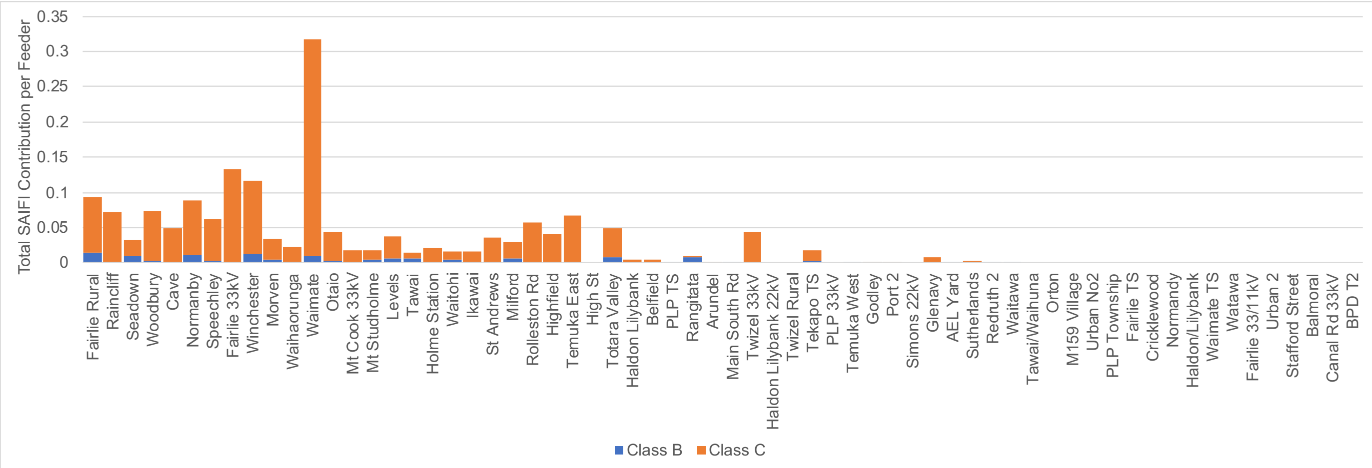
73. For unplanned outages, Figure 5 indicates that there were several HV feeders contributing to SAIDI. Whilst the Woodbury feeder stands out as the top contributor, Fairlie (33kV) Raincliff and Speechley feeders are other significant contributors. The performance of

[11] A feeder can be either an overhead line or underground cable used to distribute electricity from a zone substation to a section of the area being served by Alpine.

these feeders in AP2014 is therefore a factor that we consider further when identifying contributing failure and trigger events.

74. Figure 6 identifies the single stand out worst performing feeder for SAIFI as Waimate[12] contributing 0.31 SAIFI from 3 unplanned outages. This is equivalent to Alpine's exceedance of its SAIFI limit in AP2014. Clearly the Waimate feeder SAIFI performance is a factor in Alpine's non-compliance.

**Figure 6: SAIFI by feeder during the 2014 Assessment Period**




Source: Alpine - 2.18 E Summary Outage 13-14.xlsx

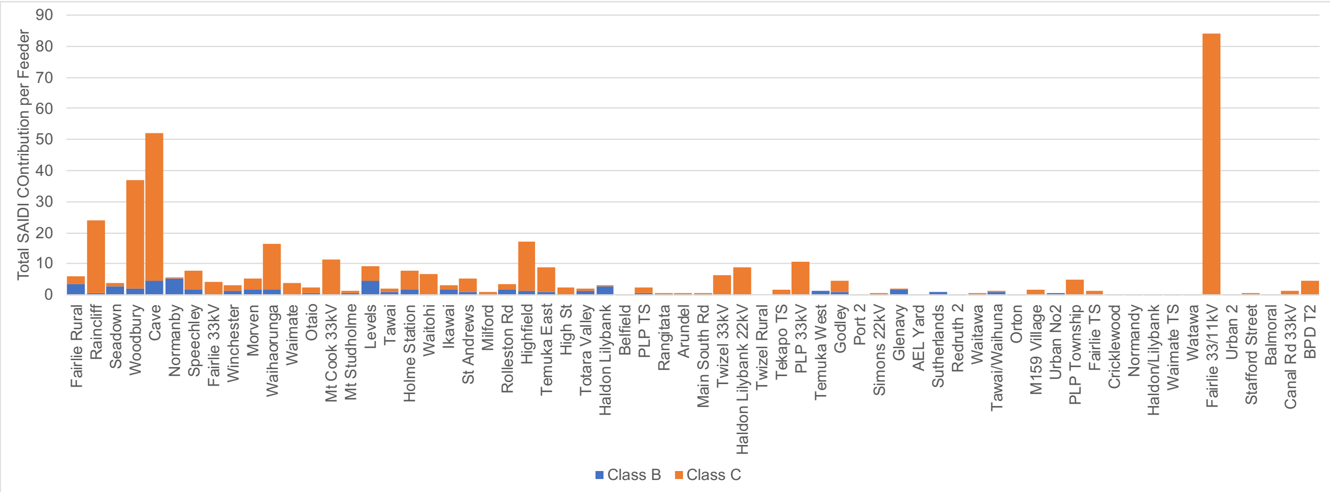
Notes: A larger format version of this chart is provided in Appendix F

## ***Worst performing feeders in 2016***

75. Figure 7 shows feeder SAIDI performance for AP2016. The single outage on the Fairlie 33kV feeder was the significant factor in Alpine's exceedance of the SAIDI limit in that period whilst the Cave, Woodbury and Raincliff feeders contributed to the exceedance. Clearly the single outage on the Fairlie 33kV feeder was the outstanding factor in AP2016 contributing to non-compliance.

[12] Waimate is located in the heart of South Canterbury's farming region roughly 100 miles from Christchurch and 30 miles from Timaru. Current population is just over 3000.

**Figure 7: SAIDI by feeder during the 2016 Assessment Period**




| | |
|---|---|
| Source: | Alpine - 2.18 E Summary Outage 13-14.xlsx |
| Notes: | A larger format version of this chart is provided in Appendix F |

### Summary of our findings on the factors that led to non-compliance

76. We have found that the factors contributing to Alpine's non-compliance were:

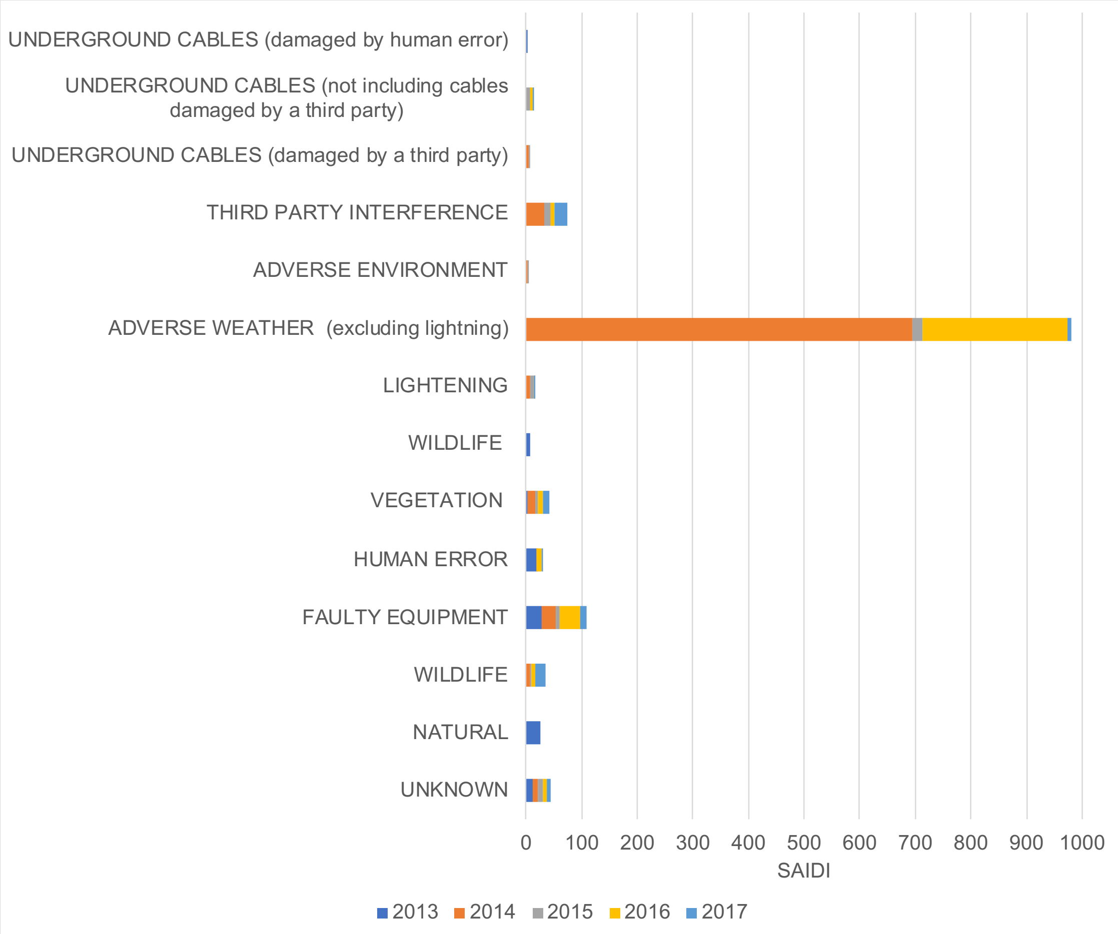
   1. the impact on SAIDI due to unplanned outages on four major event days in the 2014 Assessment Period;
   2. the impact on SAIDI due to unplanned outages at times other than major event days in the 2014 Assessment Period;
   3. SAIFI performance on the Waimate feeder during the 2014 Assessment Period; and
   4. the SAIDI performance on the Woodbury, Cave and Fairlie feeders during the 2016 Assessment Periods.

## 2.2. Our assessment of the failure events that contributed to the non-compliance

77. The contribution to customer minutes due to each type of failure mode is important to consider in determining the contributing failure events to non-compliance. The chart in Figure 8 shows that the adverse weather related events in AP2014 and AP2016 are the most significant events contributing to exceedance of the SAIDI limits in those periods.

78. Unless weather conditions have been demonstrated to be above the design parameters of the assets, our view is that weather should be considered a trigger event that has led to a failure event rather than being a failure event in itself. For example, high wind was a trigger event for a line down failure event.

**Figure 8: Failures contributing to SAIDI**




Source: Strata Expenditure and Data Analysis, data sourced from Alpine Summary Outage Excel workbooks

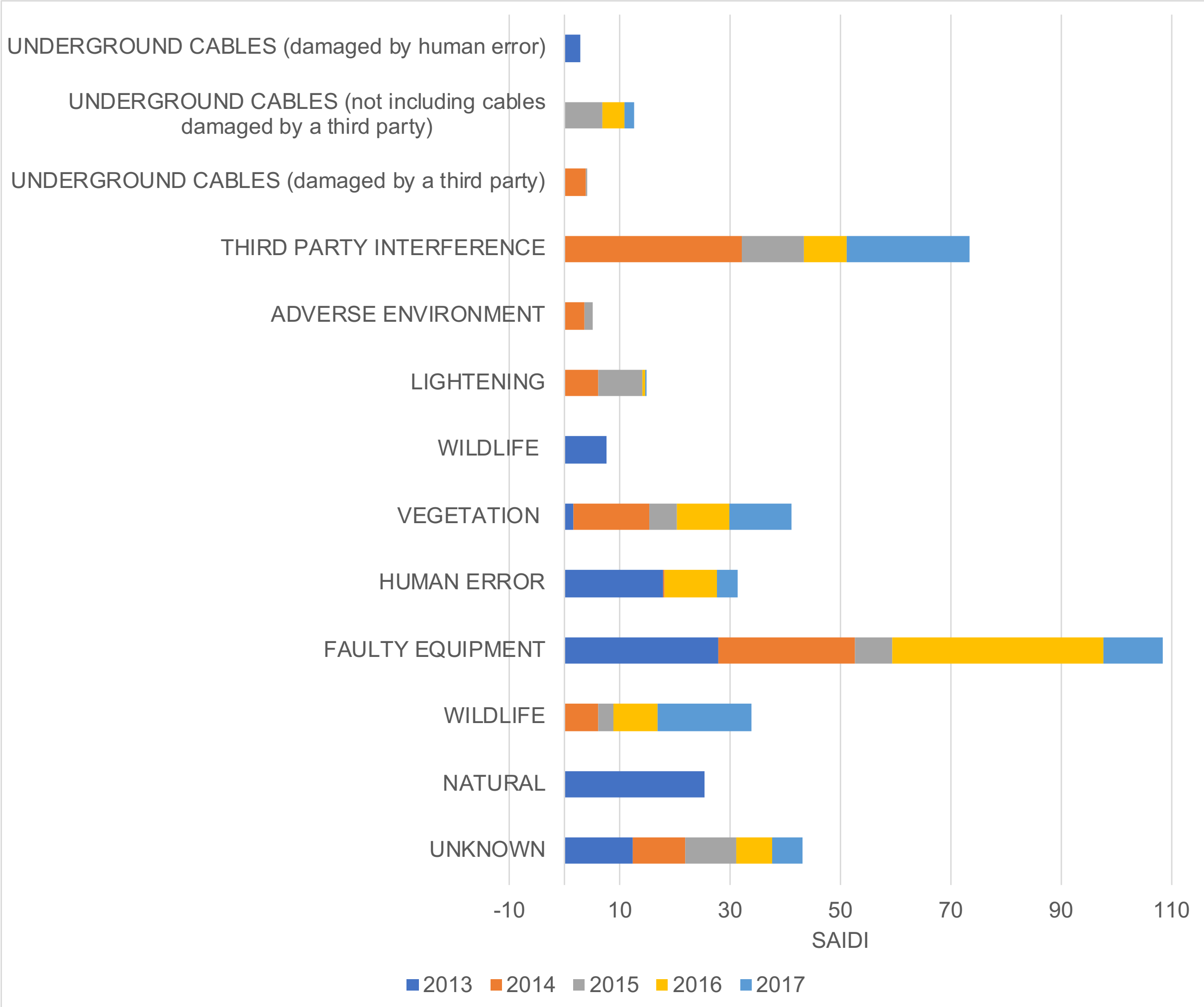
79. When adverse weather is removed from the SAIDI values, the SAIDI attributable to other failures is revealed more clearly (see Figure 9).

80. Figure 9 shows that the main failures contributing to the 2014 and 2016 underlying SAIDI are:

(a) faulty equipment;
(b) third party interference;
(c) vegetation; and
(d) unknown.

81. In 2016, human error was also a notable contributor to SAIDI.

**Figure 9: Failures contributing to SAIDI (excluding adverse weather failures)**

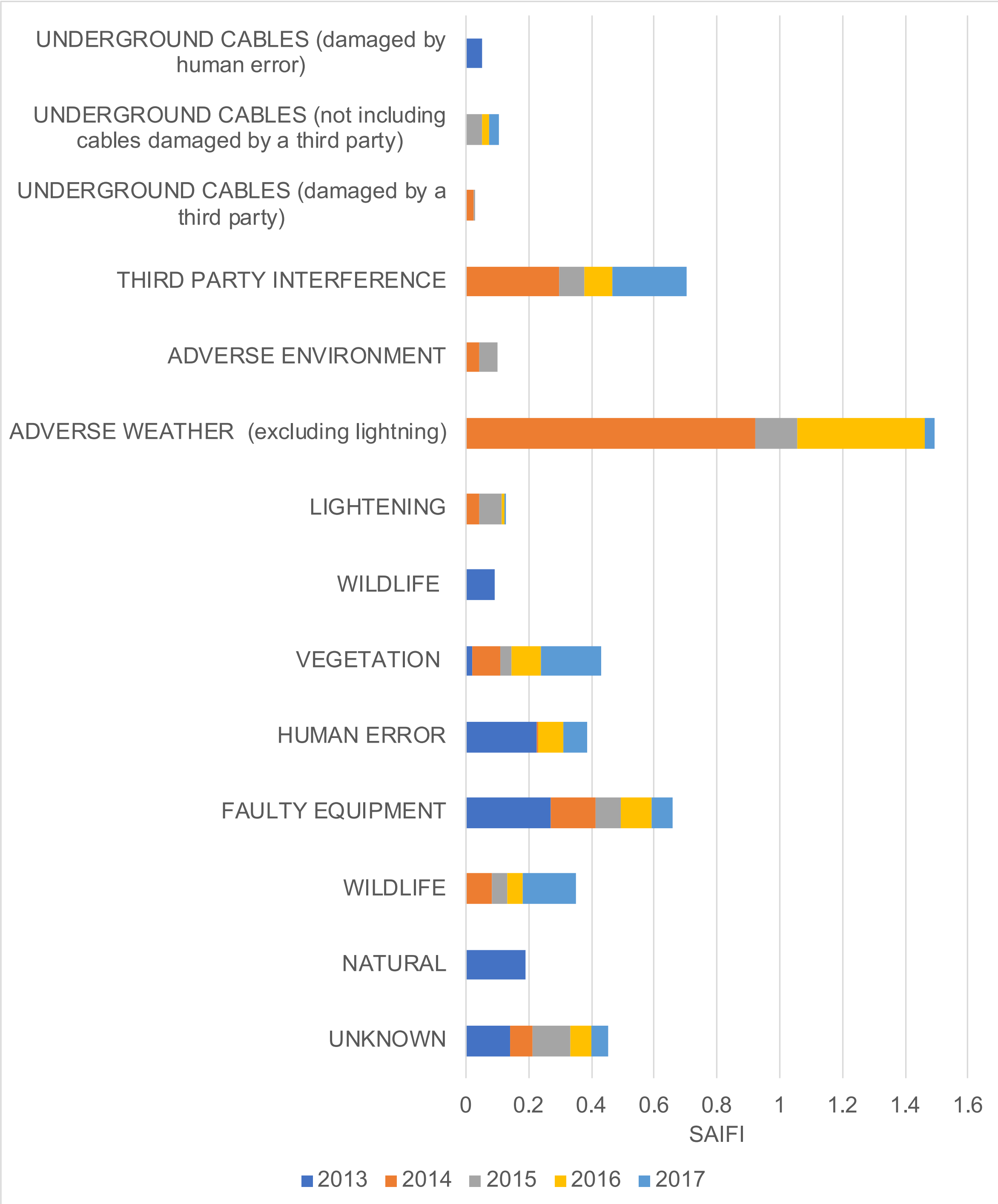



Source: Strata Expenditure and Data Analysis, data sourced from Alpine Summary Outage Excel workbooks

82. Failures contributing to SAIFI are shown in Figure 10. Faulty equipment is the dominant failure mode, which is understandable given the multitude of components on an electricity network. The other notable failure events in 2014 and 2016 were:

(a) third party interference; and
(b) vegetation; and
(c) unknown.

**Figure 10: Failures contributing to SAIFI**




Source: Strata Expenditure and Data Analysis, data sourced from Alpine Summary Outage Excel workbooks

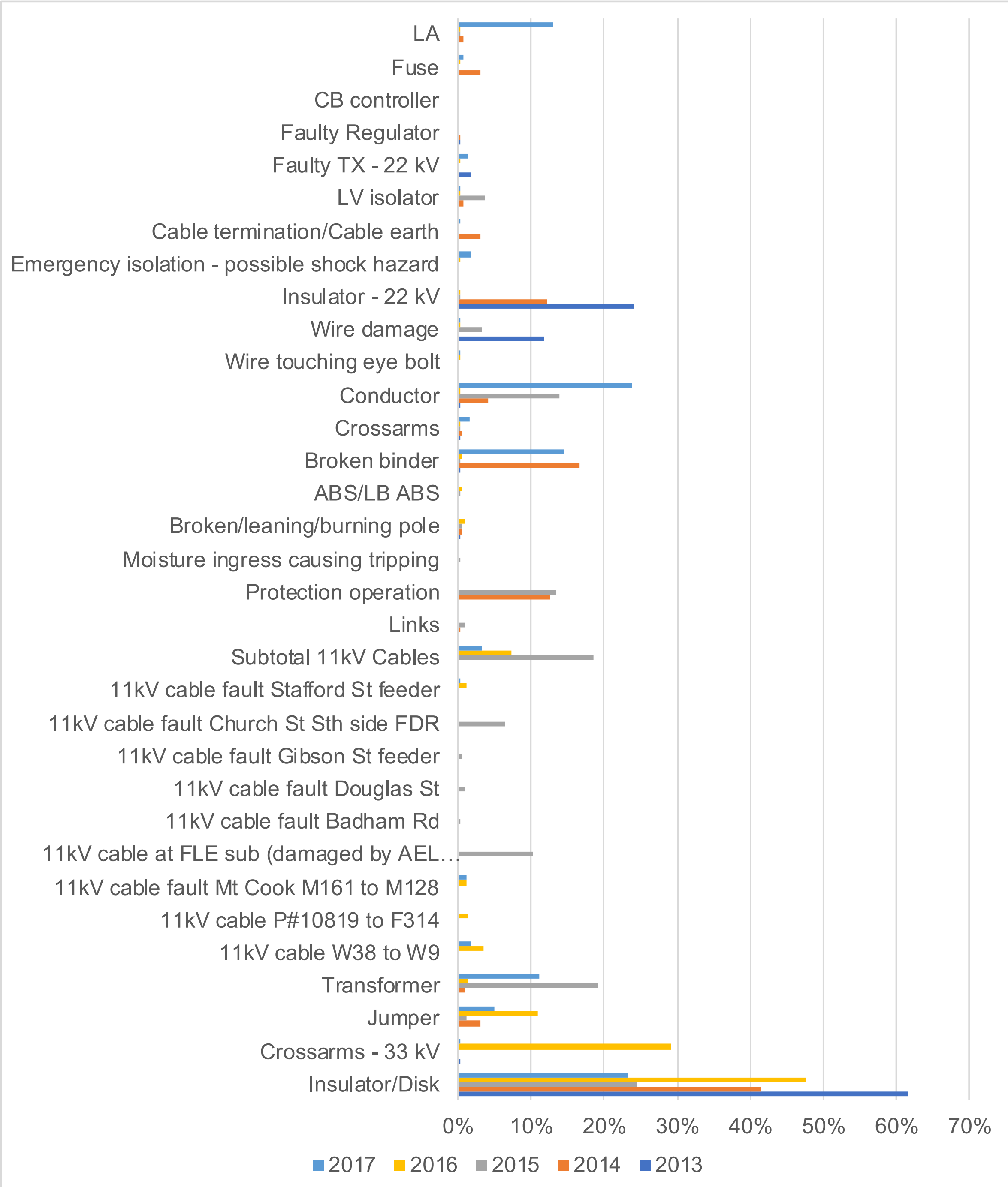
83. In our view, the data provided by Alpine presents a reasonably consistent picture of adverse weather being a significant trigger event, with the failures being attributable to faulty equipment (including broken conductors), vegetation issues and unknown causes.

84. We discuss our findings for each of these failure modes below.

## *Faulty equipment*

85. Figure 11 provides the contribution each failure mode made to SAIDI due to defective equipment. Data for five years is shown.

**Figure 11: Contributing failure events to Defective Equipment SAIDI**




Source: Alpine - 2.17 - 2.18 Asset Failures

Note: The values are the percentage contribution of each component to Defective Equipment SAIDI in each year.

86. In 2014 there are significant failures of insulator discs, broken binders and conductors. Most of these failures will be associated with overhead lines.

87. Clearly insulator performance should be a concern for Alpine. Conductor connection points and joints may also be showing some vulnerability during and after high wind events. The increased protection operations suggests that vegetation contact with overhead lines is an issue even outside the adverse weather events.

88. In 2016, crossarm failures on the 33kV overhead subtransmission lines became a high contributor to defective equipment related failures. This type of failure may be indicating age and/or condition issues or failure occurring sometime after an adverse weather event.

89. In its information response, Alpine provided a post event report relating to the adverse weather events in AP2014. This report is related to the night of Wednesday 19 June 2013 through to the morning of Saturday 20 June 2013. The associated MED was recorded on 20 June 2013 when raw SAIDI of 41.61 minutes was normalised to the boundary value of 19.26 minutes. The report states that:

> *Approximately 300mm of snow was recorded in the Fairlie and Geraldine areas. Tekapo and Sherwood downs experienced snowfalls up to 1m deep.*
>
> *The Primary cause of damage to the network was lines being hit by falling trees or branches and snow build up on the wires and the subsequent failure of, mostly, the wire. Occasionally the crossarm or ground stay failed first. Secondary to the above failures was the damage of the supporting poles.*
>
> *Most of the poles were damaged by the twisting action caused by unbalanced loads in the wires when the snow fell off these wires or when the lines are struck by tree branches.*
>
> *Trees appeared to play a significant role in events. The major outage on day one was caused by branches on the Albury to Fairlie 33kV line. The extreme weather and location of the line made locating the fault slow and very difficult.*
>
> *The snow continued to fall through to Saturday 20 June. During this, several lines were struck by falling trees.*[13]

90. In 2016, insulator discs remain a significant contributor to faulty equipment SAIDI, with 33kV crossarm and jumper failures being large contributors to defective equipment related SAIDI.

91. In its information response, Alpine also provided three snow and wind maps for most, but not all of the major event days. Each map contained a summary of the assets that had failed. The summaries are reproduced in Figures 12, 13 and 14.

[13] information response, 3.40 A Snow Storm Report June 2013.docx

**Figure 12: Snow damage map legend for 19th to 22nd June 2013**

| CODE: | DESCRIPTION: | AREA TKA/GLD: | FLE/ABY: | TEK: | TOTALS: |
|---|---|---|---|---|---|
| H | HARDWOOD | 3 | | | 3 |
| C | CONCRETE | 3 | 11 | | 14 |
| | TOTAL POLE: | 6 | 11 | | 17 |
| Cu | COPPER | | 8 | | 8 |
| G | GOPHER | 1 | | | 1 |
| Mk | MINK | 1 | 1 | | 2 |
| Mp | MAGPIE | 1 | 1 | | 2 |
| P | PETREL | | 1 | | 1 |
| H | HERRING | | 10 | | 10 |
| F | FLOUNDER | 2 | | | 2 |
| | TOTAL CONDUCTOR: | 5 | 21 | | 26 |
| | MISCELLANEOUS | | | | |
| GS | GROUND STAY BROKEN | | 3 | | 3 |
| T | TREE ON LINE | 3 | 14 | | 17 |
| LV | LV SERVICE DOWN | | 1 | | 1 |
| XA | CROSSARM BROKEN | 4 | 2 | | 6 |
| BI | BROKEN INSULATOR | | 2 | 1 | 3 |
| Bb | BROKEN BINDER | | 4 | | 4 |

Source: Alpine – information response - 3.52 C Wind & Snow.pdf

92. The snow event during June 2013 corresponds with the MED on 20 June 2013. The information on Alpine's map identifies that the snow event led to a high number of conductor failures primarily on copper and herring conductors. Interestingly, only three insulator failures occurred during this snow event yet we noted that insulator failure is the primary contributor to defective equipment related SAIDI.

93. Trees on line was also a significant failure event with 17 directly identified.

94. Alpine also provided a map relating to wind damage between the days of the 3rd to 6th July 2013. A MED relating to this event was recorded by Alpine on the 3rd July 2013.

**Figure 13: Wind damage recorded for 3 to 6 July 2013**

LEGEND:

| CODE: | DESCRIPTION: | EVENTS: |
|---|---|---|
| T | TREE DAMAGE | 47 |
| TB | BINDER BROKEN BY TREE | 7 |
| TP | POLE BROKEN BY TREE | 7 |
| TS | STAY BROKEN BY TREE | 2 |
| TW | WIRE BROKEN BY TREE | 14 |
| TX | CROSS ARM BROKEN BY TREE | 4 |

Source: Alpine – information response - 3.52 A Wind & Snow.pdf

Note: The values are the percentage contribution of each component to Defective Equipment SAIDI in each year.

95. Vegetation contacting overhead line assets is very clearly identified for the damage to conductors, poles and crossarms. The is no further detail on the 47 tree damage related failures but we expect that the faults in this category will be due to tree contacts with lines and pole tops.

96. Two major event days 18th and 19th June 2015 related to a snow storm. Alpine provided a post event report that recorded the following:

> *During the night of Thursday 18th and the morning of Friday 19th June 2015 snow caused minor damage to parts of Alpine Energy's network primarily in the Fairlie , Geraldine and Tekapo areas.*
>
> *Damage was suffered predominantly to inherently weak conductor lines and historic construction types with joint failure suspected of being a frequent cause of damage.*
>
> *The Primary cause of damage to poles was due to conductor or joint failure with some damage caused by vegetation. In the Tekapo area many crossarms failed under the mass of snow. The arm damage however possibly saved a number of pole failures.*
>
> *Only one cascade failure was reported and that was on the Bothers Range where four contiguous 2-pole concrete structures fell due to a Mink conductor joint failure.*
>
> *Pole damage was secondary to the conductor or joint failure and/or third party damage such as vegetation. Pole failure modes, mostly of reinforced concrete, were typically through lack of torsional strength to support unbalanced loads when snow fell off one conductor at a time or when a conductor or joint failed. The hardwoods that failed were 50 year-old, plus, naturally durable poles that were close to end of life and again failed due to conductor or joint failure or ground stay failure. The ground stays failed as a result of the eyebolt pulling through a rotten hardwood deadman.*

97. As in the 2013 maps, the conductor failures are predominantly copper and Herring. Broken cross arm and broken insulators are also high in the Fairlie area.

98. The information from the map is consistent with the information provided in the post event report.

**Figure 14: Snow damage recorded for 18 – 24 June 2015**

| CODE: | DESCRIPTION: | TKA/GLD: | FLE/ABY: | TEK/TWZ: | WTE: | LVL: | TOTALS: |
|---|---|---|---|---|---|---|---|
| | POLES: | | | | | | |
| SW | SOFTWOOD | | | | | | 0 |
| HW | HARDWOOD | 3 | 1 | 2 | | | 6 |
| CR | CONCRETE REINFORCED | 2 | 13 | 1 | | | 16 |
| CP | CONCRETE PRESTRESSED | | | | | | 0 |
| | TOTAL POLE: | 5 | 14 | 3 | | | 22 |
| | CONDUCTOR FAILURE: | | | | | | |
| F | FLOUNDER | | 1 | | | | 1 |
| Mi | MINK | | | | | | 0 |
| Go | GOPHER | 1 | 1 | | | 2 | 4 |
| H | HERRING | 2 | 4 | 2 | | 2 | 10 |
| Mp | MAGPIE | 2 | 2 | | | | 4 |
| Cu | COPPER | 5 | 7 | | | 2 | 14 |
| Mu | MULLET | 1 | | | | 2 | 3 |
| G | GALVANISED STEEL | | | 1 | | 1 | 2 |
| | TOTAL CONDUCTOR DAMAGE: | 11 | 15 | 3 | | 9 | 38 |
| | CONDUCTOR JOINT FAILURE: | | | | | | |
| Mi-J | MINK | | 1 | | | | 1 |
| Go-J | GOPHER | 4 | | | | | 4 |
| H-J | HERRING | 1 | | | | | 1 |
| Cu-J | COPPER | 3 | | | | | 3 |
| P-J | PETREL | | 1 | | | | 1 |
| | TOTAL JOINT FAILURE: | 8 | 2 | | | | 10 |
| | MISCELLANEOUS: | | | | | | |
| GS | GROUND STAY BROKEN | 1 | 4 | 1 | | 1 | 7 |
| LV | LV SERVICE DOWN | 23 | 9 | | 1 | 1 | 34 |
| SL | STREET LIGHT DOWN | 1 | | | | | 1 |
| XA | CROSSARM BROKEN | 5 | 10 | 11 | | | 26 |
| BI | BROKEN INSULATOR | | 7 | 3 | | | 10 |
| Bb | BROKEN BINDER | | 8 | 2 | | | 10 |
| TX | TRANSFORMER REPLACEMENT | | 1 | 1 | | | 2 |
| T | DAMAGE DUE TO TREES | 4 | 2 | | 1 | | 7 |

Source: Alpine – information response - 3.52 B Snow 2013-2015.pdf

99. Alpine did not provide, and confirmed at the on-site sessions that it did not have, any additional post event reports and maps other than those provided in its information response. It would have been particularly valuable had post event reports and wind/snow maps been produced for the two large MEDs of 10th September 2013 and 14th October 2013.

100. In our opinion, undertaking post event analysis and producing comprehensive reports and information is a critical component of GIP asset management and risk mitigation. The absence of such reports means that valuable lessons are likely to have been missed. By not undertaking rigorous post event analysis Alpine was not applying GIP.

101. On the basis of the information that is available, we have found that overhead line assets are the primary contributors to failure events on both MEDs and non-MEDs.

102. We have found that for non-MEDs failure events, the predominant cause is insulator and crossarm failure.

103. For MEDs failure events, the predominant cause lies in insulator, conductor joints and crossarm failure. This finding is supported by statements in Alpine’s 2015 post event report:

*There was weakness in the overhead lines assets that were exposed during high wind and heavy snow events*

*Damage was suffered mostly by the 50-60 year-old historic 11 kV lines built of inherently weak conductor, such as 16Cu, Herring & Mullet ACSR, that is also now near end of life. These lines have been stretched during many snow and wind events and have been repaired and returned to service each time. Many such lines were identified for rebuild prior to the Opuha Dam construction. Since irrigation water has been available in the Alpine Network area the focus for capital expenditure has been on reinforcing feeders to support the subsequent dairy load increase. This continues today.*

*The modes of failure were typical in both events and the same older inherently weak lines suffered the majority of damage.*[14]

104. The post event report notes that the failure events were predominantly on older 11kV distribution lines. This meant that those parts of the network were prone to failure during adverse weather events and therefore contributed to Alpine's non-compliance.

105. We have concluded that weaknesses in some assets made them prone to failure events during adverse weather. These failure events contributed to Alpine's non-compliance.

***Vegetation***

106. Alpine's post event reports consistently record vegetation contacting overhead lines as a major contributor to failure events. The failure data is consistent with this but only for MED events. For non-MEDs the failure data (Figure 7) clearly indicates that faulty equipment and third party interference are the primary failure events contributing to SAIDI and Alpine's non-compliance.

107. The charts in Figure15 show the level of Alpine's investment in vegetation management opex compared to other EDBs. For 2013, 2014 and 2015 Alpine is significantly lower than the weighted average of other EDBs across all ratios. The most relevant ratios for vegetation control are opex per network metre and opex per customer.

108. The low investment levels are likely to have led to the network being prone to failure during adverse weather conditions particularly wind, but also snow. Evidence of a network prone to vegetation related failure events is seen in the failure data and the post event reports.

109. Vegetation related failure events can be due to a range of failure types including; trees falling onto conductors or striking poles, branches blown into lines, branches falling onto lines and branches growing into lines. The tree regulations[15] allow EDBs to cut vegetation that encroaches within a specified growth zone but outside the growth zone, EDBs have to engage with tree owners to control trees.

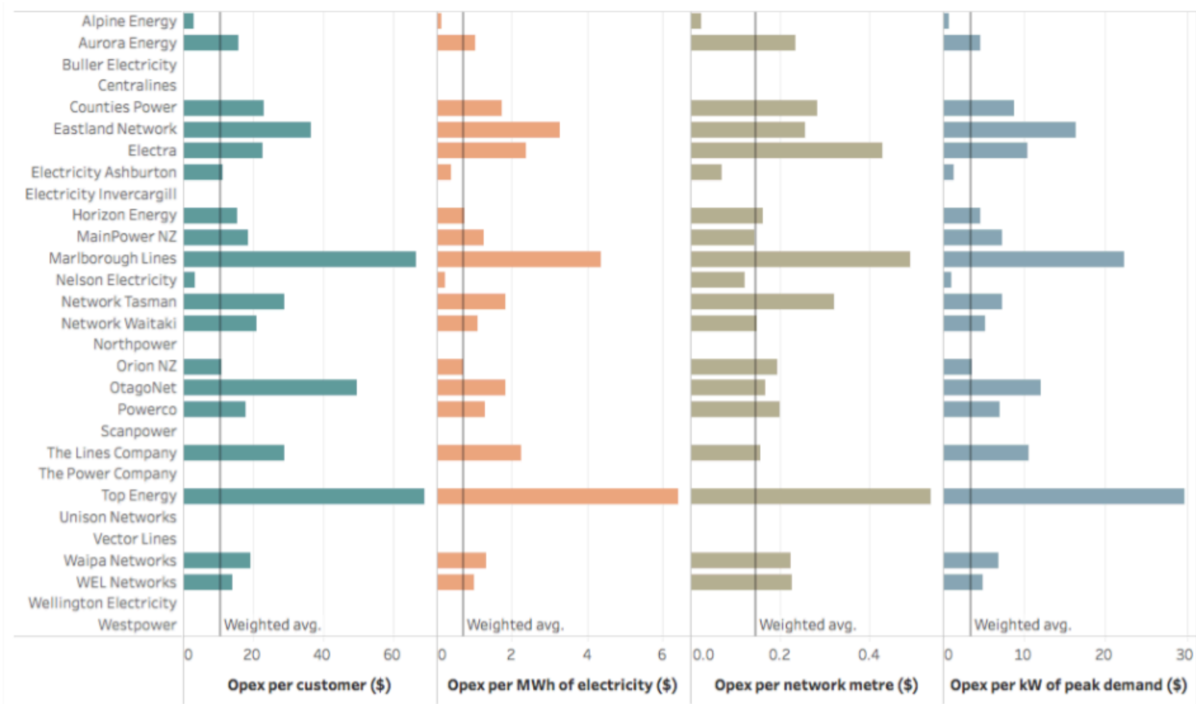
110. The proactive management of 'out of zone' vegetation is a specialised stakeholder engagement task that requires the development and application of trained human resources. The increased pruning activities will also require more specialised vegetation control crews. Clearly, investment in these resources is needed to keep ahead of the tree growth curve. The investment levels made by Alpine during the 2013 to 2016 years indicate that it was behind the curve and therefore the network was prone to vegetation related failure events.

[14] 3.40 B Snow Storm Report 2015.docx
[15] http://www.legislation.govt.nz/regulation/public/2003/0375/latest/DLM233405.html

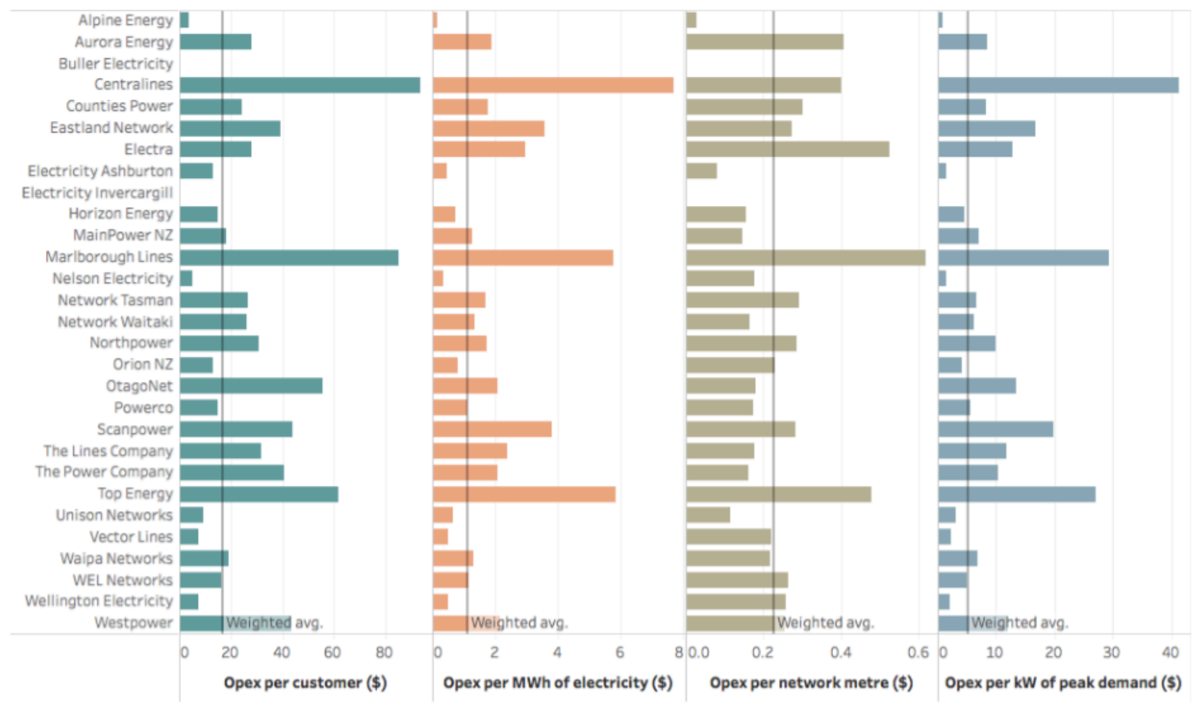
111. We have found that vegetation failure events were a material contributor to Alpine's non-compliance.

**Figure 15: Alpine's investment in vegetation management compared to other EDBs**

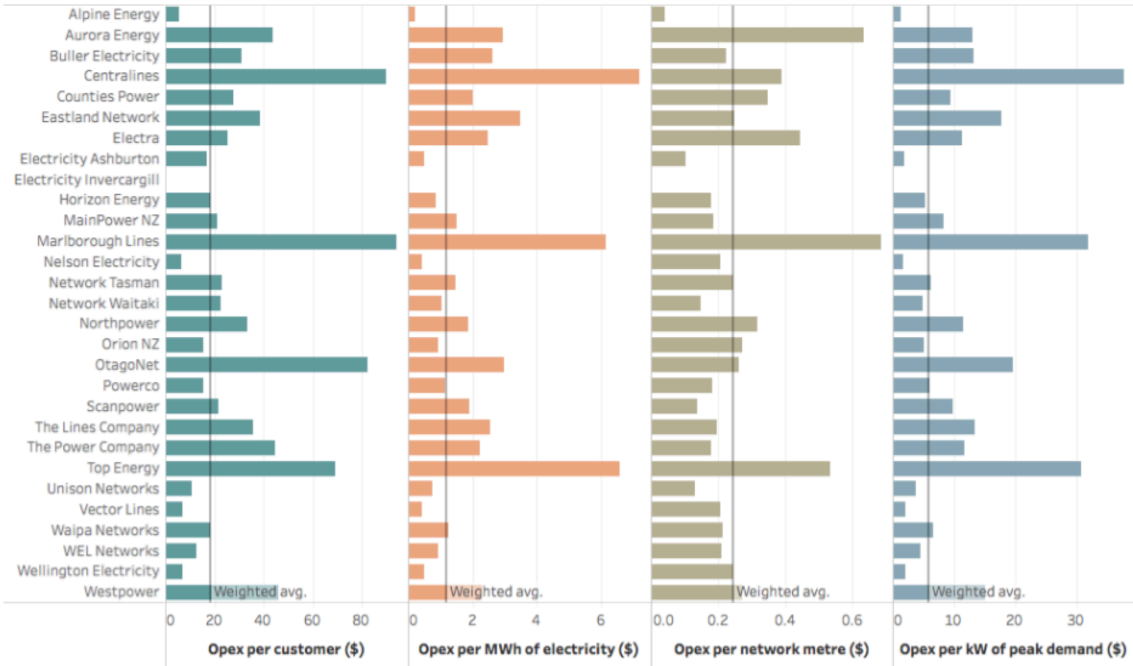
2013



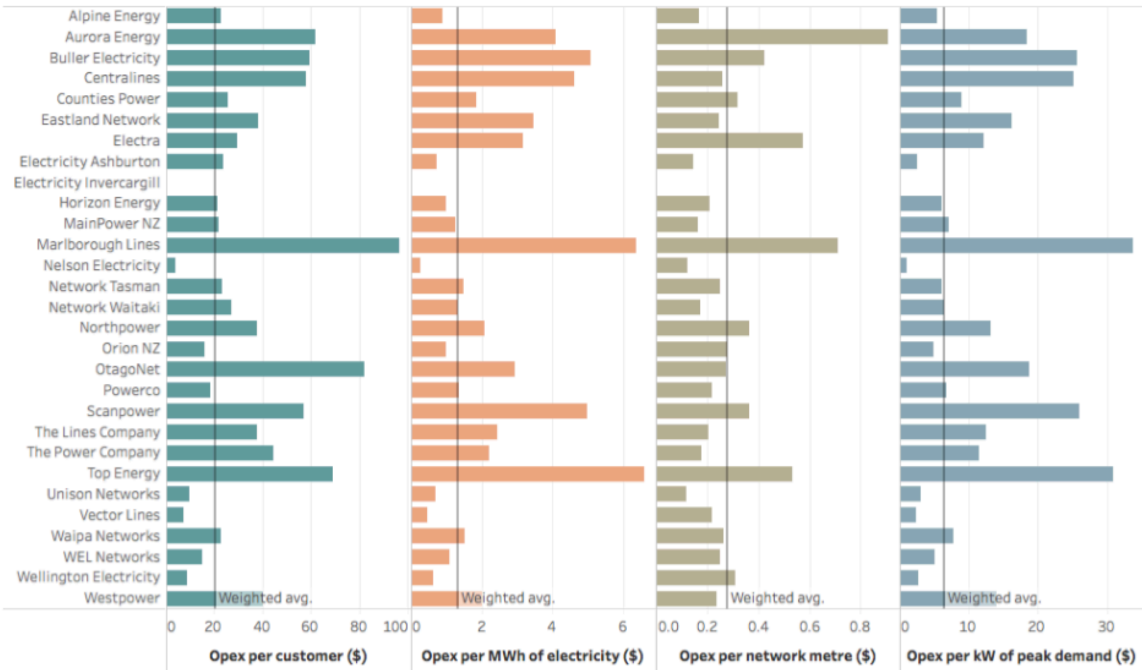

2014



2015




2016




Source: Commerce Commission Performance Accessibility Tool[16]

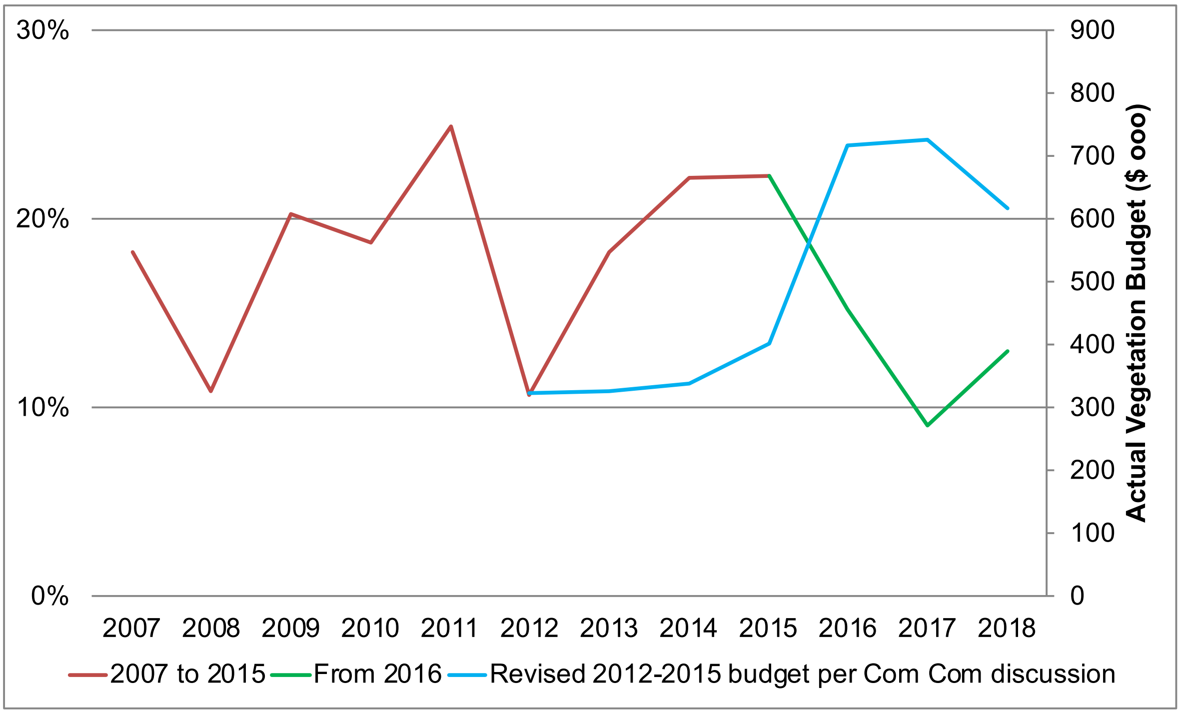
16 https://public.tableau.com/profile/commerce.commission.regulation#!/vizhome/Performanceaccessibilitytool-NewZealandelectricitydistributors/Highlevelratios

112. The 2015 snow event report noted potential indications that the increase in vegetation management was having a positive effect:

> *In comparison to past weather events trees did not appear to play a significant role in damaging assets this time. This could be an indication that the most threatening trees are being dealt with under planned maintenance.*

113. During the onsite sessions, Alpine discussed and subsequently provided details[17] of analysis that it had undertaken on the relationship between investment in vegetation management and the reduction in vegetation related failure events. Whilst the result of the analysis is preliminary, it is indicating that increased vegetation management investment can have an almost immediate impact on reducing failure events attributed to vegetation. Figure 16 reproduces Alpine's chart showing the increase in vegetation opex budget against the percentage of vegetation related faults as a percentage of total faults.

**Figure 16 Vegetation management faults as a percentage of total faults vs opex**




| | |
|---|---|
| Source: | Alpine - Network fault due to vegetation analysis RL.xlsx |
| Notes: | Prior to 2015, the vegetation management cost was included in General opex. The chart was revised by Alpine to include all vegetation management costs from 2017 onwards. |

114. Even though the results of Alpine's analysis are preliminary and based on a small dataset, it does support the view that increased investment can produce positive results. Had the increased investment been made earlier, it could have reduced the SAIDI and SAIFI in 2014 and 2016.

115. If Alpine had increased its vegetation management opex in 2013 from $300k to $700k, its analysis indicates that >10% reduction in total faults could have been achieved in AP2014 and AP 2016. Assuming that number of faults is directly proportional to SAIDI, a 10% reduction would have been insufficient to have avoided exceedance of the SAIDI limit in

[17] Network fault due to vegetation analysis RL.xlsx

AP2014. However in 2016, a 10% reduction in SAIDI would have brought Alpine under the SAIDI limit for that Assessment Period.

116. We have found that vegetation was a failure event that contributed to Alpine's non-compliance. By not identifying and increasing its vegetation management expenditure earlier than it did, Alpine was not acting consistently with GIP.

***3rd party interference***

117. The data provided by Alpine[18] records a total of 86 third party interference failure events over the five years for which data was provided. The number of events together with the contribution to SAIDI, SAIFI and CAIDI[19] is provided in Table 5.

**Table 5 Failure events attributed to third party interference**

| Assessment Period | Number of events | SAIDI | SAIFI | CAIDI |
|---|---|---|---|---|
| 2017 | 26 | 22.3 | 0.24 | 94.7 |
| 2016 | 24 | 6.5 | 0.09 | 88.8 |
| 2015 | 24 | 11.3 | 0.8 | 141.5 |
| 2014 | 33 | 32.1 | 0.29 | 107.5 |

Source: Alpine data in Excel workbooks 2.18 Summary Outage (A,B,C,D,E,F)

118. Incidents of third party interference (including car vs pole accidents) have been variable between 2014 and 2016 (AP2013 data was zero). The highest incidence of third party interference occurred in AP2014 adding 32.1 SAIDI minutes.

119. In AP2016, car accidents accounted for 5.14 of the 6.5 SAIDI minutes attributed by Alpine to 3rd party interference. One car accident was on the 33kV network and 12 on the 11kV network.

120. Whilst Alpine's AMPs mention the risks of third party interference (e.g. car vs pole), we found no analysis of the underlying causes of the nature of the incidents and their frequency. The AMPs contain no discussion on options for reducing the levels of third party interference. Discussion in the AMP is limited to the suggestion that it is the public that can take action to reduce the risks.[20]

121. Subsequently, Alpine provided information that in 2014 it commissioned an independent report to investigate car vs pole incidents in the distribution industry to determine whether we should commission a research report on driver behaviour. Alpine informaed us that its Safety and Risk Team are currently conducting a review of current research regarding the same topic and finding that the risk of collision at any particular pole is more difficult to determine due to the very large number of variables.

122. Whilst we accept that reducing incidents is not a simple task, risk mitigating activities undertaken by EDBs in collaboration with councils, agencies communities and communities is important. Where the number of events and impact on quality is material,

[18] S52ZD response, Data in six Excel workbooks 2.18 Summary Outage (A,B,C,D,E,F)
[19] CAIDI is used as a measure of the average time that a given consumer was without electricity supply during the year. CAIDI can also be considered as an indication of the average outage duration time in the year.
[20] 2016 AMP, section 7.4.1.2 External risk, page 195

we would expect an EDB operating at GIP to have undertaken analysis of the reasons and developed strategies to reduce them.

123. The SAIDI due to third party interference in AP2014 was 19.5% of Alpine's SAIDI limit yet Alpine provided no analysis or discussion on how this can be mitigated in its AMP.

124. We have found that third party interference failure events have been material contributors to Alpine's SAIDI and, whilst AP2016 was the lowest of the four years, reducing such events could have avoided exceedance of the SAIDI limit in that Assessment Period, therefore these failure events contributed to Alpine's non-compliance.

125. Analysis of the 3rd party events to identify trends, high risk locations and common factors could have identified opportunities for risk mitigation actions. Where SAIDI due to third party interference is 19.5%, as it was for Alpine in AP2014, GIP is to take steps to understand and manage this situation. The scant information provided by Alpine on the work of its Safety and Risk Team is insufficient for us to concluded that it has acted consistently with GIP in addressing third party interference risk.

### ***Cause unknown***

126. The unknown failure cause is important because, if it is a material contributor to SAIDI and/or SAIFI, it should be investigated and initiatives developed to reduce the number of incidents that are not attributed to an identifiable failure. Alpine records an unknown failure cause when its field investigation is unable to identify a specific cause.

127. The materiality of the unknown failure causes recorded is provided in Table 6.

**Table 6 Failure events attributed to unknown**

| Assessment Period | Number of events | SAIDI | SAIFI | CAIDI |
|---|---|---|---|---|
| 2017 | 24 | 5.4 | 0.05 | 101.5 |
| 2016 | 24 | 6.5 | 0.07 | 98 |
| 2015 | 18 | 9.3 | 0.12 | 75.3 |
| 2014 | 20 | 9.5 | 0.7 | 138.7 |
| 2013 | 21 | 12.3 | 0.14 | 86.3 |

Source: Alpine data in Excel workbooks 2.18 Summary Outage (A,B,C,D,E,F)

128. The key feature of Table 6 is the incremental decrease in SAIDI attributed to unknown causes. Similarly, a decreasing trend is seen in SAIFI. Despite this, the number of unknown cause events has increased. Taking action to identify the true causes of failure is GIP; we observed in 2018 that Alpine has implemented actions to ensure that true causes are identified whenever possible.

129. The number of events attributed to unknown causes has averaged around 10% of all outages for the five years. Whilst reducing the events attributed to unknown would not have reduced SAIDI or SAIFI, reducing unknown failures can improve mitigation of the underlying causes.

130. The average customer restoration time indicated by CAIDI is also quite long.

### Findings on the failure events that contributed to non-compliance

131. We have found that the failure events contributing to Alpine's non-compliance were:

    1. weaknesses in some overhead line assets that made them prone to failure events during adverse weather;

    2. vegetation as a failure event that contributed to Alpine's non-compliance and could have been mitigated had Alpine increased investment in vegetation management earlier than it did; and

    3. third party interference which made a material contribution to Alpine's AP2014 SAIDI and again, mitigation could have avoided exceedance of the SAIDI limit in AP2016.

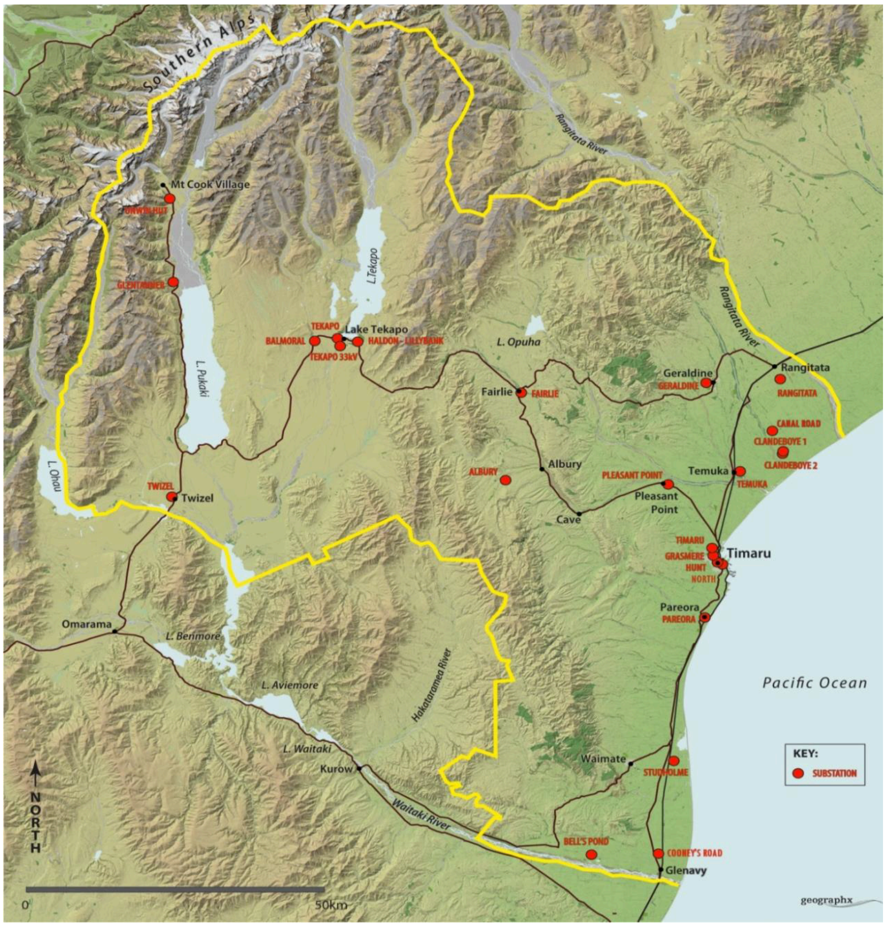
132. In our opinion, Alpine's practices in terms of taking earlier steps to mitigate the risks of these types of failure events failed to meet GIP.

133. Adverse weather has not been found to be a failure event as it is considered to be a trigger event unless the conditions were demonstrated to be above the asset design parameters.

## 2.3. Our assessment of the trigger events that contributed to the non-compliance

134. As we have concluded in section 2.2, weakness in some overhead line assets was exposed by severe weather that occurred during the 2014AP and 2016AP. We have tried to identify if the weather events during the major event days in AP2014 and AP2016 were in excess of the overhead line design parameters, or if the damage to the network during the major event days should have resulted in much lower failures and outages.

**Figure 17 Alpine's network area**




Source: Alpine 2016 – 2026 AMP

## Wind speeds in South Canterbury

135. NIWA provides the following summary on Canterbury wind conditions:

> *Gusty winds are relatively infrequent throughout most lowland Canterbury locations, occurring more frequently in the mountain ranges and exposed coastal locations.*[21]

136. Figure 18 shows the number of days experiencing high wind gusts at various Canterbury locations.

21 NIWA, The Climate and Weather of Canterbury 2nd Edition 2016, G. R. Macara ISSN 1173-0382,

**Figure 18 Number of days experiencing high wind gusts**

| Location | Days with gusts >61 km/hr | Days with gusts >94 km/hr |
|---|---|---|
| Christchurch | 52 | 2 |
| Darfield | 43 | 1 |
| Hanmer Springs | 36 | 2 |
| Kaikoura | 97 | 17 |
| Lake Tekapo | 69 | 5 |
| Mt Cook Village | 108 | 15 |
| Mt John | 158 | 72 |
| Rangiora | 30 | 0.6 |
| Timaru | 34 | 2 |

Source: NIWA, The Climate and Weather of Canterbury 2nd Edition 2016, Table 4

Notes: The table shows the mean number of days per year with gusts exceeding 61kmh (33 knots) and 94kmh (50 knots) for selected locations.

137. Mount Cook Village and Mount John (located at the south of Lake Tekapo) are clearly identifiable as the locations that experience frequent high wind gust speeds. As Figure 17 shows, both are located on Alpine's network. Alpine management confirmed during the onsite sessions that the minimum wind design limit for its overhead lines was 140kmh. NIWA's data (Figure 19) shows that wind gusts well above these values have occurred in these regions in the past.

**Figure 19 High recorded wind gusts for Canterbury**

| Location | Gust (km/hr) | Direction | Date |
|---|---|---|---|
| Christchurch (Airport) | 172.4 | WNW | 01/08/1975 |
| Darfield | 116.6 | NW | 05/05/2014 |
| Hanmer Springs | 137.2 | NW | 28/03/2001 |
| Kaikoura | 194.8 | WNW | 01/08/1975 |
| Lake Tekapo | 122.4 | WNW | 13/10/2006 |
| Mt Cook Village | 177.8 | N | 21/02/2004 |
| Mt John | 250.0 | NW | 18/4/1970 |
| Rangiora | 116.6 | NW | 22/09/2002 |
| Timaru | 164.9 | WNW | 01/08/1975 |

Source: NIWA, The Climate and Weather of Canterbury 2nd Edition 2016, Table 4

Notes: The table shows the highest recorded wind gusts at selected Canterbury locations, from all available NIWA data.

138. The NIWA data shows that wind gusts in South Canterbury locations can be significant particularly in the high country locations such as Mount John, Tekapo and Mount Cook. The maximum wind gusts recorded in 1975 in Timaru were also significant.

139. We reviewed information provided by NIWA in its NZ Historic Weather Events Catalogue for each of the MEDs identified by Alpine in AP2014 and AP 2016.

140. For the 20 June 2013, MED NIWA stated that there were high wind gusts in Canterbury with heavy snow and ice being issues at Fairlie and Tekapo. Figure 20 provides an extract from NIWA's publication.

**Figure 20 Weather event on 20 June 2013**


June 2013 New Zealand Storm ( 2013-06-20 )

Canterbury

Snow / Ice at Christchurch — Show me on map

Many city schools were closed, and hill roads were impassable due to the snow. Buses on Cashmere and Huntsbury Hill routes were cancelled. Dyers Pass Rd from the Sign of the Takahe on Cashmere to Governors Bay was closed after several motorists became stuck.

Snow / Ice at Fairlie — Show me on map

Fairlie was cut off by heavy snow and had power outages.

Snow / Ice at Tekapo — Show me on map

Source: NIWA, NZ Historic Weather Events Catalogue

141. For the most significant MED for Alpine's SAIDI and SAIFI on 10 September 2013, NIWA recorded wind speeds of 119kmh at Fairlie and wind speeds reaching 110kmh at Timaru[22]. NIWA also identified that more than 800 irrigators across Canterbury were severely damaged when they were blown over by the strong winds. The highest wind speed identified by NIWA during the event was at Mount Hutt ski field where staff reported winds reaching a record 251kmh.

142. NIWA did not record any conditions for 3 July 2013 or 14 October 2013 MEDs in its NZ Historic Weather Events Catalogue.

143. The only event recorded by NIWA in 2015 was between 18 and 23 June. NIWA's summary is reproduced in Figure 21.

**Figure 21 Weather event on 18 - 23 June 2015**


June 2015 New Zealand Storm ( 2015-06-18 )

Snow / Ice at Geraldine — Show me on map

The Geraldine Civil Defence Area Headquarters was activated and the Timaru District Council Emergency Operations Centre advised residents in snow-affected areas to stay at home and keep warm.

Most schools around Geraldine, Fairlie and Pleasant Point were closed on June 19, as the snow was 30-80 cm on the ground.

Source: NIWA, NZ Historic Weather Events Catalogue

[22] NIWA, NZ Historic Weather Events Catalogue https://hwe.niwa.co.nz/event/September_2013_New_Zealand_Storm

144. Our review of the information provided by Alpine and available from NIWA has demonstrated that high wind speeds and heavy snow loadings occurred across the region on 18 to 23 June 2015. However, the information we have viewed on the wind gust speeds and snowfall does not provide evidence that the wind speeds and snow loadings were beyond the design limits of the overhead lines.

145. Photographs provided by Alpine during our onsite sessions showed that wind and snow loadings on some assets had occurred. However, we did not see documented evidence that this had been widespread. The NIWA information indicates that weather events on 20 June 2013, and between the 18 to 23 June 2015, were significant and likely to cause damage to electricity networks.

146. Based on the evidence we have seen, our opinion is that the weather event on 10 September 2013 MED was sufficiently severe to have caused extensive damage to the network in exposed areas. For this MED, we consider that the severe weather was both a trigger and failure event. We have formed the view that, whilst the weather prone condition of the network contributed to the SAIDI performance during this MED, the majority of the damage would have been due to the extreme weather conditions.

147. Our view is that the majority of the supply interruptions on 10 September 2013 MED were attributable to the severe weather event. Actions that Alpine could have taken before the event have reduced the impact but it is unlikely to have completely eliminated the damage that was sustained.

148. With regard to the MEDs identified by Alpine for 18 and 19 June 2015, we consider the snow and ice loadings sufficient to cause failures on some parts of the network, regardless of their condition. Weather in the region would have also presented difficulty in restoring supplies. Similarly, it is likely that vegetation related issues contributed significantly to the damage and this could, to some extent, have been avoided.

149. For all other MEDs, had Alpine addressed the problems with its weather prone overhead assets and invested sufficiently in vegetation management, we think that it could have significantly reduced the impact of weather events. Given that Alpine exceeded SAIDI by just over one minute in AP 2016, the mitigating actions could have avoided its exceedance of SAIDI in AP2016 and its non-compliance.

## Findings on the trigger events that contributed to non-compliance

150. We have found that the trigger events contributing to Alpine's non-compliance were:

1. high wind occurring on MEDs and other days;
2. failure of asset management to address issues with some overhead line assets; and
3. insufficient investment in control of vegetation risks.

# 3. Actions Alpine could and should have taken to prevent non-compliance

151. Taking into account our assessment of the factors, failure events and trigger events, we have considered potential actions that Alpine could and should have taken to prevent non-compliance. In this section we discuss the actions and the potential to have reduced the impact of the adverse weather events in AP2014 and AP2016.

152. We discuss our assessment and findings on potential actions that could and should have been taken under four headings:

    1. reinvestment in fault prone asset fleets;
    2. investment in vegetation management;
    3. post event reviews and analysis; and
    4. management of reliability risks.

153. Given the relatively large (70%) contribution of the four normalised MED in AP2014 to Alpine's exceedance of SAIDI, we consider that the actions would probably not have prevented exceedance of the quality limits in AP2014. However we consider that the actions would have reduced SAIDI sufficiently in AP2016 to have prevented exceedance of the SAIDI limit in that period and avoided non-compliance.

154. In the following subsections we set out evidence to support our conclusions that these actions could have improved SAIDI and SAIFI performance and consider if, by taking these actions, Alpine could have avoided non-compliance.

## Reinvestment in fault prone asset fleets

155. We have found that Alpine's investment in the replacement and refurbishment of its network assets was, for some overhead line assets, below what was needed to ensure compliance network performance. We consider it likely that, in the periods prior to AP2014, Alpine had been focused of building new network capacity to service the growing irrigation and dairy expansion demands.

156. Evidence to support our opinion includes:

    1. the level of actual capital expenditure (capex) invested by Alpine during the relevant periods;
    2. the level of replacement against the depreciating network asset value;
    3. the increased level of investment applied by Alpine following non-compliance; and
    4. information on asset condition and investment contained in information disclosures and documents provided by Alpine.

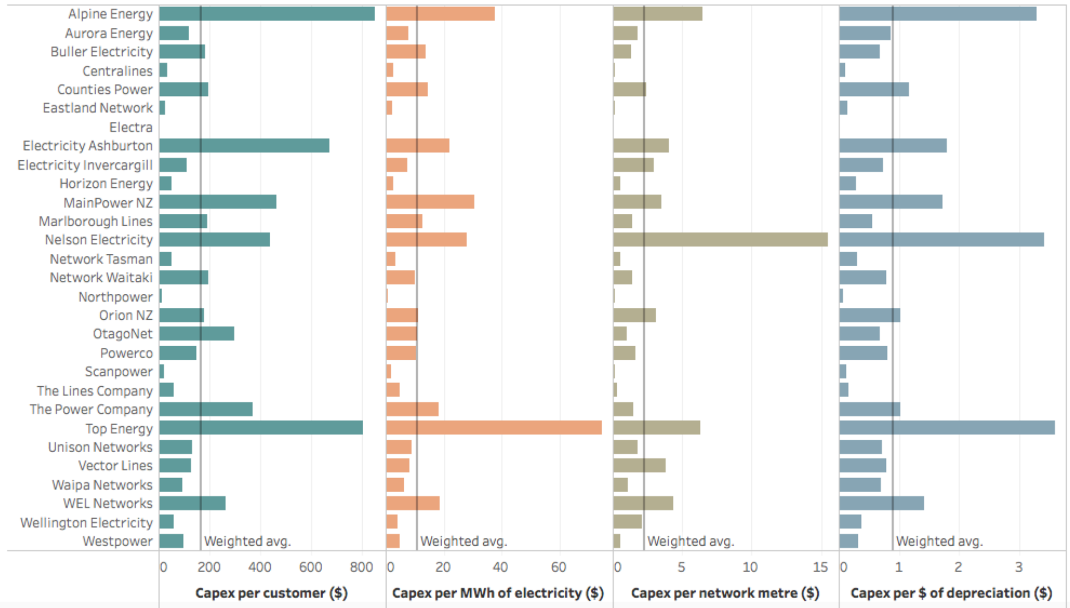
## *Actual capex on network assets*

157. Capex related to growth in customer connections and demand for electricity can drive the need for increased investment in electricity networks. Alpine's 2013 AMP identifies that its capital investment programme is largely growth driven:

> *AEL has segmented capital investment over the AMP period based on projects which must go ahead. These projects are required due to capacity or security constraints. Some projects will be conditional on third party decisions or developments such as customer projects proceeding, resource consents around irrigation schemes, etc.*

158. The information disclosures provided by all EDBs for the AP2013 give a clear indication of the growth driven focus of Alpine's capex programme (see Figure 22).

**Figure 22 2013 actual Capex for System Growth and Customer Connection**



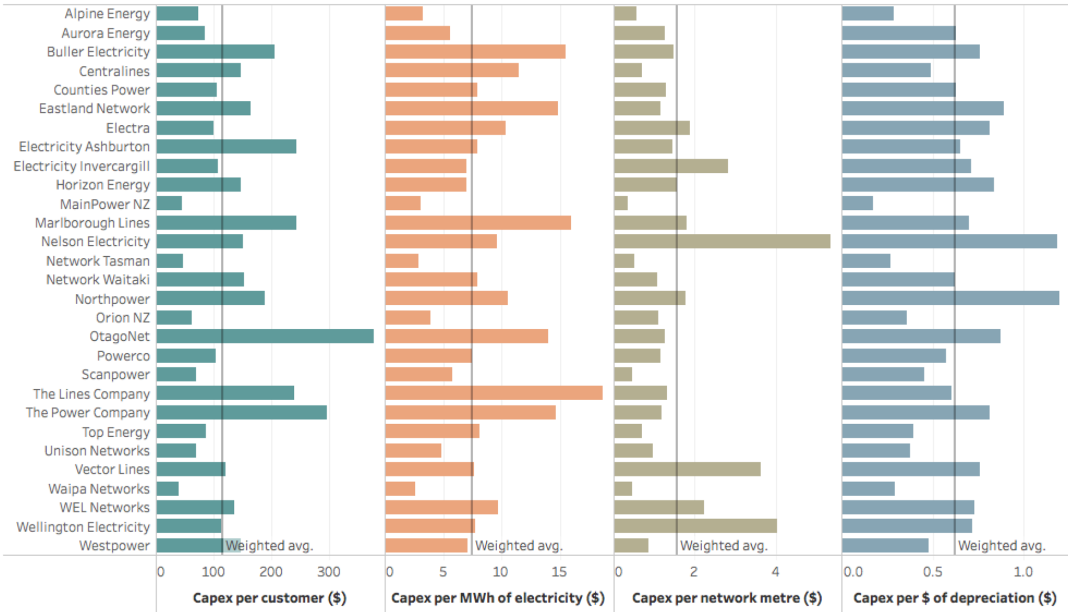

Source: Commerce Commission Performance Accessibility Tool[23]

159. Figure 23 shows Alpine's investment in network asset replacement and renewal for AP2013. This indicates that, at the time, its growth driven capex was soaring above most other EDBs; Alpine's investment in asset replacement and renewal was considerably below the weighted average of all EDBs for each ratio.

160. Alpine's investment for replacement and renewal continued to be below the weighted average for other EDBs until AP2017.

23 https://public.tableau.com/profile/commerce.commission.regulation#!/vizhome/Performanceaccessibilitytool-NewZealandelectricitydistributors/Highlevelratios

### Figure 23 2013 actual Capex for Replacement and Renewal




Source: Commerce Commission Performance Accessibility Tool[24]

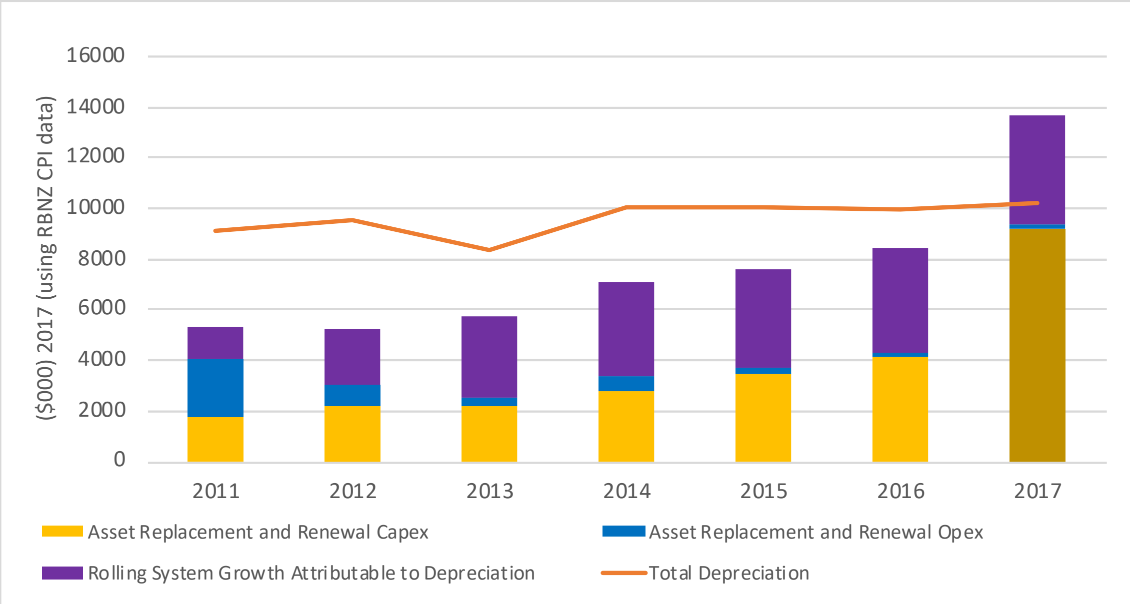
***<u>Capex replacement and renewal and asset depreciation</u>***

161. The use of depreciation ratio as an indicator of investment sufficiency can provide valuable insights. As a general measure, asset replacement rates should be similar to the depreciation of assets. If this is not the case, material variances require explanation and justification. To obtain a full perspective of the expenditure that drives asset value and depreciation we include asset replacement and renewal capex and opex and system growth capex that is attributable to depreciation.

162. Figure 24 shows the difference between Alpine's replacement and refurbishment investment and asset depreciation. In most years since 2010, investment has fallen below depreciation. This is an indicator that investment levels were potentially inadequate. When combined with information on asset age, condition and failure rate indicators the ratio of network depreciation to RAB provides a good perspective on whether the level of investment has been sufficient to maintain the state of the network assets and its performance.

24 https://public.tableau.com/profile/commerce.commission.regulation#!/vizhome/Performanceaccessibilitytool-NewZealandelectricitydistributors/Highlevelratios

**Figure 24   9 year accumulation of depreciation compared to asset investment**



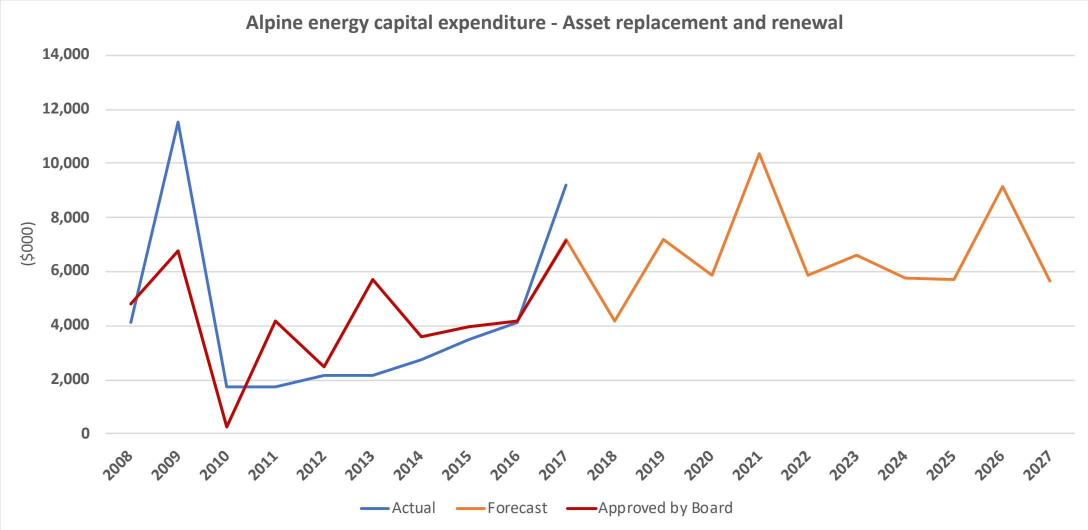

Source: 2010 to 2016 Alpine – information response
2017 - Alpine Information Disclosure Schedules

163. In our opinion, the comparatively low level of replacement and renewal capex prior to AP2016, and the gap between asset depreciation and replacement and renewal investment levels, and asset related depreciation indicates that a potential underspend and backlog was occurring.

***increased level of investment following non-compliance***

164. Figure 25 indicates that the reduced levels of asset replacement and renewal capex commenced around 2010 and continued until 2016. The increase seen from 2016 in both the forecast and actual investment in asset replacement and renewal provides an indication that Alpine had identified and planned to resolve issues that would have been created by the historical underspend.

**Figure 25 Alpine's replacement and renewal expenditure since 2008**




Source: 2011 to 2016 Alpine – information response
2017 - Alpine Information Disclosure Schedules

***Information on asset condition and investment***

165. Alpine's post event reports identified issues relating to older and weaker overhead line assets that were susceptible to failure triggered by adverse weather events:

> June 2013 snow event report
> *The damage has been restricted almost exclusively to lines being hit by falling trees or branches and lines built with low strength conductors.*[25]
>
> June 2015 snow event report
> *Damage was suffered mostly by the 50-60 year-old historic 11 kV lines built of inherently weak conductor, such as 16Cu, Herring & Mullet ACSR, that is also now near end of life. These lines have been stretched during many snow and wind events and have been repaired and returned to service each time. Many such lines were identified for rebuild prior to the Opuha Dam construction.*
>
> *Since irrigation water has been available in the Alpine Network area the focus for capital expenditure has been on reinforcing feeders to support the subsequent dairy load increase. This continues today.*
>
> *Future capital expenditure is required to totally rebuild lines, identified most at risk, using modern design and conductor. Some lines may suffice with re-conductoring in areas of nil growth.*

166. The June 2016 snow event report compared the 2013 and 2016 snow event failures and noted the following:

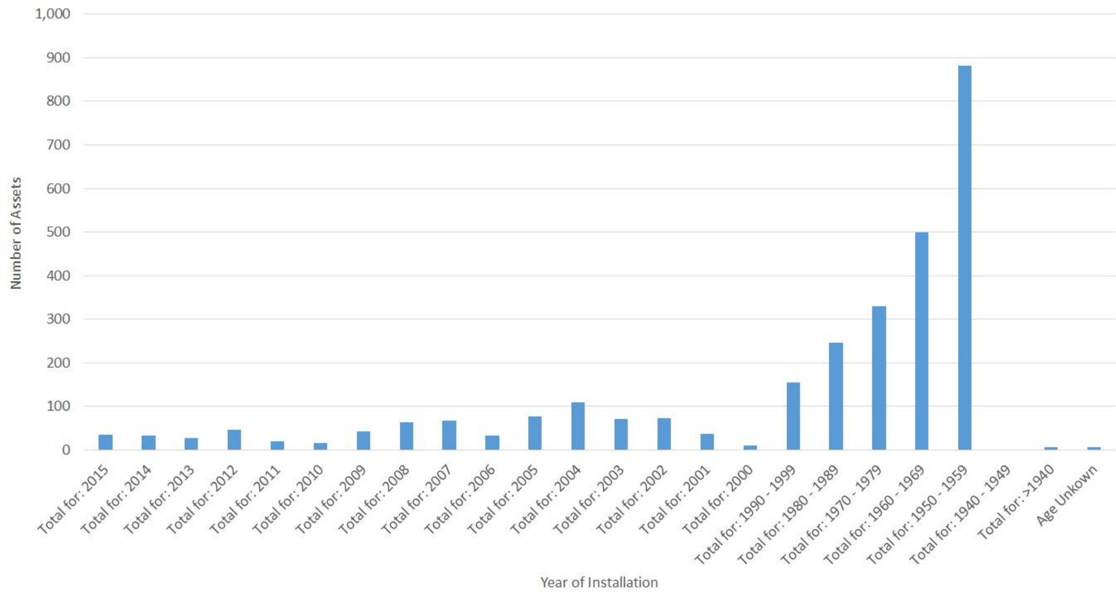
> *The modes of failure were typical in both events and the same older inherently weak lines suffered the majority of damage.*

167. We consider that a targeted HV distribution open wire conductor replacement programme should have been undertaken by Alpine from 2010. This timing is indicated by the age

25 3.40 A Snow Storm Report June 2013.docx

profile of these assets (Figure 26). Whilst Alpine had received an independent report on the general condition of its conductors and the average life expectancy of those assets, there was clear knowledge within Alpine that some conductor assets were in a condition that required attention. In our opinion, replacement investment targeted at these assets would have reduced the impact of wind and snow triggered failures.

**Figure 26 Alpine's distribution OH conductor age profile**




Source: Alpine Information Disclosure Schedules

168. We also consider that a similar, targeted replacement programme should have been initiated much earlier and extensively than it was to address the supply interruptions related to insulator failures (see Figure 11).

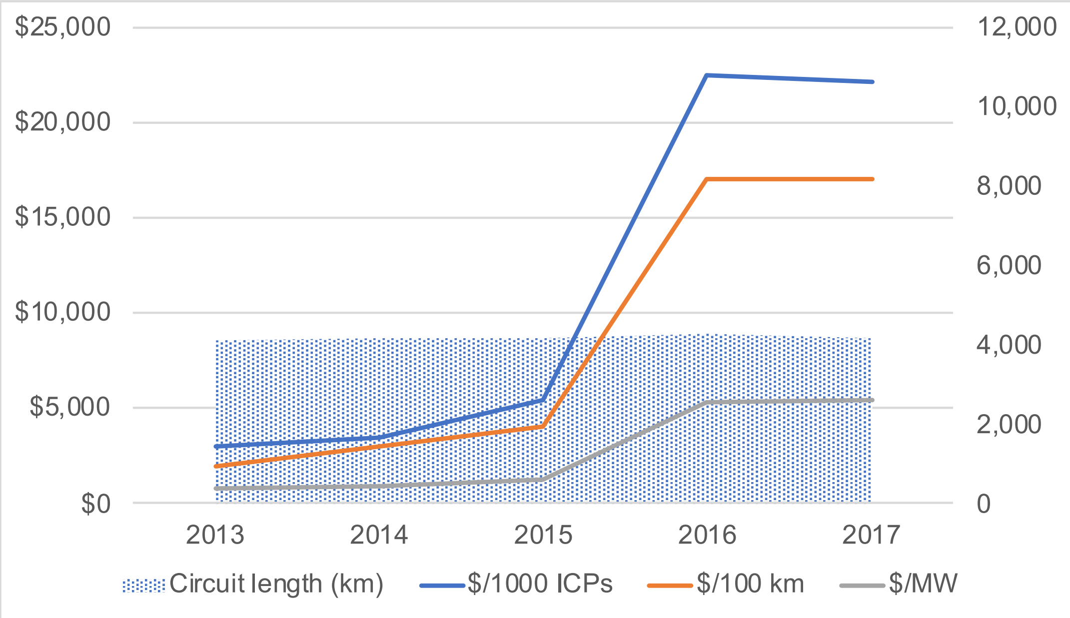
## Investment in vegetation management

169. In our opinion, there is clear evidence that earlier investment in increased vegetation management operational expenditure (opex) could have reduced the impact of wind and snow triggered failures in AP2014 and AP2016.

170. In section 2.1 we identified the link between increased investment in vegetation management and improved network performance outcomes. In Figure 15, we provided a comparison of Alpine's historical vegetation management opex with other EDBs.

171. Figure 27 provides a further view of how Alpine's investment in vegetation management has changed against the relevant network metrics. The significant step change in 2016 for vegetation opex per 100km of network, customer connections (ICP) and peak demand (MW), indicates that Alpine has become aware of the benefits that will be achieved through increased investment.

**Figure 27: Vegetation management opex ratios**




Source: Alpine Information Disclosure Schedules

172. In our opinion, there is clear evidence that increased and earlier investment in vegetation management would have improved Alpine's network performance. If the increase had occurred prior to AP2013, there would have been an improvement in network performance in AP2014. If the increase had occurred prior to AP2015, there would have been an improvement in network performance in AP2016. Any improvement in 2016 would have ensured that Alpine remained compliant.

173. GIP requires an EDB to apply sufficient and timely investment in vegetation management; by not doing this Alpine did not meet GIP.

## Responsibility for managing all reliability risks

174. Figure 28 reproduces Alpine's table of unplanned outages including its view of the level of control that it had on each outage category. Out of the nine listed outage categories, Alpine indicates its view that only three are within its 'reasonable control'.

175. Whilst elimination of all failure events is clearly outside Alpine's reasonable control, we consider that risk mitigation of all the listed outage categories are within its reasonable control. For example, in section 2.2, Alpine provided evidence of investment in increased vegetation management. Such an increase will undoubtedly reduce the impact of vegetation interaction with the network.

176. Alpine's view that it does not have reasonable control over failure events other than those due to defective equipment and human error is not, in our view, appropriate or in line with GIP. Taking this view may have led to a reduced focus on options to manage important failure events therefore contributing to its non-compliance.

**Figure 28 Alpine's view on the controllability of outages**

| Within an EDBs reasonable control | Outage Category | 2014 | | 2015 | | 2016 | |
|---|---|---|---|---|---|---|---|
| | | SAIDI minutes | % of total | SAIDI minutes | % of total | SAIDI minutes | % of total |
| No | Lightning | 06:14 | 0.74% | 08:00 | 2.92% | 00:22 | 2.09% |
| No | Vegetation | 13:62 | 1.65% | 05:13 | 8.77% | 09:30 | 6.81% |
| No | Adverse weather | 695:04 | 84.31% | 17:09 | 21.64% | 263:21 | 34.03% |
| No | Adverse environment | 3:46 | 0.42% | 01:43 | 0.58% | 00:00 | 0.00% |
| No | 3rd party interference | 36:00 | 4.37% | 11:28 | 14.62% | 07:52 | 8.90% |
| No | Wildlife | 06:02 | 0.73% | 02:54 | 7.02% | 07:59 | 7.33% |
| Yes | Human error | 0:27 | 0.03% | 00:00 | 0.00% | 09:28 | 2.09% |
| Yes | Defective equipment | 54:34 | 6.59% | 35:32 | 33.92% | 42:30 | 26.18% |
| Yes/No | Unknown | 09:53 | 1.16% | 09:19 | 10.53% | 06:31 | 12.57% |
| | **Total** | **858:40** | **100.00%** | **91:18** | **100.00%** | **347:34** | **100.00%** |

Source: Alpine – Table 2 unplanned outage statistics for the years ended 31 March 2014, 2015 and 2016

## Post event reviews and analysis

177. As discussed in section 2.2, Alpine provided only limited post event reviews of a small number of the events where multiple network failures and major outages had occurred. When questioned about this during the onsite sessions, Alpine management confirmed that these were the only reports available.

178. The reports provided by Alpine contained good field observations on the types of prevailing conditions and the types of faults experienced. They also contained information on the underlying causes of the failures and recommendations of actions to mitigate future failure events.

179. The maps of major event days again provided information on the types of failures that had occurred and the extent of the impact of the adverse weather event. Yet not all major event days had been presented in this form of report.

180. In our experience, whilst failure events are undesirable, they also present valuable opportunities to learn. For network asset managers, the lessons obtained can assist asset management planning and inform the locations where investment is needed. For operation managers, the lessons can assist in understanding how the recovery and repair operations performed and areas where there are opportunities to reduce outage durations during future events.

181. Whilst post event reviews may happen informally, the adoption of rigorous formal post event reviews will provide valuable information on how to improve future performance and is aligned with GIP. In our opinion, had Alpine initiated such reviews prior to AP2014 and AP2016, problems could have been identified and action taken to reduce the impact of the AP2016 MEDs.

## 3.1. Opinion on whether Alpine applied GIP

182. The Commission required that we provide opinion on whether or not, having regard to the relevant failure events and triggers, Alpine acted consistently with GIP for each relevant year. The Commission provided the following guidance on how GIP should be considered:

> *whether in relation to any undertaking and any circumstances, Alpine 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.*

183. We also considered Alpine's management of its network against the relevant international standards and our experience of practices applied by other electricity distributors in New Zealand and internationally. In Appendix G we have provided information on how we define and measure GIP asset management when forming our opinion.

184. Taking into account our assessment of the factors, failure events and trigger events, we identified the following four actions Alpine could and should have taken to prevent non-compliance. In our opinion, by not undertaking these actions Alpine did not act consistently with GIP:

    1. investing sufficiently in overhead line assets identified as being old, below specification and/or prone to failure in adverse weather;

    2. earlier and increased investment in vegetation management which could have reduced SAIDI and SAIFI due to vegetation impacting on overhead line assets;

    3. formal and rigorous post event reviews and analysis of asset performance and condition which would have identified areas where Alpine performance during adverse weather events could be improved; and

    4. taking some responsibility for actions that Alpine could take to mitigate both failure and trigger events that it currently considers are outside its ability to control.

185. We found that the network in 2018 is generally in good condition and we observed examples of Alpine's application of GIP in several areas of its asset management practices. However, we found that Alpine's practices prior to and during the Assessment Periods relevant to its non-compliance did not meet GIP in the actions identified above.

186. Had Alpine taken these actions, our opinion is that the failure events in the 2014 Assessment Period could have been reduced. Had Alpine taken these actions before 2015, we believe that the adverse impact on network performance due to failure events in the 2016 Assessment Period could have been reduced sufficiently to have prevented exceedance of the SAIDI quality standard limit for that period and therefore avoided non-compliance.

# 4. Opinion on the steps taken to mitigate future events

187. The Commission asked us to provide:

    1. An opinion on the extent to which Alpine has undertaken actions to prevent or mitigate similar events in the future, including a description of those actions, and an assessment of the likely efficacy of those actions; and

    2. Any recommendations on further actions that Alpine could and should undertake to prevent or mitigate similar events in the future.

188. Our opinion and recommendations on these topics are provided in this section.

## 4.1. Actions that Alpine has taken to prevent future non-compliance

189. We found evidence that Alpine is taking several actions that will improve and develop its asset management capabilities, these include:

    1. continuing increased levels of investment in vegetation management;

    2. commencing the replacement of its weaker and ageing conductors;

    3. developing a strategy for its ageing underground distribution substations in Timaru;

    4. new electronic data capture and management systems have been or are being implemented;

    5. developing a risk based framework for prioritisation of network projects;

    6. recruiting and developing its asset management human resources; and

    7. developing and applying new asset management analytical tools.

190. In addition, we found that the Alpine culture is collaborative and should provide a suitable framework for advancing its asset management capabilities.

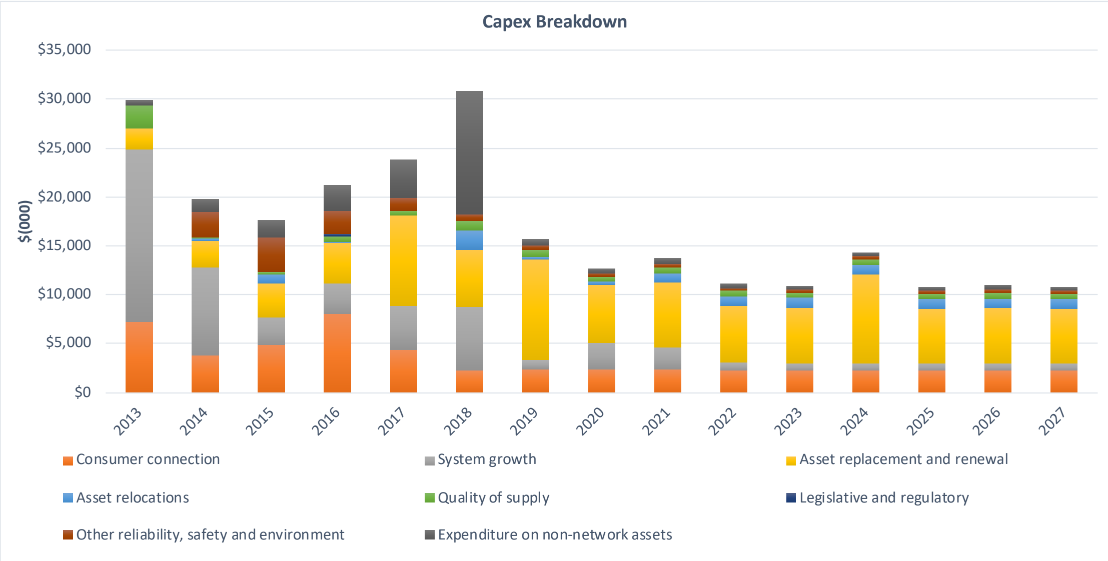
191. Out of these initiatives, the need for increased investment, and the continuing implementation of electronic data capture and analysis tools are worthy of special discussion.

### Impact of actions taken to increase capital investment

192. Alpine has increased its replacement and renewal capex by 320% above historical levels. Replacement and renewal capex increased from $2.175m in AP2013 to $9.209m in AP2017. Forecast annual average replacement and renewal capex for AP2018 to AP2027 is $6.637m which is an average annual increase of 205% above AP2013 actual.

193. Figure 29 shows the major shift from investment in system growth to replacement and renewal that commenced in 2017 and continues for the following decade.

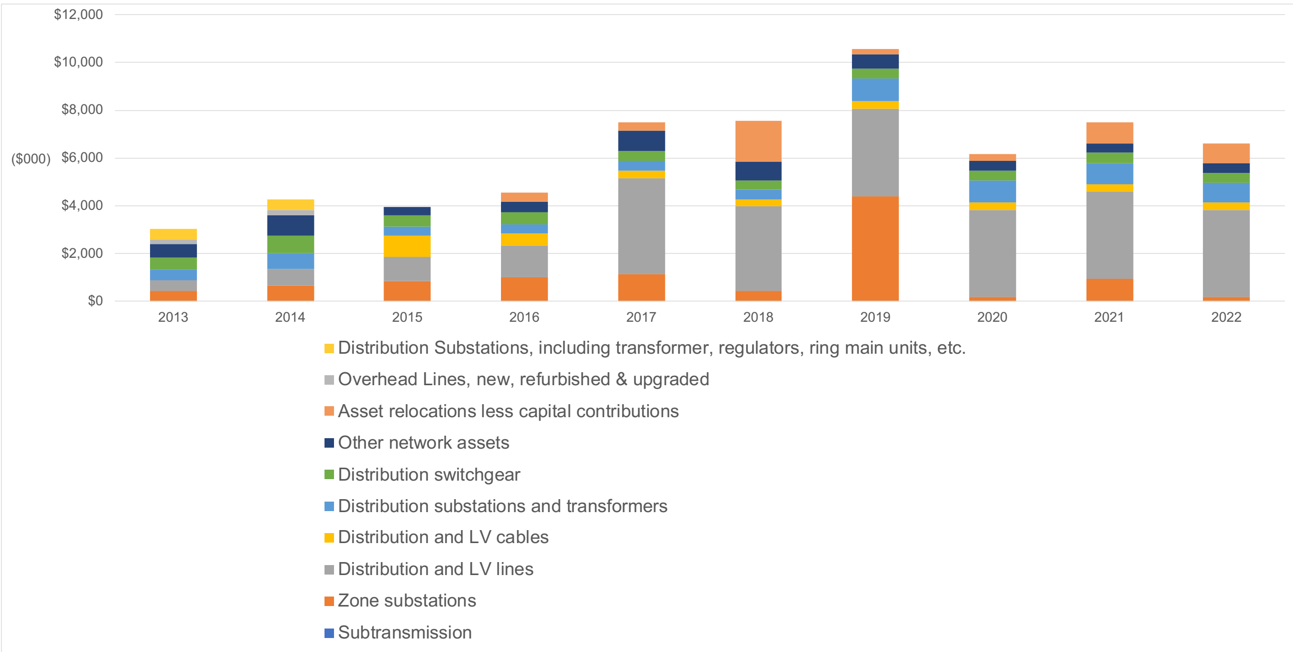
### Figure 29: Increasing investment in replacement and renewal




Source: Alpine Information Disclosure Schedules

194. The components of the replacement and renewal capex forecast in Figure 30 show that Alpine intends to spend the largest proportion of this capex on its overhead lines.

### Figure 30: Replacement and renewal capex components




Source: Alpine Information Disclosure Schedules

195. Key features to note from Figure 30 are:

1. 2017 overhead line replacement capex (Grey) is 783% above the actual spent in 2013;

2. average annual replacement and renewal capex for 2018 to 2022 is $3.624m which is 692% above that actually spent in 2013;

3. increase in distribution substation and transformer expenditure (Blue) in 2019 onwards expected to be for replacement of underground distribution substations; and

4. zone substations (Orange) relocation and upgrading of the Twizel zone substation $4m planned for 2019.

196. These are very significant increases that must deliver improved confidence in the network's ability to perform well, including during adverse weather.

197. We consider that Alpine's capital investment in its mobile substation and back up diesel generation units will be important in maintaining supplies to consumers during the planned work on its network and during unplanned outage repairs.

## Introduction of electronic data capture and analysis tools

198. Alpine has provided information on and described its future development plans for its information technology systems. From Alpine's information, we understand that significant progress has been made in establishing electronic data capture using the ESRI GIS and Schneider ArcFM tools integrated with the Technology One single asset register and data store.

199. We saw that the investment in these systems in terms of both money and the commitment of management and staff has been considerable. This commitment will need to continue as the systems will require further development and adaptation to meet Alpine's specific needs.

200. We noted that Alpine plans to use the information technology systems to provide improved data checking and reporting including the introduction of field mobility options. During the onsite sessions, we saw potential from the integrated suite of systems centred on Technology One to make an impact on future network performance. One example presented by Alpine was the use of the combination of GIS and Technology One for vegetation management. Alpine informed us that:

> *Since establishing the Vegetation Management database we have seen a dramatic decline in SAIDI implications associated to tree faults. At present (March 2018) the vegetation management database is being replaced by Technology One with vegetation information viewable on GIS.*

201. Alpine has already recognised the improvements from Technology One's provision of a single asset register and data store for the majority of asset information, and the integration of this data with GIS records for spatial retrieval. In the future, Alpine is expecting to achieve improved data checking and reporting, introduction of field mobility options and integration with SCADA and ETAP (software for undertaking load flows & fault studies).

202. As discussed previously, we found that the paper based systems Alpine is continuing to replace have been a constraint on its ability to undertake analysis on its assets. Whilst we found that the paper based systems were very good and held important information, gaining access to data embedded in paper based records was virtually impossible. We consider that development of the information technology systems to support asset managers will be extremely valuable in managing the future performance of the assets.

## 4.2. Other actions that Alpine could take to prevent non-compliance

203. In section 2.4 we identified actions that we consider Alpine could and should have taken to prevent non-compliance. In section 3.1 we provided a brief overview of actions that Alpine is undertaking to prevent future non-compliance. We believe that Alpine should continue its commitment to fully implement these actions.

204. In particular, we have noted the importance of:

    1. the continued commitment to higher than historical levels of asset replacement and renewal capex; and

    2. the continuing commitment to full implementation and development of its data acquisition and analysis tools.

205. Other than emphasising continued commitment to the above, we have no further actions to add to the list.

# 5. How Alpine addressed issues previously identified by Strata

206. The Commission asked us to provide an opinion on the extent to which the concerns noted in Strata's 2012 report on Alpine's reliability performance:

   (a) Have been addressed; or

   (b) Contributed to the non-compliance.

207. Our findings and opinions set out in other sections of this report describe our concerns related to the Commission's specific questions covered in each section. In responding to the question to be addressed in this section we have considered if there are broader concerns that have not yet been discussed.

## 5.1. The issues identified by Strata in 2012

208. In 2012 Strata found that, beyond the short term, the achievement of good network performance would depend on Alpine's continued commitment to:

- development and implementation of a reliability performance improvement plan by Alpine, on the basis of the four action points:
  - improved asset management practices that enable a more proactive approach to be taken; and
  - information and data systems for key asset management functions are significantly improved; and
  - engineering resources continue to be developed; and
  - future capex and opex is sufficient and applied appropriately.
- Assurance that future Compliance Statements are accurate.

209. Strata stated that it would also be useful if AEL reported on progress on implementing the improvement plan in future AMPs and/or in Compliance Statements.

## 5.2. Actions to improve reliability performance

210. We found that Alpine had not produced a specific implementation plan to provide a framework for completing the four tasks that Strata identified in 2012. The recommendation for a 'plan' is important because this applies a governance structure for the development and monitoring of compliance. A plan will also give the tasks visibility in the organisation and allocate accountability for delivery to specific people. Given Alpine's previous non-compliance, implementation of a plan to ensure that focus was applied to reliability performance was an important recommendation that should have been acted upon.

211. During the onsite sessions[26] Alpine stated that it had addressed Strata's 2012 recommendations by:

    1. continuing to implement improved asset management practices that enable a more proactive approach to be taken; and

    2. significantly improving information and data systems for key asset management functions; and

    3. continuing to develop engineering resources; and

    4. ensuring that future capex and opex is sufficient and applied appropriately.

212. Discussion on our findings on each of the above points are provided below.

### Improvement of asset management practices

213. We concur with Alpine that it has continued to take steps to improve its asset management practices. This view is evidenced by the development and implementation of an integrated suite of asset management and operational systems and tools. We found that Alpine's asset management capability has increased markedly through the provision of these tools and the development of asset management human resources.

214. The development of Alpine's asset management framework is guiding asset managers to apply GIP through the application of asset policies and strategies. We noted that Alpine had taken steps to align its asset management practices with ISO:55000 and that this was evident during the onsite sessions and through Alpine's continuing development and application of asset lifecycle policies and asset fleet strategies.

215. We saw evidence that Alpine has sought to learn from the practices, systems and tools used by other network businesses for asset management. It was clear that Alpine had adopted some practices used by Transpower and applied these to the management of its distribution network. Alpine had also researched the systems used by other EDBs before making its decision to purchase the Technology One system. We consider that this is evidence that Alpine is making efforts to gain broader knowledge of practices applied by its peers and through this gain a better understanding of GIP.

216. Since 2012 Alpine has established a risk policy that is based on ISO:31000 and this policy has been peer reviewed. The implementation of this initiative is currently progressing through a risk management framework that is being developed internally. We found that the conceptual framework for the further development of the risk strategy is aligned with ISO:31000 and a commonly used matrix approach is being used to standardise risk

[26] 4AEL Presentation on network data and information.pptx

identification methods and prioritise risk treatments. We consider that the risk framework that Alpine described is aligned with, and in some respects, ahead of.

217. The risk framework presented to us during the onsite is still in its conceptual stages and our impression is that it is being driven by a single manager. The implementation of risk frameworks can be difficult to roll out and will need to become accepted across Alpine, NETcon and other contractors.

218. We consider that through the development and investment in its systems and tools Alpine has made good progress since 2012 in improving information and data systems for key asset management functions.

## Improvement of data and information systems

219. We have discussed Alpine's data and information systems in other sections of this report. In terms of progress since 2012 we have seen, and recognise the improvements being derived from several new and developing systems and tools. Alpine provided[27] the following list of information and data systems developments together with the implementation dates:

- Technology One – 2017
- Esri GIS system – 2017
- Adept drawing management system – 2017
- Survalent SCADA system 2014
  - OMS 2018
  - ASOP 2019
- ETAP
  - Server licence 2016
  - Rebuily models 2017/18
- Vegetation management database in Technology One – 2017

220. We observed the use of these systems in action during the onsite sessions and concur with Alpine that they are a significant step change from the systems that were used in 2012. As the dates indicate, all the systems have taken some time to implement, for many five years since 2012. Whilst the timeframes could have been reduced, we saw evidence that demonstrated the care and attention that Alpine has taken in researching and developing its systems. This is important to avoid stranded investment if systems have to be abandoned.

221. During our field trip observations (see Appendix ) we concluded that the present process to move data gathering to Tablets with the associated automatic uploading of data into the Technology One database project should continue as fast as possible. This will allow the information being gathered to be properly analysed to ensure failure trends are quickly identified and to assist with more accurate forward forecasting of workloads and the associated expenditures.

222. The improvement in data and information systems is work in progress as there is a major task ahead in populating the databases and gaining experience in their use and application. There is significant potential for Alpine to realise significant benefits in terms of asset management and operational decision making by building on the foundations it has put in place.

[27] 4AEL Presentation on network data and information.pptx, slide 14

223. We have concluded that Alpine has made good progress towards addressing our concerns regarding its data and information systems.

224. In addition, we have considered Alpine's investment in its new data and information systems and concluded that the accuracy and reliability of its data will continue to improve as it reduces its reliance on paper based systems.

225. We have identified that Alpine's Information Disclosure schedules since 2013 were unusual because of the high number of assets for which Alpine held no condition information (e.g. condition unknown). This led us to assume that Alpine did not know the condition of many of its asset fleets.

226. During the onsite sessions, we found that despite the data limitations outlined above, Alpine's managers had a reasonable level of knowledge of the condition of asset fleets. This knowledge had been formed through review of field maintenance, fault and inspection records.

227. We found that in 2008, Alpine had initiated an independent condition investigation and report on its overhead conductor fleet. The report from this investigation provided Alpine with a detailed view of the condition of its conductors and the expected remaining life for different types of conductor. Yet in its Information Disclosure schedules, Alpine reported that the condition of its conductors was 'unknown'.

228. We found that management decided against submitting age based condition schedules and instead applied the 'unknown' grade. We consider that Alpine's approach would have been appropriate had it not been for the fact that it held a good level of knowledge on the condition of its assets. The key issue for Alpine was accessing the condition information it held and converting it into a condition grade score.

229. In our opinion Alpine should take steps to correct the asset condition data provided in its Information Disclosure schedules to reflect the best information that it has on the condition of its assets.

## Continuing to develop engineering resources

230. Alpine informed us[28] that it has increased the number of staff working in asset management from 26 in 2012 to 51 in 2018. Alpine has also continued the alignment of its departments with ISO:55000. These achievements indicate that Alpine has applied effort to developing and improving its engineering resources.

231. During the onsite sessions several presentations were given by Alpine's engineering resources and we met and held discussions with others. Several of our discussions were with engineers that had been recently recruited by Alpine. We formed the view that Alpine had either retained or maintained access to its more senior engineers and, most importantly, their knowledge and experience, whilst developing its more junior engineering resources. We found that, through this approach, there was evidence that Alpine has taken a sound approach to developing its engineering resources.

232. NETcon staff appeared to be long serving with good knowledge of the area and assets. Much of the institutional knowledge within NETcon has, to date, been retained and appears to be being used in setting up the new systems.

[28] 4AEL Presentation on network data and information.pptx, slide 15

### Ensuring that future capex and opex is sufficient and applied appropriately

233. We have discussed our findings and opinions on the sufficiency and application of Alpine's capex and opex in sections 2.4 and 3. Other than these concerns we consider that Alpine has demonstrated that since 2012, it has developed its asset lifecycle policies and fleet strategies to align with GIP including ISO:55000. This alignment is providing opportunities for Alpine to apply efficient optimisation of its capex and opex when making asset management and operational decisions.

234. Alpine's management team demonstrated how they have applied asset lifecycle approaches to power transformers. This included the policy of applying mid-life life extending refurbishment to the transformers to defer future asset replacement capex.

235. We consider that as Alpine roles out its asset lifecycle policies across all fleets, it will realise efficiencies through optimisation of its resources whilst improving reliability performance.

236. Other for the issues we have set out in other sections, we have found that Alpine has taken appropriate steps since 2012 to address or previous concerns regarding the application of its capex and opex.

## 5.3. Actions to ensure that future Compliance Statements were accurate

237. In 2012 Strata found issues relating to its collection of SAIDI and SAIFI data and that these caused errors in its reporting to the Commission in its Compliance Statements. In this review we have reviewed Alpine's current processes and methods for collection of SAIDI and SAIFI data and found that the issues identified in 2012 have been addressed.

## 5.4. Condition of network in 2018

238. We have discussed our findings on the condition of specific asset fleets in section 2 and in our record of the field visit observations provided in Appendix D.

239. As discussed in section 3.1 we found that Alpine's practices prior to and during the Assessment Periods relevant to its non-compliance did not meet GIP in some respects. Notwithstanding these issues, we found that Alpine's network in 2018 is generally in good condition and has been well maintained, examples of this are:

- power transformers receiving life extending refurbishment at 25 years; and
- records showing that in 2017 there were no zero rated poles to be addressed.

240. Remaining lives of most assets indicate that Alpine has been managing an appropriate asset replacement programme (other than as noted in the ageing overhead line issues discussed in section 2).

241. In 2008 Alpine engaged expert advisors[29] who determined its conductor life expectations for the benign environment in the Canterbury back country. Assuming that conductor life values are appropriate, Alpine will have a significant ability to defer its conductor replacements beyond those of many other EDBs. If the expected lives turn out not to be appropriate, Alpine may have to undertake a major reactive conductor replacement programme as failure rates increase. Such a programme may be difficult to resource and be expensive.

242. We consider that the expected overhead conductor life spans of 100 years plus for copper, steel, aluminium and aluminium steel reinforced (ACSR) conductors is long. Generally, in New Zealand and Australia, we have seen 45 years as the expected life, this is also consistent with the EEA's AHI Guidelines and the Commission's asset age expectations set out in the CPP Inputs Methodology.

243. We recommend that Alpine considers undertaking further analysis of its conductor study to update and reconfirm the findings of the 2008 study.

[29] Quest 11kV Conductor Life Assessment Strategies for Asset Management, August 2008, 2008 Conductor Assessment.pdf

# 6. Summary

244. In this report, we have set out our consideration of information provided by the Commission and Alpine and other information sourced independently. The following is a summary of our findings relating to Alpine's non-compliance.

245. The factors contributing to Alpine's non-compliance were:

1. the impact on SAIDI due to unplanned outages on four major event days in the 2014 Assessment Period;
2. the impact on SAIDI due to unplanned outages at times other than major event days in the 2014 Assessment Period;
3. SAIFI performance on the Waimate feeder during the 2014 Assessment Period; and
4. the SAIDI performance on the Woodbury, Cave and Fairlie feeders during the 2016 Assessment Periods.

246. The failure events contributing to Alpine's non-compliance were:

1. weaknesses in some overhead line assets that made them prone to failure events during adverse weather;
2. vegetation as a failure event that contributed to Alpine's non-compliance and could have been mitigated had Alpine increased investment in vegetation management earlier than it did; and
3. third party interference which made a material contribution to Alpine's AP2014 SAIDI and again, mitigation could have avoided exceedance of the SAIDI limit in AP2016.

247. The trigger events contributing to Alpine's non-compliance were:

1. high wind occurring on MEDs and other days;
2. failure of asset management to address issues with some overhead line assets; and
3. insufficient investment in control of vegetation risks.

248. Taking into account our assessment of the factors, failure events and trigger events, we identified the following four actions that Alpine could and should have taken to prevent non-compliance. In our opinion, in failing to take these actions Alpine did not apply GIP:

1. investing sufficiently in overhead line assets identified as being old, below specification and/or prone to failure in adverse weather;
2. earlier and increased investment in vegetation management which could have reduced SAIDI and SAIFI due to vegetation impacting on overhead line assets;
3. formal and rigorous post event reviews and analysis of asset performance and condition which would have identified areas where Alpine performance during adverse weather events could be improved; and

4. taking some responsibility for actions that Alpine could take to mitigate both failure and trigger events that it currently considers are outside its ability to control.

249. Notwithstanding the above, in 2018 we found that the network is generally in good condition and that management has a good understanding of the requirements of GIP. During the review, we observed examples of Alpine's application GIP in several areas of its asset management practices. We expect that Alpine will continue to address areas of its asset management practices that are currently failing to meet GIP.

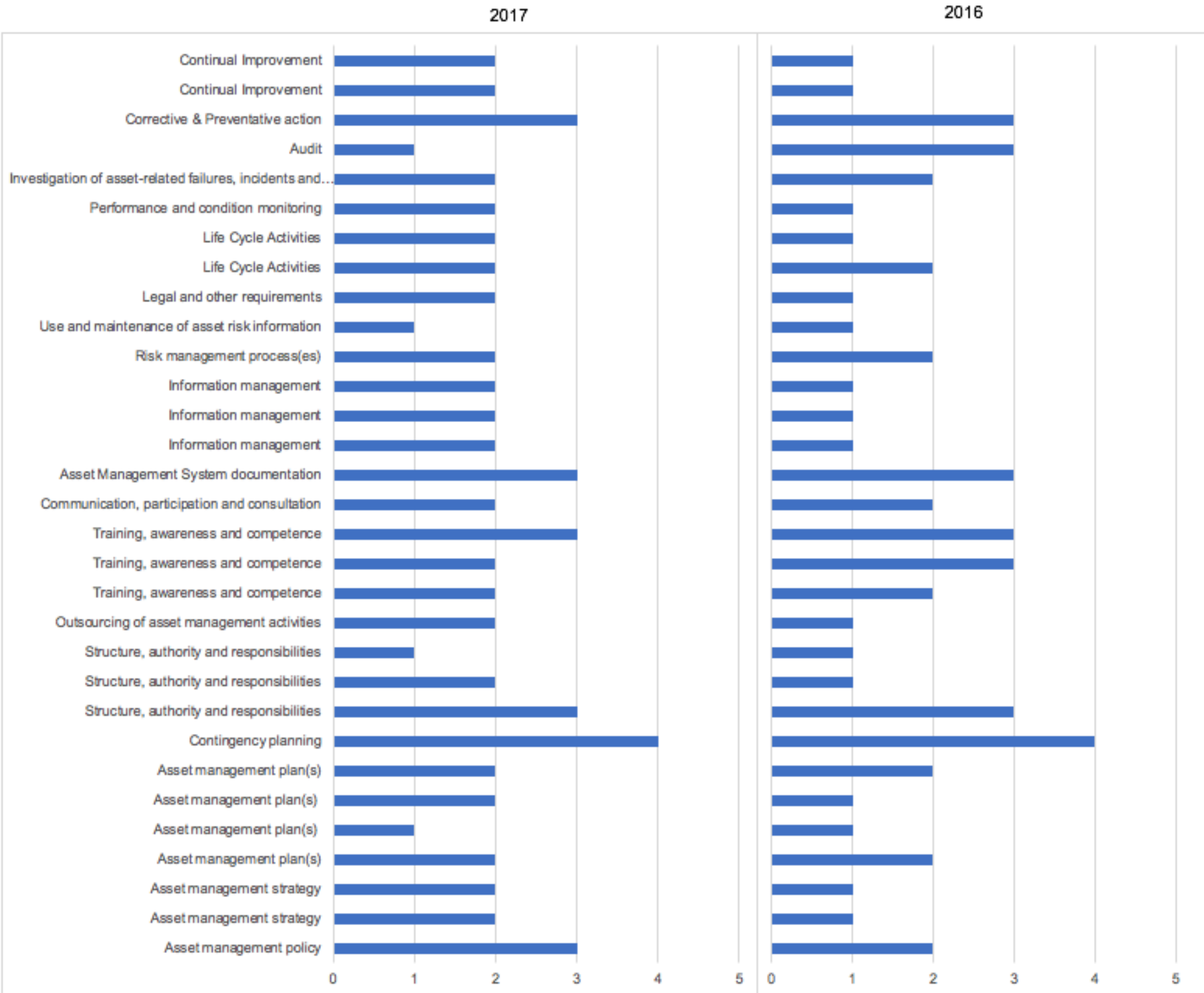
# Appendix A Glossary

| | |
|---|---|
| **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 |
| **Alpine** | Alpine Energy Limited |
| **Capex** | Capital Expenditure |
| **CBD** | Central Business District |
| **Commission** | The Commerce Commission |
| **CPP** | Customised Price Path |
| **DGA** | Dissolved Gas analysis |
| **DPP** | Default Price Path |
| **EDB** | Electricity Distribution Business |
| **EEA** | Electrical Engineer's Association |
| **FMEA** | Failure mode effects analysis |
| **GIP** | Good Industry Practice |
| **GWh** | Gigawatt-hour, a unit of electrical energy |
| **HSWA** | The Health and Safety at Work Act 2015 |
| **ICP** | Installation Connection Point |
| **ID** | Information disclosure |
| **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 |
| **NETcon** | NETcon Limited |
| **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 |
| **WorkSafe** | WorkSafe New Zealand |
| **XLPE** | Cross-linked polyethylene |

# Appendix B Alpine's assessment of its asset management maturity

B.1 Aline's 2016 and 2017 AMMAT score disclosures are provided in the charts below.



# Appendix C Alpine's assessment of its data quality

## C.1 Asset age

| | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| Capacitors including controls | 3 | 3 | 3 | 3 | 4 |
| Cable Tunnels | 1 | 3 | 3 | 3 | 2 |
| Centralised plant | 3 | 3 | 3 | 3 | 4 |
| Relays | 2 | 2 | 2 | 1 | 2 |
| Concrete poles / steel structure | 3 | 3 | 3 | 3 | 3 |
| Wood poles | 3 | 3 | 3 | 3 | 3 |
| Other pole types | 3 | 3 | 3 | 3 | 3 |
| Protection relays (electromechanical, solid state and numeric) | 0 | 0 | 0 | 0 | 0 |
| CADA and communications equipment operating as a single system | 1 | 1 | 1 | 1 | 4 |
| Distribution UG XLPE or PVC | 2 | 2 | 2 | 2 | 2 |
| Distribution UG PILC | 2 | 2 | 2 | 2 | 2 |
| Distribution Submarine Cable | 4 | 4 | 4 | 4 | 0 |
| Distribution OH Open Wire Conductor | 3 | 3 | 3 | 3 | 3 |
| Distribution OH Aerial Cable Conductor | 2 | 2 | 2 | 2 | 0 |
| SWER conductor | 3 | 3 | 3 | 3 | 4 |
| Ground Mounted Substation Housing | 1 | 1 | 1 | 1 | 0 |
| 3.3/6.6/11/22kV CB (pole mounted) - reclosers and sectionalisers | 0 | 1 | 1 | 1 | 4 |
| 3.3/6.6/11/22kV CB (Indoor) | 0 | 1 | 1 | 1 | 0 |
| 3.3/6.6/11/22kV Switches and fuses (pole mounted) | 3 | 3 | 3 | 1 | 2 |
| 3.3/6.6/11/22kV Switch (ground mounted) - except RMU | 0 | 1 | 1 | 1 | 3 |
| 3.3/6.6/11/22kV RMU | 3 | 3 | 3 | 3 | 3 |
| Pole Mounted Transformer | 2 | 2 | 2 | 1 | 2 |
| Ground Mounted Transformer | 2 | 2 | 2 | 2 | 2 |
| Voltage regulators | 3 | 3 | 3 | 3 | 4 |
| Subtransmission UG up to 66kV (XLPE) | 3 | 3 | 3 | 3 | 4 |
| Subtransmission UG up to 66kV (Oil pressurised) | 0 | 4 | 4 | 4 | 0 |
| Subtransmission UG up to 66kV (Gas pressurised) | 0 | 4 | 4 | 4 | 0 |
| Subtransmission UG up to 66kV (PILC) | 0 | 4 | 4 | 4 | 0 |
| Subtransmission UG 110kV+ (XLPE) | 0 | 4 | 4 | 4 | 0 |
| Subtransmission UG 110kV+ (Oil pressurised) | 0 | 4 | 4 | 4 | 0 |
| Subtransmission UG 110kV+ (Gas Pressurised) | 0 | 4 | 4 | 4 | 0 |
| Subtransmission UG 110kV+ (PILC) | 0 | 4 | 4 | 4 | 0 |
| Subtransmission submarine cable | 0 | 4 | 4 | 4 | 0 |
| Subtransmission OH up to 66kV conductor | 3 | 3 | 3 | 3 | 3 |
| Subtransmission OH 110kV+ conductor | 4 | 4 | 4 | 4 | 4 |
| Zone substations up to 66kV | 0 | 4 | 4 | 4 | 4 |
| Zone substations 110kV+ | 0 | 4 | 4 | 4 | 4 |
| 50/66/110kV CB (Indoor) | 0 | 4 | 4 | 4 | 0 |
| 50/66/110kV CB (Outdoor) | 4 | 4 | 4 | 4 | 4 |
| 33kV Switch (Ground Mounted) | 1 | 1 | 1 | 1 | 4 |
| 33kV Switch (Pole Mounted) | 2 | 2 | 2 | 2 | 4 |
| 33kV RMU | 0 | 4 | 4 | 4 | 0 |
| 22/33kV CB (Indoor) | 0 | 1 | 1 | 1 | 4 |
| 22/33kV CB (Outdoor) | 2 | 2 | 2 | 1 | 4 |
| 3.3/6.6/11/22kV CB (ground mounted) | 2 | 2 | 2 | 1 | 4 |
| 3.3/6.6/11/22kV CB (pole mounted) | 0 | 1 | 1 | 1 | 0 |
| Zone Substation Transformers | 3 | 3 | 3 | 3 | 4 |
| OH/UG consumer service connections | 4 | 4 | 4 | 4 | 4 |
| LV UG Cable | 3 | 3 | 3 | 3 | 3 |
| LV OH Conductor | 3 | 3 | 3 | 3 | 3 |
| LV OH/UG Streetlight circuit | 4 | 4 | 4 | 4 | 0 |

## C.2 Asset condition

| | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| Capacitors including controls | 1 | 1 | 1 | 1 | 1 |
| Cable Tunnels | 0 | 0 | 0 | 3 | 3 |
| Centralised plant | 3 | 3 | 3 | 3 | 3 |
| Relays | 2 | 1 | 1 | 1 | 1 |
| Concrete poles / steel structure | 3 | 3 | 3 | 3 | 3 |
| Wood poles | 3 | 3 | 3 | 3 | 3 |
| Other pole types | 0 | 0 | 0 | 0 | 0 |
| Protection relays (electromechanical, solid state and numeric) | 1 | 1 | 3 | 3 | 3 |
| CADA and communications equipment operating as a single system | 1 | 1 | 3 | 3 | 3 |
| Distribution UG XLPE or PVC | 3 | 2 | 2 | 2 | 2 |
| Distribution UG PILC | 3 | 2 | 2 | 2 | 2 |
| Distribution Submarine Cable | 0 | 0 | 0 | 0 | 0 |
| Distribution OH Open Wire Conductor | 1 | 1 | 1 | 1 | 1 |
| Distribution OH Aerial Cable Conductor | 0 | 0 | 0 | 0 | 0 |
| SWER conductor | 0 | 0 | 0 | 0 | 0 |
| Ground Mounted Substation Housing | 1 | 1 | 1 | 1 | 1 |
| 3.3/6.6/11/22kV CB (pole mounted) - reclosers and sectionalisers | 1 | 1 | 1 | 1 | 1 |
| 3.3/6.6/11/22kV CB (Indoor) | 1 | 1 | 1 | 1 | 1 |
| 3.3/6.6/11/22kV Switches and fuses (pole mounted) | 1 | 1 | 1 | 1 | 1 |
| 3.3/6.6/11/22kV Switch (ground mounted) - except RMU | 1 | 1 | 1 | 1 | 1 |
| 3.3/6.6/11/22kV RMU | 1 | 1 | 1 | 1 | 1 |
| Pole Mounted Transformer | 3 | 3 | 3 | 3 | 3 |
| Ground Mounted Transformer | 3 | 3 | 3 | 3 | 3 |
| Voltage regulators | 1 | 1 | 1 | 1 | 1 |
| Subtransmission UG up to 66kV (XLPE) | 3 | 3 | 3 | 3 | 3 |
| Subtransmission UG up to 66kV (Oil pressurised) | 0 | 0 | 0 | 0 | 0 |
| Subtransmission UG up to 66kV (Gas pressurised) | 0 | 0 | 0 | 0 | 0 |
| Subtransmission UG up to 66kV (PILC) | 0 | 0 | 0 | 0 | 0 |
| Subtransmission UG 110kV+ (XLPE) | 0 | 0 | 0 | 0 | 0 |
| Subtransmission UG 110kV+ (Oil pressurised) | 0 | 0 | 0 | 0 | 0 |
| Subtransmission UG 110kV+ (Gas Pressurised) | 0 | 0 | 0 | 0 | 0 |
| Subtransmission UG 110kV+ (PILC) | 0 | 0 | 0 | 0 | 0 |
| Subtransmission submarine cable | 0 | 0 | 0 | 0 | 0 |
| Subtransmission OH up to 66kV conductor | 3 | 1 | 1 | 1 | 1 |
| Subtransmission OH 110kV+ conductor | 0 | 0 | 0 | 0 | 0 |
| Zone substations up to 66kV | 3 | 3 | 3 | 3 | 3 |
| Zone substations 110kV+ | 0 | 0 | 0 | 0 | 0 |
| 50/66/110kV CB (Indoor) | 0 | 0 | 0 | 0 | 0 |
| 50/66/110kV CB (Outdoor) | 1 | 4 | 4 | 4 | 4 |
| 33kV Switch (Ground Mounted) | 1 | 1 | 1 | 1 | 1 |
| 33kV Switch (Pole Mounted) | 1 | 1 | 1 | 1 | 1 |
| 33kV RMU | 0 | 0 | 0 | 0 | 0 |
| 22/33kV CB (Indoor) | 0 | 4 | 4 | 4 | 4 |
| 22/33kV CB (Outdoor) | 3 | 3 | 3 | 3 | 3 |
| 3.3/6.6/11/22kV CB (ground mounted) | 3 | 3 | 3 | 3 | 3 |
| 3.3/6.6/11/22kV CB (pole mounted) | 1 | 3 | 3 | 3 | 3 |
| Zone Substation Transformers | 3 | 3 | 3 | 3 | 3 |
| OH/UG consumer service connections | 1 | 1 | 1 | 1 | 1 |
| LV UG Cable | 3 | 3 | 3 | 3 | 3 |
| LV OH Conductor | 1 | 1 | 1 | 1 | 1 |
| LV OH/UG Streetlight circuit | 1 | 1 | 1 | 1 | 1 |

## C.3

# Appendix D Field observations

D.1 Site Visits were undertaken on Tuesday 29th and Wednesday 30th to view specific condition assessment (CA) processes and to gain an understanding of the network general condition and its operating environment. It is important to note that the field inspections were not undertaken to provide a detailed assessment of the health of the network, our objectives were to:

(a) to observe how asset information was gathered and recorded; and

(b) to obtain a general impression of the general condition of the assets observed.

D.2 All operational site visits had appropriate Safety Instruction/Tailgate sessions and sign on procedures followed and all visitors had previously been checked as wearing the required levels of PPE.

D.3 Where visits were accompanied by NETcon staff they were all very helpful and were knowledgeable in their specialist areas. All questions and requests for information were answered without hesitation and they co-operated fully.

Day 1 Morning

D.4 The focus of this visit was to review the CA process in use for monitoring poles and associated overhead equipment. The site was south of Timaru and the general network in this area was viewed.

D.5 The two-person team was starting on a series of pole inspections of a line built some 9 years ago, thus this was the first full inspection under the 10 yearly regime operated. The poles were treated softwood. The process of inspection, measurement and photographing was viewed or discussed and the recording sheets examined. Completed sheets from the previous day were also reviewed.

D.6 The present inspection process is a traditional one requiring excavation around the base of the pole to a depth of 500mm below ground level to check the sub surface condition of the pole base. This was achieved by the use of a mechanical excavator followed by hand digging.

Checking pole and conductor height

Pole base inspection – hand digging last part

D.7 In discussions it was identified that Alpine had tried various forms of more modern pole testing/inspection that use various electronic/acoustic techniques to identify the state of the wood below ground level, but so far none had proved to be fully trustworthy with poles identified as solid by them being found to have severely deteriorated pole butts when excavated. Thus, they still retain the traditional process as being the most accurate at present. They are currently testing a further new machine, so far with positive results. If successful this will reduce the time and cost of inspections.

D.8 Back at the office the process followed when the inspections sheets are received was explained and the various outputs examined.

D.9 The information gathered on site is sent for an engineering review to ensure the installation is correctly designed and is fit for purpose. When a sheet identifies that routine (non-urgent) work is required then this is added to a map-based job instruction sheet that forms the basis of a maintenance job-pack for the work to be carried out.

D.10 The industry standard pole marking process is followed (e.g. Red tags for poles that need urgent replacement – within 3 months) and there is a spreadsheet of all red-tag poles maintained to ensure They are promptly actioned outside of the routine process noted above. Several other specific issue spreadsheet registers are also updated as necessary from the inspection sheets.

D.11 When work is completed the inspections sheets with attached work packs are filed and registers updated. It was noted that there appears to be a close ongoing relationship between the Alpine Manager and the NETcon team which assists information flow and decision making.

D.12 During the travelling to and from the site, the condition of the lines and poles was observed along the main road and side roads. There were a few areas with trees that had been trimmed to maintain clearances and no locations were seen where there was obvious encroachment into the clearance zone. Generally, shelter belt trees were on the other side of the road to the line with most being outside of the "fall zone". In one area where the line and shelter belt trees were on the same side of the road, the trees were cut well below the line level and the pollarding on the top of the trunk indicated this has been a long-standing practice.

D.13 The installations appeared to be neat and tidy, conductor sags appeared equal for all phases and no excessive sags were observed. Poles were vertical or very close to vertical, stays were in place where expected and were not slack.

Day 1 Afternoon

D.14 This visit was to view the work recently completed to address the issues that were causing an 11kV feeder to perform poorly (i.e. had been suffering significant numbers of outages resulting in a high number of lost SAIDI minutes. The site was inland from Geraldine (North of Timaru) and the general network in this area was viewed, including travelling though Temuka.

D.15 The project viewed was a substantial line maintenance and upgrade project that had just been completed on what had previously been the company's "worst performing" feeder from an outage and SAIDI minutes perspective. Whilst part of the line was along the normal roadside several km's previously ran across county through a farm and it was this section that was the problem. There was a major problem with trees contacting the line and access to carry out any work was very difficult in this area with flooding common. The line had suffered many breakages and had large numbers of clamps joining wires together.

D.16 Along the roadside sections there were several poles identified as being close to end of life as well as cross arms and insulators. Finally, the conductor was of the type that had been identified as at the end of its life by the independent study undertaken, (Old, small cross section copper conductor) and thus was a hazard.

D.17 The work undertaken involved building a new line along the road so that the existing line through the farm could be removed (with just a service line rebuilt to keep supplies to the farm operations). The existing roadside line had been completely refurbished with new poles, cross-arms, insulators and equipment where required. The line was observed to be in very good condition and there were no tree issues. The construction was all tidy the work appeared to have been carried out to a high standard.

D.18 On the way to and from the site the lines were observed, Geraldine itself was undergrounded along the main road, however side roads remain overhead. No tree issues were noted and the reticulation appeared to be tidy.

D.19 On the way back from the line reconstruction site, the opportunity was taken to view the Geraldine Zone substation (from outside the fence). This substation is a typical rural style installation with outdoor buswork and switchgear. There is a single 33kV line feeding the substation originating in Temuka. Work was underway adjacent to the existing substation to create a connection point for the mobile generator.

D.20 From an outside inspection the substation equipment appeared to be in good condition, there were no signs of significant corrosion and the overhead wiring was neat and tidy.

Geraldine Substation – Hard stand preparation

Typical Reticulation in rural Geraldine Area

Day 2 Morning

D.21 The focus of this visit was to review the CA process in use for monitoring zone substations and distribution substations (i.e. ground mounted equipment). The zone substations were in Timaru CBD (Victoria Street and North Street), the area is all underground. The distribution substation was near Clandeboye, north of Timaru near the coast and the general network in this area was also viewed.

D.22 Technically the CBD zone substations are switching stations as there is no transformation of voltage on site, the substation being fed by 11kV feeders from the Transpower Timaru GXP. The Victoria street site was visited to view old style arrangement with Oil Circuit Breakers (OCB's), electro-mechanical protection relays etc. North street is a very recent substation with modern switchgear (Vacuum type) electronic relays, etc. North street also houses the emergency control room for use if the main deport control room is unavailable for any reason.

D.23 The sites were very tidy and appeared to be maintained to a good standard. For these major asset locations individual check sheets had been developed to cover the specifics of the site and the installed equipment. These were viewed and appear to be well developed and thorough. Returned sheets are reviewed by the manager and any identified issues are put into a work pack, prioritisation is reviewed by the control room. (Any issues identified that require immediate attention are reported directly to the control room).


Victoria Street Substation – OCB's and electro- mechanical relays

North Street Substation – new switchgear, electronic relaying

D.24 From the CBD the route to the distribution substation was up to Temuka then out towards the coast through to a farm/dairy installation near Clandeboye. The distribution substation had been installed nearly 10 years ago and only supplied the single customer, a milking/local milk processing plant.

D.25 The inspection was underway when we arrived and the check sheet was reviewed. The checks and tests carried out are comprehensive and include both Partial Discharge monitoring and Thermal Imaging of the installation. As part of the inspection any minor works are also undertaken such as cleaning cooling fins of grass and it was noted that minor surface rust on the enclosure has been treated with inhibitor and a sprayed top coat of paint.

D.26 There was one issue noted – the ground level had been changed since the original installation resulting the substation being partially below the current finished ground level with a potential flooding issue and also a build up of rubbish/grasses/weeds. As it is a single customer and the substation is on their land the process to address is will be to notify the customer of the issue. The customer could select to change the surrounding ground level or the substation could be raised.

Distribution substation, LV end

Showing ground level issue

D.27 Discussions confirmed that the same (Paper based) process as for pole/overhead CA was followed to produce work packs where further attention was required.

D.28 Again during the travel the network was observed with similar results. Trees were generally on the other side of the road or were well trimmed. Poles and lines were tidy.

Day 2 Afternoon

D.29 This time was spent undertaking a brief inspection driving around the network to gain a general understanding of the network asset condition and the environment in which it operates.

D.30 A good understanding of the state of the network along the coastal area had been gained during the visits noted above so the focus of this visit was to look at the inland areas, the MacKenzie county. The route followed was highway 8 from Washdyke through Fairley via Burkes Pass to Tekapo; then Pukaki and Twizel, changing to the 83 at Omamrama past Benmore to the 82 at Kurow through Waimate and back up the 1 to Timaru.

D.31 There are extensive lengths of feeders with no customers on them until a village is reached, in the high county these are very exposed across the basin, lines typically going across country rather than along the roadway. The general condition of these long lines observed was very tidy, poles were vertical or very close, conductor sag in a span was equal and stay ways appeared to be tight.

D.32 In the villages the distribution was usually overhead with some modern developments located in tourist areas being underground. The reticulation in villages was again tidy and appeared to be fit for purpose.

D.33 Trees were only seen to be an issue growing into the trimming zone and needing attention in the near future in three locations.

D.34 From a shelter belt perspective there were no significant exposures noted where such trees were in parallel with lines, however a common issue noted was that the lines often went through a shelter belt at right angles and only the immediate tree under the line had been addressed, the adjacent trees remained as a threat (Note: there were all well outside the trim zone but were an issue from the fall perspective). There are several Transpower 110kV 220kv and 350kV DC lines in the high-country area and it was noted these also face the same issue with right angle crossings of shelter belts, in some cases there were trees under the transmission lines – trimmed to suit, but full height trees adjacent.

D.35 For the Alpine lines there were several locations observed where there were individual trees, or small clumps, that could be an issue from a fall zone perspective.

D.36 The lines were watched to identify if there were an unusual number of mid span joins in the conductors (which can sometimes indicate breakages) but during the afternoon only two such joins were noted of which one appeared to be as a result of moving pole positions.

Typical Village Reticulation – Fairlie Pass

Typical cross country reticulation – Burkes

D.37 A stop was made at Tekapo Substation to view the installation which appeared to be well laid out and looked to be in good condition. Adjacent to this substation was one of the mobile substation.

Tekapo Substation incoming feeder

Mobile substation parked at Tekapo

## Summary of views on Condition Assessment Process and Actions

D.38 From the processes observed, the inspection sheets completed and the test methods in use it is concluded that the CA process is being carried out to an appropriate standard and detail. The maintenance needs identified appear to be being picked up and addressed though the manual paper-based system – the observed state of the lines and other assets supported this.

D.39 However, whilst spreadsheets were used to track specific issues the lack of an integrated asset management software system means that the analysis of data to look for trends, improvement opportunities, etc has not been carried out. Further the need to manually transfer data from site sheets into spreadsheets introduces the risk if errors in the process. The use of Tablets on site to replace paper and pen is currently being trialled which together with the new asset management software, should see an improvement in this area.

## Summary of view on Network Condition and Operating Conditions

D.40 Note: The following section is based on the limited inspections carried out during this visit and reports on the current condition of the equipment, etc. It is based on the experience of the observer and it should not be construed as a full detailed engineering analysis of the network.

D.41 The overhead lines appeared to be in good serviceable condition. No signs of poor maintenance were seen - such as excessively leaning poles, disconnected braces, uneven conductor sagging, slack or broken stay wires or the extensive use of mid span conductor joints. The poles themselves clearly had a variety of ages with some older poles (50+ yrs) in service, but they appeared to be in good condition.

D.42 In urban areas where overhead lines were in use they followed typical practices for spans and service connections, there were a few instances noted where ornamental trees were clearly an ongoing issue to keep trimmed, but this appeared to be well under control.

D.43 In rural areas many feeders ran for extended distances across country and were very exposed to the elements. As the area suffers from extensive snow falls there will be times when access to fix any issues will be very difficult.

D.44 The number of trees that represented a “Fall Zone” type hazard looked to be generally lower than for other previously observed networks, however the right-angle crossing of shelter belts did pose potential damage problems.

D.45 The underground system (Substations, LV pillars, etc) similarly appeared to be in good condition and well maintained, this applying to areas observed outside of the accompanied visits.

D.46 The present process to move data gathering to Tablets with the associated automatic uploading of data into the Tech One database project should continue as fast as possible. This will then allow the information being gathered to be properly analysed to ensure failure trends are quickly identified and to assist with more accurate forward forecasting of workloads and thus expenditures.

D.47 Ongoing pressure must be kept on tree trimming and the exiting approach of working with land owners to try to remove fall zone trees continued. Whilst the lines were currently observed to be clear from trees, this situation can deteriorate very quickly if the impetus is lost with the associated increase in outages.

D.48 It is clear that access to many locations under extreme weather conditions is poor. Many of the smaller communities are reliant on single line feeds (which are clearly totally uneconomic to duplicate) so the use of mobile standby generators to provide (even restricted) supplies is appropriate and consideration could be given to increasing the present fleet to enable them to be spread across the geographical area.

Strata ENERGY CONSULTING

# Appendix E Alpine's annual asset inspection records

| NETcon | Check Sheet<br>Distribution Transformers 1-Yearly Maintenance | NCT_CS_010<br>Page 1 of 3 |
|---|---|---|
| | Alpine Energy Standard AEL.MS.006 | |

*The annual maintenance applies to all Ground Mounted Transformers and 2-Pole Transformers*

| | | | |
|---|---|---|---|
| Location *(address)* | | | |
| Distribution Substation No. | | | |
| Transformer Serial No | | Manufactured Date | |
| Manufacturer | | | |
| Technician | | Inspection Date | |

**Visual inspection**

| **Chkd** *Tick the box below* | **Description** | **Defect Code** *(As per footer)* |
|---|---|---|
| **Ground Mounted Transformers General Visual Check** | | |
| ☐ | Cubicle is clean, free from debris | |
| ☐ | Any damage or corrosion is within acceptable limits | |
| ☐ | Doors are in sound condition and secure | |
| ☐ | Door latches are effective and in good condition | |
| ☐ | Area around the unit base is clear of rubbish and weeds and an adequate gap at floor level is maintained by the base floor mounting to prevent moisture build up. | |
| ☐ | Hazard label is attached in a prominent position and legible | |
| ☐ | AEL asset ownership and identification labels are attached and legible | |
| ☐ | Mounting and foundations are visually secure and free from damage, settling, cracking and spalling | |
| ☐ | Thermochromics strip indication is within acceptable range (50 degrees C – 100 degrees C) | |
| ☐ | Equipment and associated cables, particularly cable crotches, are visually free from signs of electrical discharge and tracking. Cables are undamaged | |
| ☐ | Silica gel desiccant breathers are dry and full (where fitted) | |
| ☐ | Desiccant has been replaced where indicated by colour | |
| ☐ | Oil levels clearly visible in sight glass (where fitted); sight glass or level indicators are clean and secure | |
| ☐ | No visible oil leaks from bushings, Tap Changer or tank | |
| ☐ | Breathing vent transport plug removed (free-breathing units) | |
| ☐ | Tap change mechanism bolted and locked on tap: ________ | |
| ☐ | Earthing connections are visually secure, undamaged and free from corrosion | |
| ☐ | Debris such as bird nests, vermin, vegetation, rags are cleared from the site | |
| ☐ | Any surface corrosion is within acceptable limits | |
| ☐ | Any site hazards encountered are noted in the comments section below. | |

| Failure timeframe | Fixed while on site | Reported as a Fault | Replace / repair within 3 months | Replace / repair within 12 months | Replace / repair within 1-3 years |
|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 3 | 4 |

| Author | NETcon Technical Services | Approved By | | Revision No. DRAFT 3 | Issue Date | 29/12/2016 |
|---|---|---|---|---|---|---|

Printed copies are uncontrolled

| NETcon | Check Sheet<br>Distribution Transformers 1-Yearly Maintenance | NCT_CS_010<br>Page 2 of 3 |
|---|---|---|
| | Alpine Energy Standard AEL MS.006 | |

| Chkd *Tick the box below* | Description | Defect Code *(As per footer)* |
|---|---|---|
| **2-Pole Substation Transformer General Visual Check** | | |
| ☐ | HV/LV Insulators and bushings are visually clean, unbroken and secure | |
| ☐ | Support structure, tank and radiators are visually undamaged, clean and free from graffiti, secure, free from corrosion, damage and leaks | |
| ☐ | Oil levels are clearly visible in sight glass (where fitted); sight glass or level indicators are clean and secure | |
| ☐ | No oil leaks are visible from bushing or tank | |
| ☐ | Breathing vent transport plug removed (free-breathing units) | |
| ☐ | Tap change mechanism is bolted or locked on tap: ________ | |
| ☐ | All mounting bolts are correct for number, size and condition with no visual damage, and secure. Any corrosion is within acceptable limits | |
| ☐ | Signs and equipment numbers are legible, firmly secured and contain up to date information | |
| ☐ | Hazard label is attached in a prominent position and legible | |
| ☐ | Any surface corrosion is within acceptable limits | |
| ☐ | Earthing connections are visually secure, undamaged and free from corrosion | |
| ☐ | Debris such as bird nests, vermin, vegetation, rags are cleared from the site | |
| ☐ | Site is free from weeds and un-intended plant growth, including mould | |
| ☐ | Site is free of vegetation rubbish and trimmings | |
| ☐ | Timber supports bolts are secure and tightened. There is no visually defective timber or cracks in the timber | |
| ☐ | Steel supports bolts are secure and tightened. No corrosion affecting the structural integrity or main structural members. | |
| ☐ | There is no possible public access to the transformer or other live equipment | |
| ☐ | Statter LV circuit breaker switch indication is correct and visibly in good condition | |

| Ground Mount Load Check | | | | | |
|---|---|---|---|---|---|
| MDI Reading (actual meter reading) | A | B | C | | |
| CT Ratio (✓) | 1000:5 | 800:5 | 500:5 | 250:5 | Other |
| If no MDI's installed take Clamp meter reading & record time of reading | A | B | C | Test Time | |
| | | | | Test Date | |

MDI's Reset________________ Date: ____________

| Asset ID | Location | Time | Red | Yellow | Blue | Neutral | Comments |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| Failure timeframe | Fixed while on site | Reported as a Fault | Replace / repair within 3 months | Replace / repair within 12 months | Replace / repair within 1-3 years |
|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 3 | 4 |

| Author | NETcon Technical Services | Approved By | | Revision No. DRAFT 3 | Issue Date | 29/12/2016 |
|---|---|---|---|---|---|---|

Printed copies are uncontrolled

Strata ENERGY CONSULTING

| NETcon | Check Sheet<br>Distribution Transformers 1-Yearly Maintenance | NCT_CS_010<br>Page 3 of 3 |
|---|---|---|
| | Alpine Energy Standard AEL.MS.006 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Thermal – Acoustic – Partial Discharge**

| Thermal Scan | Ultrasonic Scan | Partial Discharge Scan |
|---|---|---|
| PASS / FAIL / N/A | PASS / FAIL / N/A | PASS / FAIL / N/A |

| | |
|---|---|
| ☐ | Thermographically Scan Equipment:<br>Scan with thermographic camera to check for hot spots. Record any connections that are more than 10°C hotter than those on the rest of the unit. |

**Defects fixed on site**

| Description | Qty | Time | PO Requested |
|---|---|---|---|
| *Describe work done on site, materials used* | | | |
| | | | |

**Condition Assessment Score** *Circle one*

| Condition | Definition |
|---|---|
| 1 - Excellent | No detectable degradation |
| 2 - Good | No visible significant condition issues; 60%-80% of remaining design life. |
| 3 – Medium | Sound condition; no visible serious condition issues; 40% - 60% of remaining design life |
| 4 - Poor | Is generally in poorer condition than for the above categories; <5 years of remaining service life. |

**Comments**

**Quality Assurance**

| | | |
|---|---|---|
| Signed by Technician as complete and accurate.<br>Results recorded on relevant test card and check sheet | *Signature* | *Date* |

| | | | |
|---|---|---|---|
| Reviewed in office for completeness | *Name Please print* | *Signature* | *Date* |

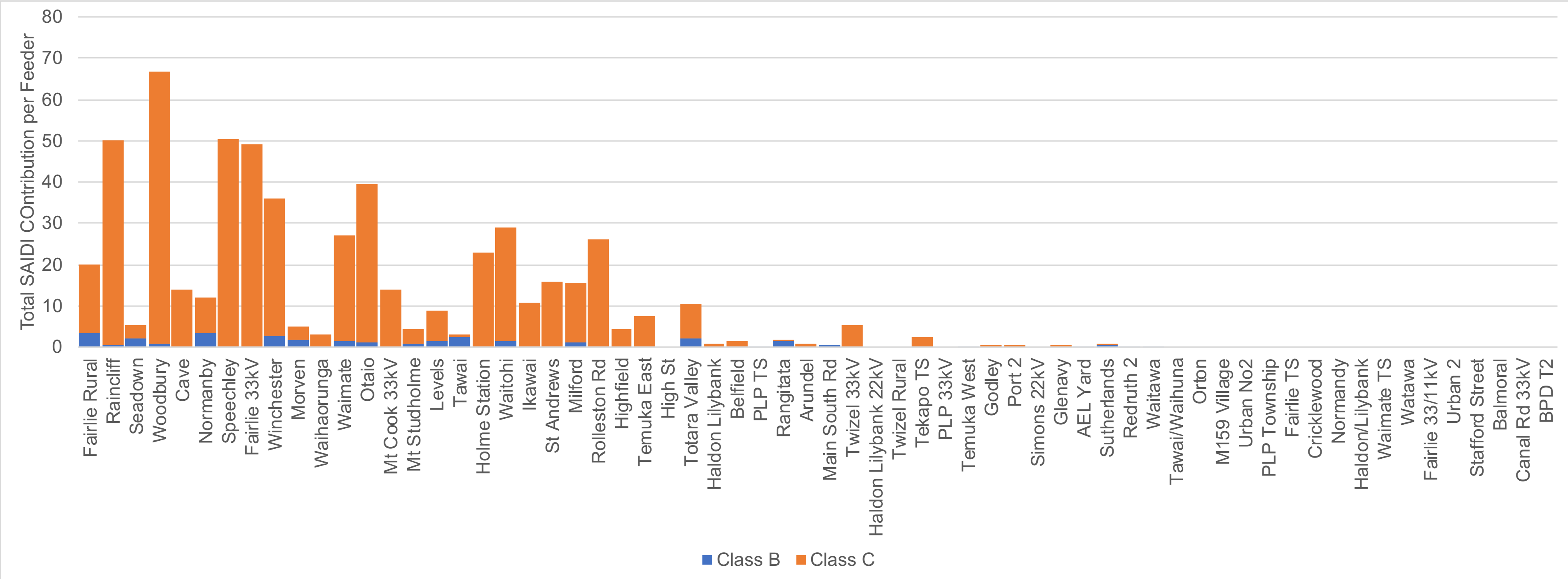
| Failure timeframe | Fixed while on site | Reported as a Fault | Replace / repair within 3 months | Replace / repair within 12 months | Replace / repair within 1-3 years |
|---|---|---|---|---|---|
| Priority | 0 | 1 | 2 | 3 | 4 |

| Author | NETcon Technical Services | Approved By | | Revision No.<br>DRAFT 3 | Issue Date | 29/12/2016 |
|---|---|---|---|---|---|---|

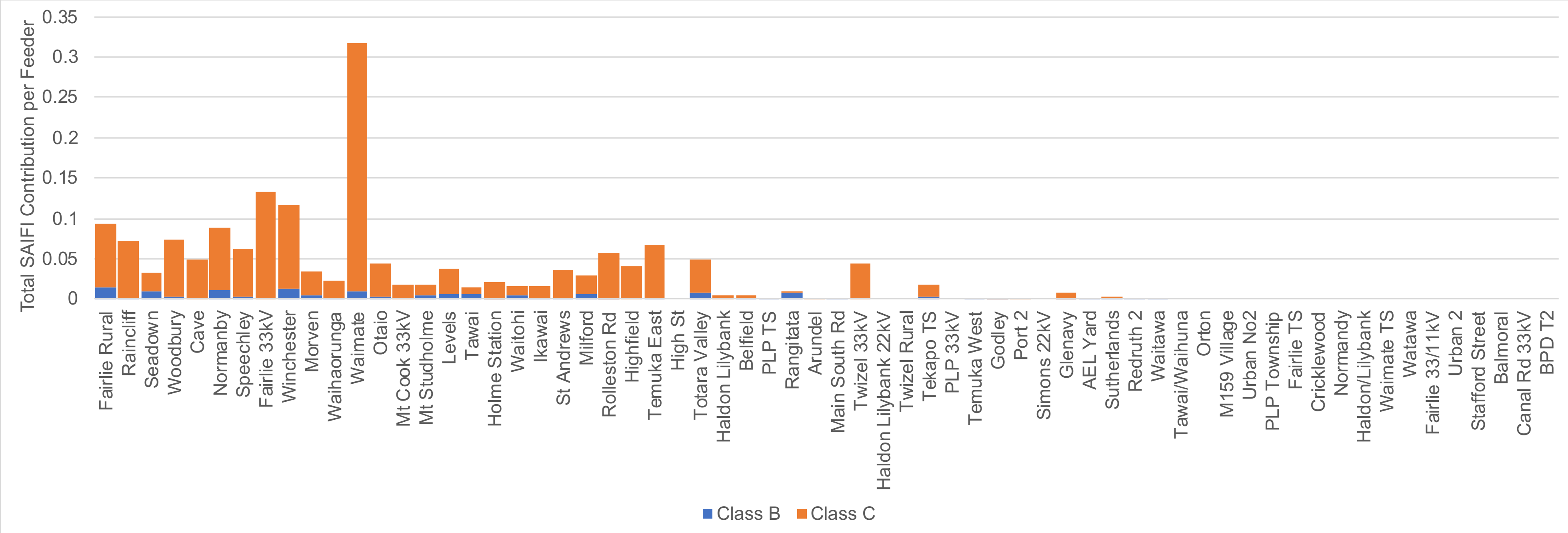
Printed copies are uncontrolled

# Appendix F Larger format charts

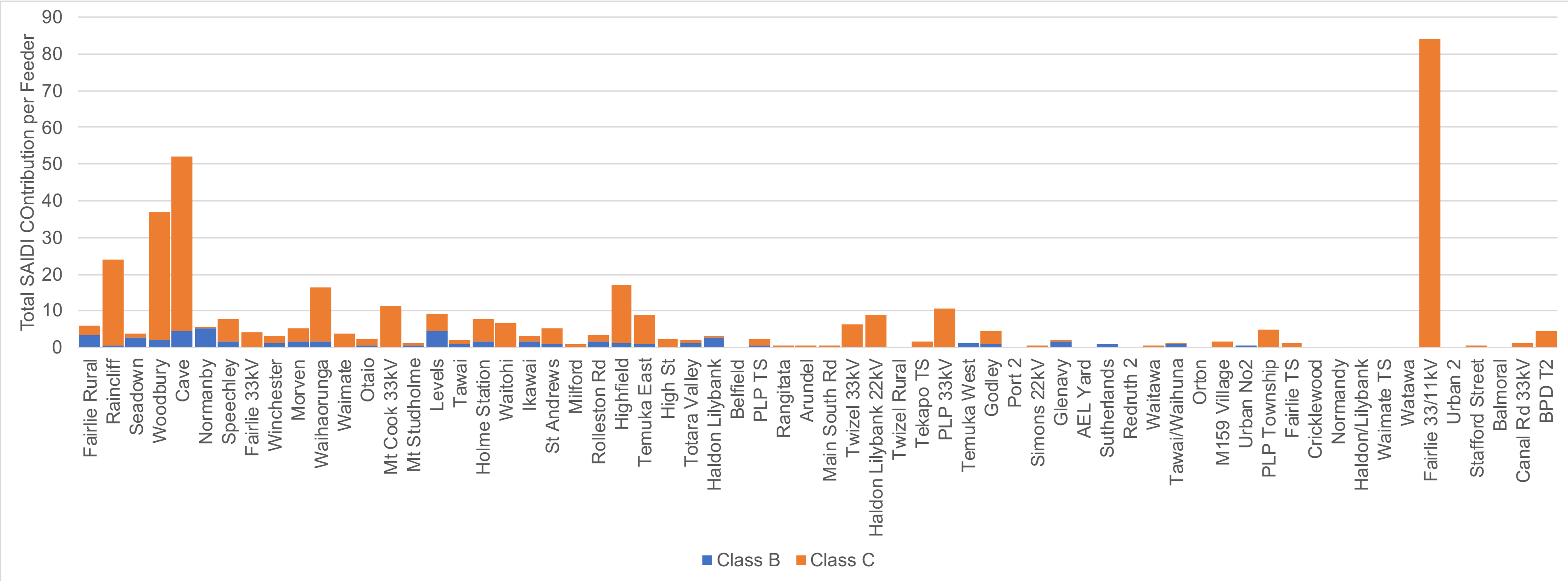
F.1 Figure 5 SAIDI by feeder during the 2014 Assessment Period



F.2 Figure 6 SAIFI by feeder during the 2014 Assessment Period



F.3 Figure 7 SAIDI by feeder during the 2016 Assessment Period



# Appendix G Defining and measuring Good Industry Practice asset management

G.1 The Commission asked that, when we form opinions on whether Alpine acted in accordance with Good Industry Practice, we should consider whether Alpine 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:

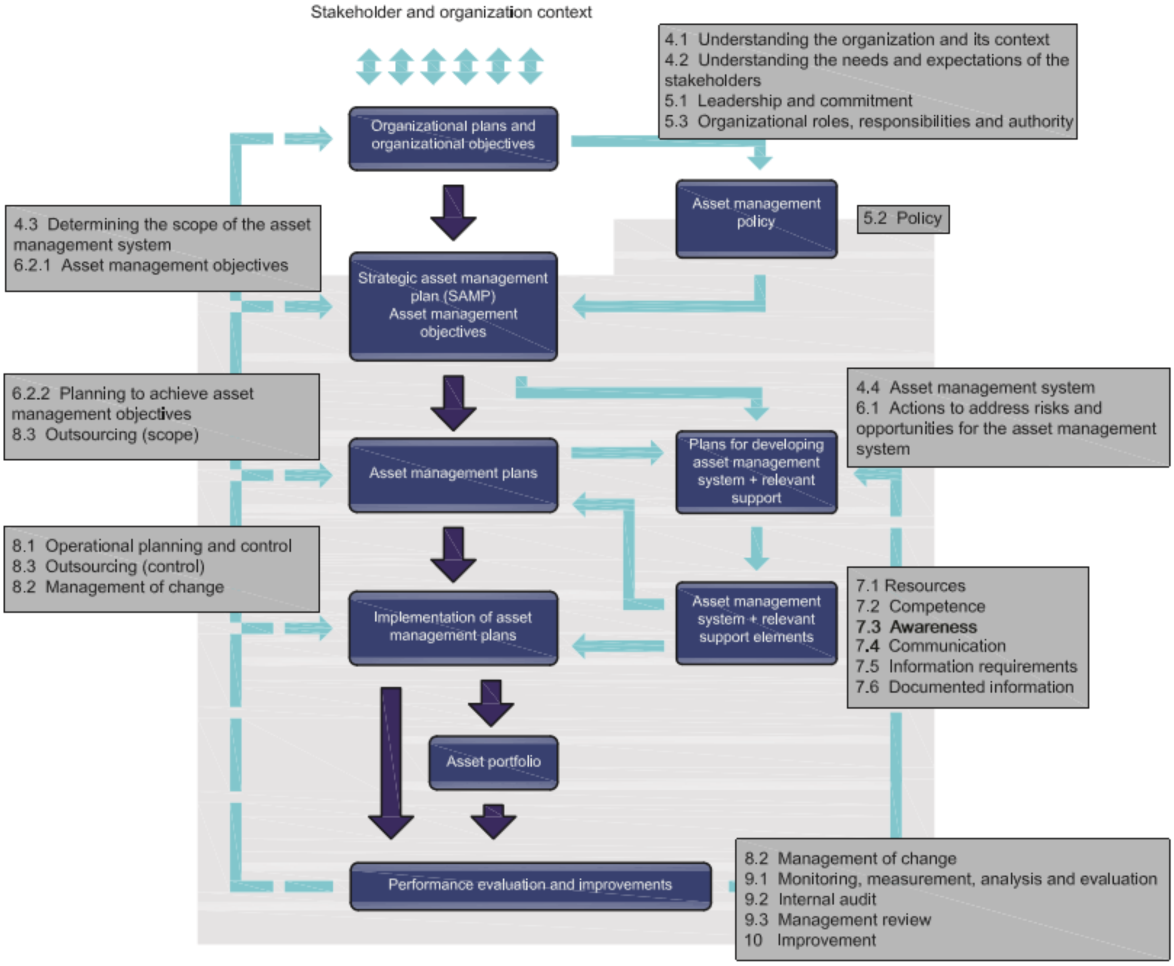
- AS/NZS – ISO55001 – which specifies requirements for an asset management system;
- AS/NZS-ISO31001 – which specifies requirements for risk management;
- AS/NZS-ISO14001 – which specifies requirements for environmental management; and
- NZS 7901 – which specifies the requirements for safety management 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.*[30] 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.[31]

**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 the 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 the present and future needs of its customers at the least whole-of-life cost. The asset

[30] ISO 55000, section 2.5.1
[31] There are also internationally recognised guidelines to complement the ISO 55000 suite, such as the International Infrastructure Management Manual (IIMM)

objectives must 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 the 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[32] or replacing) the asset(s).

G.10 Justification for renewing individual assets or asset fleets[33] 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.[34] The principles for establishing that there is a bone fide case for the impending need to retire an asset or asset fleet include:

1. evidence that the asset condition monitoring and assessment is robust (i.e. not biased towards overstating the likelihood of asset failure); and
2. 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[35] value with the consequences of failure.[36] 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.

---

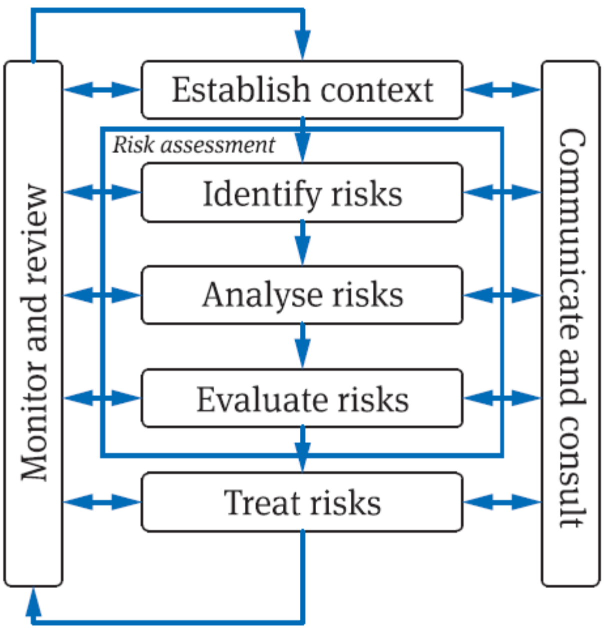
[32] This is essentially a life extension strategy and includes, for example, reinforcing wooden poles at the base or replacing components such as seals in switchgear.
[33] If the assessment is applied to an asset 'fleet', then there should be sufficient evidence that the condition assessment and assessment of risk of failure is applicable to the asset fleet.
[34] 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).
[35] 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.
[36] 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 referred to as the reference for Good Industry Practice providing a framework and process for managing risk.

**ISO 31000 – risk management process**




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[37] 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 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.[38] 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 EDB's asset management systems and practices against the requirements of the PAS 55 Asset Management Methodology[39] which was superseded in 2014 by the ISO 55000 suite.

---

[37] For example, run-to-fail, proactive replacement based on condition, proactive replacement based on obsolescence

[38] Under Part 4 of the Commerce Act 1986

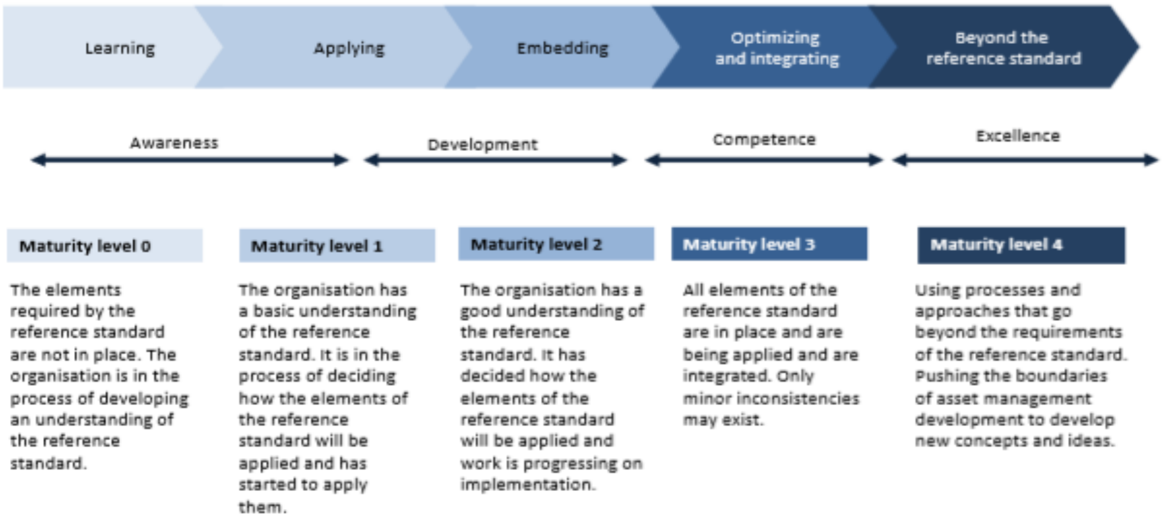
[39] Publicly Available Specification, published by the British Standards Institution in 2004

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;
- 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.

**AMMAT asset maturity levels**




Source: Commerce Commission, How mature are electricity distributors' asset management practices[40]

## 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.

[40] Commerce Commission, *How mature are electricity distributors' asset management practices*, EEA Conference and Exhibition, 2013, page 3