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Visibility of Low Voltage Networks across Electricity Distribution Businesses

Summary report - Disclosure year 2024

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CONTENTS

Glossary 3

Purpose 4

Background 4

Summary of disclosures 6

Smart Meters 6

Access to Smart Meter Data 6

Data Collected using Smart Meters 6

Uptake 7

LV monitoring devices 8

Other data collection 9

Modelling and insights 9

Conventional Approaches 9

Advanced Data Utilization 10

Collaboration with Insights Specialists 10

Use of GIS 11

Planned practice 11

Challenges 12

Access to Smart Meter Data 12

Real-Time Data and Coverage 12

Data Storage and Analysis 13

New Technologies 13

Upskilling Staff 13

Observations and Recommendations 14

Appendix A: EDB Disclosures 16

Glossary

Acronyms	
ADMD	After Diversity Maximum Demand
DERs	Distributed Energy Resources
DPP4	Default Price Quality Path 4
EDBs	Electricity Distribution Businesses
EVs	Electric Vehicles
GIS	Geographic Information Systems
ICPs	Installation Control Points
ID	Information Disclosure
INSTA	Innovation and Non-traditional Solutions Allowance
LV	Low voltage (in reference to network types)[1]
MEPs	Metering Equipment Providers
Opex	Operational expenditure
Part 4	Part 4 of the Commerce Act 1986
PVs	Photovoltaics or Solar Panels
TIDR2024	Targeted Information Disclosure Review 2024

[1] 'Low voltage' is defined in the Electricity Distribution Information Disclosure Determination 2012 (ID determination) as the nominal Alternating Current (AC) voltage of less than 1000 volts or the assets of the EDB that are directly associated with the transport or delivery of electricity at those voltages

Purpose

1. The purpose of this report is to provide a high-level summary of the 2024 disclosures from electricity distribution businesses (EDBs) relating to visibility of constraints within their low voltage (LV) networks. The aim is to assist stakeholders in understanding the extent to which EDBs can identify constraints on their LV networks.

2. In addition to providing a high-level summary, this report includes our observations on the progress EDBs are making in improving their LV network visibility. We also offer recommendations for future disclosures to improve transparency and information sharing.

Background

Information disclosure regulation—our role under summary and analysis

3. As the economic regulator of 29 EDBs in New Zealand, we require public disclosure of a range of information about performance. This information includes asset management plans, pricing methodologies, and financial and network data.

4. The aim of information disclosure (ID) regulation is to allow people to assess whether the purpose of Part 4 of the Commerce Act 1986 (the Act) is being met. In broad terms, the 'Part 4 Purpose' is to promote the long-term benefit of consumers, by promoting outcomes consistent with those produced in competitive markets.[2]

5. Under s 53B of the Act, we are required to publish summary and analysis of the information disclosed by distributors. The purpose of summary and analysis is to promote greater understanding about the performance of distributors, their relative performance, and changes in their performance over time.

Targeted Information Disclosure Review 2024

6. EDBs face an increasing pace of change and significant challenges from decarbonisation. Increased load on the network and the growing adoption of distributed energy resources (DERs) such as solar panels (Photovoltaics or PVs) and electric vehicles (EVs) are expected to most heavily impact the LV network, where visibility is poorest. It is crucial for EDBs to develop their understanding of their LV networks to effectively meet customers' increasing electricity requirements, while at the same time ensuring power quality and improving the resilience of their networks.

7. On 29 February 2024, we published our Targeted Information Disclosure Review 2024 (TIDR2024) for EDBs. This review introduced changes to existing ID requirements and added new ones.[3] The TIDR2024 is part of a broader package of

[2] The relevant outcomes are set out in (a)-(d) of the Part 4 Purpose. Refer: s 52A(1) of the Act.
[3] Commerce Commission, Targeted Information Disclosure Review (2024) – Electricity Distribution Businesses – Final Decision, (29 February 2024).

projects aimed at adapting the regulatory regime to changes in regulated sectors, particularly the impacts of climate change and decarbonisation.

8. Feedback from stakeholders during the TIDR2024 process highlighted significant and varying data access challenges faced by EDBs concerning LV network information. Recognizing these challenges, we designed our TIDR2024 requirements to enable EDBs to comply more easily by providing high-level narrative requirements, including those related to data access. This approach gives EDBs the opportunity to qualify and contextualize the information they disclose.[4]

9. As a result, we added the following requirements in TIDR2024 to Attachment A of the ID determination[5], which requires EDBs to describe:

   9.1 in relation to both load and injection constraints on LV networks specifically:

      9.1.1 any challenges, and progress, towards collecting or procuring data used to inform the EDB of current and forecast constraints, including historical consumption data; and

      9.1.2 any analysis and modelling (including any assumptions and limitations) the EDB undertakes, or intends to undertake, with that constraint-related data.

10. EDBs were first required to disclose this information in a document publicly available on the EDBs' websites by 31 August 2024. The published disclosures for each EDB are linked in Appendix A: EDB Disclosures on their LV Visibility, Disclosure year 2024.

11. We consider data access to be a critical topic for ID, especially in the context of demand growth caused by decarbonisation. How EDBs plan and manage risk related to data access challenges is highly relevant to stakeholders assessing the purpose of Part 4. Data access challenges can impact EDBs' efficiency in innovation and their ability to respond to changing consumer demands and new technologies.

12. Finally, if EDBs share such constraint information it will assist them and providers of non-network solutions to identify opportunities and practices (including EDBs' requests for proposals) to address those constraints. This will assist a stakeholders' assessment of whether EDBs are making efficient investment decisions and delivering services at a quality that reflects consumer demands.

[4] Commerce Commission, Targeted Information Disclosure Review (2024) – Electricity Distribution Businesses, Final decision – Reasons paper, (29 February 2024).

[5] Electricity Distribution Information Disclosure determination 2012 [2012] NZCC 22. A copy of the current consolidated determination, which is not the legal authority, can be accessed via our website: Commerce Commission, Electricity Distribution Information Disclosure Determination (Targeted Review 2024) Amendment Determination 2024, (29 February 2024).

Summary of disclosures[6]

13. Several EDBs began their disclosures by emphasizing the importance of gaining greater visibility over their LV networks, particularly given changing customer behaviours and the increasing adoption of DERs. The disclosures collectively indicate that EDBs are intensifying their efforts to enhance data collection and visibility across their LV networks. [7]

14. EDBs are currently utilising a variety of tools to help them develop visibility of their LV networks. These include smart meters, advanced sensors, and monitoring systems, each of these are discussed below. There is variability between EDBs in the level of uptake of these tools and the data they collect from them.

Smart Meters

15. Smart meters are essential tools for gaining insights into constraints on the LV network. They measure and record energy consumption and power quality data in real-time, providing detailed and accurate information that can be transmitted to utility companies for monitoring and analysis. This data removes the need for assumptions and enables EDBs to understand LV network performance and utilization, make informed decision and manage the network more efficiently.

Access to Smart Meter Data

16. Recognizing the importance of smart meter data, nearly every EDB detailed their level of access to this information. Approximately 80% of EDBs access some form of smart meter data. However, there are considerable differences in the types of data collected and the proportion of the network covered. This variation is influenced by factors such as the extent of smart meter deployment, the capabilities of the meters, and the agreements in place with Metering Equipment Providers (MEPs) and retailers.

Data Collected using Smart Meters

17. The types of smart meter data EDBs are currently collecting include:

    17.1 Electricity Consumption: Real-time and historical data on energy usage, which helps in understanding consumption patterns and identifying peak demand periods.

    17.2 Power Quality: Information on power quality parameters such as frequency, harmonics, and phase imbalances. This data is important for maintaining the stability and reliability of the network.

[6] Note: Portions of this section of the report (paragraph 13 – 47) were generated using the Artificial Intelligence tool, Copilot.

[7] As of the publication date of this report, Centralines and Unison Networks have not provided Director's certification for their Low Voltage Visibility disclosures.

17.3 Voltage Levels: Measurements of voltage at different points in the network, which are crucial for detecting and addressing voltage sags, swells, and other anomalies.

17.4 Load Profiles: Detailed load curves showing how electricity usage varies over time. These profiles are essential for load forecasting and planning network upgrades.

17.5 Event Data: Logs of events such as outages, voltage sags, and swells. This data helps in diagnosing issues and improving the resilience of the network.

17.6 Temperature: Internal temperature of the meter, which can indicate overheating or other issues that might affect meter performance and safety.

Uptake

18. EDBs such as Counties Energy and WEL Networks have invested in their own smart meters across their networks and were already seeing benefits from the data that these smart meters provide.[8] However, for the majority of EDBs, smart meter data on their networks is held by retailers and MEPs.

19. Of the EDBs accessing smart meter data through retailers and MEPs, the majority are currently accessing consumption data only. While this data is useful, it is can be less valuable than power quality data for planning and managing network constraints. EDBs such as Vector and Network Tasman receive both consumption data and more detailed power quality data. Vector acquires monthly 30-minute consumption data and daily power quality data from MEPs, while Network Tasman has real-time access to power quality data. [9]

20. The complexities involved with obtaining data from retailers and MEPs means many EDBs only have smart meter data on a subset of their network. Mainpower for example currently only has access to smart meter data on 8% of its network while Powerco has recently been able to procure consumption data for around 99% of its installation control points (ICPs).[10] Access to smart meter data for greater proportions of the network reduces the need for assumptions in modelling and improves decision making.

[8] Counties Energy Disclosure, page 13, WEL Networks Disclosure, page 1
[9] Vector Disclosure, page 2, Network Tasman Disclosure, page 1
[10] Mainpower Disclosure, page 1, Powerco Disclosure, page 3

21. A small number of EDBs also note that through discussions with MEPs they have established there are smart meters on their network that haven't been configured to record the data they need. These EDBs are working with their MEPs to have the meters re-configured to record the required data. In addition, there are varying proportions of EDB networks that are not equipped with smart meters. For those EDBs that disclosed the percentage of their network currently equipped with smart meters, the coverage is typically at least 90%. Networks with more urban populations tend to have a slightly higher percentage of smart meters within their networks.

LV monitoring devices

22. As well as smart meters, about half of EDBs disclosed that they are employing the use of LV monitoring devices. These devices include sensors and meters that capture data on voltage, current, power quality, and other critical metrics.

23. EDBs are typically installing these devices at strategic points within their network, such as substations and distribution transformers, particularly in areas where they anticipated high use of DERs. As Northpower states this approach "will allow us to gain a better understanding of customer load behaviours, and areas that are most likely to have existing constraints."[11]

24. As noted by Horizon in its disclosure,[12] transformer LV monitoring devices provide insights into the LV networks, including:

    24.1 Net utilisation of a distribution transformer, and its individual LV runs;

    24.2 Voltage level at the LV bus of the distribution transformer;

    24.3 Net energy consumption and/or export (kWh) of the distribution transformer;

    24.4 Power Quality measurement, in particular voltage harmonics, sags, swells and transients.

25. Most of the EDBs that did not have access to data from tools such as smart meters and LV monitoring devices noted that they use maximum demand indicators to record LV peak loads. Maximum demand indicators allow EDBs to collect useful data for monitoring, capacity planning, and preventive maintenance.

[11] Northpower Disclosure, page 55
[12] Horizon Disclosure, page 3

Other data collection

26. Several EDBs also noted the importance of having access to data on solar panel and EV charger installations when planning for potential constraints on the LV network. Customers need to register solar panel systems, making this information accessible. However, information on EV uptake was less accessible. Nelson Electricity noted in its disclosure that it was using smart meter and transformer load data to detect solar distributed generation, network-connected batteries, and EV chargers.[13]

27. EDBs disclosed that they were collecting other types of data, either through one-off or regular updates, to accurately forecast growth in load and generation and subsequent constraints at an LV level. These include:

    27.1 Asset and DER locations;

    27.2 Data from EV chargers and inverters;

    27.3 Council growth figures, building consent applications and development plans;

    27.4 Economic data, particularly population and dwelling statistics.

Modelling and insights

28. As with the differing levels of data collection, there is variability between EDBs in the sophistication of analysis and modelling of constraints on their LV networks. While all EDBs undertake some level of analysis to understand these constraints, the approaches and tools used can differ widely. Without this analysis EDBs can only identify constraints reactively. [14]

29. While conventional analysis is still in use, integration of smart meter and LV monitoring data has significantly enhanced the ability of most EDBs to proactively identify and manage constraints.

Conventional Approaches

30. The small number of EDBs which do not have access to smart meter or transformer monitoring data rely on more conventional methods to model constraints. These EDBs typically calculate the After Diversity Maximum Demand (ADMD) to model distribution transformer peak load. For instance, Centralines uses this methodology in their constraint forecasting, noting that it works with a defined margin of error across a wide range of customer types.[15]

31. Another example is Firstlight Network, who currently utilise asset data consisting of customer connections attached to the supply point with a model of recommended maximum connections to determine any constraints.[16]

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[13] Nelson Electricity Disclosure, page 3
[14] Under the Electricity Industry Participation Code 2010, constraints are required to be published.
[15] Centralines Disclosure, page 2
[16] Firstlight Network Disclosure, page 2

Advanced Data Utilization

32. For the majority of EDBs however, the smart meter and LV monitoring data they collect has become integral to their analysis and modelling of constraints. Below are three examples of modelling EDBs are undertaking using this data and what insights these provide:

32.1 Aurora: Used consumption data to conduct a study of distributed generation hosting capacity during the initial stages of the Upper Clutha DER solution project. After this, a network-wide hosting study was conducted. The study gave Aurora an understanding of the ability of the LV network to host (connect) PVs and EV chargers and where the constraints are, based on penetration level.[17]

32.2 Buller Electricity: Currently using a software platform to process power quality data collected in combination with distribution transformer, feeder and zone substation information. This provides alerts and a geographical view of potential Loss of Neutral faults, phase imbalance, voltage excursions and transformer overloads and constraints as well as many other network issues.[18]

32.3 WEL Networks: Data analytics are applied to the load and power quality information from smart meter and Power Quality (PQ) analysers to create statistical demand profiles for each customer group. This establishes a baseline for current customer behaviour, and is used to locate potential flexible demand, and increasing the certainty of large customer connection requests.[19]

Collaboration with Insights Specialists

33. While many EDBs conduct their own analysis and modelling, some collaborate with insights specialists to enhance their capabilities. For example, Orion has been trialling platforms with two smart meter analytics providers to understand existing applications, identify current limitations, and determine which areas of their business would benefit the most.[20]

[17] Aurora Energy Disclosure, page 2
[18] Buller Electricity Disclosure, page 1
[19] WEL Networks Disclosure, page 1
[20] Orion Disclosure, page 3

Use of GIS

34. Geographic Information Systems (GIS) technology is widely used by EDBs to map and analyse their network infrastructure. Several EDBs have begun integrating spatial data with LV network data. The combination of this Information is helping EDBs in visualizing network constraints, planning maintenance activities, and optimizing the placement of new infrastructure.

35. Several EDBs also disclosed that they were using GIS tools to help model constraints on their LV network. Top Energy, for instance, disclosed it has developed GIS maps to capture solar installations visually to represent congestion and hotspots on its network that could potentially develop constraints.[21] Many EDBs currently publish detailed GIS information on their websites. For example, Vector provides GIS maps that show historical network loading at the LV network level and planned system growth projects.

Planned practice

36. In their disclosures, many EDBs outlined their plans to improve data collection and modelling on their LV networks. For most EDBs, this involved gaining greater or complete access to smart meter and LV monitoring data on their network. To do this, EDBs planned to install more monitoring devices on LV assets and work closely with retailers and MEPs.

37. Some EDBs that don't currently have access to any smart meter data, such as Firstlight Network, note they are monitoring the progress of larger EDBs in accessing this information and will consider engaging further when the service is better understood.[22]

38. To progress their level of access to data many EDBs disclosed that they have or are working toward doing trials with different tools such as LV monitoring devices. These trials allow EDBs to assess the benefits of these and other emerging technologies, while avoiding the risk of over committing resources in the short term. EDBs have also been conducting trials on how they use the data they collect.

[21] Top Energy Disclosure, page 1
[22] Firstlight Network Disclosure, page 2

39. Further planned practices to improve LV network visibility include:

    39.1 Detecting, Modelling and Accounting for DERs;

    39.2 Monitoring customer compliance for distributed generation;

    39.3 Increasing automation in data collection and modelling;

    39.4 Improving accuracy of data collection and modelling and adapting when needed;

    39.5 Developing data collection and analytics frameworks;

    39.6 Developing LV phase mapping;

    39.7 Gaining access to other smart meters owned by MEPs.

40. Finally, EDBs are participating in collaborative initiatives to share best practices and develop standardized approaches for data collection and modelling. By working together, EDBs are leveraging their collective knowledge and experience.

Challenges

41. EDBs are encountering several challenges as they strive to enhance the visibility of their LV networks. The main challenges include:

Access to Smart Meter Data

42. The most common challenge for EDBs in enhancing their LV network visibility was gaining access to smart meter data from retailers and MEPs. These challenges relate to cost and length of contracts being offered. EDBs commented that many retailers and MEPs require them to commit to multi-year data acquisition agreements. They note these multi-year agreements are troublesome given that many EDBs are in the early stages of utilising this data. EDBs also note further risk should a regulatory mandate on smart meter data provision come in force within the contract period.

43. Several EDBs are planning to conduct trials with smart meter data. These EDBs believe many constraint issues on the LV network could be solved by taking limited data extractions, addressing the issues identified, then returning for a subsequent data extraction in several years' time. Data providers generally do not support this approach, only offering multi-year agreements.

Real-Time Data and Coverage

44. EDBs note that current service offerings often lack the functionality to provide near-real-time smart meter data, limiting its use to long-term planning rather than operational applications. Additionally, most EDBs only have smart meter and LV monitoring data for a subset of their network, necessitating assumptions to fill in the gaps. This results in limitations in modelling and lower confidence in forecasting constraints.

Data Storage and Analysis

45. Some EDBs have raised concerns about the ability to store and analyse the large volumes of data provided by smart meters. For instance, Electra notes that even half-hourly consumption data generates considerable volumes, with significant costs associated with storage and initial processing. [23]

New Technologies

46. Many EDBs note that the increasing adoption of DERs, coupled with the current lack of data on their use, creates significant uncertainty. To manage this uncertainty EDBs emphasize the need for new standards, registrations, and funding will be needed to manage these technologies effectively. Wellington Electricity highlights the need for regulatory support to implement these changes.

Upskilling Staff

47. A small number of EDBs have also raised challenges related to the need to upskill staff and contractors on the use and installation of new technologies such as LV monitoring devices.

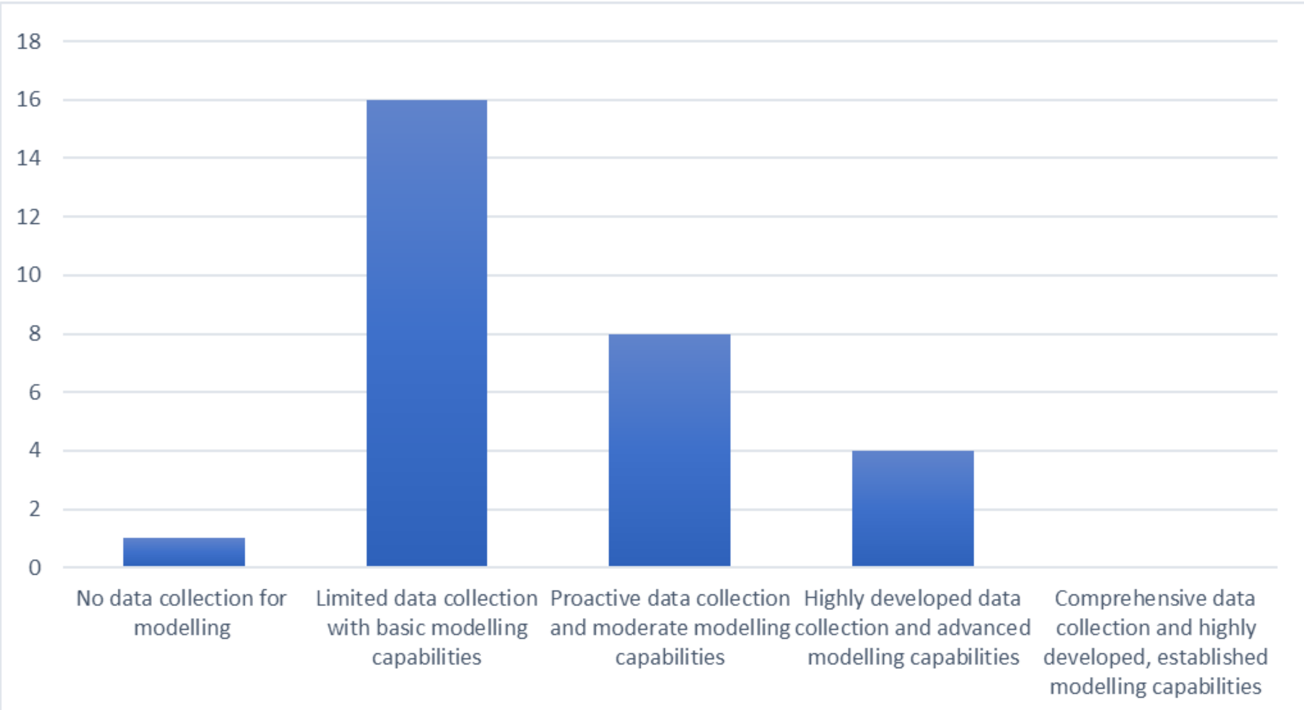
[23] Electra Disclosure, page 6

Observations and Recommendations

48. Overall, we are pleased with EDBs compliance and transparency with these initial disclosures. It is clear that EDBs recognise the value in making information about their LV network visibility available to stakeholders. The main themes across EDB disclosures were consistent, highlighting the need to improve data access, address challenges in obtaining information, and developing understanding of investment opportunities for smart meters and LV monitoring devices.

49. In Figure 1 below, we approximate the status of EDBs, in disclosure year 2024, regarding their data collection and modelling capabilities for constraint planning on their LV network. This assessment primarily considers the sophistication of monitoring tools, the proportion of the LV network they cover, the timeliness of data collection, the level of constraint modelling, and how this information is applied to asset management. Highly developed EDBs achieved over 90% smart meter visibility, collecting most data in real time, and were utilising additional tools beyond smart meters. They also had integrated modelling practices and had demonstrated practical outcomes of increased visibility.

Figure 1: Approximate status of EDBs in the collection and modelling of data on their LV network to manage constraints, Disclosure year 2024



50. The default price quality path for EDBs (DPP4) begins 1 April 2025. This includes additional operating expenditure allowance for EDBs to purchase LV network data.[24] Between 2025 and 2030 we recommend EDBs significantly advance their data collection practices and modelling capabilities to effectively plan for constraints. We

[24] Commerce Commission, EDB DPP4 – Final Decisions – Reasons Paper – Attachment A – Decisions at a glance, (20 November 2024). #03.3, page 2

also recommend that subsequent disclosures demonstrate these advancements and how EDBs are using LV network data.

51. Notable differences were observed between EDBs in the level of detail provided in their disclosures. This is to some degree understandable given EDBs are at different stages in their journey to improve their LV network visibility. However, some EDBs that had more developed data collection and modelling practices provided limited information. In future disclosures we recommend that these EDBs discuss their practices and challenges in greater detail, particularly as some EDBs noted they are monitoring the progress of larger EDBs to inform future practice. We understand there is a high level of collaboration and knowledge sharing between EDBs. Any further details EDBs can provide in their disclosures will enhance collaboration.

52. We also recommend that in future disclosures EDBs discuss in greater detail the progress made in establishing data agreements with retailers and MEPs. This information provides useful context for other EDBs when establishing their own agreements. It also helps regulators such as the Commission and the Electricity Authority understand common challenges and establish the need for any intervention.

53. A small number of EDBs did not clarify the type of data they were collecting. For example, disclosing they were collecting smart meter data without clarifying whether this consumption data of more detailed power quality information. Additionally, it was not always disclosed whether data was collected in real time and at what time intervals. We recommend EDBs make this clear in future disclosures.

54. In addition to detailing current practices and challenges, we recommend that EDBs clearly outline the benefits they are experiencing from improved LV network visibility. The disclosure of these benefits will help stakeholders understand the outcomes of increased visibility and an EDBs' effectiveness in planning for future network demands and establishing future commercial arrangements. WEL Networks disclosure included an informative list of benefits they are seeing from increased visibility.[25]

55. Finally, several EDBs, such as Counties Energy and Waipa Networks, also provided information on their future initiatives that go beyond their planned analysis and modelling practices. These including potential investment and publication plans.[26] We encourage EDBs to continue disclosing more detailed information on their LV visibility roadmaps, and to report their progress in subsequent disclosures. By making this information available, stakeholders can better assess the progress EDBs are making.[27]

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[25] WEL Networks Disclosure, page 2

[26] Counties Energy Disclosure, page 2, Waipa Networks Disclosure, page 3

[27] Additional disclosure requirements set in TIDR2024, for EDBs to describe policies or practices for sharing information on current and forecasts constraints are required within the next mandatory AMP. Further details on these requirements can be found in section D3.3 of the Targeted Information Disclosure Review (2024) – Electricity Distribution Businesses, Final decision – Reasons paper, (29 February 2024).

Appendix A: EDB Disclosures on their LV Visibility, Disclosure year 2024

EDB	Disclosure links (31 August 2024)
Alpine Energy	Voltage quality and constraints disclosure
Aurora Energy	Monitoring Load and Injection Constraints
Buller Electricity	Asset Management Plan Additional Information
Centralines	LV Disclosure 2024, cl 2.6.1B
Counties Energy	Monitoring Load and Injection Constraints on LV Networks
EA Networks	Monitoring Load and Injection Constraints
Electra	Addendum to the 2024-2034 Asset Management Plan Update
Electricity Invercargill	Voltage quality and constraints disclosure
Firstlight Network	LV Monitoring Disclosure
Horizon Energy	Monitoring and Forecasting Network Constraints
MainPower NZ	Additional Disclosure under Clause 2.6.1B
Marlborough lines	Additional Requirements (Attachment A 17.2.2 and 17.4.4)
Nelson Electricity	Voltage Quality and Constraints Disclosure
Network Tasman	Practises for Monitoring Load and Injection Constraints
Network Waitaki	Voltage quality and constraints disclosure
Northpower	Narrative Describing Practices that Complies with Clause 17.2.2 of Attachment A (page 55)
Orion NZ	Voltage quality and constraints disclosure
OtagoNet	Voltage quality and constraints disclosure
Powerco	LV Monitoring Disclosure
Scanpower	Voltage and Quality Constraints Disclosure
The Lines Company	Qualitative Information Monitoring Load and Injection Constraints
The Power Company	Voltage quality and constraints disclosure
Top Energy	Amendment D3.3 – Network Constraints
Unison Networks	LV Disclosure 2024, cl 2.6.1B
Vector Lines	Low voltage network visibility
Waipa Networks	Additional Information Disclosure
WEL Networks	Low Voltage Information Disclosure 2024
Wellington Electricity	LV Monitoring Disclosure
Westpower	Additional Information 31st August 2024