# Low voltage network visibility

31 August 2024

# 1. BACKGROUND

Vector is required to publicly disclose qualitative information in narrative form that describes its practices in compliance with the disclosure requirement of monitoring load and injection constraints, as per clause 2.6.1B of the electricity information disclosure determination.[1] The clause 2.6.1B includes two sub-clauses, listed below and detailed in Section 2 of this document.

1) Any challenges and progress in collecting or procuring data required to inform Vector's current and forecast constraints on its low voltage (LV) network, including historical consumption data; and

2) Any analysis and modelling (including any assumptions and limitations) Vector undertakes, or intends to undertake, with that constraint-related data.

Vector also summarises its practices for sharing information on current and forecast constraints across Vector's network (both load and injection), including any LV network constraints information. This information is provided to assist potential customers and providers of non-network solutions in their decision-making, as detailed in Sections 3 and 4 of this document.

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# 2. VECTOR'S VOLTAGE QUALITY AND CONSTRAINTS ON ITS LV NETWORK

Vector has processes in place to manage compliance of supply voltages as stipulated by the Electricity (Safety) Regulations 2010. However, maintaining the network within the permissible range is becoming increasingly complex due to factors such as distributed generation (e.g., solar PV) raising voltage higher in summer, and new electric loads (e.g., EV charging) testing the lower limits. Additionally, the future rapid and synchronised responses of many devices to external signals could also cause local voltage volatility.[2]

Without LV network visibility, Vector can only identify constraints reactively by responding to complaints.

To improve network planning and operation of the LV network, Vector has started using smart meter data, where available, to provide visibility of the voltage on the LV network. Once fully deployed, this will enhance our ability to model and analyse LV network performance.

This is a key capability we are creating as part of our Future Network Roadmap (FNR), which focuses on three pathways: Modernisation, Orchestration, and Enabling.[3] Each pathway consists of several planks that detail the new capabilities required to meet Vector's strategy. Improving LV network visibility and managing the associated data are key planks of the modernisation pathway.

## 2.1 COLLECTING AND PROCURING DATA

Vector currently has two LV visibility initiatives underway, both of which have the potential to enable step changes in our ability to monitor and analyse performance by proactively identifying load and power quality constraints.

1) Smart meter data acquisition - Vector has made substantial progress in acquiring smart meter data from retailers and Metering Equipment Providers (MEPs). This includes:

   - Monthly supply of 30-minute kWh data for 98% of smart meters on the Vector network, with approximately five years of historical data acquired; and
   - Daily supply of operational power quality data (voltage, current, phase angle) for approximately 30% of the network.

2) A trial to monitor LV feeders at distribution transformers – this will provide valuable insights into the LV network at feeder and phase level in near-real-time, enabling us to proactively identify and respond to voltage performance issues.

For further details on how we are using data to improve LV voltage quality, please also refer to section 7.3 of Vector's 2024 Asset Management Plan (AMP).

While the historic challenge of accessing smart meter data has been largely overcome, Vector has made significant (and ongoing) investments in systems to manage large data volumes and employ advanced analytics for operational insights. Vector has implemented an energy data platform, Diverge, for the ingestion management and analysis of smart meter data.

Once the fleet of third-party owned meters on Vector's network is upgraded, they will be able to supply power quality smart meter capabilities. We are working with the metering providers on options to accelerate this upgrade. This has the potential to delay access to power quality smart meter data for approximately 60% of the network for up to 5 years.

## 2.2 DATA ANALYSIS

Even though we do not have a complete set of smart meter power quality data, the data we do have is significant enough to be useful for analysis and network modelling.

[1] Electricity Distribution Information Disclosure (Targeted Review 2024) Amendment Determination 2024, dated on 29 February 2024

[2] Section 7.3, Vector's 2024 electricity asset management plan, please find the link: https://blob-static.vector.co.nz/blob/vector/media/vector-2024/electricity-asset-management-plan-2024-combined-final-updated.pdf

[3] Sections 2 and 4.5, Vector's 2024 electricity asset management plan

In areas of the network where there is a limited power quality data coverage, Vector uses estimation techniques to derive the consumption and power quality profiles of distribution equipment, which makes it useful for analysis and modelling of the distribution network.

When performing analysis of individual customers, we do require all relevant meter data to be available, and where it is unavailable, we revert to the deployment of temporary bespoke monitors (such as data loggers).

Vector uses various analytical tools (e.g. DigSilent) and models (e.g. Customer Scenario Model[4]) to gain network insights from smart meter data on the LV network and other network device time series data sets. These models are integrated with network topology and connectivity information from Vector's GIS systems where practical. The ongoing effort and investment in these tools and models are key capabilities under the new planning tools plank of the modernisation pathway of the FNR.

The key models and tools that enable planning through advanced data analytics on constraint related data are listed below:

- Customer Scenario Model
- Network wide modelling for constraint detection
- SAIDI risk modelling by network section
- Bespoke load voltage drop models
- Development of algorithms to identify specific network constraints or anomalies based on smart meter data:
    - Loose neutral and LV anomaly detection (where individual power quality meter data is available)
    - LV network connectivity - phase and feeder detection (where individual power quality meter data is available)
    - Phase imbalance detection and adjustment (where sufficient power quality meter data is available)
    - EV detection (where individual power quality and kWh meter data is available)
- Distribution transformer demand (with intelligent data interpolation)
- Distributed generation connection modelling (where sufficient power quality and kWh meter data is available)
- Quantify demand response effectiveness and compliance

Further details are set out in sections 10.3 and 10.4 of the AMP including the assumptions and limitations applied by our planning and data analytics teams, which are firmly anchored in granular, bottom-up data analysis at the customer level.

## 3. CUSTOMERS CONNECTIONS

Vector's current approach to sharing information on network constraints to inform decision making of potential new customers can be summarised as follows:

- Information is shared whenever a potential customer submits an expression of interest
- To support customer engagement at a very-early stage, our open data portal publishes key network information where users can visualise detailed geospatial information https://data.vector.co.nz/
- For Distributed Generation connections specifically, process and application information (including constraints) can be found on the Vector website https://www.vector.co.nz/personal/electricity/distributed-generation

## 4. NON-NETWORK SOLUTIONS

Vector's current approach to sharing information on network constraints to inform decision making of potential providers of non-network solutions can be summarised as follows:

- Information is shared whenever a potential provider submits an expression of interest
- Signposting areas that have been identified as best suited to non-network solutions to create opportunities for accelerating the growth of managed load in those areas (refer to section 10.5 of the AMP for further information on signposting opportunities)
- To support customer engagement at a very-early stage, our open data portal publishes key network information where users can visualise detailed geospatial information https://data.vector.co.nz/
- For Distributed Generation connections specifically, process and application information (including constraints) can be found on the Vector website https://www.vector.co.nz/personal/electricity/distributed-generation

[4] Vector uses a Customer Scenario Model to forecast the impact of customers' technology adoption rates and behavioural trends on the network. It models customer load at the ICP/LV level and aggregates the load at feeder level to inform network planning.