PulsePoint Edition: Hiko Energy Insights on Identifying and Managing Low-Voltage Network Congestion

As the global impetus towards sustainability gathers pace, the integration of Electric Vehicles (EVs) and other Decarbonisation loads adds to the complexity of Low-Voltage Network management. In this inaugural PulsePoint publication, Hiko Energy Insights undertakes a thorough examination of New Zealand's Low-Voltage Network, offering actionable insights that are shaping the future of congestion management in this once overlooked segment of our national infrastructure.

Traditional Approach vs Data Driven Approach

Traditionally, utilities addressed congestion with manual inspections and reactive post-incident infrastructure upgrades informed by customer reports of network non-performance. This reactive model is costly, resource intensive, disruptive to customers and wholly unreasonable and unnecessary with the technology available to us today.

Our data-driven analysis of the low-voltage network involved utilising smart meter data to gain insights into network performance. Utilising voltage and load profiles from meters provided valuable information on the networks operating envelopes, while historical data spanning several years captured seasonal variations and demand patterns. Various analytical methods were explored to assess LV Network performance, including statistical techniques and modelling to analyse large datasets and extract meaningful insights. The focus was placed on the season of highest demand, which was in the winter months due to increased demand from space heating .

LV Networks were categorised based on their delivered voltage envelopes to identify networks experiencing congestion or strain, and those with available capacity.

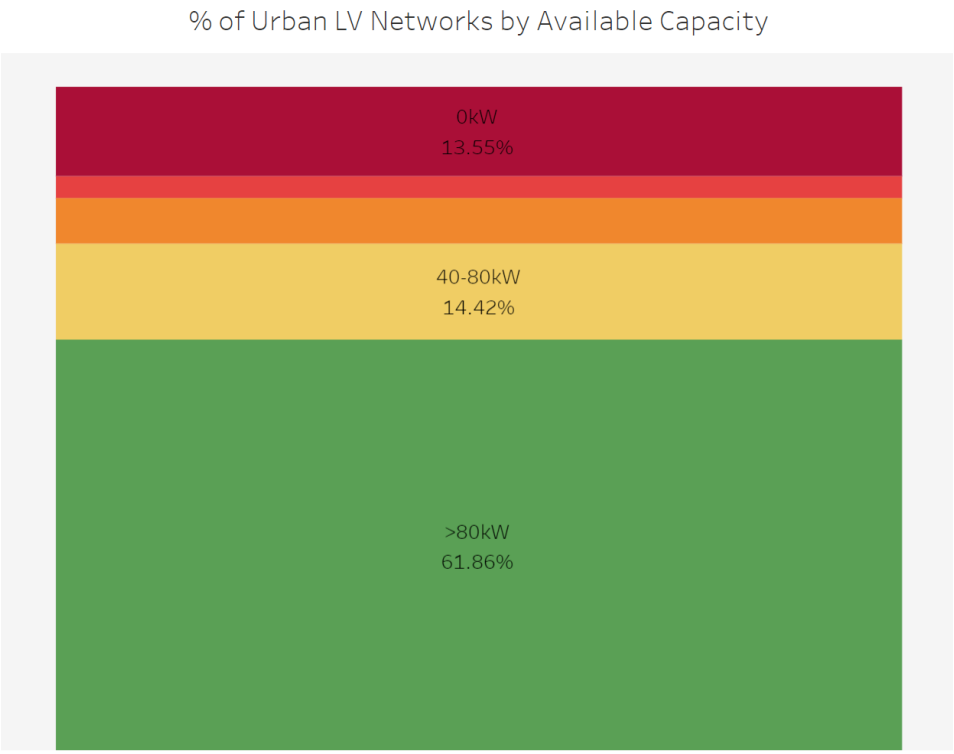

Figure 1: Of the ~1,500 NZ Urban LV Networks Hiko assessed 13.5% of these were found to be operating at their capacity limits

Trends in voltage variations were examined to identify patterns and anomalies, looking for correlations with factors such as time of day, demand, and weather conditions. Additionally, transformer capacity was assessed to ensure our algorithms that calculate available network capacity did not overload key components of the network.

This comprehensive approach provided a detailed understanding of LV Network performance dynamics. By considering geography and key network elements in the capacity algorithms a hierarchical matrix of reinforcement options can be applied to a region to produce a least cost forecast to accommodate decarbonisation demand. This informed decision making and targeted investment provides for optimised financial efficiency at a time where resource is constrained due to the unprecedented requirements of nationwide electrification.

Andrew from Network Tasman observes, "Historically, our approach to managing congestion was reactive. Integrating Hiko's predictive analytics has been a

game-changer, permitting us to intervene before congestion escalates to a level where service is compromised and providing confidence in where we can accommodate growth without further investment."

Customer Insight: Network Tasman

Working in collaboration with Network Tasman, Hiko Energy Insights has concentrated on the critical challenges presented by winter congestion. With the escalation of decarbonisation demand, the strain on existing infrastructure has intensified, heightening congestion risks—risks that undermine both grid stability and threaten to compromise the quality of our service delivery.

The data analysis revealed insights into LV Network performance, identifying networks operating at capacity and those able to support additional demand. By understanding the real-world operating envelopes that consider all elements of the distribution supply system Hiko customers gain valuable insights to optimise network efficiency.

Hiko's delivery of a capacity heatmap that is based on real world parameters rather than design standards had allowed us to target investment in networks that require reinforcement and provide us confidence as to which networks can accommodate growth without investment.

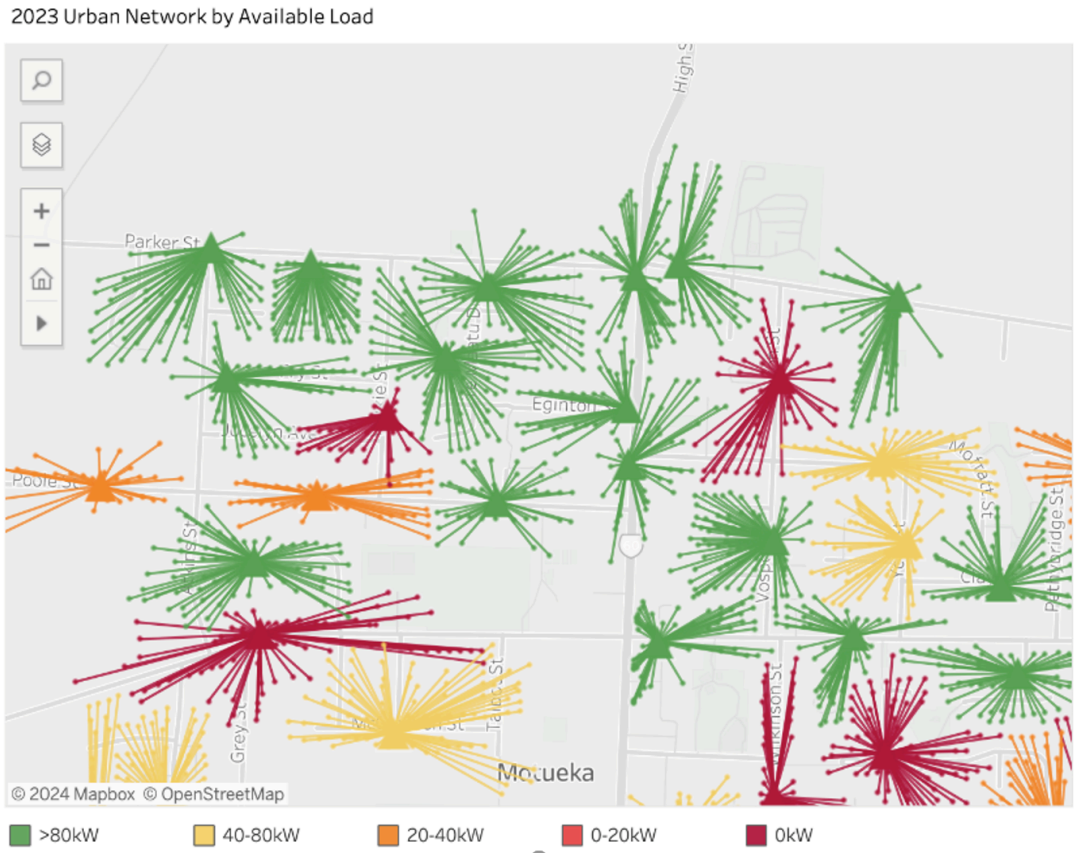

Figure 2: Map view shows LV Networks that are operating at capacity next to Networks that have plenty of capacity, a low-cost solution to allow more demand to be serviced in both of those networks might be to shift break points.

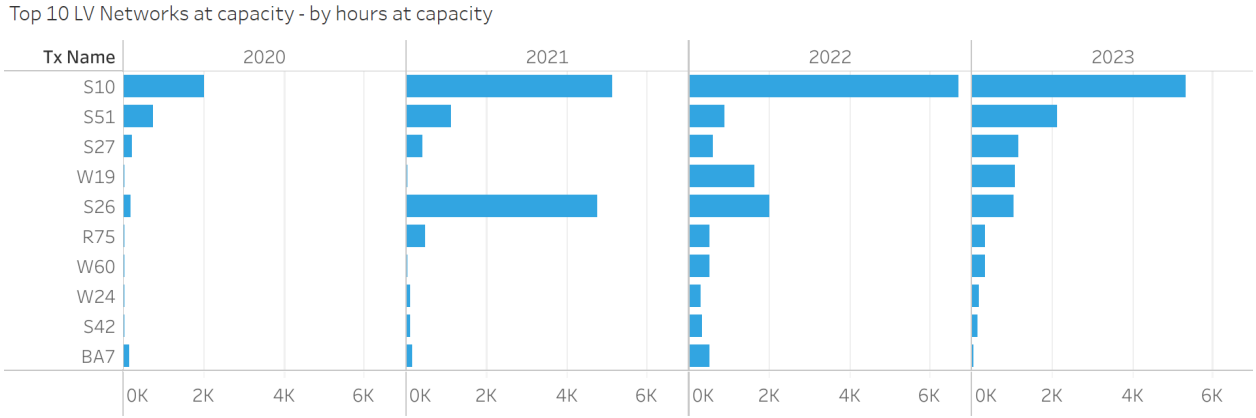

Figure 3: Ranks LV Networks that are operating at capacity providing easy reference for Planning Engineers.

Our exploration has highlighted the imperative for a nuanced approach to congestion, paving the way for judicious and impactful network strategies that ensure efficiency and resilience.

This collaborative data-driven approach highlights the value of leveraging smart meter data and statistical analysis to address evolving energy demands and optimise LV Network infrastructure for future sustainability.

Join the Discussion

As electrical engineers, you recognize the urgency of addressing this issue to ensure grid stability and meet the demands of decarbonisation.

Join the conversation on addressing congestion in low-voltage networks. Share your insights and innovative ideas to tackle this pressing challenge.

Together, let's explore new strategies and technologies for optimized network performance.

Reach out today to be part of the solution.

About Hiko

Hiko Energy Insights is leading the charge in distribution network management solutions, delivering comprehensive analyses of service delivery and network performance. Our suite of analytical tools arms utilities with the acumen to tackle congestion and decarbonisation with conviction.