

Meeting Date: 12 March 2020

UNDERSTANDING THE VALUE OF ELECTRICITY TO CONSUMERS

SECURITY
AND
RELIABILITY
COUNCIL

Note: This paper has been prepared for the purpose of the Security and Reliability Council (SRC). Content should not be interpreted as representing the views or policy of the Electricity Authority.

Understanding the value of electricity to consumers

1. Background

- 1.1. At its 24 October 2019 meeting, the SRC considered a paper about transmission security. During the course of the discussion of that paper, the grid owner offered to present to a future meeting of the SRC about its studies on the value of lost load (VoLL). The SRC agreed, noting it was a topic already identified for discussion in 2020.
- 1.2. Transpower, in its capacity as the grid owner, has provided the attached summary of its 2018 study of VoLL.
- 1.3. The SRC has previously received information about the [Authority's 2013 investigations of VoLL](#). [A 2015 SRC paper](#) concluded that:
 - a) a single VoLL figure is an inappropriate measure of the value that New Zealand electricity consumers place on unserved energy
 - b) a carefully designed survey-based approach to estimating the VoLL works.
- 1.4. The attached summary from Transpower nicely illustrate the range of VoLL and concludes:

“We consider that the results of this investigation are a step towards a better understanding of VoLL. Our study addresses some of the [Authority’s] concerns that a single VoLL is inappropriate and provides a basis on which to account for consumers valuing lost load differently. However, we do acknowledge that VoLL is difficult to determine with certainty.”
- 1.5. The secretariat has scheduled this topic for Q2 2021 as part of the SRC meeting themed around ‘understanding the consumer’. Refer to agenda item #15 for the proposed multi-year work programme.

2. Questions for the SRC to consider

- 2.1 The SRC may wish to consider the following questions.

- Q1. What further information, if any, does the SRC wish to have provided to it by the secretariat?
- Q2. What advice, if any, does the SRC wish to provide to the Authority?



TRANSPOWER'S 2018 VALUE OF LOST LOAD STUDY

1. Purpose

The purpose of this paper is to inform the Security and Reliability Council of the work Transpower undertook in 2017-2018 investigating the Value of Lost Load (VoLL) consumers associate with power interruptions. A summary report of our VoLL study and some supporting information has been [published here](#).

2. Summary of Value of Lost Load Study

During 2017-2018 we undertook an investigation of the Value of Lost Load (VoLL). VoLL represents the economic value, in dollars per MWh, that a consumer places on electricity they plan to consume but do not receive because of a power interruption. It is different in concept to the price consumers pay in the wholesale and retail markets for electricity. Both the wholesale and retail prices reflect consumers' demand for electricity, whereas VoLL reflects consumers' demand to avoid power interruptions and its consequences.

The Electricity Industry Participation Code 2010 specifies a value for VoLL of \$20,000/MWh. This value dates from late 2004, and part of the motivation for the review was to ensure that this value was still a valid value to use.

Our experience from undertaking the investigation is that VoLL is challenging to determine. There is no market of readily observable prices that can be used to determine the value consumers place in avoiding interruptions. As such, we are largely reliant on survey methods to estimate VoLL. In this regard, we took guidance from the work the Electricity Authority (EA) previously did in this area, particularly in their study between 2008-2013¹.

To determine VoLL we engaged PwC and Advisian to undertake surveys of consumers to determine VoLL across a range of attributes (e.g. type of consumer, duration of the interruption, season, weekday/weekend, time of day). PwC completed an online survey of 404 residential and 619 business consumers, while Advisian directly surveyed a selection of large industrial users.

The results from these studies suggest that VoLL varies significantly between different consumers and across a range of different attributes. For example, the results suggest that residential consumers value VoLL significantly lower than what businesses do, and that VoLL typically reduces as the interruption length increases². Like the EA's conclusions associated with their investigation, viewing VoLL as a single figure is very simplistic. In practice, it varies significantly across a range of attributes.

Another aim of the investigation was to understand how VoLL might vary between the different Points of Supply (PoS) we supply across the country. As each PoS supplies a different selection of consumers, it would seem reasonable to assume that the VoLL at each PoS will also vary. We have estimated the proportion of residential, agricultural, commercial and industrial electricity supplied at each of PoS, and combined that with our knowledge of the historical distribution of the duration of interruptions, and VoLL for different types of consumers, to calculate a weighted average VoLL figure for each PoS. Figure 1 summarises the approach we used, while Figure 2 illustrates the results.

Reflecting the results of the VoLL surveys, PoS's with a higher proportion of residential consumers have a lower VoLL than PoS's with a higher proportion of business consumers. The PoS VoLL results generally vary between \$17k/MWh and \$40k/MWh and centre around \$25k/MWh. Overall the results are broadly consistent with inflating the 2004 figure of \$20k/MWh to a present-day figure.

We consider that the results of this investigation are a step towards a better understanding of VoLL. Our study addresses some of the EA's concerns that a single VoLL is inappropriate and provides a basis on

¹ See <https://www.ea.govt.nz/about-us/what-we-do/our-history/archive/dev-archive/work-programmes/transmission-work/investigation-of-the-value-of-lost-load/>

² VoLL is reported in per MWh terms. Short power interruptions will bear all fixed costs but may be associated with only a small amount of lost load in MWh terms, leading to a high VoLL relative to longer power outages with higher amounts of lost load in MWh terms but the same fixed costs.

which to account for consumers valuing lost load differently. However, we do acknowledge that VoLL is difficult to determine with certainty.

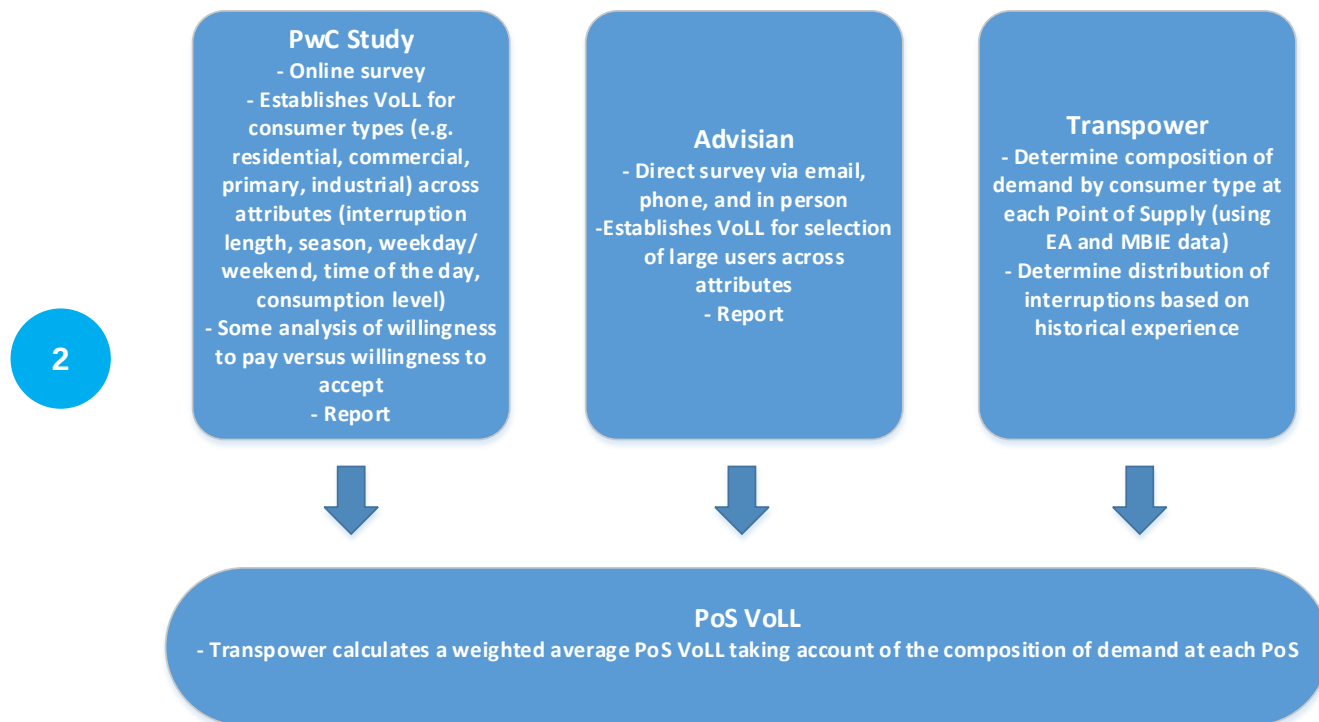


Figure 1: Approach to calculating PoS VoLL

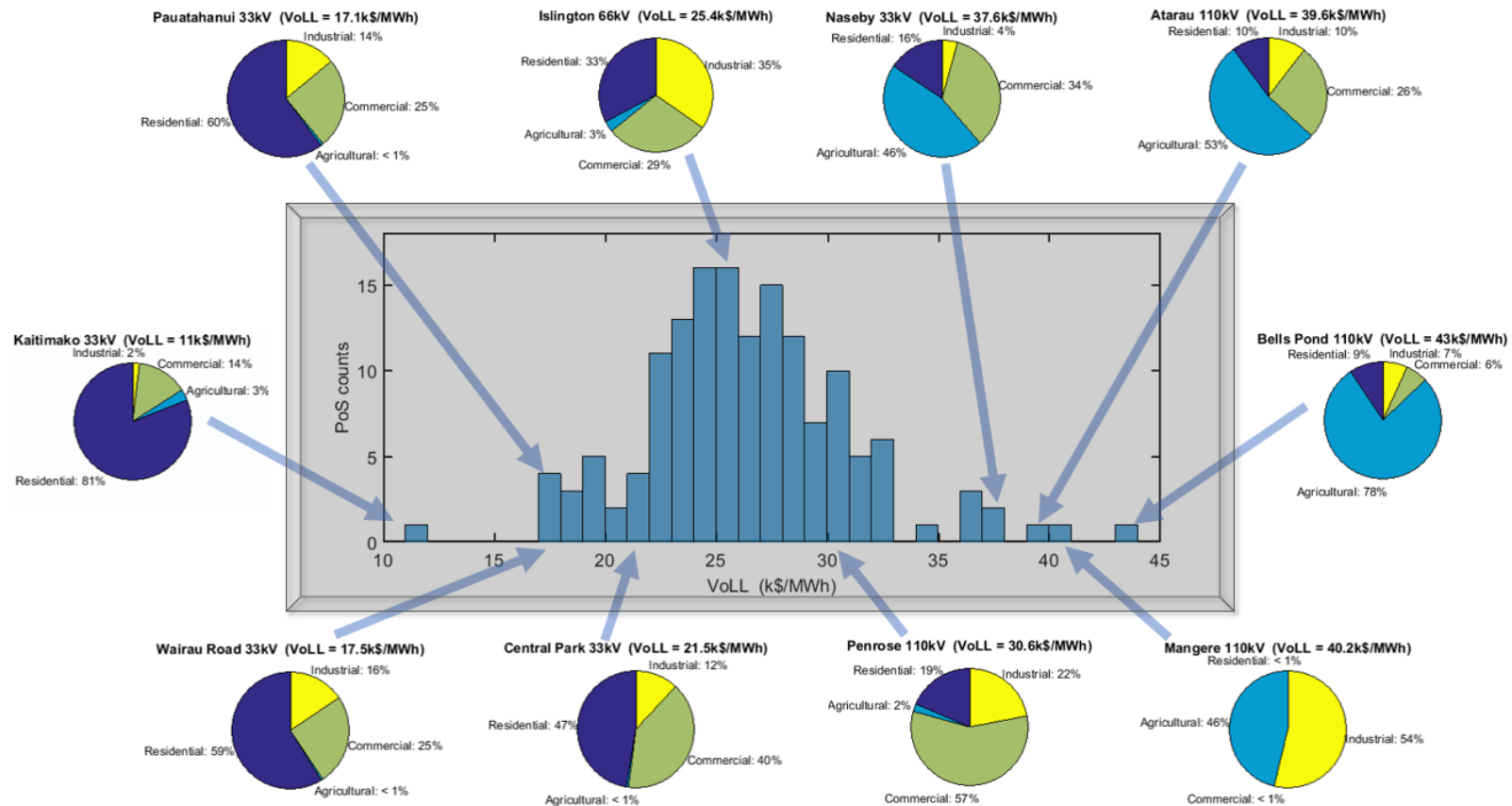


Figure 2: VoLL distribution across the different PoS. The surrounding pie charts show the demand decomposition behind selected PoS. The different demand decomposition is the underlying cause for the variation in VoLL.



3. Use of VoLL

We use VoLL in the following ways:

In our cost benefit analysis

We use VoLL in our assessment of the economic benefits of investing in the grid to improve reliability.

From a service perspective the expected economic consequence of a power interruption can be calculated as:



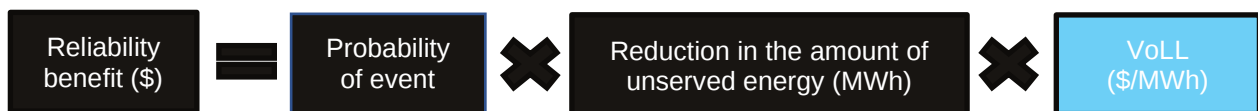
where:

Probability of event, represents the probability of an event such as an equipment outage

Unserved Energy, represents the amount of electricity in MWh that will not be supplied because of the event

VoLL represents the economic value placed on avoiding an interruption in \$/MWh.

Reliability benefits relating to preventing (or mitigating) an event (via appropriate investment) can be calculated as:



where:

Reduction in the amount of Unserved Energy, represents the reduction in the amount of electricity in MWh that will not be supplied because of the event, with the reduction coming from mitigation or investment

The reliability benefit can be compared to the cost of investment to determine if it is economic to invest (i.e. if the benefits exceed the costs). Multiple investment options for mitigating the event are usually considered. In this way, VoLL is an important planning assumption.

In our criticality framework

We have developed a criticality framework for our assets that is informed by the “risk” associated with a given asset being out-of-service. Within this framework we quantify a range of risks including: service performance, safety, environmental and direct cost risks.

VoLL helps inform the service performance risk associated with our assets as it helps inform the economic consequence of an asset being out-of-service that results in a power interruption.

In our performance measure construction

For each regulatory period the Commerce Commission set quality standards. For the upcoming regulatory period, from 2020-2025, the Commission has set grid performance measures for groups of PoS, with the grouping of PoS being informed by the economic consequence of a power interruption at PoS. As above, the economic consequence of a power interruption is informed by VoLL.