



The future

# The Value of Lost Load (VoLL)

## Methodology Statement Addendum B Peer Review

29 July 2016



**CONTENTS**

**CONTENTS** 2

**VERSION HISTORY** 3

**APPROVAL** 3

**GLOSSARY** 4

**FOREWORD** 5

**1 EXECUTIVE SUMMARY** 5

**2 RESULTS** 6

**3 MODIFICATIONS TO THE PLANNED APPROACH** 9

**4 NEXT STEPS** 11

## VERSION HISTORY

Version	Date	Author	Status	Comments
1	14 June 2016	Impact research	Draft	
2	29 July 2016	T. Kennelly/ K. Quigley	Version 1	

## APPROVAL

Name	Role	Date
Steve Cox	Head of Network Engineering	28 July 2016
Paul Turner	Innovation Delivery Manager	28 July 2016

## GLOSSARY

Abbreviation	Term
CE	Choice experiment
DECC	Department of Energy and Climate Change
DNO	Distribution network operator
ECP	Engaged customer panel
GB	Great Britain
LCT	Low carbon technology
Ofgem	Office of Gas and Electricity Markets
RIIO-ED1	Electricity distribution price control 2015 to 2023
RP	Revealed preference
SME	Small and medium enterprise
SP	Stated preference
VoLL	Value of Lost Load
WTA	Willingness to accept
WTP	Willingness to pay

## FOREWORD

The Value of Lost Load (VoLL) project will investigate if a single, uniform VoLL, applied to all customer segments, remains appropriate as Great Britain (GB) moves towards an economy increasingly reliant on electricity, driven by the decarbonisation agenda. Extensive customer research will build on previous studies in this area to determine if a revised VoLL model would benefit customers.

The project is funded by the Network Innovation Allowance, introduced as part of the RIIO-ED1 price control, which provides an allowance for RIIO network licensees to fund projects that have the potential to improve network operation and maintenance and to deliver financial benefits to the licensee and its customers.

The project commenced in October 2015 and will be conducted over a 28-month period. It will culminate in a comprehensive assessment of how VoLL should be defined across a range of customer segments and ultimately inform a potential revised model to help distribution network operators (DNOs) better plan their network investment and customer strategies.

This report is one of a series of project dissemination documents and serves as an addendum to the VoLL methodology statement which sets out the proposed research methodology and sampling approach.

The VoLL methodology statement (version 2) and its three addendums are available on the project [webpage](#).

- *Methodology Statement Addendum A: Literature Review*
- *Methodology Statement Addendum B: Peer Review*
- *Methodology Statement Addendum C: Stakeholder Consultation.*

The key findings set out in this document specifically reference the learning from an external review of the methodology statement (version 1) by an independent peer reviewer, Professor Ken Willis of Newcastle University.

Professor Willis is Emeritus Professor of Environmental Economics at Newcastle University. His research concentrates on environmental valuation (using stated preference and revealed preference travel-cost and hedonic price models) and cost-benefit analysis; covering biodiversity, cultural heritage, energy, forests, landscape, quarries, recreation, transport, waste disposal and water quality and supply.

He is currently the Editor of the *Journal of Environmental Economics and Policy*. He has undertaken research projects on 'Renewable Energy and its Impact on Rural Development and Sustainability in the UK' for the Department of Trade and Industry; on 'The Growth Potential for Micro-generation in England, Wales and Scotland' for the Department of Business, Enterprise and Regulatory Reform; and a 'Cost-Benefit Analysis of Sustainable Public Procurement' for the Department for Environment, Food and Rural Affairs.

Professor Willis also has substantial experience in evaluating the suitability of market research methodologies and the application of advanced statistical analysis and econometric techniques in analysing consumer preferences and choices.

## 1 EXECUTIVE SUMMARY

### 1.1 Introduction

The purpose of this peer review is to assess the suitability of the VoLL customer survey methodology proposed by Electricity North West's market research partner, Impact

Research. The review will also determine if the survey methodology provides a comprehensive assessment of how VoLL should be defined and measured across a range of customer segments to inform a potential revised framework, which will assist DNOs to better plan their network investment and customer strategies.

The analysis contained within this report, in addition to the literature review of the VoLL methodology and the stakeholder consultation, has been utilised by Electricity North West to refine the overall research approach, culminating in an updated VoLL methodology statement (version 2).

## **1.2 Summary of Professor Ken Willis' key findings**

The research study outlined by Impact Research provides an admirable and rigorous examination of how VoLL can be measured through customer engagement and surveys.

The combination of online and telephone customer surveys will ensure sampling coverage of all customer segments in the most efficient and economical way. The main survey of 5,000 customers, split between 4,300 domestic customers and 700 small to medium enterprises (SMEs), in Electricity North West's operating region and from networks maintained by other licensed DNOs across GB, will provide statistically significant results.

The stated preference choice experiment (CE) proposed by Impact Research will allow estimates of willingness to pay (WTP) to be made for variations in duration of interruption, customer notification of interruption and customer assistance. There are some issues that require consideration in the application of the CE, in the analysis of the data and in the interpretation of the results. These relate to part-whole bias, scope effects, willingness to accept (WTA) and market demand.

The analysis proposes to use a mixed logit model to account for heterogeneity in customer preferences. This is considered appropriate. However, if comparisons are to be made with the London Economics (2013)<sup>1</sup> study, the analysis should also include a standard conditional logit model.

The research methodology and analysis proposed by Impact Research for estimating VoLL based on the future needs of customers is a practical and effective way of investigating if a single, uniform VoLL, applied to all customer segments, remains appropriate as GB moves towards an economy increasingly reliant on electricity. The methodology is admirable and comprehensive in its approach.

## **1.3 Next steps**

There will be ongoing learning as the project progresses and the approach will therefore be reviewed regularly to reflect any pertinent feedback and adapt to lessons learned.

# **2 RESULTS**

This section summarises Professor Ken Willis' peer review analysis of the key components of the VoLL methodology; specifically, the literature review, customer engagement methodology, the stated preference technique intended to measure VoLL and planned statistical analysis. Professor Willis' peer review of the VoLL methodology has been published in full on the project [webpage](#).

---

<sup>1</sup> London Economics, 2013, The Value of Lost Load (VoLL) for Electricity in Great Britain, Final Report for OFGEM and DECC.

## 2.1 Literature review

The literature review conducted by Impact Research is quite comprehensive and informs the proposed research strategy about methods of assessing the preferences and choices of customers in relation to electricity power supply and interruptions. No literature review can be totally comprehensive since this would lead to an overload of information. The literature review focuses on relevant literature and is suitable for the purpose of the study, providing an appropriate review of the literature on estimating the value of avoiding supply interruptions and the value of lost load to customers. This shows how VoLL varies between seasons; during the day and week: at peak, off-peak and weekends; by type of customer; and by length and frequency of outage.

What is perhaps lacking is any reference to literature on the economic analysis of consumer demand and consumer choice, where this is relevant to stated preference (SP) techniques. The literature cited is used to assess whether it is appropriate to use SP or revealed preference (RP) techniques to measure the value to customers of service reliability: changes in the frequency of supply interruptions and durations of outages.

While Impact Research clearly justifies that SP rather than RP techniques should be used in the study, the inclusion of references to literature on the economic analysis of consumer demand and consumer choice could be used to support the preferred survey method and the SP approach proposed for assessing customer preferences and demand for electricity supply.

## 2.2 Customer engagement methodology

The research study outlined by Impact Research is an admirable and rigorous examination of how VoLL can be measured through customer engagement and surveys.

The study appropriately proposes using focus group meetings in the qualitative stage of the research by convening an engaged customer panel (ECP). This ensures that the research effectively engages with key customer segments, both domestic (urban, rural and worst-served) and industrial and commercial (particularly SMEs and industries heavily reliant on electricity). This will ensure that the survey instrument developed by Impact Research for the study will be readily understood by customers and elicit accurate and reliable responses from them.

In assessing whether VoLL varies by customer segment and how VoLL might vary with low carbon technology (LCT) adoption, the study and survey design needs to consider how LCTs might affect electricity supply dependence and reliability (and hence VoLL). The methodology might benefit from clarifying at the outset whether the purpose is only to investigate how customers with different levels of LCTs in their homes and businesses value lost load, or whether it will also assess customers' preferences for outages and duration at different levels of LCT adoption.

As GB decarbonises heat and transport and customers become more reliant on electricity for their energy needs, VoLL may change. To provide informed responses and assessments, customers need to understand how their reliance on electricity might change (eg in transport or domestic heating and cooking) and the extent to which LCTs are able to meet the future demand for electricity. Accurate, robust and reliable estimates of VoLL can only be made if customers fully understand the implications of LCT adoption for electricity supply. VoLL might increase in the future as a result of:

- The adoption of LCTs and decarbonisation of heat and transport with its implied service changes to electricity demand
- Customer preference for more reliable electricity supply as income and wealth increase
- Increasing risk aversion to outage frequencies and durations
- Increasing use of and reliance on electricity in society.

Separating and measuring these four influences over time is not an easy task. But the proposal by Impact Research will readily permit VoLL to be estimated in relation to variation in customers' adoption of LCTs in their homes or businesses.

The questions that the ECP will be asked to consider and address (set out in Section 5.1 of the VoLL methodology statement (version 2)) should provide some understanding of customers' views which can be used in developing the quantitative phase of the research.

The combination of online and telephone survey methods will ensure sampling coverage of all customer segments in the most efficient and economical way.

The pilot sample sizes proposed by Impact Research (40 ECP members, 100 domestic customers and 30 SME customers) should be adequate to test the SP survey instrument, although the pilot sample of 30 SME customers is not likely to produce statistically significant results.

The main survey of 5,000 customers (split between 4,300 domestic customers and 700 SME customers) in Electricity North West's operating region and from networks maintained by other licensed DNOs across GB will provide statistically robust results. A sample of 250 within each DNO region should ensure a representative sample and statistically significant results for each DNO region, if required. The sample sizes proposed will ensure that estimates of customers' preference for the attributes of electricity supply are statistically significant and that, subject to safeguards, accurate and reliable estimates of WTP for VoLL, for different customer segments, can be determined.

If the analysis is to be undertaken by household and business adoption of particular LCT products then some stratified random sampling may be required to ensure sufficient observations in each LCT category.

Splitting the sample between summer and winter to reflect seasonal demand is appropriate. The only concern is with December 2016: as Christmas approaches customers may be less willing, because of seasonal commitments, to participate in a survey. It may be more effective to bring the survey forward to cover the later part of November and the early part of December or alternatively the beginning of December and the first two weeks in January.

The collection of data on customers' experiences of supply interruptions will allow the estimation of the effect on VoLL of duration of interruption, notification of interruption and customer assistance.

### **2.3 WTP stated preference approach to measuring VoLL**

The CE proposed by Impact Research will allow customers' trade offs between attributes to be estimated. The four attributes proposed (duration, notification, customer assistance, payment amount) are a mixture of quantitative (duration, payment amount) and qualitative (notification, customer assistance) variables. The CE will allow estimates of WTP to be made for variations in duration, notification and customer assistance.

There are some issues that require consideration in the application of the CE and in the analysis of the data. These relate to part-whole bias, scope effects, WTA and market demand. These are summarised below.

It is proposed that the CE omits some variables included in the London Economics (2013) study, so that other variables not previously included can be tested. Care must be taken to avoid part-whole bias with this procedure. The values for notification and customer assistance may not be additive to London Economics estimates for other attributes. It would be preferable if all variables were included in the analysis.

If it is not practical to include all variables in the CE, it may be possible to examine part-whole bias by checking that the WTP estimate for duration of outage (common to both the London

Economics and Impact Research studies) is equivalent. If it is significantly greater, then calibrating values for notification and customer assistance on the London Economics duration of outage WTP value may partly avoid over-estimating the total value of VoLL.

Neither the London Economics study nor the Impact Research proposal includes a variable in the CE for number of occurrences per year (frequency of supply interruptions). In the interpretation of the results it should be recognised that, because of scope effects, WTP for successive outages per year will decline monotonically from the WTP value for one outage. This has implications for the application of the results.

WTA values are quite difficult to measure accurately compared to WTP values. WTA values typically exceed WTP values for the same marginal quantity change. This can be reduced, or even eliminated entirely, by trading experience. While trading experience can be included in contingent valuation studies, it is not easy to replicate in stated preference CE studies. The WTA scenario is not fully explained in the proposed method, and should state whether symmetry between WTP and WTA is to be assumed in the analysis of the data.

The CE does not include the 'current situation' in the CE variables. Consumer choice is usually made with reference to the customer's current situation, ie level of service and bill amount. As it is difficult to describe the current situation that each customer faces, it would be beneficial to give some justification for omitting the current situation eg it is too difficult to describe to customers in terms of probabilities of outages of varying durations, and to clarify that omitting the current situation, will still allow the number of customers who do not wish to pay for an improved level of services to be estimated.

## **2.4 Statistical analysis**

The statistical analysis proposed by Impact Research will investigate WTP and WTA by subgroups of customers.

The analysis proposes to use a mixed logit model to account for heterogeneity in customer preferences. This is appropriate. However, if comparisons are to be made with the London Economics (2013) study then the analysis should also include a standard conditional logit model, since London Economics' WTP values are estimated using the more econometrically restrictive conditional logit model.

## **3 MODIFICATIONS TO THE PLANNED APPROACH**

The VoLL research approach was refined as a direct result of the peer review as follows, and the methodology statement (version 2) was produced to incorporate these recommendations:

### ***Inclusion of literature on the economic analysis of consumer demand and consumer choice***

The rationale behind the economic analysis of consumer demand and consumer choice, where this is relevant to stated preference techniques, is explained in Sections 2.4 and 2.5 of *Methodology Statement Addendum A: Literature Review*. References to literature giving more detailed support to the preferred survey method and the proposed SP approach were added to the bibliography.

### ***Assessment of customers' preferences in response to the adoption of LCTs***

The peer reviewer sought clarification as to whether the approach would also assess customers' preferences for outages and duration in response to the adoption of LCTs in electricity supply. This was a relevant observation given that one of the project objectives (Section 1.4 of the VoLL methodology statement) is to quantify how VoLL might vary with anticipated LCT adoption.

Section 10.3 of the VoLL methodology statement (version 2) was updated with more granular detail on the approach to measuring future VoLL which explains that there is likely to be greater uncertainty in consumers' responses as they consider VoLL specifically in relation to future LCT adoption. It is assumed that it will be most realistic to compare VoLL for current LCT users with VoLL for all other customers. From these comparisons it will be possible to infer the potential change in value as customers' LCT usage and electricity consumption changes in the future.

The original approach was enhanced to include survey questions concerning the future adoption of LCTs. These will be introduced to respondents with explanatory materials, embedded in the survey, which set out customers' anticipated increased reliance on electricity, driven by the decarbonisation agenda.

Impact Research anticipates that, in addition to explaining the future impacts of LCT adoption, there is value in specifically asking a proportion of the survey sample to imagine an LCT future and respond to the CE from this perspective. Half of the respondents will be asked to make their choices in the context of a future scenario, with greater dependence on electricity, framed specifically around the use of one of three LCTs:

- Electric vehicle (EV) ownership
- Photovoltaic (PV) system ownership
- Electric heat pump (EHP) ownership.

The remaining respondents will relate choices to their current experience only. This approach should enable a realistic estimation of the potential future shift in VoLL. However, this will only be possible if the pilot survey sample demonstrates that respondents can imagine the LCT future with sufficient clarity.

A pilot will be conducted with a group of customers to review the survey instrument and any supporting materials before it is rolled out more widely. Pilot responses will be analysed to assess customers' ability to imagine future LCT scenarios. Taking into consideration the importance of the potential future shift in VoLL, the method was amended to encompass an enlarged pilot survey sample (increased from 130 to 700). This mitigation also addressed the peer reviewer's assertion that the proposed sample size would not allow for statistically robust analysis of SME responses. This amendment is documented in Section 7 of the VoLL methodology statement (version 2).

Section 8.1 of the methodology statement was also amended to reflect an increased sample size for the main customer survey from 5,000 to 6,000 participants. The larger survey population allows for statistically robust analysis of the LCT future scenarios by all customer segments. Although provision has been made for this analysis, it will only be administered if the pilot survey demonstrates that respondents are able to imagine future LCT scenarios with sufficient ease and clarity.

The revised approach also makes provision for stratified random sampling to ensure sufficient observations in each LCT category, such as electric vehicle, photovoltaic and electric heat pump users.

### ***Avoidance of customer survey activity over the Christmas 2016 period***

Section 8.1 of the VoLL methodology statement (version 2) states that interviews will be conducted in two phases, winter 2016/17 and summer 2017 with 50% of each customer type (consumer and SME) being completed in each phase. The peer reviewer's concern that it might be difficult to engage willing survey respondents because of seasonal commitments will be reflected in winter fieldwork taking place up to 21 December 2016 and recommencing after 3 January 2017, to avoid detrimental impact on the study over the Christmas and New Year period.

### ***Inclusion of 'current situation' in the CE card***

The peer review concluded that some justification for omitting the current situation from the SP exercise was required. Section 8.5 of the VoLL methodology statement (version 2) was updated to clarify that the focus of the study concerns responding to the future needs of customers. As such, values should not be anchored to the current experience. Therefore, the current situation will not be explicitly represented in the scenarios.

However, prior to completing the CE in the customer survey, participants will be asked how they perceive the performance of their current service in terms of the attributes that will be tested. This will encourage respondents to evaluate the attribute levels and establish a personal benchmark. They will have the option to respond 'don't know' in all cases.

### ***WTP stated preference approach to measuring VoLL: avoiding part-whole bias***

The original research approach to the CE proposed the omission of some variables included in the London Economics (2013) study, allowing other variables that had not previously been tested, to be evaluated. The peer review concluded that care must be taken to avoid part-whole bias with this procedure.

Section 10.1 of the VoLL methodology statement (version 2) was subsequently updated to identify the risk of part-whole bias resulting from only some of the attributes being the same across studies. The risk will be mitigated by scaling the WTP or WTA findings against a strong common attribute, such as duration of outage.

### ***Inclusion of a standard conditional logit model***

Appendix B (Economic analysis, choice modelling and the estimation of WTA/WTP) in the VoLL literature review references Impact Research's intention to use a mixed logit model in the analysis to account for heterogeneity in customer preferences. The method was updated to estimate VoLL using a combination of mixed logit and a standard conditional logit model to allow direct comparison of the results with the London Economics study, even though conditional logit models are more econometrically restrictive.

### ***Symmetry between WTP and WTA***

Peer review analysis concluded that WTA is difficult to measure accurately compared to WTP and that the original approach had failed to sufficiently explain the WTA scenario. Appendix B (Economic analysis, choice modelling and the estimation of WTA/WTP) in the VoLL literature review was refined to clarify that symmetry between WTP and WTA would not be assumed and results for both values will be reported, based on evidence from previous studies.

The enhanced method also clarified that WTP values were expected to be considerably lower than WTA. This is anticipated to be the case, largely because participants may feel that they have an entitlement to the good/service and/or may believe that the good/service, constitutes a 'public good' ie security of the electricity supply. When consumers are accustomed to receiving a service for which they pay, they typically expect greater payment in order to offset the loss of that service than they are willing to pay to retain it. This is because individuals perceive a sense of ownership or property rights for something they already have (in this case a secure electricity service). Psychologically, the loss from giving something up feels greater than the gain from retaining it and avoiding the loss.

## **4 NEXT STEPS**

There will be ongoing learning as the project progresses and the approach will therefore be reviewed regularly to reflect any pertinent feedback and adapt to lessons learned.