ofgem Making a positive difference for energy consumers

Safety, Resilience, and Reliability Working Group - QoS

31/03/2020

Agenda

- Introductions and actions review (10:10 - 10:20)
- VoLL – Fraser Nash Review (10:20 – 12:00)
- IIS CML Target Setting (12:15 – 13:00)
- Lunch (13:00 – 13:30)
- Short interruptions reporting (13:30 – 14:30)
- AOB and close (14:30 – 15:00)

Conference call details:

Dial: 0800 376 8224

PIN: 82957238#

Value of Lost Load (VoLL) to Customers

Robbie Urwin

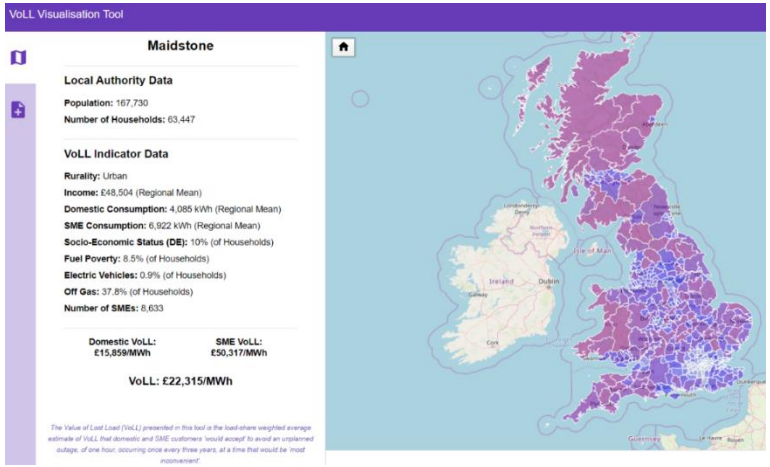
31st March 2020

SYSTEMS AND ENGINEERING TECHNOLOGY

FRAZER-NASH CONSULTANCY

Agenda

1. Project Background and Scope
2. Developing a Disaggregated VoLL Model
3. Accuracy of a Disaggregated VoLL Model
4. Recommendations on VoLL Disaggregation



(*Questions between sections*)

Project Background

Context of the VoLL2 project, the Impact Research survey, current uses for VoLL (IIS, CNAIM, CBA) and scope of the Frazer-Nash project.

VoLL Background

VoLL: Value of Lost Load

The value placed by customers on their security of supply

Units of £ / Megawatt Hour (MWh)

Includes domestic and SME customers only

Ofgem used a constant figure of ~£16,000 /MWh GB-wide for RIIO ED1

Aligned to value used for Energy Not Supplied (ENS) for Transmission

ENWL research shows that VoLL is now higher than £16,000/MWh

ENWL research also shows that VoLL varies across customer segments

Where is VoLL Currently Applied?

- Setting the **IIS** incentive rate
- Calibrating the Cost Benefit Analysis (**CBA**) model to evaluate the benefits of investment
- Tailoring network performance factor in the Common Network Asset Indices Methodology (**CNAIM**)

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The Impact Research VoLL Survey

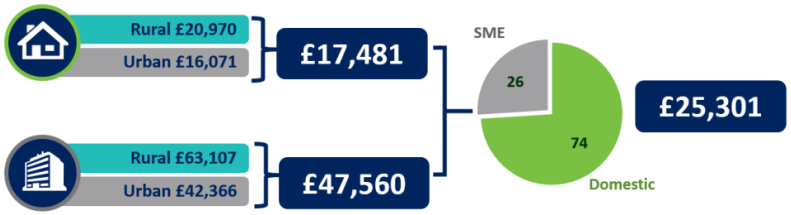
- Impact Research replicated the London Economics study to determine an updated VoLL for 2019
- 6,500 customers surveyed
  - 5,000 domestic
  - 1,500 SME
- Customers presented with various trade-off scenarios
- Hierarchical Bayes analysis then used to calculate VoLL

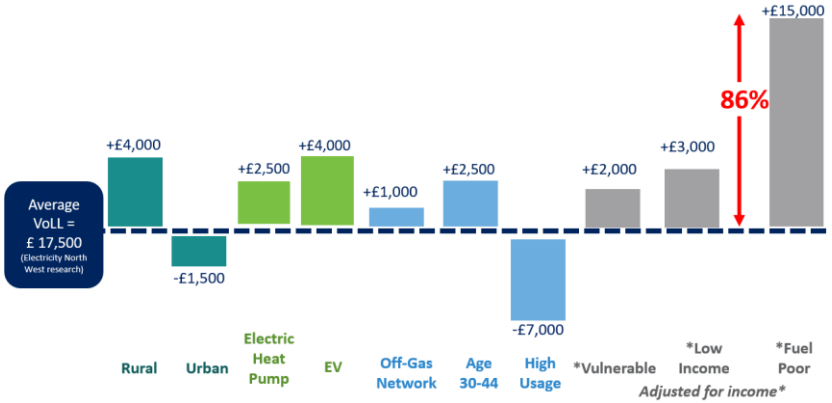
WTA	Option A	Option B	
Frequency of power cuts/s (over a three-year period)	7-14 power cuts	4-6 power cuts	Not sure
Duration of the power cut/s	More than 6 hours per power cut	6 hours per power cut	
The amount you receive for this happening	Payment to you: 15% of your annual electricity bill	Payment to you: 5% of your annual electricity bill	
Please make your selection here	○	◉	○

An example trade-off scenario presented to customers in the survey. Customers were asked to select the option that most accurately reflected their view on what they would expect to receive in such a situation.

Findings from the Impact Research VoLL Survey

- VoLL is now significantly higher than £16,000/MWh
- VoLL varies significantly across different customer segments
- The current approach:
  - Under represents the fuel poor
  - Does not reflect the needs of these dependant on LCT's
- A disaggregated model would enable DNOs to make decisions more reflective of customer needs
- There is a requirement to develop a model that can utilise the survey data to accurately estimate VoLL for different customer segments





The Frazer-Nash VoLL Project

- The objectives of the Frazer-Nash VoLL project were:

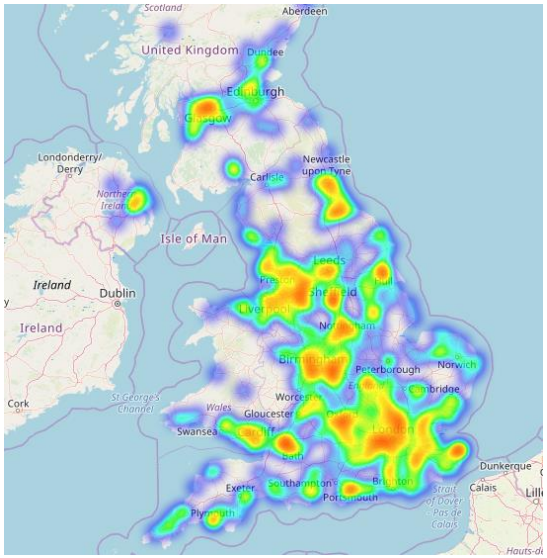
1. To explore the implementation of a disaggregated VoLL model that accounts for the variation in VoLL for different types of customers
2. To determine demographic indicators that are correlated with VoLL
3. To implement a prototype disaggregated VoLL model
4. To gather VoLL indicator data for GB and use the prototype model to estimate the variation in VoLL across the UK
5. To visualise these estimates in a ‘VoLL Visualisation Tool’

Developing a Disaggregated VoLL Model

How has the model been developed? What data sources have been used to estimate VoLL across GB? What is the VoLL Visualisation Tool?

VoLL Indicators

- VoLL Indicators: The key characteristics of a customer that most influence how they value loss of electricity supply
- For each respondent, the customer survey catalogues:
  - **Customer Type**
    - **Domestic**
    - **SME**
  - Age
  - Gender
  - **Rurality**
  - **Income**
  - Vulnerability
  - **Fuel Poverty**
  - **Socio-Economic Status**
  - **Electricity Consumption**
  - Electricity Supply Reliability
  - Gas Supply
  - Low Carbon Technology (LCT) Adoption
    - Electric Vehicles (EV)
    - Heat Pumps (HP)
    - Photovoltaics (PV)
- Analysis of the survey results has been performed to determine which of these attributes are the **most significant VoLL indicators**



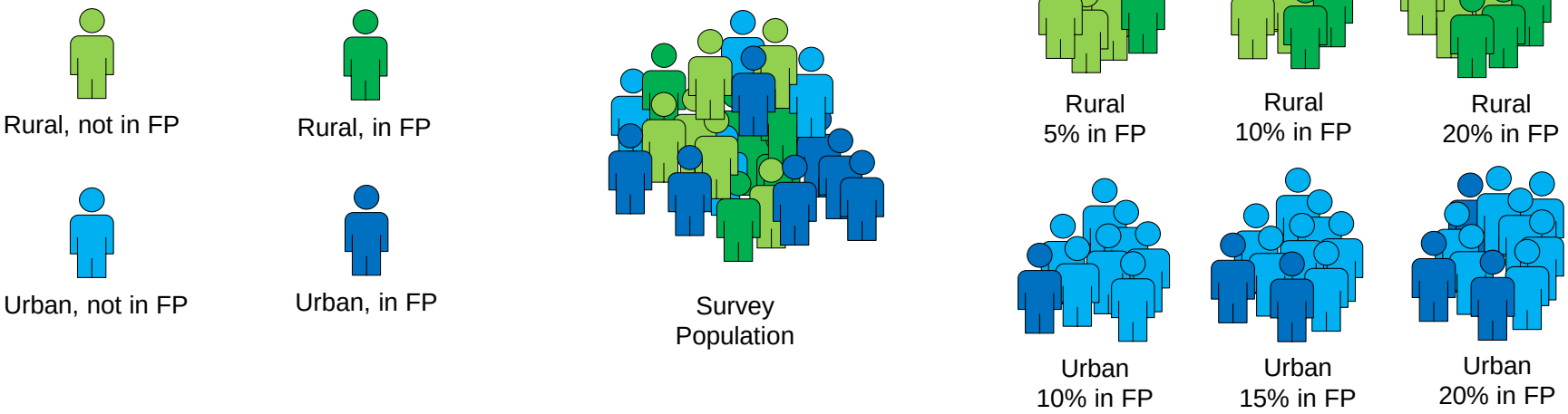
Locations of survey respondents. Orange and red areas have a greater density of respondents.

VoLL Estimation for Customer Segments

SIMPLIFIED EXAMPLE – JUST CONSIDERING RURALITY AND FUEL POVERTY

- VoLL can be estimated for the entire survey population
- VoLL can also be estimated for samples of the survey population that represent different customer segments (so long as the sample contains 200+ customers)

VoLL Estimation for Sample Populations

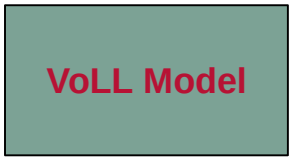


- VoLL can also be estimated for sample populations containing a mix of customer segments (more representative of 'real' populations)

The VoLL Model

- A VoLL model can be trained using millions of different sample populations drawn from the customer survey
- The model can then be used to predict the VoLL for **ANY** sample population for which the VoLL indicators are known
- For example this could be:
  - The households in a Lower Super Output Area (LSOA – approx. 1500 population)
  - The households in a radius around a distribution substation
  - The households known to be served by a primary substation

Rural
8% in FP



18,450 £/MWh

VoLL Indicator Estimation

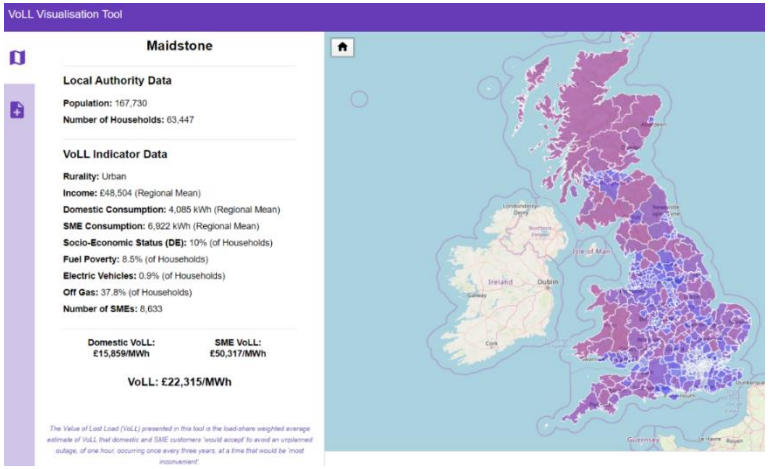
- In order to estimate the VoLL for any given sample population it is therefore necessary to estimate the population's VoLL indicators
- The prototype VoLL model estimates VoLL at an LSOA level
- VoLL indicator estimates have therefore been made for each LSOA in Great Britain
- The table below details the VoLL indicators used for the prototype model

VoLL Indicator	Data Source	Granularity	Indicator Importance
SME Locations	ONS	Local Authority	High
Rurality	ONS	LSOA	High
Fuel Poverty	ONS	LSOA	High
EV Adoption	Open Charge Map	Charge Point Locations	Medium
Income	ONS	LSOA	Medium
Consumption	ONS	LSOA	Medium
Gas Supply	CSE	Postcode	Medium
Age	ONS	LSOA	Low

ONS = Office for National Statistics, CSE = Centre for Sustainable Energy

The VoLL Visualisation Tool

- The VoLL Visualisation Tool allows you to explore the results of the prototype VoLL model in an interactive map
- VoLL displayed at Local Authority and LSOA level



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Additional VoLL Indicators

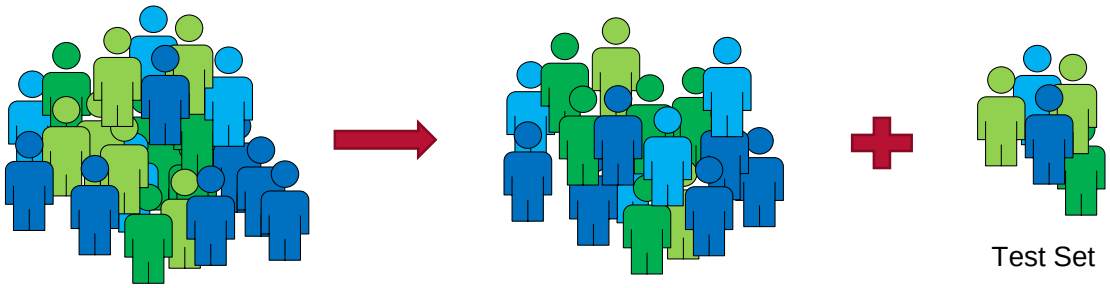
- Gender and PV ownership not included as not significant in estimating VoLL
- Additional VoLL indicators not included in the prototype model include:
  - Vulnerability
    - Vulnerability data is held in the Point Service Register (PSR)
    - Not included in the prototype due to sensitivity of the data
  - Supply Reliability
    - It is theoretically possible to include this in a VoLL model, if DNOs were to provide historic data on customer interruptions
    - Not included at this stage as the practicalities of collecting and aggregating this data is too large a task for the prototype project
  - Heat Pump Ownership
    - Not included due to lack of available data on installation
- Including these additional indicators would improve the accuracy of the VoLL model (but not by an order of magnitude)

Accuracy of a Disaggregated VoLL Model

How accurate is the disaggregated VoLL model? How has accuracy been assessed? How important is model accuracy?

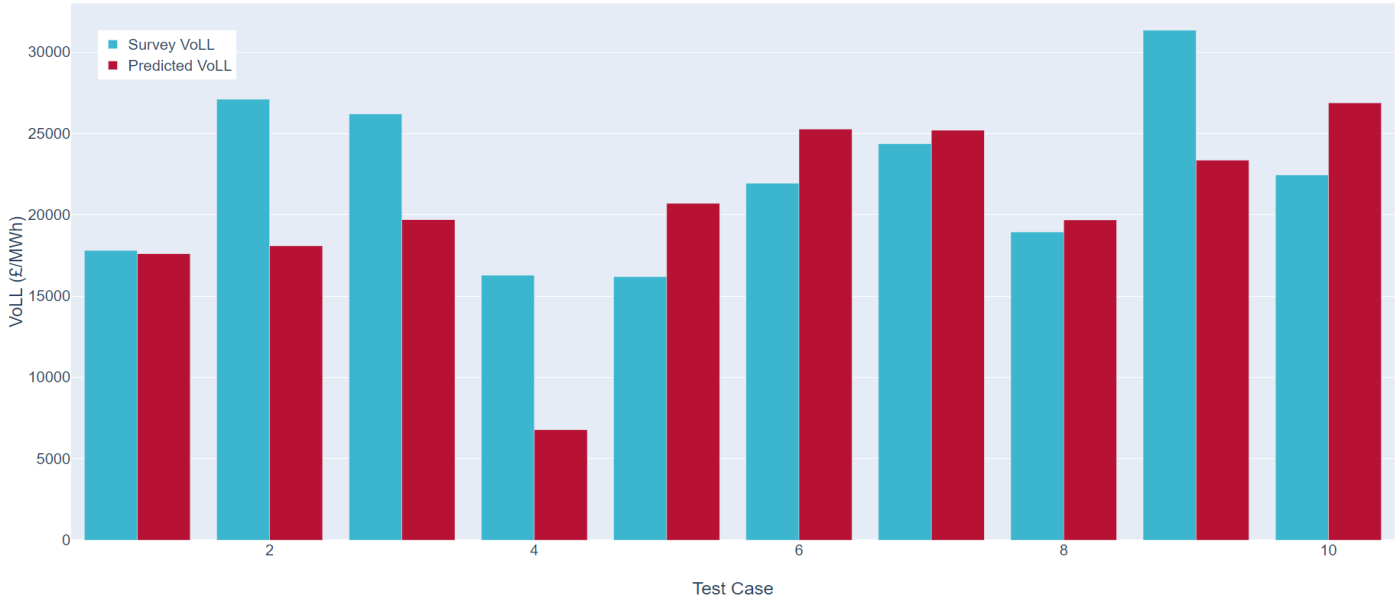
Assessing Model Accuracy

- By withholding a portion of the survey data it is possible to test the accuracy of the model using data it has not ‘seen’ before
- Repeating this many times allows us to estimate how good the model is at predicting different values of VoLL
- Not that different from going out and collecting more survey data with which to test the model



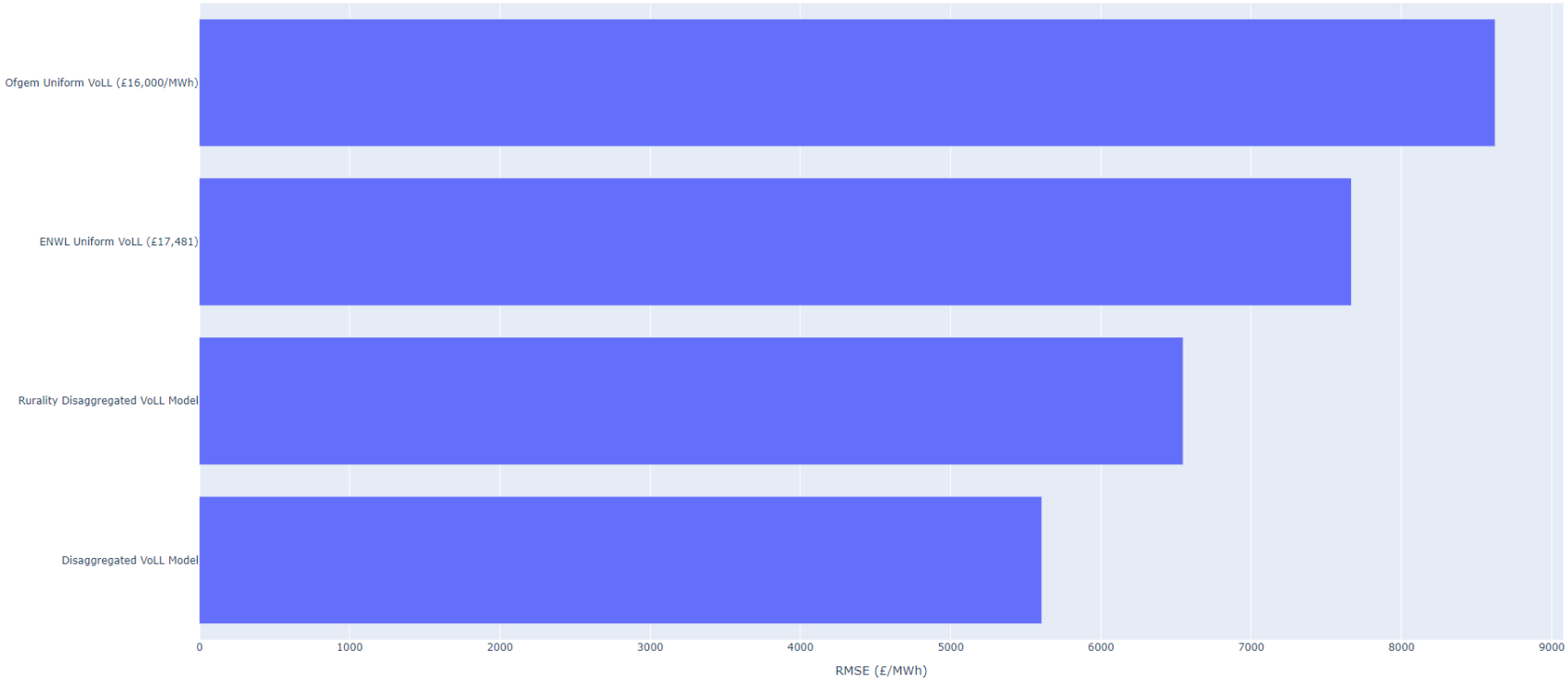
Accuracy of the Disaggregated Domestic VoLL Model

- Accuracy of sample test cases



Accuracy of the Disaggregated Domestic VoLL Model

- RMSE over all test cases compared to other models



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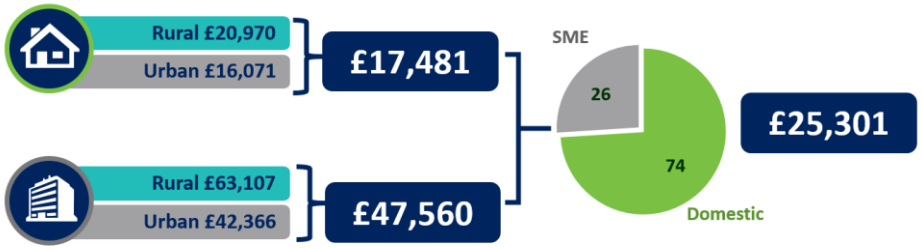
Overall Accuracy of the Disaggregated VoLL Model

- **Inaccuracy in the model for domestic VoLL**
  - Our disaggregated model is for domestic VoLL
  - As shown, a disaggregated VoLL model would be £3,000/MWh more accurate in the domestic component
- **Inaccuracy in the model for SME VoLL**
  - Not enough survey responses to build a fully disaggregated model
  - Prototype model disaggregates by rurality only (as below)
- **Inaccuracy in the ratio of domestic and SME VoLL**
  - This ratio is calculated by electricity consumption
  - 74:26 used by London Economics and Impact Research, but ONS 2019 data suggests that it is now 83:17
  - By using localised values, the overall estimate of VoLL is potentially £2,000/MWh more accurate



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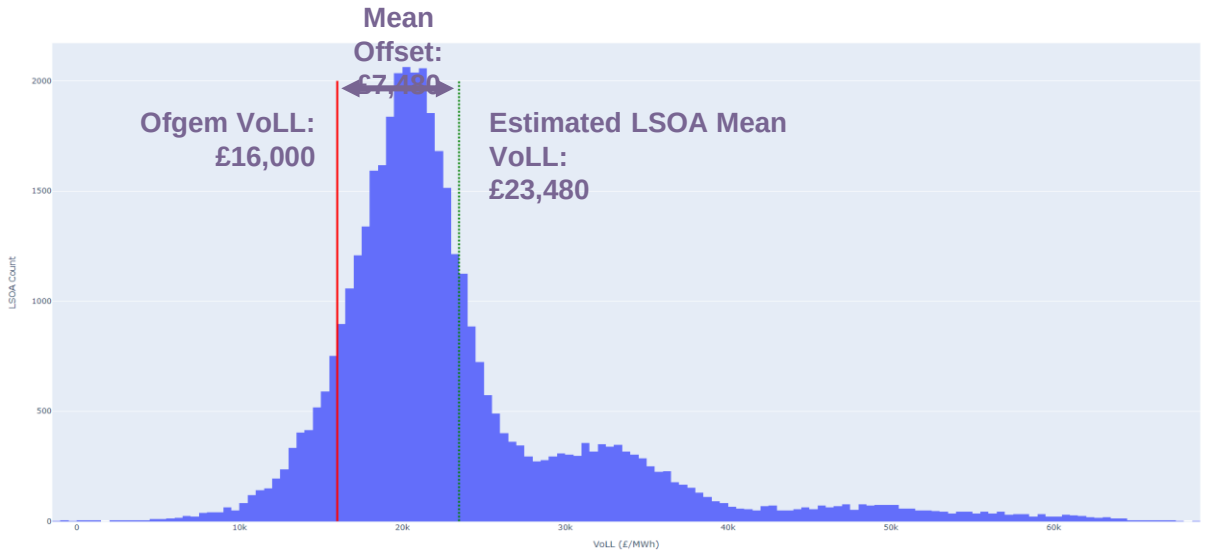
Recommendations on VoLL Disaggregation

Model complexity, geographic granularity and application to IIS, CNAIM and CBA.

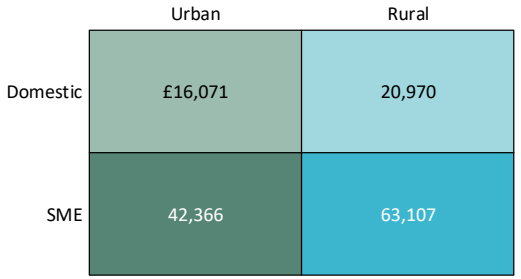
Update the Uniform Value of VoLL

- Once you include SME VoLL, this study estimates the mean VoLL across GB LSOA's to be £23,480
- The most effective single action to improve the accuracy of VoLL would be to update the uniform value
- Our analysis suggests this improvement would be **£7,500**



Simple Disaggregated VoLL Model

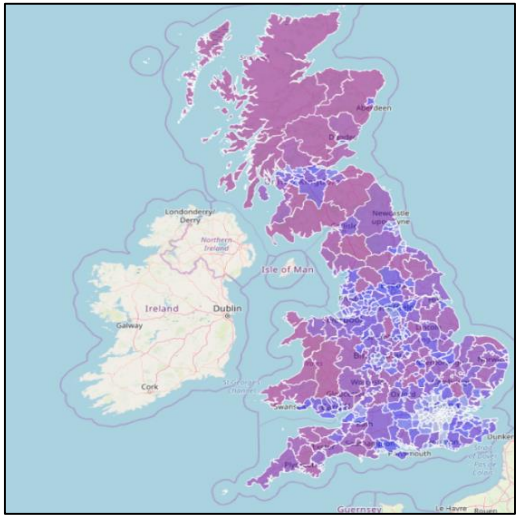
- Use four constant values for VoLL:
  - Urban Domestic VoLL
  - Rural Domestic VoLL
  - Urban SME VoLL
  - Rural SME VoLL
- Combine domestic and SME VoLL using a location specific electricity consumption ratio
- Our analysis suggests that, compared to using a uniform VoLL, this approach would improve accuracy by:
  - **£1,000/MWh** for rurality disaggregation
  - **£2,000/MWh** for disaggregated domestic and SME VoLL combination



Complex Disaggregated VoLL Model

- Use a full range of VoLL indicators such as income, fuel poverty, electricity consumption and LCT use
- Train a disaggregated VoLL model using machine learning
- The prototype disaggregated VoLL model has been shown to be:
  - £2,000/MWh more accurate than a uniform VoLL
  - **£1,000/MWh** more accurate than a rurality disaggregated VoLL model

- *However*:
  - This approach brings considerable extra complexity in data requirements and model maintenance
  - The extra complexity potentially also makes the calculation less transparent
  - Further research would be recommended to improve the approach



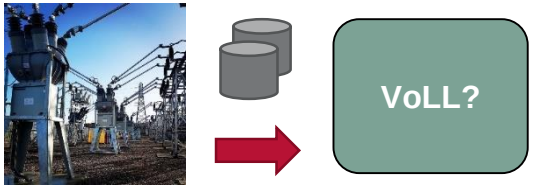
Recommendations on Geographic Granularity

- **Data granularity**
  - Demographic data is generally available at LSOA level
  - DNO data may be available at household level
- **VoLL granularity**
  1. Distribute an LSOA VoLL dataset
  2. Deploy a disaggregated VoLL calculation tool
  3. Develop a VoLL database for network assets

1

2

3



Recommendation for application to IIS, CNAIM and CBA

1. Update the uniform VoLL used for the IIS incentive rate

2. Further investigate the application of a disaggregated VoLL to CNAIM and CBA

   - Developing a VoLL database for network assets the best long term solution

   - Initially basing this on a ‘simple’ disaggregated VoLL model more likely to be a ‘quick win’

Break

IIS target setting – Alternative CML methodologies

SRR Working Group

31 March 2020

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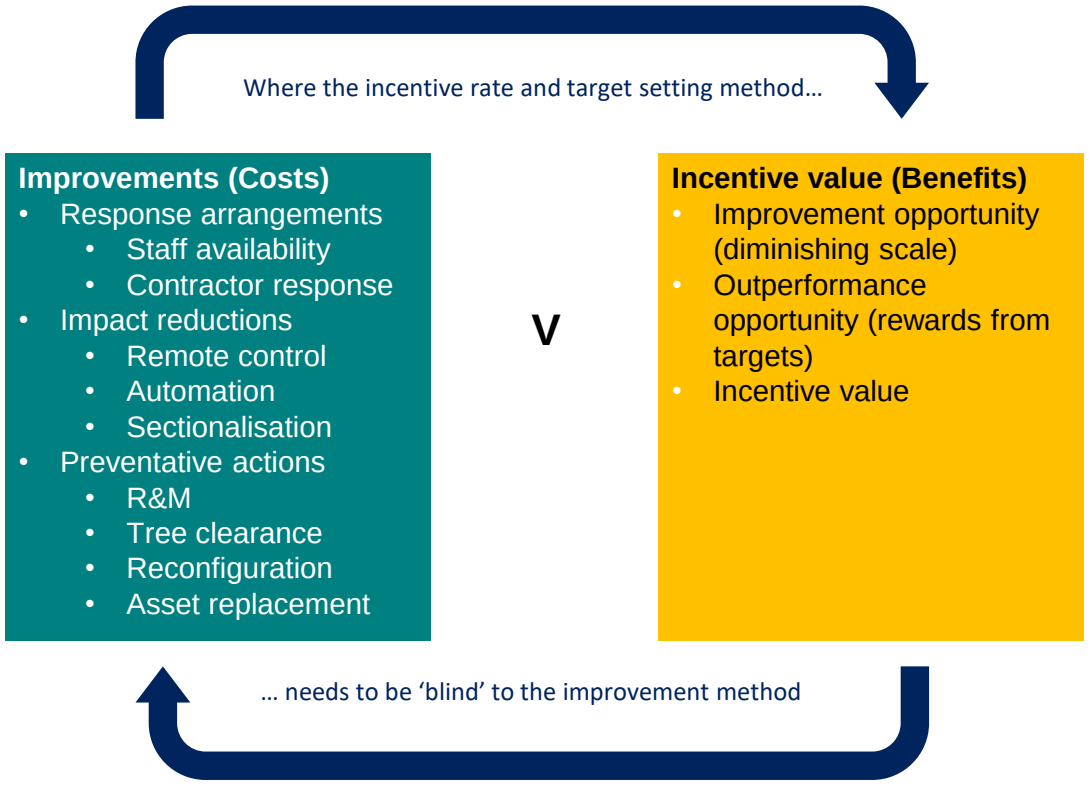
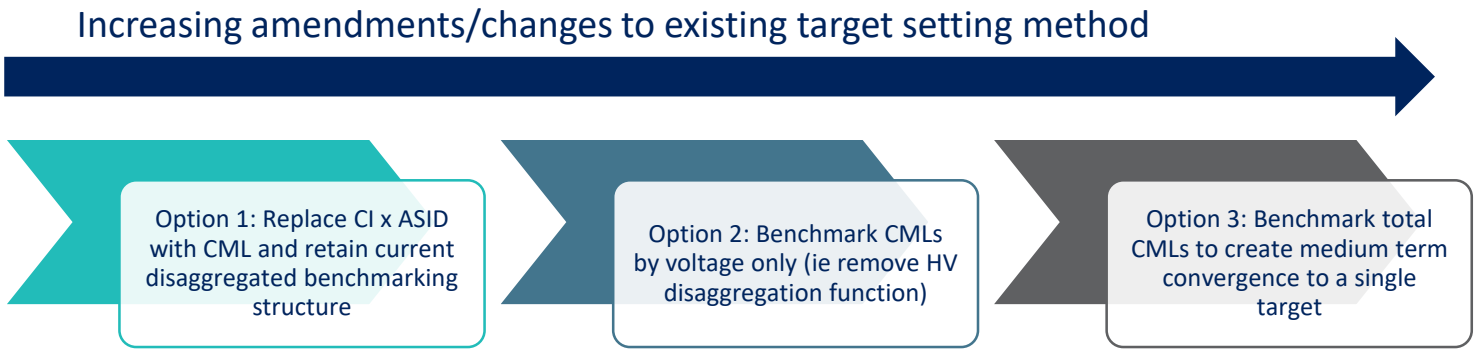
IIS balance of costs & benefits



Problem statement with CML target setting

- Currently CML targets are set as a function of CIs through application of an Average Supply Interruption Duration (ASID) function
- WPD presented options for refining this approach at the last meeting
- However, the use of CIs to develop an ASID function (duration/frequency) incurs the following issues:
  - CIs exclude Short Duration Interruptions (SDIs) by definition hence reductions in ASID to <3 minutes through automation etc. are not credited in the current methodology
  - This potentially leads to the perversity that the ASID actually increases following the intervention due to the use of the Average function
- To remediate the limitations of using ASID in target setting, actual or benchmarked CMLs could be used removing solution bias
- This would also align the benchmarking approach to the actual customer experience of the metric being benchmarked, ie CMLs

Options for address CML target setting



- Micro adjustments for network factors
- Macro adjustments for network factors
- No adjustment for network factors

- Our stakeholder and customer research reveals significant interest in the third option

Option 1 - Benchmarking CMLs maintaining HV Disagg

- For LV
  - Average of the last 4 years of CMLs for DNOs to create a start point
- For EHV & 132kV
  - Average of the last 10 years of CMLs for DNOs to create a start point
- For HV
  - IF $CML^{DNO} > CML^{IND}$ Then $(CML^{DNO} * 0.25) + (CML^{IND} * 0.75)$ Else CML^{DNO}
- Use the existing individual voltage improvement factors for the following years

Benchmarking CMLs using HV Disagg - Indicative results

	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28
ENWL	28.8		25.6	25.1	24.5	24.1	23.6	23.1	22.7	22.2
NPGN	41.6		30.0	29.3	28.7	28.1	27.6	27.0	26.5	26.0
NPGY	36.1		28.9	28.3	27.8	27.2	26.6	26.1	25.6	25.1
WMID	28.0		25.2	24.7	24.2	23.7	23.2	22.7	22.3	21.8
EMID	21.3		20.6	20.2	19.7	19.3	18.9	18.5	18.1	17.8
SWALES	28.0		26.1	25.6	25.1	24.6	24.1	23.6	23.2	22.7
SWEST	32.2		27.1	26.5	26.0	25.5	25.0	24.5	24.0	23.5
LPN	14.0		13.7	13.5	13.3	13.1	13.0	12.8	12.6	12.4
SPN	35.1		26.8	26.2	25.7	25.2	24.6	24.2	23.7	23.2
EPN	31.6		27.1	26.5	25.9	25.4	24.8	24.3	23.7	23.2
SPD	28.0		24.3	23.8	23.2	22.7	22.2	21.7	21.2	20.8
SPMW	27.5		22.7	22.1	21.6	21.1	20.6	20.1	19.6	19.2
SSEH	58.8		35.1	34.4	33.7	33.0	32.3	31.7	31.0	30.4
SSES	39.6		31.5	30.9	30.2	29.6	29.0	28.3	27.8	27.2

- Calculated using current target-setting methodology
- Data up to 2017/18 included; two year lag assumed as per current approach

- ‘2018/19’ data represents starting point based on methodology on previous slide

Option 2 - Benchmarking Each Voltage Level

- For LV & HV
  - Average of the last 4 years of CMLs for DNOs to create a start point

- For EHV & 132kV
  - Average of the last 10 years of CMLs for DNOs to create a start point

Use the following calculation for each voltage level to create year 1 (2019/20)

- IF $CML^{DNO} > CML^{IND}$ Then $(CML^{DNO} * 0.25) + (CML^{IND} * 0.75)$ Else CML^{DNO}

- Use the voltage improvement factors for following years

Benchmarking Voltage Levels CML Indicative results

	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28
ENWL	28.8		28.3	27.7	27.1	26.6	26.0	25.5	25.0	24.4
NPGN	41.6		33.6	32.9	32.2	31.5	30.8	30.1	29.5	28.9
NPGY	36.1		32.4	31.8	31.1	30.4	29.8	29.1	28.5	27.9
WMID	28.0		27.7	27.1	26.5	25.9	25.4	24.9	24.3	23.8
EMID	21.3		21.3	20.8	20.4	19.9	19.5	19.1	18.7	18.3
SWALES	28.0		26.8	26.2	25.7	25.2	24.7	24.2	23.7	23.3
SWEST	32.2		30.3	29.7	29.0	28.4	27.8	27.2	26.7	26.1
LPN	14.0		13.9	13.7	13.5	13.3	13.2	13.0	12.8	12.6
SPN	35.1		32.1	31.4	30.7	30.1	29.4	28.8	28.1	27.5
EPN	31.6		29.5	28.9	28.2	27.6	26.9	26.3	25.7	25.2
SPD	28.0		27.5	26.9	26.3	25.6	25.1	24.5	23.9	23.4
SPMW	27.5		26.0	25.4	24.8	24.2	23.6	23.0	22.4	21.9
SSEH	58.8		38.6	37.8	37.0	36.2	35.4	34.7	33.9	33.2
SSES	39.6		33.9	33.2	32.5	31.8	31.1	30.4	29.8	29.1

- HV treated in same way as LV to reflect diminishing contribution to overall performance

- Overall target is sum of voltage-specific components

Option 3 – Benchmarking Total CMLs

- For LV & HV
  - Average of the last 4 years of CMLs for DNOs to create a start point
- For EHV & 132kV
  - Average of the last 10 years of CMLs for DNOs to create a start point
- Add all these together for each DNO to create the start point
  - Average these total CMLs to create an industry average

Use the following calculation

- IF $CML^{DNO} > CML^{IND}$ Then $(CML^{DNO} * 0.25) + (CML^{IND} * 0.75)$ Else CML^{DNO}

Benchmarking Total CMLs Indicative results

	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28
ENWL	28.8		28.8	28.8	28.1	27.1	26.1	25.2	24.4	23.7
NPGN	41.6		34.5	30.7	28.6	27.2	26.1	25.2	24.4	23.7
NPGY	36.1		33.2	30.4	28.5	27.2	26.1	25.2	24.4	23.7
WMID	28.0		28.0	28.0	27.9	27.0	26.1	25.2	24.4	23.7
EMID	21.3		21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
SWALES	28.0		28.0	28.0	27.9	27.0	26.1	25.2	24.4	23.7
SWEST	32.2		32.2	30.2	28.4	27.1	26.1	25.2	24.4	23.7
LPN	14.0		14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
SPN	35.1		32.9	30.3	28.5	27.2	26.1	25.2	24.4	23.7
EPN	31.6		31.6	30.0	28.4	27.1	26.1	25.2	24.4	23.7
SPD	28.0		28.0	28.0	27.9	27.0	26.1	25.2	24.4	23.7
SPMW	27.5		27.5	27.5	27.5	26.9	26.0	25.2	24.4	23.7
SSEH	58.8		38.8	31.8	28.8	27.3	26.1	25.2	24.4	23.7
SSES	39.6		34.0	30.6	28.5	27.2	26.1	25.2	24.4	23.7
Average	32.2		29.5	27.8	26.7	25.8	24.9	24.1	23.4	22.8

- Process leads to rapid convergence of CML target
- Could be modified by adjusting glidepath calculation, ie to force convergence by 2030, 2040 etc.

Summary of results

	Current Perfomance	CML Targets Current	Option 1	Option 2	Option 3
	2018/19	2022/23	2027/28	2027/28	2027/28
ENWL	28.8	35.5	22.2	24.4	23.7
NPGN	41.6	47.9	26.0	28.9	23.7
NPGY	36.1	49.9	25.1	27.9	23.7
WMID	28.0	45.6	21.8	23.8	23.7
EMID	21.3	33.5	17.8	18.3	21.3
SWALES	28.0	27.1	22.7	23.3	23.7
SWEST	32.2	34.4	23.5	26.1	23.7
LPN	14.0	34.4	12.4	12.6	14.0
SPN	35.1	39.0	23.2	27.5	23.7
EPN	31.6	41.2	23.2	25.2	23.7
SPD	28.0	36.7	20.8	23.4	23.7
SPMW	27.5	30.0	19.2	21.9	23.7
SSEH	58.8	45.6	30.4	33.2	23.7
SSES	39.6	41.8	27.2	29.1	23.7

- Options would need to be tested
- Changes are independent of other potential amendments eg to improvement factors
- Uses existing data; no need to re-state history
- Our proposal is to include options 1 & 2 as possibilities in the SSM Consultation and consider Option 3 as a longer-term goal.

Pros & Cons – CML benchmarking

Option	Pros	Cons
Current approach	• Well established • Adjusts for legacy network issues	• Not solution agnostic due to reliance on ASID & exclusion of SDIs • Perverse incentives to chase ASID • Doesn't benchmark the target metric directly • Complex
1 – disaggregated using CMLs	• Links benchmarking to customer-observed experience hence more intuitive • Uses existing data • Solution agnostic	• No less complex
2 – disaggregated by voltage only	• Simpler to assess • Accommodates macro network differences • Reflects reducing significance of HV contribution to overall performance	• Halfway house – achieves neither full convergence nor allowance for network differences
3 – total CML level	• Long term convergence of performance targets • Simplicity • Removes 'postcode lottery'	• No acknowledgement of key network differences • Potential additional issues of cross-subsidy

- Other aspects to the approach eg improvement factors & cherry picking of benchmarks would still need to be addressed

Appendix - CML options identified by WPD

General considerations:

- Introduce transitional arrangements for CMLs
- Review improvement rates – for CMLs 1% or 3% depending on the network type
  - Align to revealed improvement rates
  - Consider diminishing opportunity
- Replace improvement rates with rolling recalculation of benchmarks/targets
  - Consider visibility of targets for price control package
  - Consider cost benefit certainty during price control
  - Consider whether rolling recalculation is necessary in a shorter price control

Band specific:

LV	HV	EHV/132kV
• Revise blend of BM and own performance	• Consider if using upper quartile in each disagg band is 'cherry picking'	• Higher of own ave vs BM (alignment with LV/HV) • Consider ability to change response to meet BM

Lunch

Short interruptions reporting

- UKPN and SSE circulated a template proposing edits for how short interruptions could be reported in the future.
- The template builds on the current ONI workbook, and proposes to remove short interruptions reporting from the IIS Interruptions pack.
- Reporting would, subject to changes that may need to be made to systems to accommodate the new template, start as soon as possible.
- Consistency of categorisation and information provided would need to be ensured.

- Further thoughts and feedback welcomed.

AOB, Actions, and Close

- We have one further ‘meeting’ scheduled for 5th May – do we need it? What should we cover?
  - Scope to have shorter meetings covering specific items instead of wider meetings like this one.
- Current plan is still to publish SSMC in Summer 2020

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