RetroMeter

A Strategic Innovation Fund Discovery Phase Project

WP3 Deliverable 3 - Review of relevant regulations and Deliverable 4 - Identification of constraint management zones

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Glossary

ADMD	After Diversity Maximum Demand - the coincidental peak load the network is likely to experience based on the number of customers connected to the particular network.
Best View	A scenario in the DFES which is the Electricity North West's highest certainty scenario that focuses on high certainty in the next 1 to 10 years.
BAU	Business as Usual
CBA	Cost Benefit Analysis
CEM	Common Evaluation Methodology – developed by DNOs to provide transparency on how decisions are made to choose the most suitable solution to meet network needs
CI	Customer Interruptions – the number of customers in every 100 whose supplies have been interrupted per year over all incidents
CML	Customer Minutes Lost – the average duration of an interruption to supply per customer per year
Consumer Transformation	A scenario in the DFES in which the 2050 net zero target is met by a high degree of societal change as well as deep electrification of transport and heat
DDSR	Domestic Demand Side Response
DFES	Distribution Future Electricity Scenarios
DNO	Distribution Network Operator
EHV	Extra High Voltage – a voltage of 33kV or 132kV
ENA	Energy Networks Association
EREC	Engineering Recommendation
ESO	Electricity System Operator
LCNF	Low Carbon Network Fund
LV	Low Voltage
NGED	National Grid Electricity Distribution
NHR	Network Headroom Report
NDP	Network Development Plan
NIA	Network Innovation Allowance

Open Networks	A programme facilitated by ENA to standardise customer experiences and align processes to make connecting to the networks as easy as possible and bring record amounts of renewable distributed energy resources, like wind and solar panels, to the local electricity grid.
P4P	Pay for Performance
RIIO-ED2	The price control for the electricity distribution networks 2023 - 2028
SIF	Strategic Innovation Fund
SSEN	Scottish and Southern Electricity Networks
System Transformation	A scenario in the DFES in which the 2050 net zero target is reached by relying on hydrogen to decarbonise the more difficult sectors of heat and heavy transport
UKPN	UK Power Networks
WP	Work Package

1 Introduction

The Strategic Innovation Fund (SIF) is supporting network innovation that contributes to the achievement of net zero, while delivering net benefits to energy consumers. Ofgem sets the strategic innovation challenges and invites applications for projects to address them. To mitigate the risk associated with innovation, the innovation is funded in three phases:

1. *Discovery phase (feasibility studies):* define the problem and the value in solving the problem.

2. *Alpha phase (experimental development):* focus on preparing and testing the different solutions identified during the discovery phase.

3. *Beta phase (build, operation and/or demonstration):* focus on the deployment of the solution to the problem.

RetroMeter was submitted as a solution to address the SIF Round 2 Challenge 4: "Accelerating Decarbonisation of Major Energy Demands: Improving energy efficiency at all levels in the system".

2 RetroMeter overview

RetroMeter will provide and demonstrate a consistent methodology to accurately measure the energy and cost savings of retrofits, unlocking pay-for-performance (P4P) financing, increasing uptake and leading to reduced costs for consumers and additional flexible services for the DNO.

This discovery phase is being led by Electricity North West, and principally delivered by EnergyPro Ltd, Energy Systems Catapult, Carbon Co-op, supported by Manchester City Council.

This discovery phase project will be delivered through 3 work packages (WP):

- WP1 - Develop a list of available and proposed UK energy consumption datasets, with access plans for each.

- WP2 - Assess output parameters and current state of measurement & verification methods and propose two or three methods for development in the Alpha phase.

- WP3 - Identify barriers to P4P energy efficiency models; develop a least-cost quantitative model to value the benefits to householders, network users and DNOs; and propose and refine three delivery model options for development in the alpha phase.

This report addresses two deliverables as part of WP3:

1. A study of precedent and relevant regulations study including identification of regulations or price control elements relevant to metered energy savings and previous research conducted by DNOs.

2. Details of the process to identify constraint management zones and the identification of specific candidate zones for energy efficiency investment in the Electricity North West region.

3 Review of relevant regulations and previous research

3.1 Relevant regulations

A review of the DNO licence conditions and business plans for RIIO-ED2 has highlighted some obligations and commitments regarding energy efficiency.

This clearly shows the need for energy efficiency as a service. Techniques such as that being developed in RetroMeter will be vital in understanding the benefits this service can bring to DNOs.

3.1.1 Network development plan licence condition

DNOs are required to publish a statement of network development information which should include the flexibility services or energy efficiency services that the DNO reasonably expects to need across their network area each financial year.

3.1.2 Procurement and use of flexibility services licence condition

DNOs must coordinate and direct the flow of electricity onto and over its network in an efficient, economic, and coordinated manner including:

a. procuring and using flexibility services where it is economic and efficient to do so.

b. procuring flexibility services in the most economic manner possible.

c. procuring flexibility services in accordance with objective, transparent and market-based procedures.

d. promoting the uptake of measures to improve energy efficiency, where it can cost-effectively alleviate the need to reinforce the network. This may include procuring energy efficiency services, where it is economic and efficient to do so.

e. establishing and maintaining objective, transparent, cost-reflective, and non-discriminatory rules, including terms and conditions and rules and tariffs where applicable, governing the procurement and use of flexibility services and, where relevant, energy efficiency services.

f. taking all reasonable steps to ensure the effective participation of all in the provision of flexibility services or energy efficiency services, including not unduly restricting new and existing providers of those services from competing in their provision.

3.1.3 Electricity North West business plan commitments

In our business plan for RIIO-ED2 we reaffirmed our commitment to flexibility first and extended this commitment to include the use of energy efficiency.

To help facilitate this commitment we aim to have 100% network visibility through the tactical installation of network monitoring and aggregated consumption data from smart meters. This data will enable us to publish heatmaps for our Low Voltage (LV) networks by 2025. This represents a step change in our ability to signpost and seek solutions for constraints on the LV network.

General approach to promoting energy efficiency: In RIIO-ED2 we will continue to promote energy efficiency widely to deliver sustained energy savings for customers. We have seen that engaging with

energy efficiency programmes can be a catalyst to wider systemic changes. For example, encouraging someone to think about the amount of energy they use within their home may lead them to consider changing energy tariff, installing solar panels, buying an electric vehicle, etc. and sharing this message with others.

Purchasing energy efficiency instead of network assets: Our goal in RIIO-ED2 is to work in partnership with others to deliver three targeted energy efficiency programmes within defined geographic boundaries to reduce network utilisation instead of reinforcing the network.

3.2 Previous research conducted by DNOs

A search of the innovation projects registered on the Energy Networks Association (ENA) Smarter Networks Portal has resulted in a number of relating to the value of energy efficiency to both customers and networks. An overview of these projects is given below.

Learning from the DEFENDER and CrowdFlex projects may be relevant for RetroMeter. The projects are currently active and an exchange of learning would reduce any possible duplication and lead to better outcomes for GB customers.

3.2.1 Demand Forecasting Encapsulating Domestic Efficiency Retrofits (DEFENDER)

DEFENDER[i] is a National Grid Electricity Distribution (NGED) Network Innovation Allowance (NIA) project due to complete in July 2023. It is aiming to develop the capability to accurately assess the impact of energy efficiency retrofits on current and future demand, and develop an understanding of the business case for retrofit investment as an alternative to reinforcement.

The project will create an analysis tool capable of generating domestic After Diversity Maximum Demands (ADMDs) and load profiles for a large number of property types to use in network forecasting and planning. It will also carry out an economic analysis of the business case and opportunities for DNOs to promote energy efficiency retrofit. This analysis will be supported by the creation of a tool for constraint management optioneering capable of assessing the value of energy efficiency retrofit, while accounting for the uncertainty in investment outcomes.

3.2.2 CrowdFlex

Crowdflex[ii] is a SIF project which has recently completed Alpha phase led by the Electricity System Operator (ESO) and supported by Scottish & Southern Energy Networks (SSEN) and NGED. An application has been submitted for a SIF Beta project.

CrowdFlex explores how domestic flexibility can be utilised to align demand to generation, improve coordination across the network, reduce stress on the system, while reducing consumer energy bills via new tariffs and incentives. The objective of CrowdFlex is to establish domestic flexibility as a reliable energy and grid management resource, providing it alongside Business as Usual (BAU) solutions such as network reinforcement or new thermal capacity.

Currently, flexibility services are procured deterministically, contracting a firm capacity, reflecting the operation of large thermal generators. However, domestic flexibility is inherently stochastic. CrowdFlex will investigate how domestic flexibility can be rolled-out in the near term through deterministic flexibility services, helping accelerate decarbonisation and minimising costs, while also develop pathways to introduce stochastically procured flexibility services, unlocking more value for the whole system.

CrowdFlex will conduct a large-scale trial in parallel to developing a methodology to model domestic flexibility. The model is necessary to forecast baseline demand and the availability of assets to offer flexibility services.

In the Alpha phase 2 trials were conducted using different methodologies for baselining:

- *Time of Use tariffs* - Customers' half-hourly data was analysed for 4 weeks before switching to the time of use tariff to determine their baseline energy consumption. It was further analysed for 24 weeks after switching to measure the response and to what extent it endures. A baseline was constructed for each household by calculating the percentage of daily consumption that occurred in evening peak period averaged across each day of the 4 weeks before a switch. This process was then repeated for the 6 months following the switch to determine the change in demand within the evening peak period.

- *Big Turn Up/Down Event* - The baseline was defined as the power demand maintained across the 2-hour period, averaged over the 4 same days of the 4 weeks prior to the event. Each customer's consumption is then measured over the 2-hour period of the event. The difference between the average consumption over the duration of the event and the baseline is the household's response. As there is an equal probability that a household will change its demand on a given day compared to the same day the previous week, a threshold must be set to determine whether customers actually participated. The threshold is set by assessing all half hourly deviations relative to their 4 week baselines. This gives a distribution of deviations over a customer's entire consumption history and if the event deviation was outside the median absolute deviation level for a given customer then they are considered to have participated.

CrowdFlex has highlighted the importance, and the technical challenge, of determining a proper demand baseline.

The Alpha phase research indicated that in the Beta phase, CrowdFlex should:

- Implement existing guidance (P376) as a base case but evaluate alternatives to deriving baselines. Alternatives for evaluation should include statistical evaluation on a per-household level, or across the portfolio.

- Identify and categorise non-routine changes to demand (including but not limited to weather, holidays, acquisition/disposal of smart technologies)

- Determine and test which are explainable/predictable and thus amenable to being modelled explicitly (such as weather impacts), and which are best predicted via a machine learning approach

3.2.3 Firefly

Firefly[iii] is a UK Power Networks (UKPN) NIA project which completed in June 2020 and aimed to trial how DNOs can serve customers through energy efficiency. It conducted an extensive exploration of global best practice to assess how DNO-led mechanisms and measures can save money for customers.

An energy efficiency model was identified based on the North American market. The model included a cost benefit analysis (CBA) to assess the benefit of an energy efficiency programme compared to traditional reinforcement. The results showed that although there is potential in energy efficiency for the purpose of reducing peak demand and deferring reinforcement, further work is required to tailor the model to the UK market. Further outputs from the project can be found on the UKPN website.[iv]

The initial plan was to carry out a phase 2 project to trial the energy efficiency measures. The outcomes from the energy efficiency model showed that there was limited scope for deferring network reinforcement when considering energy efficiency measures on their own. Consequently phase 2 will not be pursued as originally planned.

3.2.4 Social Constrained Managed Zones

Social Constrained Managed Zones[v] is an SSEN NIA project which completed in December 2019.

The closedown report stated that "A method for calculating the social and environmental benefits of Social Constrained Managed Zone participation was developed and approved. A method for calculating the social and environmental benefits for participants was investigated but not fully achieved, as it was identified that a number of factors influence the outcome. Further development and acceptance testing is required in future flexibility rollouts, to enable an appropriate method for calculating the benefits. The project also produced a Social Constrained Managed Zone supplier manual with National Energy Action (NEA) providing an indication of the load-reductions that Social Constrained Managed Zone providers might expect to achieve from different technologies and to resultantly ease future customer CBA in flexibility markets.

3.2.5 Solent Achieving Value from Efficiency (SAVE)

Solent Achieving Value from Efficiency (SAVE)[vi] is an SSEN (Low Carbon Network Fund (LCNF) Second Tier project which completed in June 2019.

The project aimed to assess the use of domestic demand side response (DDSR) measures as an alternative to traditional reinforcement. Through the collection and analysis of 15-minute household electricity consumption and survey data, SAVE was able to effectively evaluate the effect of DDSR measures tested during the trial periods. By directly measuring electricity consumption (in contrast to self-reported behaviour) the evaluation was able to detect customers changing their behaviour unconsciously. By conducting the analysis using a number of different timeframes the analysis was able to distinguish between short-term (novelty) effects and longer-term change.

4 Constraint management zones

In Electricity North West our constraint management zones are identified as part of, and to inform, our flexible tender process detailed below:

4.1 Flexible tender process

Electricity North West has a 'flexibility first' approach, in that it promotes flexibility as an efficient solution for network capacity provision and seeks to deploy at all opportunities where it is robust and economic to do so. As a result, for every capacity requirement detailed in our Network Development Plan (NDP)[vii] we have outlined the flexibility services option alongside the asset solution and indicated whether this requirement is likely to materialise immediately, or in the next 3-5, or 5-10 years. This is to ensure there is clear signposting of all future requirements for flexibility services providers and it demonstrates our approach of not foreclosing a flexibility services or energy efficiency opportunity before the market has been fully tested for a response.

Half-hourly through year capacity balancing requirements across our Extra High Voltage (EHV) network can be identified using the detailed assessments supported by methodologies developed as part of our ATLAS[viii] NIA project. This allows us to define detailed flexibility requirements, such as

number of days per month, energy requirements per day and capacity requirements per season to procure the required capacity of flexible services only when they are needed, ensuring the efficient and economic use of customers money.

The constraints identified in the Best View scenario within the NDP are reviewed on an annual basis in alignment with the latest Distribution Future Electricity Scenarios (DFES)[ix]. Where further data is needed to understand demand growth, monitoring may be deployed.

Within the NDP we have quantified the minimum level of flexibility required using the Best View scenario up to 2050. We have also presented what levels of flexibility may be required by 2050 under the Consumer Transformation and System Transformation scenarios to highlight the range of future uncertainty. The actual flexibility requirement presented in a tender release may be higher than that detailed in the Network Headroom Report (NHR) tables as it accounts for connections pipeline uncertainty and delivery risk mitigation.

4.1.1 Demand Forecasting

On an annual basis, our forecasting team will create the DFES using a combination of:

- Historical network data
- Regional insights created from talking with our stakeholders (local authorities, planning agencies, customers, community associations etc)
- Local and national policies
- External insights for industry consultancies
- Connections data

The Best View scenario is combined with connections applications data to provide a forecast of capacity requirements on a half hourly basis for the required period (currently 5 years).

The forecasts have any requirements removed which would not be resolved using flexible services e.g., fault level and harmonics.

4.1.2 Tender creation

The Best View forecast is fed into an automated tender creation tool, developed by Electricity North West, which filters and sorts the data into the formats required to create the tender documents. Filtering and processing includes:

- Removing requirements that are too small to be economically practical to contract for.
- Adding additional availability hours to bridge gaps in the forecasts where it would be impractical to schedule availability otherwise. For example, if the forecast identifies a potential overload between 06:30-07:00, and then a further requirement from 07:30-08:00; in reality we would pay the resource to be available from 06:30-08:00 with no break between 07:00-07:30.
- Applying standardised levels of estimated dispatch duration based upon the required availability.
- Sorting data by substation, dates, times, days etc.
- Filtering out any relevant existing flexible services contracts for the same period.

- Creating geographical representations of the data for display on our open data portal.

Additionally each contract requirement is evaluated using the Common Evaluation Methodology (CEM) Tool to calculate the ceiling price that would make a flexible service cost efficient compared to the counterfactual alternative solutions available e.g., reinforcement, incurring CI/CML penalties, utilising backup generation (faults & planned works), incurring penalties relating to curtailment of flexible connections.

4.1.3 Tender publication

Tenders are published twice a year, every 6 months. Each tender lasts for a 4-month period which includes 3 months for participants to read the tender requirements, pre-qualify their company and assets, and a two week bidding period.

4.1.4 Criteria for participation

To participate in Electricity North West's flexibility services, the flexibility provider will need to meet the following high-level conditions:

a. The flexible resource must:

   i. be already connected to the network location being supported; providers should use the highlighted area on the maps provided on our website and on the Piclo platform as an indication of whether the resource is in the right geographic location, or

   ii. be able to locate (i.e. install, commission, and deliver) the flexible resource in the locality of the network asset being supported 1 month prior to the delivery start date.

b. The minimum size for directly contracted resources is 50kW. There are no restrictions on the size of sub-sites of aggregated portfolios, but the total portfolio size needs to be at least 50kW (flexibility capability and not capacity).

c. The provider should be able to deliver and manage, upon the Electricity North West's request, a net reduction in demand or an increase in export, as seen by the distribution network, through flexibility or energy efficiency

d. The flexible resource should have the ability to act (ie provide a response) reliably and consistently, in both magnitude and duration, throughout the contracted windows.

e. Generators and electrical storage, greater than 16A per phase, looking to export to the network will need to have a long-term parallel connection and be compliant with the requirements of Engineering Recommendation (EREC) G59 or EREC G99.

f. The provider/flexible resource should be able to deliver the service by the specified delivery start date

4.1.5 Selection

Tender submissions will be evaluated based upon their technical criteria, i.e. do they meet the technical requirements of the service they are bidding for, and financial assessment.

Electricity North West are ideally looking to fulfil the entire requirements of the service within each tender, however are willing to accept partial bids. Over the course of multiple tenders, it is sometimes

possible to procure additional capacity in the event of shortfalls. It should be noted however that where submissions are deemed too small verses the requirements then these may be rejected as these would not defer the counterfactual actions required.

All tender submissions are also evaluated using the CEM tool, including the incorporation of network losses. In most cases, where demand is reduced or shifted to from a peak period to a non-peak period network losses will be reduced making these solutions more attractive. In some cases when distributed generation is used to provide demand reduction, this can increase network losses.

4.2 Post tender

4.2.1 Baselining

As part of the Open Networks project we have developed a range of standardised baselining methodologies[x] which can be used across the industry when measuring and settling flexible services dispatch contracts. We encourage participants within our tenders to engage with us regarding which baselining methodology represents the best solution for their site's asset type and the data they can provide on historical and future usage patterns.

The supported baselines are:

- Mid 8-in-10: a rolling historical baseline which uses data from the "middle" of the last 8 of 10 days.
- Mid 8-in-10 with same day adjustment: a rolling historical baseline which uses data from the "middle" of the last 8 of 10 days, but also applies a "same day adjustment".
- Mid X-in-Y: a custom rolling historical baseline, where the user can choose how many days to consider and what length of same day adjustment to use.
- Nominated: a nominated baseline, which allows the user to input the self-declared baseline of the asset in advance of the flexibility dispatch event.
- Zero: a baseline which assumes that the asset is not operating except for when providing a flexible service.

An industry standard baselining tool[xi] and user guide[xii] has been produced to allow participants to verify their baselines, delivering transparency into how baselines are calculated by DNOs.

4.2.2 Baselining in the context of the RetroMeter project

Electricity North West have not yet received any flexibility tender responses which use energy efficiency measures.

Participants are responsible for proposing their preferred baselining methodology at the point of tendering. For energy efficiency measures, it is envisaged that participants would need to provide historical metering data for the properties where they intend to deploy the energy efficiency measures. This data would be used to determine the historical baseline from which to measure the effectiveness of the energy efficiency measures.

Following the deployment of energy efficiency measures, it is likely that participants may decide to install additional electrical equipment which may mask the energy savings they have achieved through

energy efficiency measures. Depending on the energy efficiency measure and the additional electrical equipment allowances may be made. For example:

- if insulation was installed to reduce heating demand and, at a later date, an electric vehicle was purchased the customer would still be eligible for the payments associated with the energy savings from the insulation installation. The energy used by the electric vehicle should be netted off the customers baseline, so it does not impact the customers income. Where this scenario occurs, the participant would need provide agreement in writing prior to installation.

- whereas if, following the deployment of the insulation to reduce heating demands, the customer installed additional electrical heating increasing their electrical heating demand on the network, no allowance will be given, and the customers income would be reduced.

All scenarios will be assessed on a case-by-case basis.

Elements of weather correction will need to be considered within the baseline where energy efficiency measures are related to building heating and cooling demands, however currently a methodology for this has not been created.

4.3 Current constraint management zones

Using the process above we have recently issued our 2023 spring tender[xiii] which asks flexibility providers for 1097MW of flexibility in 32 locations across our region. The site requirements[xiv] document details the site specific requirements for the currently forecasted constraint management zones including:

- Postcodes
- Voltage
- Maximum Requirement
- Delivery start date
- Months, days, times required

5 How DNOs will use RetroMeter

The project direction for the SIF Discovery phase included the following condition to be addressed:

Prior to the end of the Discovery Phase, the Funding Party must provide to the monitoring officer consideration for how the DNO might utilise or leverage the information gained as part of this Project to increase network efficiency. For example, to fund strategic retrofit projects or integrating the data into reinforcement decisions.

DNOs can utilise a robust methodology, such as that proposed in RetroMeter, to quantify the energy, cost and carbon savings associated with retrofit of energy efficiency measures for the following applications:

1. *Peak demand reduction* – the effect of installing energy efficiency measures on peak demand comes in two forms:

    a. It will result in a reduction in customer's general energy consumption provided there is no comfort take-back, leading to a reduction in the general demand on the network. An accurate quantification of the energy savings will allow DNOs to include as part of

their forecasting methodologies and subsequently their decisions on reinforcement needs.

b. Increasing the thermal efficiency of their home allows customers' to install a lower rated heat pump to achieve the same level of comfort thereby reducing the effect on the network peak demand. This allows delivery of a fabric first approach to the electrification of heating and reduces the network reinforcement requirements.

2. *Procurement of flexible services* – as stated in the earlier sections of this document DNOs have a licence obligation to consider energy efficiency measures as part of flexible services solutions. When flexible services are used customers are paid for the service they provide and currently there is no accurate method to assess the response associated with energy efficiency. The outputs of RetroMeter will provide this fair, transparent and accurate methodology.

3. *Promoting energy efficiency with stakeholders* – DNOs have committed to promoting the use of energy efficiency with our stakeholders and encouraging their uptake. Using the RetroMeter methodology DNOs will be able to provide independent accurate assessments of the benefits in terms of energy and carbon savings as well as savings on customers' bills. This enhanced information will provide further comfort in our messaging and help stakeholders access financing for the retrofit thereby increasing the use of energy efficiency.

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