LCPDelta

Switching up the smart system: How the smart system can transform energy resilience

Report 2: Three themes to better utilise the British smart meter system

A project for CALISEN

25 JUNE 2026

Summary

Our research identifies specific use cases where smart meters can deliver more benefits for Great Britain. The report analyses these opportunities using evidence from real-world trials and modelling to demonstrate the benefits and associated policy requirements. It highlights the role smart meters can play in enhancing grid resilience, optimising the energy system, and delivering operational savings.

Voltage Control

The management of voltage levels across the low voltage (LV) electricity network to keep them within statutory limits

System Optimisation

Via flexibility; the ability to dynamically balance fluctuations in supply and demand under varying conditions

Operational Savings

Reduce the time, cost, and resources needed to manage the electricity system and consumer accounts, including social returns

Use case

- **Voltage Control:** Smart meter-enabled voltage control improves energy efficiency and grid resilience by providing visibility of voltage levels beyond substations. Trials show that optimising voltage using smart meter data can reduce consumption, lower bills, and cut carbon.
- **System Optimisation:** Smart meters enable consumer-led flexibility by providing near real-time data, allowing consumers to shift usage and support grid stability. Smart meters enable services such as the Demand Flexibility Service (DFS) which can reward households for reducing demand.
- **Operational Savings:** Smart meters replace manual readings with automated, half-hourly data, reducing costs, potential errors, and enabling more accurate settlement and billing. They also help identify and support vulnerable customers more effectively.

The research models base case and best case scenarios e.g. current rollout versus 100% rollout

Potential gross benefit across GB consumers

- **£572-770m** from Conservation Voltage Reduction (CVR) voltage control
- **£103-139m** from avoided overvoltage
- **£1-1.5m** from Winter DFS
- **£415-560m** from excess energy to customers enabled by smart meters
- **£312-420m** from operational savings of the full smart meter rollout
- **£185-250m** of social return from using smart meters to identify vulnerable households

Total annual gross benefits of £1.9bn at 100% rollout

Lifetime benefit

Smart metering rollout

Original objectives of smart metering

- Accurate billing
- Near real time data on consumption and usage cost to consumers through their in home display (IHD)
- Reduction of consumers' energy consumption through behaviour change
- Reduced energy supplier operating costs
- Enabling future energy system innovation (such as smart grids)

Original technical specification for the GB smart metering system:

- Half-hourly measurement and storage of electricity consumption
- Remote meter reading
- Near real-time data provision to an in-home display
- Support for Time-of-Use tariffs
- Credit and prepayment functionality
- Load limiting, outage logging, and power quality data (including voltage)

Originally, the UK Government planned for suppliers to take all reasonable steps to install smart meters in "all homes and businesses' by 2019."

Where we are today

Smart meters have met the original objectives for the overall smart metering implementation programme and enabled services such as the demand flexibility service in winter and time of use tariffs from suppliers.

- The reduction in consumers' energy consumption is disputed. However, smart meters have enabled many apps with behavioural insights that can be used by consumers to help reduce their energy usage based on the more accurate billing and data generated by the smart meter.

On the technical side of the GB smart metering system, some smart meters do not operate as intended (with 7.4% operating in non-smart mode at the end of Q1 2026). Furthermore, for Distribution Network Operators (DNOs) trying to access voltage data, more than 30% of smart meters did not respond in the BEETS trial and there are latency issues related to cellular (2G and 3G) as well as long-range radio.

Technical needs and requests from suppliers were met, however DNO requirements were not the focus of the original rollout.

- While not the purpose nor is it required of a smart meter, load limiting is a functionality that is offered. However, it's method of function has changed from SMETS1 to SMETS2 and it's not currently in use. Ongoing projects, such as LCP Delta's Smart ReStart, are investigating its usage.
- Voltage is currently recorded by the meter at 1-minute intervals, although DNOs can only retrieve it in 30-minute average intervals. 1-minute data would improve project planning for DNOs. Trials to retrieve the 1-minute voltage data found only a 57% success rate.*

*Smart Meter Innovations and Test Network (SMITN)

Voltage Control

Smart meter-enabled voltage control provides a significant opportunity to improve energy efficiency, grid resiliency and deliver savings to consumers.

Maintaining voltage within statutory limits has historically been challenging due to limited visibility beyond substations, leading to widespread overvoltage and inefficient appliance operation. Smart meters change this by offering voltage measurements beyond substations at the grid-edge or “end of the line”, enabling DNOs to identify and correct overvoltage conditions.

Evidence from trials such as BEET and DataMate shows that using near real-time smart meter data to optimise voltage at the system level can reduce consumption, lower bills, cut carbon, and increase hosting capacity for DERs. Scaled nationally and after improvements in access to real-time voltage measurement data, voltage optimisation could unlock hundreds of millions of pounds in annual consumer savings.

Overall, smart meters provide essential voltage visibility and data measurements assuring safe and effective delivery of efficient, resilient, and future-ready LV network operations.

Two scenarios were used to value the benefits of each of the smart meter use cases.
Base case assumes a 74.3% smart meter rollout across GB, the best case assumes 100%

High-level policy support requirements

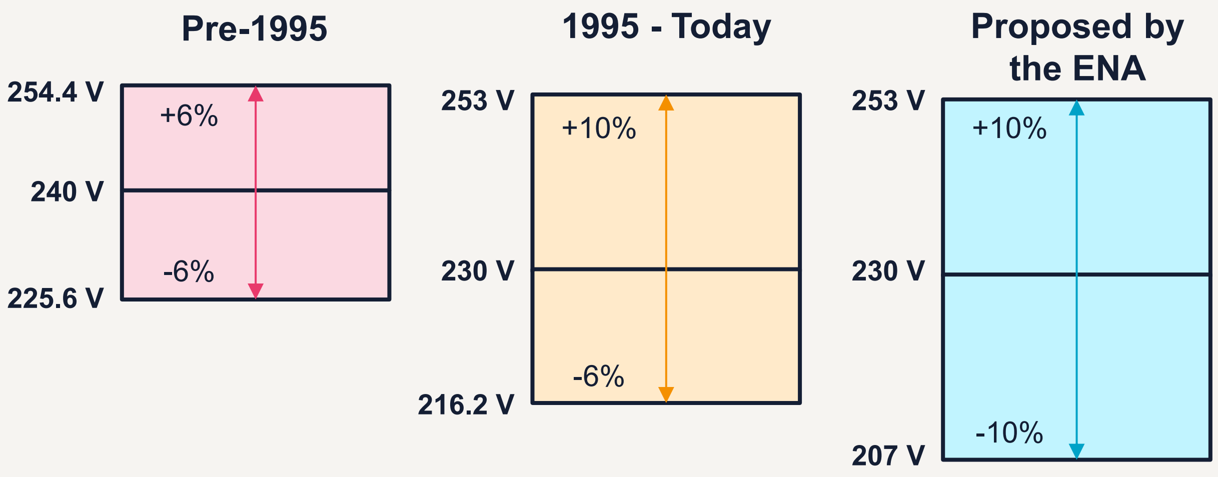
- Real-time voltage measurement data at grid-edge to support DNOs adjusting operational voltage limits and anticipating grid failure (currently smart meters provide near real-time data half-hourly).
- Timely access for network operators to smart meter voltage measurements, collected from DCC (via ‘Read Network Data’ Service Request or via a new and improved system).
- Continued innovation project support, supporting developments that avoid voltage inefficiency and reduce voltage driven constraints.
- Consideration of the ENA’s consultation on Modernising Statutory Voltage Limits, to accommodate both the higher UK voltage limits and the lower EU voltage limits.

Voltage Control – Introduction

Voltage Control offers multiple benefits, here we focus on optimisation to improve energy efficiency

Voltage Control is the management of voltage levels across the low voltage (LV) electricity network to keep them within statutory limits

In 1994, the European Commission decided to harmonise the standard UK mains voltage of 240V and the European standard of 220V in order to allow the same products to operate across the EU. This led to altered statutory voltage limits so that the harmonised supply voltage must be 230 V +10% / -6%, allowing both systems to operate within a common voltage range.



Most European appliances, including those supplied to the UK market are designed to work around 220V, even though UK supply often averages closer to 240V. As supply voltage affects efficiency of many (inductive) loads, domestic appliances tend to consume more energy than needed. Voltage control towards the lower permissible limit can improve energy efficiency.

Maintaining voltage within statutory limits is essential for maintaining power quality for grid resilience. It also prevents equipment damage and ensures equipment works as designed

Voltage control in LV networks is not automatic. The tap position in a transformer refers to specific connection points on the windings that allow for voltage adjustments, but which are not automatically adjusted in operation.

Overvoltage is common in distribution networks to compensate for voltage dropping along LV feeder lines further away from the substation. Network operators do this to ensure the voltage reaching homes and businesses does not drop below statutory limits, as they do not have visibility of the voltage level at the end of feeder lines.

However, the deployment of distributed energy assets, such as solar panels, can cause an increase in voltage level at the point of consumption, creating a challenge for network operators managing voltage levels.

Voltage optimising devices can be installed at the consumer unit (fuse box) in homes or businesses to ensure voltage remains at an optimum value to minimise energy consumption. However, while voltage optimisers can improve energy efficiency for the end user, they may not always perform as desired if the DNO has no visibility of voltage levels throughout the LV network.

When adjusting and optimising voltage at a system level, there is a trade off: between lower voltage improving some appliances' efficiency but simultaneously increasing line losses for the DNO or even damaging appliances.

This provides an opportunity for smart meters to provide near real-time voltage visibility to support voltage optimisation and grid resilience.

Voltage Control – The role of smart meters

Smart meters can revolutionise the visibility of voltage levels at the end of the line, improving grid resilience management

Accessing voltage measurements from smart meters

Smart meters are critical to this use case as they provide insight into grid-edge voltage stability by providing voltage measurements.

While the main purpose of a smart meter is to measure energy and there is no requirement relating to the accuracy of voltage measurements, smart meters can measure voltage with an accuracy of ±1%.

Voltage measurement data can be retrieved from electricity smart meters using a DCC 'Read Network Data' Service Request. This request can be made by import suppliers as well as electricity distributors. Distribution network operators often have visibility at substations but not for variations beyond that point in the LV network. Data from smart meters could provide similar visibility within the low voltage network.

Optimise voltage measurement collection using a sample of smart meters.

To avoid volume and performance limitations for processing data via smart meter gateways and the DCC radio network, it is recommended that voltage readings are taken from a subset of smart meters within a primary substation's area half-hourly, instead of from every smart meter.

Smart meters are typically configured as standard with a 30-minute voltage averaging period; however, this can be changed to a 10-minute averaging period which would provide a more granular view.

Acting on voltage data to improve grid resilience

By accessing smart meter voltage measurement data, network operators can have visibility through the LV network to better manage network voltage levels and support grid resilience.

DNOs currently have visibility of voltage levels at substations but not beyond that, at individual homes and businesses. Smart meters themselves do not directly change the voltage, but provide the data required for networks to identify overvoltage and undervoltage conditions and adjust voltage accordingly at the system level to deliver savings safely.

This use case utilises existing smart meter infrastructure and data request methods without the need for a voltage optimiser at the consumer unit (fuse box) in homes, which would come at an additional cost to consumers.

The opportunity lies in harnessing this data to deliver savings, as DNOs do not currently analyse and act upon voltage measurements from smart meters under business as usual.

By reducing incoming voltage, voltage control is estimated to be able to save 5-8% annually in electricity costs. There are other potential uses cases and benefits of Voltage Control, such as enabling further Distributed Energy Resources (DER) integration while maintaining grid stability, that are not included in this figure.

+ *5-8%*

Voltage Control – Case Studies

BEET provides a trial example of the savings that are possible when using smart meter data for voltage control

Boston Spa Energy Efficiency Trial (BEET)

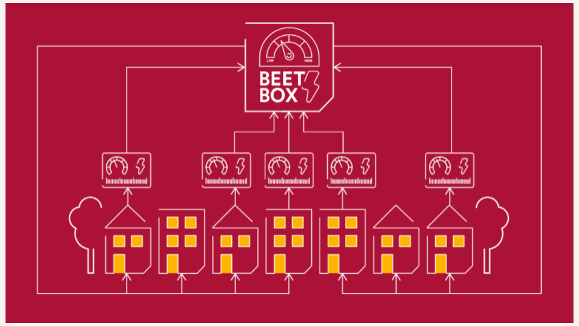
Approach: Half-hourly smart meter data is used to optimise voltage via “BEET-Box” devices, to achieve Conservative Voltage Reduction.

Result: Reduced voltage, reduced consumption, reduced cost. Improved hosting capacity for EVs and PV.

+ *£28* Estimated average annual household energy bill saving*
+ *20kg* Estimated carbon reduction per household
+ *3%* Average reduction in voltage from voltage optimisation**

What next? The trial period ended in September 2025. Northern Powergrid plan to rollout the concept to the majority of customers (up to 80%) in their operating area by 2033.

** based on several factors, including Ofgem’s definition of typical usage and assumed unit costs of £0.30 per kWh.*
*** based on measured data from November 2023 versus November 2024.*



BEET is a £1.3m Northern Powergrid innovation project helping around 15,000 households and businesses around Boston Spa and Wetherby to reduce energy bills.

BEET utilizes a specially developed technology, the **BEET-box**. Smart meter voltage data feeds into the BEET-Box, which applies an optimisation algorithm to the data every 30 minutes to determine the most efficient voltage to supply on the 11kV network at that time and the adjustment to the level of voltage required. The BEET-Box sends this voltage target to the network management system (NMS) which in turn adjusts the supplied voltage (by adjusting the automatic voltage control (AVC) relays at the 33/11kW substations) to provide only the level of power that appliances need to work effectively.

This is known as **Conservation Voltage Reduction (CVR)** – reducing distribution system voltage away from inefficient overvoltage to reduce energy consumption and peak demand.

Find out more:
https://www.northernpowergrid.com/beet

Voltage Control – Case Studies

Ongoing trials show why smart meters are important to near real-time voltage control, resulting in savings to consumers

Voltmetric

Voltmetric is a £1m SSEN Distribution innovation project aiming to establish a new Voltage and Power Quality index for quantifying the value of different voltage interventions.

Voltmetric combines smart meter and LV monitor data to create voltage and power quality health indices. The trial aims to provide the basis for a new incentive framework to be developed by Ofgem in this area, supporting the ability of networks to invest accordingly to improve voltage and power quality.

The methodology of the project related to smart meters, where the results will be of particular interest, include:

- Identifying the data required to determine a Voltage and Power Quality index, including data relating to smart meters
- Implementing a data collection method and frequency
- Running test cases to verify network intervention approaches

Find out more on the project page.

Keep an eye on this, trial completion is due October 2026. Started in April 2025, this trial is ongoing and could lead to tangible change in relation to the direction of investment and intervention to avoid voltage driven constraints. The role of smart meters is likely to be vital in providing the data needed for the index, with learnings in relation to data collection.

DataMate

DataMate is a £127k UK Power Networks innovation project aiming to crowdsource data from grid-edge-connected devices to enable DNOs to obtain data proactively and effectively manage voltage challenges stemming from the increasing number of LCTs connecting to the network.

UK Power Networks has seen a rise in voltage complaints from customers experiencing tripped EV chargers or PV inverters, caused by the voltage limits of LCT equipment being triggered. Usually, when voltage complaints arise, self-serve voltage recorders are provided to customers to capture data. The process is a reactive response, often involving numerous customer visits, resulting in a slow speed of complaint resolution.

DataMate sought to establish a platform to allow DNOs to harness data, conduct root-cause analysis, improve granular visibility and proactively identify voltage incursions, as the data is available from customers' own LCTs but DNOs cannot currently unlock the data.

The fragmented nature of LCT providers' data and systems also adds further complexity and cost as DataMate expects to pay LCT providers (data holders) for the data provided. **Smart meters provide another, less expensive way of delivering the same value, providing near real-time voltage measurement data.**

Find out more on the project page.

+*£4.4* Estimated average annual household energy bill saving*

** based on an estimated £37.1m per annum saving (from DataMate enabled voltage optimisation) and 8.5m customers across UKPN license area*

Voltage Control – Value Potential

There is considerable value potential to DNOs and consumers from CVR voltage control and avoided overvoltage

Total potential value in GB from Voltage Control

In the BEET trial, 15,000 customers were estimated to save £28 each annually. If rolled out nationwide, it could reduce household bills by up to £770m. Northern Powergrid's estimates are based on these assumptions:

- £0.30/kWh electricity unit cost
- 3% voltage optimisation
- 3,100 kWh typical domestic annual consumption (for savings per customer), and 85,600 GWh GB annual consumption (for GB savings)

£572 million across GB — *Base case*

£770 million across GB — *Best case*

These figures include the total benefit for GB including the savings for:

- Consumers: annual savings for network services & annual savings on energy bills
- Networks: reduced operating cost, avoided reinforcement, avoided monitoring devices & reduced DNO labour costs

Doubling voltage optimisation has a higher impact to potential annual savings than reducing the unit cost. As total electricity consumption is expected to continue increasing, future trials and innovation projects to further improve voltage optimisation across GB will have an increasingly significant impact on savings to consumers.

In the DataMate trial, UK Power Networks estimated the financial benefit across its license area which serves 8.5m customers. In the table below these benefits are estimated across GB (29.6m electricity meter points).

		Estimated Saving (£m)	
	Financial Benefit	Across UKPN area	Across GB
Network Operators	Reduced operating cost	159.5 – 178.6	555.4 – 621.9
Network Operators	Avoided reinforcement (i.e., transformer upgrades)	10.4 – 20.9	36.2 – 72.8
Network Operators	Avoided monitoring devices (i.e., in LV substations)	10.1	35.2
Network Operators	Reduced DNO labour costs	10.2	35.5
Consumers	Annual saving for users of network services (e.g., faster resolution, increased LCT utilization)	2.7 – 2.9	9.4 – 10.1
Consumers	Annual saving on consumer energy bill	37.1	129.2

£103 million across GB consumers — *Base case*

£139 million across GB consumers — *Best case*

Potential opportunity and value

There are significant financial benefits to both consumers and networks from voltage optimisation enabled by smart meter data. Meter asset providers and operators could consider new product offerings or business models that would enable its participation in the value chain. For example, developing a new hardware update or widget that would be rolled out in future smart meter models that would provide networks will accurate, near real-time voltage measurement data.

System Optimisation via Flexibility

Balancing electricity supply and demand is more challenging as we use more intermittent renewables such as wind and solar. Flexibility means adjusting when and how we use energy to keep the system stable whilst exploiting these variable and often abundant resources.

Smart meters support flexibility by providing near real-time data, so consumers can be incentivised to shift usage or to reduce demand at busy times. One example is the Demand Flexibility Service, which rewards households for cutting energy use during peak periods. This helps avoid switching on extra fossil-fuel plants, saves money, and supports a greener grid. Without smart meters, these services would not work fairly or at scale.

In short, smart meters and flexibility make the energy system more affordable, smarter, cleaner, and more resilient.

Two scenarios were used to value the benefits of each of the smart meter use cases. Base case assumes a 74.3% smart meter rollout across GB, the best case assumes 100%

High-level policy support requirements

- Allow licensed aggregators and grid operators (not just suppliers) to send commands via smart meter signals.
- Ensure homes have compatible hardware, either through next-generation meters with APC or standalone APC devices.
- There is an ongoing consultation, "Smart Secure Electricity Systems" (SSES) aimed at defining load control licence regulations and conditions. Industry needs this clarity.

System Optimisation via Flexibility - Introduction

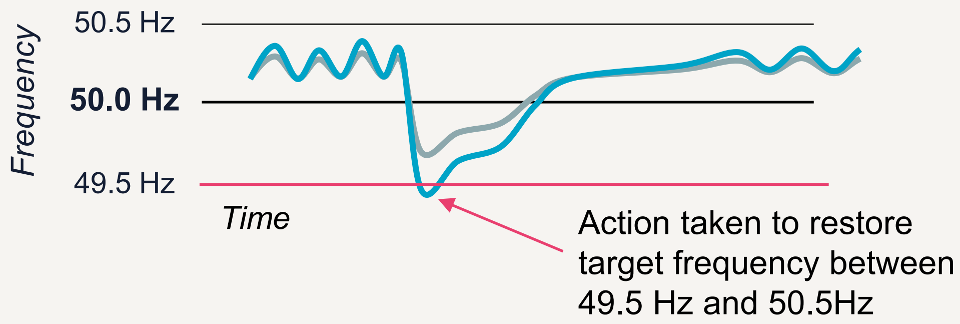
Flexibility is the balance of supply and demand, and we focus on the solutions to maintain frequency.

Flexibility is the ability to dynamically balance fluctuations in supply and demand under varying conditions.

Flexibility in the electricity system refers to the ability to modify generation or consumption patterns in response to external signals (e.g. price) to maintain balance between supply and demand in near real-time. This is critical because:

- Renewable energy sources like wind and solar are intermittent, unlike fossil-fuel plants which are dispatchable.
- Electrification of transport and heating increases demand variability.
- GB's grid must operate securely while meeting decarbonisation targets (Clean Power by 2030, Net Zero by 2050).

Frequency fluctuations reflect the balance between supply and demand. Frequency falls if demand is greater than supply, and rises if supply is greater. NESO is responsible for keeping the frequency within ±1% of 50Hz, illustrated below.



Traditional sources of flexibility

Historically, the GB electricity system relied on large, transmission-connected assets and operational measures. These remain critical today, and include:

- Transmission-connected generation: Gas and nuclear plants provide inertia, frequency response, and reserve.
- Industrial & Commercial flexibility: Large users can reduce or shift load during peaks, e.g. turning down processes.
- Reserve services: Products like Short-Term Operating Reserve cover unexpected demand or generation changes.

New and emerging sources of flexibility

The transition to a low-carbon system introduces new flexibility solutions:

- **Consumer-led flexibility**: Smart meters enable consumers to participate in flexibility through time-of-use tariffs and flexibility events and can leverage their smart connected devices like EV chargers and heat pumps.
- Energy storage: Batteries and long-duration technologies absorb excess renewable generation and discharge during scarcity.
- Distributed generation: Small-scale renewables and CHP connected to distribution networks provide local flexibility and ancillary services.
- Interconnection: Cross-border links enable imports / exports for balancing.
- **Local flexibility markets**: Aggregators group small assets (individual consumers relying on smart meters) into Virtual Power Plants (VPPs).
- Low-carbon dispatchable power: Hydrogen-ready turbines and biomass provide backup during prolonged, low renewable output.

System Optimisation via Flexibility – The role of smart meters

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Role of smart meters in flexibility services

The smart meter infrastructure enables consumer-led flexibility and VPPs relying on domestic assets

Smart meters in Great Britain are a critical enabler of domestic flexibility because they provide the digital infrastructure for near real-time data exchange, dynamic pricing, and automated control.

- Smart meter functionality goes beyond simple billing and underpins several flexibility services which did not exist before the roll-out of smart meters.

Smart meters allow granular consumption data to be collected and transmitted securely through the Data Communications Company (DCC) network.

- This data is recorded in half-hourly intervals and supports accurate measurement of demand shifts during flexibility events, such as the Demand Flexibility Service (DFS).
- It also enables suppliers and aggregators to forecast demand more accurately and design tariffs that incentivise flexible behaviour.

Smart meters enable time-of-use (ToU) tariffs and dynamic pricing when combined with granular data and remote tariff updates via the DCC. Consumers can be provided price signals that encourage them to shift usage to off-peak times or periods of high renewable generation.

Data transfer from smart meters to operators is constrained by the DCC network, with readings typically retrieved once per day. Enhancing communication infrastructure would enable more frequent data collection across the GB smart meter network and provide greater network benefits.

Smart meters strengthen grid resilience by improving situational awareness and enabling rapid demand-side action during system stress.

- Near real-time data could help operators detect emerging issues and respond quickly, while flexibility services such as DFS reduce peak demand and mitigate blackout risk.
- Automated control and accurate forecasting also reduce reliance on costly backup generation and support faster restoration after outages.

Acting on smart meter data for flexibility services

The half-hourly consumption data from smart meters is a key enabler for flexibility and incentivising consumers to increase, decrease, or shift their electricity use over time-of use tariffs and control services. Key smart meter functionality for flexibility include:

- Half-hourly consumption data – needed to settle flexible tariffs and to verify response in flexibility events.
- Remote, near real-time readings – enables suppliers and networks to monitor load patterns and spot issues or opportunities.
- Data access framework – consumers can authorise suppliers, aggregators, or others to access their half-hourly data for services like DFS and smart tariffs.

> Smart meters act as the digital backbone for a more flexible, affordable, and secure electricity system

System Optimisation via Flexibility – Case Studies

Smart meters are essential to the offering of system optimisation via flexibility for domestic consumers

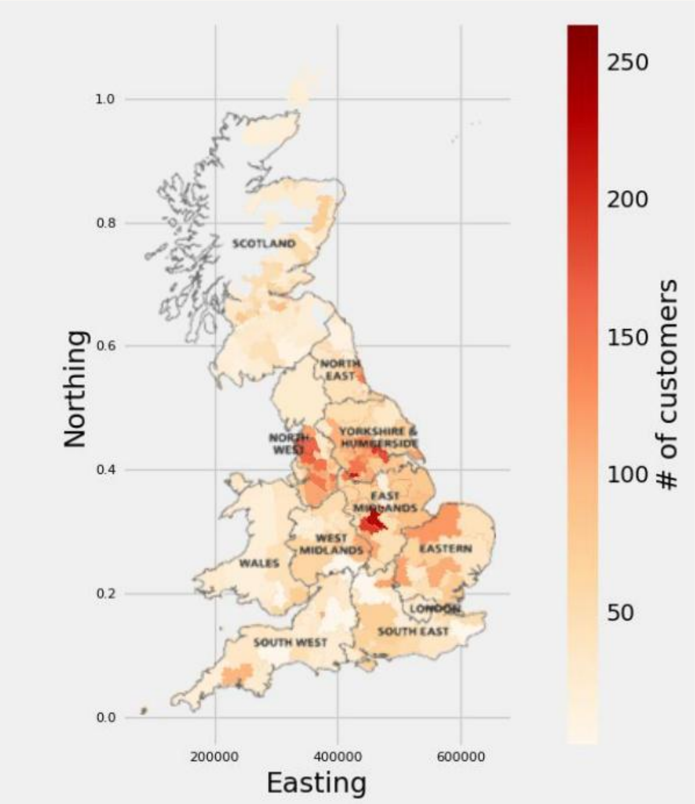
Demand Flexibility Service (DFS)

Approach: Half-hourly smart meter data used to pay consumers and businesses to shift or reduce demand during peak consumption periods.

Result: Total demand reduced during the peak consumption period lowering the need to fire up fossil-fuel plants.

+ *1.98M* Electricity supply points that took part in winter 2024/25 events
+ *3.9GWh* Total demand reduction across all events in winter 2024/25
+ *£944k* Payments for delivery of flexibility in winter 2024/25

The DFS launched in Winter 2022/23 has evolved from a winter contingency measure to a year-round merit-based flexibility tool driving consumer participation and system resilience.



Consumer location heat map for Winter 2022/23. Source: NESO

How it works

To participate in the DFS, households require a smart meter that enables half-hourly electricity metering data.

Smart meters allow NESO and suppliers to see when consumers reduce their electricity usage, half-hour by half-hour. That half-hourly data is used to (1) build a "normal use" baseline, (2) compare it with what consumers did during a DFS event, and (3) calculate how much flexibility was delivered and how much money should be paid.

Without a smart meter, NESO couldn't verify delivery of flexibility.

Smart meters & DFS

Without smart meter data, the DFS service could not work at a national scale or with any real accuracy or fairness.

System Optimisation via Flexibility – Case Studies and Modelling

SP Energy Networks & Octopus Energy "Windy Day Fund"

A 2022 UK trial in Dumfries & Galloway and Ayrshire (Scotland) explored how domestic demand flexibility can help absorb excess renewable generation that might otherwise be curtailed, while giving tangible financial benefits to participating households.

Around 8,692 households in the SP Energy Networks distribution area were invited to opt in to the event, with around 2,500 households participating.

- Octopus Energy targeted periods of high renewable generation and low demand, inviting eligible smart-meter customers to increase usage during selected two-hour windows. Households raising consumption by more than 10% received free energy for that period, with higher rewards for doubling usage.
- The average reward for participating customers was £5, with some saving up to £73. Across six events, total demand increased by ~20 MWh.

Excess energy that is curtailed has many potential use cases which have been explored in the UK.

- In Ireland, using excess (curtailed) wind energy to heat domestic hot water for fuel poor households has been studied which could save the Irish state €4 million by 2030
- In GB, wind generation exceeding grid capacity led to DESNZ offering discounts on electricity costs for data centres located in high wind generation regions.

System optimisation value in GB via flexibility

- In the Winter 2024/25 Demand Flexibility Service (DFS), 1.98 million participating smart meters (with 19.1 million smart meters operating) enabled a total demand reduction of 3.9 GWh and total payments of £944k for delivery of flexibility.
- Scaling up the figure from the Winter 2024/25 DFS to the smart meter rollout today and a full smart meter rollout, gives a gross total potential benefit from the Winter DFS:

£1.08 million across GB — *Base case*

£1.46 million across GB — *Best case*

- Taking the curtailed average benefit of £5 in free energy for customers across six events and applying this to 197 curtailment events in 2025 and ~3 million participating households, results in a gross annual benefit from using curtailed energy of:

£415 million across GB — *Base case*

£560 million across GB — *Best case*

£1.9 billion curtailment cost across GB in 2025

While the DFS is already operational, the largest blockers to access are 1) the smart meter rollout not being completed and 2) smart meters that are installed but operating in "dumb" mode, hence not sending half-hourly meter reads.
Ofgem has proposed new rules to offer compensation to customers for smart meters not operating in smart mode if not fixed within 90 days.

System Optimisation via Flexibility – Potential opportunity

Smart meters could further enable automating flexibility, but regulatory support is needed

Potential opportunity

Smart meters could be used to automate flexibility rather than relying on manual actions from consumers.

- The GB smart metering system introduced an Auxiliary Proportional Controller (APC) function, (defined in the PAS 1878) to allow the throttling of a device's power between 0 and 100% rather than just a power on/off as existed in Auxiliary Load Control Switches (ALCS).
- In practice the APC functionality remains mostly dormant, with no widespread deployment. Additionally, only licensed energy suppliers can send control signals via the DCC network.
- Roughly 60% of installed smart meters today have potential ALCS functionality, but this only offers on/off control.

There is an ongoing consultation, "Smart Secure Electricity Systems" (SSES) aimed at defining load control licence regulations and conditions.

- As it stands, load control is expected to centre on the energy smart appliances (ESA) themselves including electric vehicles (EVs), EV charge points, heating appliances and batteries.
- Ancillary devices could be used to enable the load control of an ESA, including the use of Auxiliary Proportional Controllers (meeting security expectation as set out in SLC 46).

Smart Secure Electricity Systems

- By 2028, phase two of the SSES, a minimum common protocol (potentially based on an updated PAS 1878) is planned to be specified.
- In the short term, flexibility control will likely be through the ESA's internet connectivity, using open APIs or standards agreed with industry.
- The smart meters' APC functionality could play a larger role later, but some changes are needed for it to be viable.
    - Notably, expanding access to the DCC-controlled smart meter signals beyond just suppliers is crucial. The new load control licensing may pave the way for licensed aggregators or grid operators to send commands through the smart meter system.
    - Additionally, hardware needs to be in homes. Either through the installation of next-generation meters with built-in APC, or the deployment of standalone APC devices that can receive the DCC signals and modulate appliance load. Industry trials are ongoing to test these capabilities.

Ongoing consultation

The UK Government's current stance is 'technology neutral but security-focused', ensuring flexible loads can be controlled in a secure and standardised way. ***The APC via smart meters*** *is possible and remains an option under consideration, but it will* ***require further regulatory support and industry uptake to become a practical alternative.***

Operational Savings

Managing the electricity system and customer accounts used to involve manual meter readings and estimates, which were slow, costly, and the data was often inaccurate. This caused billing errors, disputes, and extra work for suppliers.

Smart meters could change this by providing near real-time, half-hourly data, removing the need for manual reads and making settlement faster and fairer. They also unlock big operational savings for energy suppliers by reducing site visits, cutting admin costs, and improving forecasting. Government analysis shows smart meters could save suppliers billions over time, while also helping identify and support vulnerable customers more effectively.

In short, smart meters take the guesswork out of energy use, cut costs, and enable a smarter, more resilient grid.

Two scenarios were used to value the benefits of each of the smart meter use cases. Base case assumes a 74.3% smart meter rollout across GB, the best case assumes 100%

High-level policy support requirements

- DNOs are already running initiatives such as VIVID to use smart meter data to identify Priority Services Register eligible customers, but the full benefits will only be realised if access to individual smart meter data is streamlined and improved.
- Mandate the installation of smart meters in all newbuilds to accelerate rollout and futureproof new housing developments.

Operational Savings - Introduction

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Operational savings reduce the time, cost, and resources needed to manage the electricity system and consumer accounts

What do settlement and meter operations look like with analogue electricity meters?

For most domestic consumers without smart meters, suppliers rely on periodic manual reads, either monthly or quarterly, and estimated consumption profiles to reconcile wholesale purchases with actual demand ("settlement").

- In practice, this means site visits from field personnel, customer-submitted reads, and a back-office process that reconciles differences months later.
- Errors in reads or missing data lead to estimated bills, subsequent back-billing, higher complaint volumes, and costly corrections.

As only periodic manual reads were available, vulnerable customers without smart meters are identified manually or via self-registration on the Priority Service Register (PSR). DNOs conduct extensive engagement and promotion for the PSR which has significant time and cost implications.

- Manual assessment to detect consumers who didn't self-identify as vulnerable or lacked awareness of their situation can also miss potential vulnerable customers.

Why does this create operational and customer problems?

Settlement and billing processes without smart meters have to use data which may be estimated data, may not be timely or may have inaccuracies, giving suppliers a poor, potentially erroneous view of when energy is used. This increases the supplier's wholesale imbalance risk, inflates their back-office workload to resolve disputes, and reduces overall customer trust.

- In addition, to capture the meter readings, field personnel are required to visit premises, enduring overhead costs for energy suppliers and logistical complexity.

How do smart meters improve the situation and enable grid resilience?

Smart meters will play a key part in replacing periodic or estimated reads with actual consumption data for every half an hour period. This data will be used across industry once the MHHS Programme goes live. This shift enables accurate settlement as opposed to profiles and estimates, reducing imbalance risk and improving forecasting. Automated data flows cut costly site visits and back-office corrections, while eliminating billing errors and complaints. Vulnerable customers can be identified proactively through usage patterns, reducing manual PSR processes.

For grid resilience, smart meters support demand-side flexibility, ToU tariffs, and dynamic control of EVs and heat pumps. Granular data enhances network planning, outage prevention, and integration of low-carbon technologies, strengthening reliability and decarbonisation efforts while enabling a smarter, more efficient energy system.

Operational Savings – The role of smart meters

The role of smart meters

Why are smart meters essential?

For smart meters, no routine, or physical cyclical meter readings, are required which significantly reduces their operational cost when compared to traditional analogue meters, driving costs down for energy suppliers.

MHHS makes use of trusted, secure, high-frequency consumption data at the meter point. Smart meters capture consumption in half-hourly intervals and communicate it over the national network operated by Smart DCC.

- This unlocks settlement reform and the associated operational savings (no routine manual reads, fewer disputes, less back-billing), which simply are not available at scale with legacy, or manual, approaches.
- Ofgem's settlement reform pages explicitly state smart meters can record every half hour and provide the opportunity to make settlement more accurate and timely. This allows energy suppliers and network operators to match supply and demand more precisely, reducing forecasting errors, imbalance costs and manual processes.

New builds

The smart meter rollout is driven by the energy supplier rollout plans with no current legal obligation to install smart meters in new builds. Mandating smart meters in new builds is an easy way to accelerate the rollout and future proofing new builds, particularly in light of the Labour government's ambitious housing new build targets.

How do smart meters technically enable the flow?

- On-premise measurement & encryption: The smart meter and communications hub collect usage, wrap it in multi-layer encryption, and maintain a home area network (HAN) to interface with the in-home display and devices.
- Wide-area transmission via DCC: Readings are sent via secure wide-area networks (cellular/radio) to the DCC servers. DCC does not retain the consumption data; it securely transports it to the relevant market participants (energy suppliers and DNOs) for billing and, in future, for settlement through the MHHS architecture. All smart electricity meters are scheduled to be migrated to MHHS operations by May 2027.
- Market integration for MHHS: DCC is implementing new user roles, interfaces, and capacity upgrades to support the MHHS Target Operating Model, ensuring the industry can retrieve half-hourly data at national scale with appropriate assurance and testing.

Smart meters take the guesswork out of consumers' electricity usage and unlock innovative flexibility solutions (both tariff driven and direct) for consumers to take part in optimising the grid.

Operational Savings – Case Studies

DESNZ's cost benefit analysis demonstrates the operational savings benefit of smart meters to suppliers

DESNZ Cost Benefit Analysis of Smart Meter Rollout

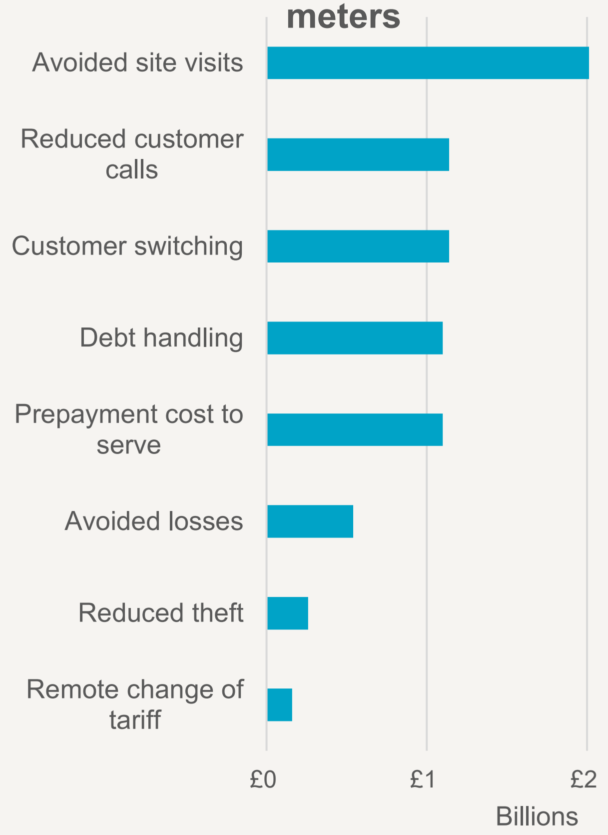
Approach: Analysis of the costs and benefits of the smart meter rollout based on up-to-date (2019), real world evidence from the programme.

Result: The programme's business case passed the breakeven point in 2019 with every additional smart meter added to the system adding to the positive and growing net benefits. The top 3 benefits to **suppliers** are:

+ *£3.76* Net benefit to suppliers per meter per year due to avoided site visits
+ *£2.21* Net benefit to supplier per meter per year due to reduced costs of customer switching
+ *£1.91* Net benefit to suppliers per meter per year due to reduced cost of call handling

What next? As the smart meter rollout continues, the benefits for suppliers will continue to increase. The latest 2025 report estimates the total supplier benefit to be **£8 billion**, using prices discounted to 2025 (based on the 2019 cost-benefit analysis).

Breakdown of energy suppliers' accrued benefit (2013 – 2034) for domestic sector from smart meters



The Smart Meter Rollout Cost Benefit Analysis is the UK government's assessment of the long-term costs and benefits of installing smart electricity and gas meters across GB.

The report examines the economic case for the smart meter programme from 2013 to 2034, quantifying impacts across households, businesses and the energy sector.

For energy suppliers specifically, the analysis identifies operational efficiencies as a key benefit: smart meters reduce the need for manual meter readings, cut down administrative costs and improve billing accuracy.

Although supplier benefits are estimated to be lower than in earlier assessments (due partly to shifts in the retail market and increased customer-provided readings), they still amount to £billions over the appraisal period.

The UK Government's original 2019 cost-benefit analysis and the updated 2025 cost-benefit analysis are available online.

Operational Savings – Vulnerability and fuel poverty

There is overlap between fuel poor and vulnerable customers with many fuel poor also being vulnerable

Vulnerability and Fuel Poverty

Vulnerability can be defined in many ways.

The Priority Services Register is the energy industry's primary method for providing help, support, and adapted services to those who are vulnerable during power cuts. However, it is only one way of defining vulnerability. Eligibility to join the PSR typically includes customers who :

- Use medical equipment reliant on electricity or water
- Live with children under five
- Are blind or partially sighted
- Are deaf or hard of hearing
- Have a chronic illness, anxiety, depression or any mental health condition
- Have a disability

Fuel poverty is focused on whether households can afford adequate energy services. The definition of fuel poverty varies across GB.

- The UK government uses the Low-Income Low Energy Efficiency (LILEE) metric measuring if a household's home has an energy efficiency rating of band D or below and if, after spending the required amount on energy, the household's income falls below the official poverty line.
- National Energy Action (NEA) defines households to be in fuel poverty if they need to spend more than 10% of their income on energy to maintain adequate warmth.

Addressing vulnerability and fuel poverty

There are many ways of addressing fuel poverty and vulnerability. PSR registration can help with accessibility and critical support, but it's unlikely to solve long-term affordability issues. Below are a few examples of the different support mechanisms available to vulnerable and fuel poor customers in GB.

Fuel poverty intervention examples	PSR eligibility intervention examples
Warm home discount provides fuel poor households with energy bill rebate	Receive priority support during power cuts or emergencies
Energy efficiency retrofits working with energy suppliers, local authorities and housing providers	Access to hardship funding and energy efficient appliances (DSO/retailer dependent)
Energy supplier debt write-offs, hardship funds, payment plans, or repayment holidays	Special help may be provided, if required, through providers like the British Red Cross

Operational Savings – Case Studies and Modelling

Trials demonstrate why smart meters are vital to vulnerable customer identification and support

VIVID

Other additional benefits are emerging as smart meters become the standard meter type installed, such as VIVID.

VIVID is a completed SIF Alpha project that combined energy-sector data (including smart meter data) with local authority and third-sector data to identify vulnerable households missing from the PSR, enabling timely and targeted practical and financial support.

SSEN and UKPN reported high PSR "penetration" (77% and 67% respectively), but an average PSR gap of ~30%, equating to ~1.4M households across the two, and more than 5M households when extrapolated GB-wide.

Benefits at GB-scale option were estimated at £219M to 2035, assuming VIVID will increase the number of customers added to the PSR by ~7% per year. This includes various weightings, deadweight calculations and optimism bias factors (e.g., 7.5% increase of new PSR customers receive advice, 1.5% increase of existing customers receive advice). The VIVID discovery phase and VIVID alpha phase are available online.

DNOs currently lack operationally-scalable household-level access to data for vulnerability use cases. While regulation is moving towards greater aggregated openness and consumer-consented sharing, effective vulnerability identification would benefit from a nationally consistent, authorised vulnerability service. This should provide a clear lawful basis, strong controls and audit, and fast onboarding, avoiding reliance on bespoke and slow project-based approaches.

Operational savings potential value

- From the UK's original cost benefit analysis in 2019 of the smart metering rollout, we aggregated the supplier benefits per meter per year including:
  - Avoided site visits, customer switching, reduced customer calls, prepayment cost to serve reduction, avoided losses (difference between electricity entering and leaving the transmission and distribution network) and remote changes to tariff.

Current rollout (74.3%)

*£312 million per year across GB**

Full rollout

*£420 million per year across GB**

- From the VIVID project, the lifetime GB wide benefit from the project was:

£185 million across GB — *Base case*

£250 million across GB — *Best case*

As part of their standard licence conditions, DNOs have a duty to actively run processes that identify PSR eligibility when they interact with customers. Smart meters could be a pathway to improve these processes in an efficient and inexpensive way. Policymakers should consider the solutions currently used by DNOs and whether they are the most efficient and up to date.

**Gross annual benefits, including consideration of operating costs of smart meters*

When can these use cases become useful to the system?

Each use case reaches usefulness at a different point in the smart meter rollout. Below we set out the penetration thresholds needed for each to deliver value.

Voltage Control

The management of voltage levels across the low voltage electricity network to keep them within statutory limits

Threshold: Low, already broadly achieved

DNOs currently lack visibility of voltage conditions beyond the substation. To make voltage-control applications useful, they only need a representative sample of smart meters on each LV feeder to understand end-of-line voltages. Once a subset of households per substation has smart meters, DNOs can derive accurate, near real-time voltage profiles.

Full rollout is not required. Beyond 50% penetration, this use case will hit DCC volume and performance limits. With today's penetration already exceeding this threshold, the focus should be on meter placement and observability, to ensure phase coverage and how quickly DNOs can access the data.

System Optimisation

Via flexibility; the ability to dynamically balance fluctuations in supply and demand under varying conditions.

Threshold: High, but penetration isn't the only factor

Consumers must have a smart meter operating in smart mode to participate in domestic flexibility schemes. Higher penetration increases the potential volume of flexible demand, thereby increasing system value. However, despite 72% national smart-meter coverage, only ~2.5 million households currently participate in any form of flexibility (~ 10% of installed smart meters). Beyond smart meter penetration, the main barriers are low consumer awareness of flexibility, limited understanding of what smart meters enable, and low trust / interest in dynamic tariffs.

Increasing smart-meter penetration alone will not unlock the value. The real thresholds are behavioural and operational: more consumer engagement, more automation and more meters reliably delivering half-hourly data.

Operational Savings

Reduce the time, cost, and resources needed to manage the electricity system and consumer accounts

Threshold: Very high, approaching 100%

Operational savings grow with each additional smart meter installed. But the final benefits, particularly retiring legacy settlement, communication, and meter-management systems, require near-universal coverage. The "last few percent" of households without smart meters will drive disproportionate cost, because maintaining dual systems (smart + legacy) becomes inefficient and expensive.

To realise the full operational-savings potential, the system must reach ~100% smart-meter penetration. In addition to installation, action needs to continue to address non-communicating smart meters. Unlike other use cases, partial penetration does not unlock most of the value for this use case as the benefits are back-loaded.

Contact us

For further information please contact our team.

Jeremy Harrison
Senior Consultant

jeremy.harrison@lcp.com
+44 (0)13 1285 1762

Robin Kaloustian
Consultant

robin.kaloustian@lcp.com
+44 (0)203 943 9414

Tom Veli
Head of Energy Networks

tom.veli@lcp.com
+44 (0)20 7550 4659

Becca Yap
Consultant

becca.yap@lcp.com
+44 (0)20 4603 3796

Tim Zhou
Associate Consultant

timothy.zhou@lcp.com
+44 (0)13 1285 1761

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