CORNWALL INSIGHT

CREATING CLARITY

HeatNet Deliverable 3.1.2: Policy, Regulatory, and Interoperability Review

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Introduction

HeatNet is a Strategic Innovation Fund (SIF) supported innovation project that is examining the application of machine learning algorithms to coordinate electrical loads from clusters of heat pumps on LV subnetworks. The HeatNet solution can support grid stability while maintaining consumer heating set points, balancing heat pump performance with weather conditions and thermal inertia. The project is particularly focused on how to integrate this new technology into network management processes and explore business models to unlock value from this capability.

This report forms part of a suite of deliverables that we are providing to the project, across commercial, policy and regulatory, and cost-benefit analyses. It:

- Assesses the components of HeatNet's LV heat pump demand management service and its applicability across relevant energy market vectors (e.g. a network management tool for DNOs, as a customer-facing home energy management platform)
- Draws on regulatory and commercial market research, modifications impact analysis, and dedicated primary research to identify relevant energy market regulatory interactions across these vectors, including:
    - Technical and interoperability requirements
    - Customer interface and consent
    - Code governance frameworks
    - Metering requirements for other value streams
    - Wider policy and regulatory developments
- Presents a ranking for developments identified under each of these areas, based on the materiality to HeatNet and its potential application(s), using a red-amber green methodology

This draft copy of the report is provided to support ongoing project discussions and a focused discursive session with the HeatNet team.

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1. Executive Summary

HeatNet could access multiple value streams, from improving connections and upgrades to accessing novel and existing system services

HeatNet uses machine learning algorithms to coordinate electrical loads from clusters of heat pumps on LV subnetworks. It supports grid stability while maintaining consumer heating set points, balancing heat pump performance with weather conditions and thermal inertia. This novel capability has the potential to help DNOs better manage and protect their networks without compromising consumer comfort.

There are multiple pathways that Passiv could take to commercialise the HeatNet solution, each bringing specific associated policy and regulatory considerations. For the purposes of policy and regulatory review, we have considered three overarching 'Value Verticals' under which we believe Passiv may be able to provide benefit via the HeatNet solution. These are:

Value vertical:	1 Improve new connections and upgrade processes	2 Improve ongoing voltage management on distribution networks	3 Provide system support via wider flexibility services
Overview	Deployment modelling and/or ongoing asset control used to derive value at the point of connection, via facilitating extra heat pump installations / a quicker connections process / a lower-cost connection	Participate in novel ongoing service(s) developed by DNOs to procure dynamic voltage control from HeatNet users	Use sophisticated asset control algorithms to deliver flexibility actions under the wider suite of existing services *alongside* a network management offering
Timings of opportunity	1-3 years	5+ years	1-3 years

Based on these different Value Verticals, and the activities that may be associated with them, we have assessed the potential interactions with the policy and regulatory landscape in the GB energy market, across network-specific interactions, customer-facing considerations, and relevant developing workstreams that could impact on the HeatNet solution in the future.

For each element identified, we have evaluated its likelihood of affecting the HeatNet solution, and the potential materiality of any such interaction(s). This was used to rank the relevant policy and regulatory elements based on their impact on the different commercial Value Vertical HeatNet could pursue. A summary is provided on the following page.

Technical requirements on smart appliances and developing regulation on their control are key policy and regulatory elements for HeatNet

Item	Summary	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
PAS 1878	Standard outlining the requirements for energy smart appliances (ESAs).	Already implemented, but future iterations expected	3 Already implemented	3 Need to ensure that standard is being met for any equipment captured by the ESA definition, as well as verifying compliance.	We understand that Passiv has been closely involved with the development of the standard.
PAS 1879	Standard setting out minimum requirements for performing Demand Side Response activities.	Already implemented, but future iterations expected	3 Already implemented	3 Requirement to meet minimum standards when undertaking DSR activities.	We understand that Passiv has been closely involved with the development of the standard.
Interoperable DSR Initiative	UK government-backed program aimed at validating and demonstrating the effectiveness of smart, flexible device's ability to participate in demand-side response.	Ongoing	3 Already underway	3 This workstream will demonstrate how the PAS standards can be met	Passiv is already involved in Stream 1 of the programme.
P375 and P376 baselining mods	Set the approaches used to calculating flexibility performance against baselined expectations of asset behaviour in applicable balancing services	Approved and currently applied in the market	3	3 Direct and material impact on how actions can be commercialised and rewarded in flexibility services	Assess methodologies and required technical impacts. Evaluate implications for optimisation decisions
Market Facilitator role	Creating the asset register, and liaising across industry to join up parties and develop flexibility market at local and national scale	Confirmed July 2024 Implementation expected March 2026	3	3 Supports HeatNet to market, but also makes engagement in other opportunities easier	Compare commercial offer to other value for similar assets available
Delivering a Smart and Secure Electricity System	In March 2023, DESNZ *published its response* to the 2022 consultation; this included wide-ranging options for flexibility support	Planned secondary legislation in 2024 with operationalisation in 2025 (now delayed)	3 Secondary legislation is progressing	3 The proposed load control licence could be a fundamental enabler or blocker for HeatNet. Key details delivered via PAS workstreams	Monitor ongoing work on Load Control licence creation and respond to consultations to represent the project. We understand that Passiv has been closely involved with PAS development

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2. Summary of HeatNet Proposition

Potential value available across three main verticals

To inform this policy and regulatory review, we have developed an initial assessment of the value areas available to Passiv and the HeatNet solution. The primary value areas identified are split across three verticals, based on the type of activity, relevant market segments, and likely routes to market they entail. The three verticals are summarised in the table below. We note that activity under each vertical is not necessarily mutually exclusive (e.g. HeatNet could notionally achieve value under both Vertical 1 and Vertical 2).

Development of the commercial opportunities and associated business models available and viable for the HeatNet solution are continuing to be developed and iterated as part of this project, in parallel to this deliverable. As such, further refinement and detail on these verticals and the potential business models under them will be provided in Deliverable 3.1.3.

Value vertical:	1 Improve new connections and upgrade processes	2 Improve ongoing voltage management on distribution networks	3 Provide system support via wider flexibility services
Overview	Deployment modelling and/or ongoing asset control used to derive value at the point of connection, via facilitating extra heat pump installations / a quicker connections process / a lower-cost connection	Participate in novel ongoing service(s) developed by DNOs to procure dynamic voltage control from HeatNet users	Use sophisticated asset control algorithms to deliver flexibility actions under the wider suite of existing services *alongside* a network management offering
Route(s) to Market	Site owners/developers – private wire arrangements DNOs IDNOs Asset installers	DNOs (potentially across universal DSO provision or location-specific voltage management zones) Existing Flexibility Service Providers (FSPs) Directly via Passiv acting as a FSP	Existing FSPs Directly via Passiv acting as a FSP Other low carbon technology equipment manufacturers (OEMs)
Barriers	Ability for DNOs to directly own/control assets Charging structure opportunities for IDNOs Customer consent requirements for ongoing control	Time and uncertainty to develop novel voltage management service(s) Potentially limited revenue stacking opportunities with other services Customer consent requirements for ongoing control	Potentially limited revenue stacking opportunities with voltage management services Technical barriers to accessing DSO and NESO services
Timings of opportunity	1-3 years	5+ years	1-3 years

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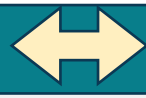
3. Policy and regulatory risk review

Impact assessment methodology

- In this section we summarise our review of how the HeatNet solution may be affected by current and developing policy and regulatory initiatives under five key areas :
  - Technical and interoperability requirements
  - Consumer Interface and Consent
  - Code Governance and Frameworks
  - Integrating with Flexibility Value Streams
  - Wider Developments
- For each of these areas, Cornwall has provided a detailed view and a summary assessment with supporting commentary, examining:
  - Likelihood
  - Impact
  - Materiality
  - Potential mitigants/ opportunities
- A rating has been provided on the scale set out below, with materiality calculated as the product of likelihood and impact

Rating	3	2	1
Meaning	High impact/ Likelihood	Medium impact/ Likelihood	Low or no impact/ Likelihood

- The impact and likelihood scores have been multiplied to form an overall risk score of 1-9 (i.e. a 3 likelihood and 3 impact rating would result in an overall score of 9)
- Additionally, we have set out the key Cornwall assumptions and the justification for these in the following assumptions table which follows the review of each area
- Arrow ratings have been provided to indicate whether issues are positive or negative potential developments for the HeatNet solution

Rating			
Meaning	Negative impacts	Positive impacts	Neutral/ both positives and negatives

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3.1 Technical and Interoperability Requirements

Detailed product standards set technical parameters for Passiv's energy smart appliances control

In this section, we assess the potential impact areas for HeatNet from policy and regulatory developments focused on the interoperability of the energy smart appliances that HeatNet are looking to manage, alongside a summary of the device-level regulatory coverage in the energy market. We expect these elements to be applicable across the three value verticals that we identified in Section 2 as they set the parameters within which demand side response actions (under which at this stage we expect potential voltage management actions to be captured) can be taken with energy smart appliances.

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
PAS 1878	Standard outlining the requirements for energy smart appliances (ESAs). Intended to support safe and interoperable use of ESAs for Demand Side Response. Includes requirements on functionalities, response time, cyber security, remote interfaces, performance criteria and compliance.	ESAs should support at least one physical network interface. ESAs should be supplied with a Customer Equipment Manager (CEM), which is a communications gateway functionality, and an Energy Smart Appliance Gateway (ESAG). ESAs should only connect to one DSR Service Provider (DSRSP). Under the approach, ESAs will determine their flexibility offers, and provide them to the DSRSP through the CEM and ESAG. The DSRSP will then be able to request the implementation of an offer. After the DSR event, the ESA will provide information to the DSRSP, and the DSRSP will provide verification information to the grid-side actor.	Already implemented, but future iterations expected	3 Already implemented	3 Need to ensure that standard is being met for any equipment captured by the ESA definition, as well as verifying compliance.	We understand that Passiv has been closely involved with the development of the standard.

Specific standards and developing trials set the interoperability requirements for ESA control

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
PAS 1879	Standard setting out minimum requirements for performing Demand Side Response activities. The standard specifically calls out the control of ESAs to decrease peak load and allow the control of network characteristics. The standard details the functionality, communications capability, and cyber security required as a minimum to deliver interoperability, security, and optionality while not restricting innovation.	ESAs should be capable of at least on of: reducing demand, deferring demand, expediting demand, increasing demand, decreasing generation, or increasing generation. The standard primarily focuses on those providing energy services. Customers should be able to switch provider without needing to install or purchase new equipment. Communications should be authenticated and encrypted. The service should reduce the risk of network outages and reduce the risk of cyber security incidents.	Already implemented, but future iterations expected	3 Already implemented	3 Requirement to meet minimum standards when undertaking DSR activities.	We understand that Passiv has been closely involved with the development of the standard.
Interoperable Demand Side Response Initiative	The Interoperable Demand Side Response (IDSR) testing initiative, is a UK government-backed program aimed at validating and demonstrating the effectiveness of smart, flexible device's ability to participate in demand-side response.	There are three workstreams in the IDSR programme, including Stream 1 which aims to develop and demonstrate heat pumps which meet the requirements of PAS 1878 and 1879. Stream 2 is aiming to unlock DSR services in line with PAS 1878 and 1879, by connecting DSRSPs with a Customer Energy Manager. The third stream is demonstrating how EV chargepoints and batteries could be controlled in settings indicative of the real world.	Ongoing	3 Already underway	3 This workstream will demonstrate how the PAS standards can be met, and will have useful learnings for the deployment of the HeatNet solution.	Passiv is already involved in Stream 1 of the programme.

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3.2 Code Governance and Frameworks

Energy codes and licences set the landscape into which the HeatNet proposition will be deployed

Here we set out the relevant elements from electricity network code governance arrangements that may interact with the HeatNet proposition or its potential applications for electricity networks. Although we generally expect limited direct materiality for Passiv, these are applicable across the three value verticals, particularly Vertical 1 on new connections

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
Electricity Distribution Licence	The distribution licence authorises a DNO (including IDNOs) to operate their distribution business subject to various licence conditions. HeatNet will not need to obtain one as it will not be participating in the distribution of electricity, but it should be aware of how these licences set the regulatory framework for the DNOs it will interact with.	The licence defines voltage levels for charging boundaries at above or below 22kV (EHV/HV) and 1kV (HV/LV) and Use of System charges vary depending on the voltage level. We do not expect HeatNet would be able to change a customers' voltage sufficiently to cross a charging threshold.	Current	3 These rules are currently in effect and create the framework within which HeatNet installations will operate	1 While the distribution licence creates the framework within which HeatNet installations will operate, we do not expect its specific rules to have a significant direct impact	Engage with UKPN to understand the impact and possibility of going above or below the thresholds, particularly the 1kV HV/LV threshold
		25.3(e) Requires DNOs to publish Long Term Development Statements (LTDS) that identify parts of the network it expects to experience voltage problems in the next 5 years. This may help HeatNet target areas of the network to deploy its technology				Assess the LTDS data of the various DNOs
		31E.20 allows DNOs to procure a flexibility service to maintain voltage. Alongside current and inertia, these are referred to as "Distribution Non-Frequency Ancillary Services". This is included for information and we do not expect it to be an issue for HeatNet				No action required
		43B.1 sets out the limited situations in which network companies can own/operate generation assets. We do not expect this to impact the HeatNet technology, but network-owned generation could theoretically compete with the service provided by the technology				We consider it unlikely that a network company would be able to own a generation asset that could compete for voltage support

Ensuring installations align with relevant engineering recommendations limits Passiv's risk

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
EREC P29	This Engineering Recommendation (EREC) outlines the rules regarding the Planning Limits for voltage unbalance in the UK. In a 3 phase system, the degree of voltage unbalance is approximately expressed as a percentage, being the maximum deviation from the average of the three phases, divided by the average.	P29 states that voltage unbalance should not exceed 1.3% for systems with a nominal voltage below 33kV, or 1% up to 132kV. Where voltage unbalance will exceed these levels, the most commonly available solutions are: • Provision of phase balancing or filtering equipment • Connecting to a different supply point, • Rearranging the phase connections • Connection at a higher voltage level	Current	3 These standards are currently in effect and are likely to apply to HeatNet installations	1 Installations should be able to comply with requirements through correct design	Comply with standards listed in the EREC and engage with the DNO on any elements that are unclear or that HeatNet design elements may not easily comply with.
EREC G5	This EREC outlines the rules regarding harmonic voltage distortion for equipment connected to the distribution networks. It sets the roles and responsibilities of the parties involved in the management of harmonics and is used in the process of connection assessment.	The assessment procedure for connecting non-linear equipment to the LV network is usually a desktop study and does not require measurement of the harmonic levels on the network. A Stage 1 Assessment, described in G5/4-1, may be undertaken by assessing the following: • Compliance with the relevant IEC 61000 standards; • The power rating and type of convertor used as described by G5/4-1 Table 6 • The harmonic current emissions from the non-linear equipment as described by G5/4-1 Table 7. Where the harmonic current emissions from a piece of equipment are higher than prescribed limits a Stage 2 assessment is required.	Current	3 These standards are currently in effect and are likely to apply to HeatNet installations	1 Installations should be able to comply with requirements through correct design	Comply with standards listed in the EREC and engage with the DNO on any elements that are unclear or that HeatNet design elements may not easily comply with.

Technical and commercial licenses bring operational considerations but no material issues for HeatNet

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
Distribution Code	The D Code is the primary rulebook for the technical requirements DNO systems must meet, in accordance with their licences. Most of the voltage requirements it imposes are found in its subsidiary Engineering Recommendations (ERECs), which we consider separately.	The D Code allows that, under certain circumstances, the DNO may agree to other limits or levels. Additionally, any Demand Unit must be able to remain connected and operating normally when the supply voltage is within the range of 0.90pu to 1.10pu of nominal declared voltage. DPC5.2.1 requires users to contact the DNO in advance if they plan to make any significant change to their connection, electric lines or electrical Equipment; install or operate any generating equipment; or do anything else that could affect the DNO's distribution system or require alterations to the connection.	Current	3 These standards are currently in effect and are likely to apply to HeatNet installations	1 No direct impact expected	Comply with requirements for equipment design and engage with the DNO as necessary
DCUSA	The Distribution Connection & Use of System Agreement is the commercial rulebook covering how DNOs charge for connection to and use of their networks. It has very limited direct relevance to voltage barring an exception for network charges.	The DCUSA specifies that reactive power flows at an export site during a settlement period in which no active power was exported shall not incur network charges. The same goes for reactive flows associated with a site operating subject to Grid Code requirements or sites providing voltage control to a DNO.	Current	3 These rules are currently in effect and are likely to apply to HeatNet installations	1 No direct impact expected	None necessary

Voltage-specific rules inform the network environment that HeatNet's solution will be used

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
EREC P28	This EREC outlines the rules regarding voltage fluctuations and the connection of disturbing equipment to the distribution networks. It is for use by parties seeking to to connect disturbing equipment with the potential for voltage fluctuation, and for DNOs assessing the suitability of such equipment to connect.	P28 applies a general limit of ±3% to voltage fluctuations, assessed at the point of common coupling. This is the point in the public network that is electrically closest to the installation and to which other customers could be connected. Equipment with a rated current ≤ 16 A per phase can be connected to LV public network without reference to the DNO or further assessment. The ENA's Heat Pump Register indicates many heat pumps should be able to connect under these conditions. Where fluctuations exceed the predicted level, the DNO may require the customer to take mitigating action or disconnect the equipment	Current	3 These standards are currently in effect and are likely to apply to HeatNet installations	1 Installations should be able to comply with requirements through correct design	Comply with standards listed in the EREC and engage with the DNO on any elements that are unclear or that HeatNet design elements may not easily comply with.
Grid Code	The Grid Code is the technical rulebook governing connection to the transmission system. While a crucial code for large generators and large demand users, including those on the distribution network whose flows might affect the transmission network, we do not see it being relevant to the HeatNet project.	The Grid Code's requirements generally only apply to demand connections when they have a capacity of 10MW+ in Northern Scotland, 30MW+ in Southern Scotland, and 50MW+ In England & Wales, which we do not expect to be relevant to HeatNet. Users participating in NESO voltage services only need to comply with the Grid Code to the extent that it applies to them	Current	1 We do not expect any Grid Code rules to apply to HeatNet's project	1 No direct impact expected	None necessary

Customer Limitation Schemes provide a framework for site-level voltage control under specific instances

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
EREC G100	This EREC specifies technical requirements for customers' export and import limitation schemes (CLSs) . It is designed to facilitate the use of CLSs whilst maintaining the integrity of the distribution network in terms of safety and supply quality. CLSs are most commonly used when the connection of customer equipment would require reinforcement work that would be expensive and/or delay the connection, and the CLS can allow this work to be avoided. These rules do not apply when the combined current rating of both the uncontrolled loads and the relevant controllable loads at the installation are less than the maximum import limit (MIL), and hence may not always be relevant for HeatNet.	The DNO will assess the Customers' Devices and the proposed CLS in terms of their effect on thermal limits of the network, voltages at the customer's connection point, and the DNO's protection measures. They must be set in such a way to meet the following criteria: • Will not cause excursions above or below the statutory limits for more than one minute • Will never exceed 112% of nominal voltage or be less than 87% of nominal voltage if LV. At HV, these thresholds are 108% and 92% respectively • Shall not impose a greater current flow than 145% of the nominal fuse rating. • Failing into a safe state which disables the relevant equipment or limits it to a compliant low power state A CLS is required to detect any defect in communication between its components and devices. This particularly includes detecting discontinuity of the secondary circuit or the magnetic circuit of any current transformers employed. Testing is also necessary, with reduced requirements if the CLS is fully type tested, which domestic-level CLS are expected to be.	Current	2 These standards are currently in effect but will not apply to sites if their maximum load is lower than their MIL	1 Installations should be able to comply with requirements through correct design	Comply with standards listed in the EREC and engage with the DNO on any elements that are unclear or that HeatNet design elements may not easily comply with.

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3.3 Integrating with Flexibility Value Streams

Flexibility service structures set the parameters for demonstrating response from HeatNet activities

In this section, we assess the potential impact areas for HeatNet from policy and regulatory developments focused on engaging with wider existing flexibility services. The impacts are, unless otherwise noted, specifically relevant to Value Vertical 3 for HeatNet's commercial offering. However, broader learnings or relevant considerations may be applied to the solution's development or other commercial routes.

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
P375 and P376 baselining mods	P375 ("Settlement of Secondary BM Units using metering behind the site Boundary Point") and P376 ("Utilising a Baselining Methodology to set Physical Notifications") set the approaches used to calculating flexibility performance against baselined expectations of asset behaviour in applicable balancing services (including the Balancing Mechanism and deviation volumes under P415).	These modifications set the methodologies that will directly impact the approach and ability for HeatNet to demonstrate its delivery of agreed flexibility services under key revenue streams. Application of the methodology (set on relevant days across a rolling 60 day period, with event days excluded) could also impact on optimisation decisions under the HeatNet solution, with the impact on baseline profiles potentially factored in. Baselining may also be required under novel voltage management services, with these modifications offering potential approaches.	Approved and currently applied in the market	3	3 Direct and material impact on how actions can be commercialised and rewarded in flexibility services	Assess methodologies and required technical impacts. Evaluate implications for optimisation decisions
Virtual Lead Party role	VLPs are a type of Balancing & Settlement Code (BSC) party that is not subject to the same level of charges and obligations as traditional BSC parties such as licensed suppliers and generators. They can create secondary Balancing Mechanism Units (BMUs), which can represent individual assets or groups of assets in the same Grid Supply Point Group. Secondary BMUs can then be entered into the BM without relying on a supplier, or other licensed party	If HeatNet does pursue activities in the wider flexibility markets, the VLP role is likely to be the pathway used. This could be directly through acceding to relevant BSC requirements, or via partnering with an existing accredited VLP.	Approved and currently applied in the market	2 Flexibility service provision is possible outside of the VLP process	3 Direct impact on the ability to access certain revenue streams and the requirements associated with this	Engage specialist partners to deliver flexibility management or develop internal capabilities, depending on the revenue stream required

Flexibility service structures set the parameters for demonstrating response from HeatNet activities

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
P415 access to wholesale markets for asset metered devices	P415 "Facilitating Access to Wholesale Markets for Flexibility Dispatched by Virtual Lead Parties" is a BSC modification that changes balancing responsibility by essentially allowing VLPs to trade an asset's "deviation volumes" on the wholesale market. To be allowed to trade, VLPs must first qualify a new type of BSC party called a Virtual Trading Party (VTP)	P415 arrangements could provide a route to market for HeatNet's asset control that could reduce the reliance on whole-home technology management and support proposition structures that do not require a licensed supplier within the consortium	Implemented Nov 2024	3	2 Wholesale market participation may be burdensome and tangential to the core HeatNet offering	Explore opportunities for product structures and customer-facing options that P415 enables
Load control licence proposals	DESNZ proposes that a licence would be required to enter into contracts with consumers for controlling Energy Smart Appliances for demand flexibility. It is also proposed that those carrying out the actual control of devices will require a licence.	Application of the licence to HeatNet activities may set parameters for product design and asset control that affect multiple different value propositions	Consultation closed June 2024, currently progessing	2	3 Potential for increased regulatory burden if a licence is required for control activities.	

The Virtual Lead Party role offers Passiv a path to existing markets for its asset control capabilities

- A VLP is a relatively new market role option open to parties wishing to provide flexibility services, created in 2019 to widen access to the Balancing Mechanism (BM) and other flexibility markets. VLPs are a type of Balancing & Settlement Code (BSC) party that is not subject to the same level of charges and obligations as traditional BSC parties such as licensed suppliers and generators
- VLPs are able to create secondary Balancing Mechanism Units (BMUs), which can represent individual assets or groups of assets in the same Grid Supply Point (GSP) Group. Secondary BMUs can then be entered into the BM without the need to rely on a supplier, or other licensed party
- The introduction of VLP arrangements was driven by the European Balancing Guidelines requirement to separate the role of the Balancing Service Provider (BSP; the party that offers balancing services) from the Balance Responsible Party (BRP; the party who is responsible for a customer's imbalance position). The VLP is the former rather than the latter. This means that when a customer engages in the BM via a VLP, responsibility for its imbalance position remains with the supplier. VLPs are not trading parties, meaning they cannot trade wholesale power for customers' needs
- VLPs have an additional limitation in that they can only serve half-hourly (HH) metered sites that are registered in Supplier Volume Allocation (SVA). This means that they cannot serve transmission-connected customers (which will be registered in Central Volume Allocation, or CVA) or non-HH customers, the latter of which will exclude most domestic and small business customers
- The VLP option is a potential route to market for the HeatNet solution to engage with other flexibility services in the GB market. This includes participation with aggregated heat assets, depending on the technical requirements for specific flexibility services. These requirements, as they relate to domestic heat assets via a VLP route to market, are set subsequently in this section

Virtual Lead Party (VLP)

- Competes only to manage assets in the BM
- Cannot trade wholesale volumes
- Can only register secondary BMUs
- Can only manage HH metered SVA sites
- Lightly regulated – but this may change
- Lower setup costs but reduced scope for revenue

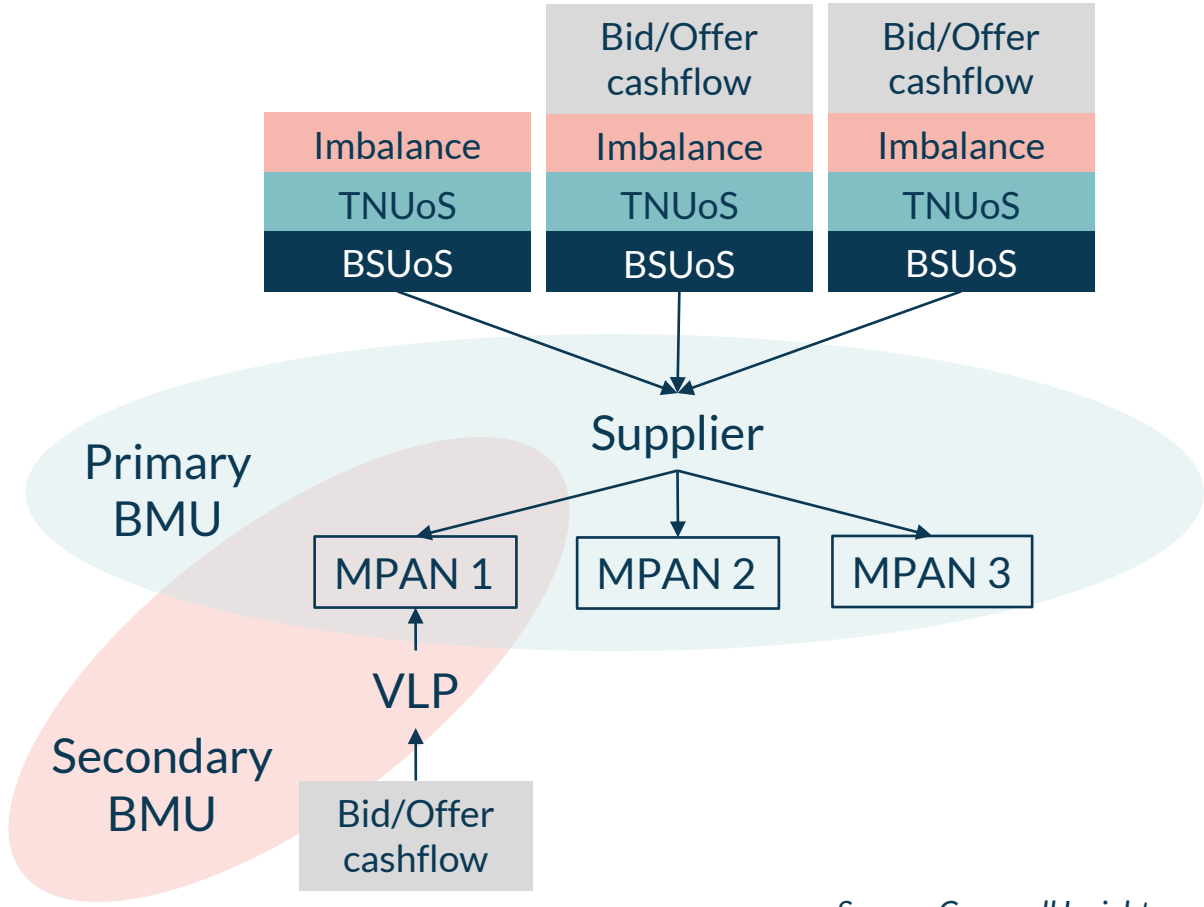
Licensed electricity supplier

- Competes for whole supply of customers
- Able to trade on wholesale market
- Can register all types of BMU
- Able to serve non-HH and CVA sites
- Additional regulatory burden
- Considerable setup/system costs

VLPs can access specific assets and commercialise flexibility via the Balancing Mechanism

- Assets and sites served by a VLP have their Metering System Identifiers (MSIDs) allocated to the VLP's Secondary BMU. However, the MSID still sits under the Primary BMU of the supplier/generator that registered it. This effectively means that a Secondary BMU is an additional layer of BSC arrangements for the site, rather than replacing the Primary BMU. This is illustrated in Figure 1
- The functioning of the Secondary BMU means that credits & charges related to the site's BM actions (Bid/Offer cashflow) will accrue to the VLP's account. Depending on the terms of its agreement with the site, it will pass a share of these through to the site
- However, all other charges and obligations associated with the site remain the responsibility of the actual lead party (most likely a supplier). These include:
    - Imbalance position
    - Network charges (e.g. TNUoS and BSUoS)
    - Policy costs
    - Metering etc.
- Like other BM activities, VLP actions are taken into account when the supplier's energy imbalance position is calculated to ensure the supplier is kept whole
- VLP activities are supported by the ability to use sub-metering in their secondary BMUs following implementation of P375 *Settlement of Secondary BM Units Using Metering Behind the Site Boundary Point* in 2022. This allows the potential flexibility actions of HeatNet's BtM demand assets to be separated from the power flows for the whole site

Figure 1: Illustrative cashflow/responsibilities using Secondary BMU



Source: Cornwall Insight

Material technical and commercial barriers limit access to existing flexibility services for HeatNet

Use case	Barriers category	Static Fast Frequency Response	Dynamic Containment, Moderation, and Regulation	STOR	Fast Reserve	Quick Reserve	Slow Reserve	Balancing Reserve	Demand Flexibility Service	Balancing Mechanism
Domestic customer accessing services via independent Virtual Lead Party (VLP) or Asset Meter VLP Aggregator	Technical barriers	1 second performance metering possible for some asset metering, but higher requirement than SMETS2(CAD) Performance metering accuracy (1%) higher than EVSC regs (10%) & COP11 (+2.5% to −3.5%) 30 seconds response time	20Hz performance metering Operational metering requirements[1] 0.5-2 seconds maximum time between a change in frequency and change in the delivery of response 1-10 second maximum time to full delivery	Balancing Mechanism operational metering required for BM units Non BM units required to send metering data every 15 seconds (these can be duplicate meter readings for up to 1 minute)	Operational metering requirements are too high a requirement for many (not possible for SMETS2 & CAD, EVSC regs & COP11) 2 minute ramp to full delivery likely a barrier for some	Operational metering requirements are too high a requirement for many 1 minute ramp to full delivery likely a barrier for some	Operational metering requirements are too high a requirement for many	Operational metering requirements are too high a requirement for many		Standard operational metering requirements too high for many However, relaxed requirements are enabling up to 300MW of small scale assets to participate in the BM (60 second frequency, +/- 2.5% accuracy, 60 second latency)
	Commercial barriers	EFA blocks may be a barrier to some non electricity system dedicated assets 1MW minimum capacity & decimalisation currently represent barriers for smaller providers	EFA blocks may be a barrier to some non electricity system dedicated asset	Committed Windows not always appropriate for non-dedicated assets 3MW minimum capacity & decimalisation represent barriers for smaller providers Zero baseline may be a barrier to some non-dedicated assets	Data costs for high frequency data 25MW minimum capacity, GSP GROUP requirements & decimalisation currently represent barriers for smaller providers	Data costs for high frequency data 1MW minimum capacity, GSP GROUP requirements & decimalisation currently represent barriers for smaller providers	Data costs for high frequency data -1MW minimum capacity, GSP Group requirements & decimalisation currently represent barriers for smaller providers	Data costs for high frequency data 1MW minimum capacity, GSP Group requirements & decimalisation currently represent barriers for smaller providers	Cost of accessing supplier boundary meter data Poor user experience for consumers in giving consent to access Service rules not allowing Capacity Market and other stacking.	Data costs for high frequency data 1MW minimum capacity, GSP Group requirements & decimalisation currently represent barriers for smaller providers Compensation for demand turn up (P444 proposal)
	Regulatory barriers				Half Hourly Settlement requirement for boundary meters	Half Hourly Settlement requirement for boundary meters	Half Hourly Settlement requirement for boundary meters	Half Hourly Settlement requirement for boundary meters	Half Hourly Settled boundary meters BSC/supplier boundary meter data	Half Hourly Settlement requirement for boundary meters

[1] *Operational Metering parameters are 1HZ frequency, 1% accuracy, 5 seconds latency*

Not capable of participating | **Barriers likely blocking some of the market** | **Barriers stopping all the market**

Source: NESO

Regulatory barriers further restrict market access for HeatNet under a non-Virtual Lead Party approach

Use case	Barriers category	Static Fast Frequency Response	Dynamic Containment, Moderation, and Regulation	STOR	Fast Reserve	Quick Reserve	Slow Reserve	Balancing Reserve	Demand Flexibility Service	Balancing Mechanism
Domestic customer accessing services via a non-VLP Aggregator	Technical barriers	1 second performance metering possible for some asset metering, but higher requirement than SMETS2(CAD) Performance metering accuracy (1%) higher than EVSC regs (10%) & COP11 (+2.5% to −3.5%) 30 seconds response time	20Hz performance metering Operational metering requirements[1] 0.5-2 seconds maximum time between a change in frequency and change in the delivery of response 1-10 second maximum time to full delivery	Non BM units required to send metering data every 15 seconds (these can be duplicate meter readings for up to 1 minute)	Operational metering requirements are too high a requirement for many (not possible for SMETS2 & CAD, EVSC regs & COP11) 2 minute ramp to full delivery likely a barrier for some	Operational metering requirements are too high a requirement for many 1 minute ramp to full delivery likely a barrier for some	Operational metering requirements are too high a requirement for many			
	Commercial barriers	EFA blocks may be a barrier to some non electricity system dedicated assets 1MW minimum capacity & decimalisation currently represent barriers for smaller providers	EFA blocks may be a barrier to some non electricity system dedicated asset	Committed Windows not always appropriate for non-dedicated assets 3MW minimum capacity & decimalisation represent barriers for smaller providers Zero baseline may be a barrier to some non-dedicated assets	Data costs for high frequency data 25MW minimum capacity, GSP GROUP requirements & decimalisation currently represent barriers for smaller providers	Non-BM provider service access later than BM Data costs for high frequency data 1MW minimum capacity, GSP GROUP requirements & decimalisation currently represent barriers for smaller providers	Data costs for high frequency data 1MW minimum capacity, GSP Group requirements & decimalisation currently represent barriers for smaller providers		Cost of accessing supplier boundary meter data Poor user experience for consumers in giving consent to access Service rules not allowing Capacity Market and other stacking.	
	Regulatory barriers				Half Hourly Settlement requirement for boundary meters	Half Hourly Settlement requirement for boundary meters	Half Hourly Settlement requirement for boundary meters	Designed to be dispatched in Balancing Mechanism so need to be a BSC party (supplier, VLP, AMVLP)	Half Hourly Settled boundary meters BSC/supplier boundary meter data	Need to be a BSC party (supplier, VLP, AMVLP)

[1] *Operational Metering parameters are 1HZ frequency, 1% accuracy, 5 seconds latency*

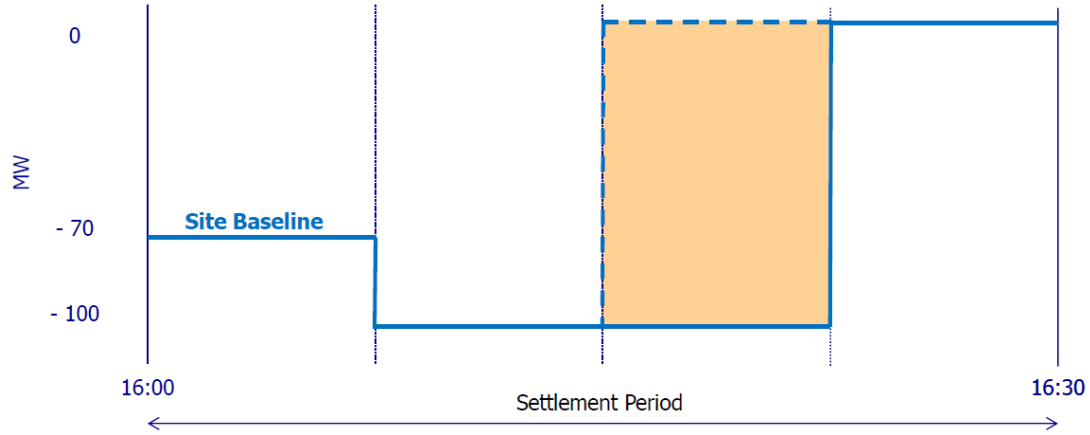
Not capable of participating | **Barriers likely blocking some of the market** | **Barriers stopping all the market**

Source: NESO

P415 offers an asset-specific route to the wholesale market and integrated asset control offerings

- P415 "*Facilitating Access to Wholesale Markets for Flexibility Dispatched by Virtual Lead Parties*" is a BSC modification that has been implemented in November 2024. It changes balancing responsibility by essentially allowing VLPs to trade an asset's "deviation volumes" on the wholesale market. To be allowed to trade, VLPs must first qualify a new type of BSC party called a Virtual Trading Party (VTP)
- A deviation volume is a new type of settlement volume that represent the difference between a site's forecast and actual volumes for a given half-hour that were associated with VTP actions. It is therefore a positive or negative MWh import/export deviation to the total system. These can be traded on the wholesale market on behalf of the customer, meaning that neither the registered Supplier nor its counterparty bears any liability for delivery of the trade
- Once the VTP agrees a flexibility action with the customer, it will be able to trade the MWh volume in the wholesale market in advance of Gate Closure and submit an Energy Contract Volume Notification into settlement. Any further imbalance between the instructed and physically delivered volume will be the VTP's responsibility. An additional complexity is that the site's supplier will likely have bought power to meet the customer's expected demand, but if the customer increases or reduces demand due to the VTP action, the supplier will unexpectedly find itself out of balance. P415 therefore includes a compensation mechanism to reimburse the supplier relative to a pre-established baseline
- Figure 2 shows the demand of a customer site that has agreed with its VTP to shut down early compared to its baseline. For 7.5 minutes it will consume 100MW less than usual, equivalent to 25MWh. This is represented by the shaded area. P415 means the VTP can now sell some or all of this 25MWh in the wholesale market, notifying this trade into settlement as normal. Any imbalance between the delivered volume and the instructed volume notified to settlement is the VTP's responsibility. In practice, a secondary BMU would have multiple sites, potentially each with different suppliers, and there may also be Balancing Mechanism dispatches, but the principles remain the same
- Baselining has existed as a concept since its introduction in 2023 under P376 *Utilising a Baselining Methodology to set Physical Notifications*. While it has not been mandatory for VLPs to use the baselining methodology for their secondary BMUs, it will be a requirement for VTPs, with Elexon only calculating deviation volumes for baselined BMUs. Recent historic data is used to estimate the energy flows that would normally occur at a boundary point, so this can be used in settlement instead of the Final Physical Notification to determine whether a balancing service has been fully delivered
- While the VTP will receive Credited Energy Volume for its actions, it is not allocated actual metered volume and is explicitly not undertaking supply. They can be considered similar to Non-Physical Traders – another type of BSC party – and like them are not liable for non-commodity costs
- For HeatNet, this could offer a route to market for flexibility service provision and asset-specific control services. Depending on the commercial model adopted, it could offer a channel to deliver a customer-facing proposition on an asset-specific basis

Figure 2: Illustrative example of VTP action for demand site

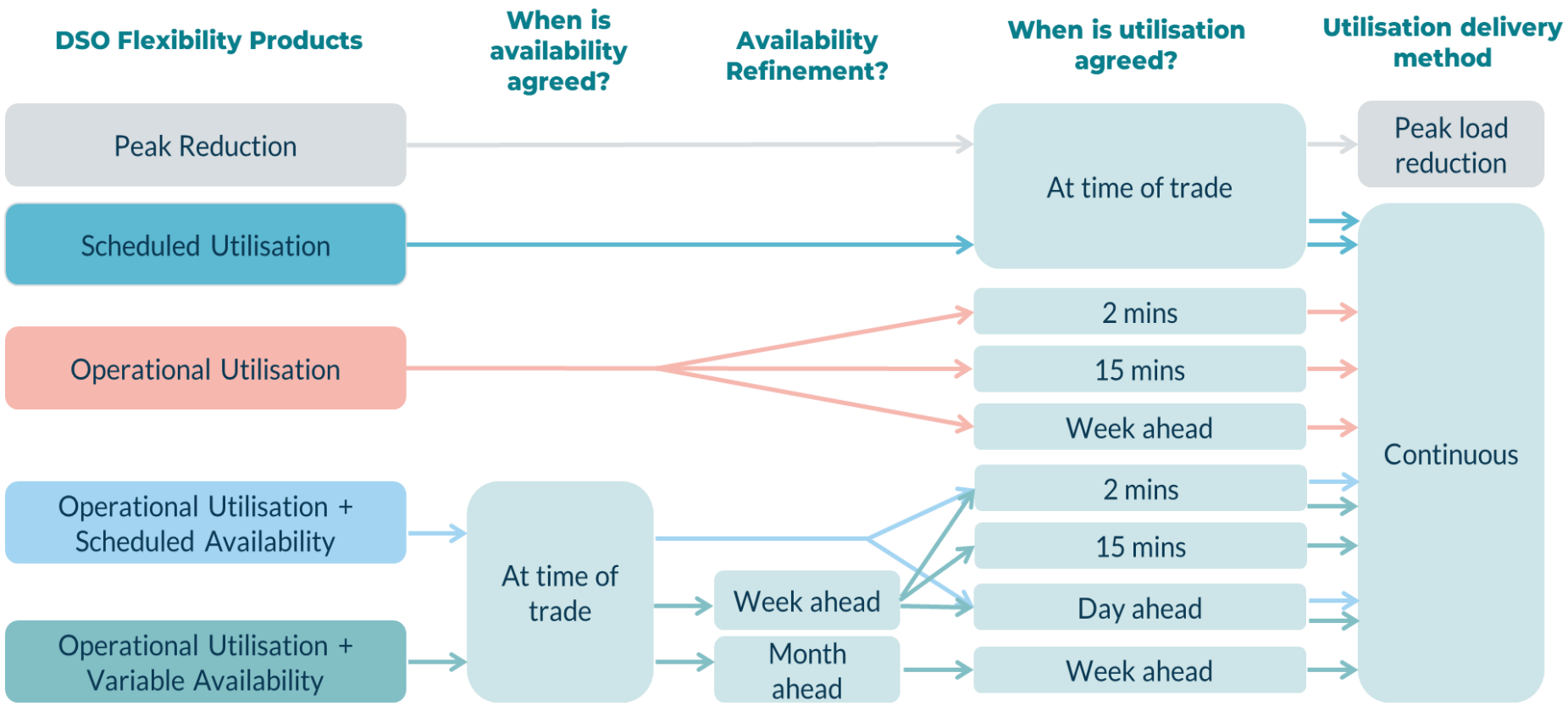


Source: Elexon P415 Solution Summary

DSO services may offer locationally-specific supplementary revenue opportunities for HeatNet

A new suite of standard flexibility products developed by the Energy Networks Association is being rolled out by the six GB Distribution System Operators. An overview of the five standardised services is set out in Figure 3 below. We note that not all services are currently offered by each of the DNOs.

Figure 3: Summary of new DSO product structures



Source: ENA

When considering the DSO services for HeatNet, we would note that –

- Each of the DSOs have varying flexibility needs and requirements due to the physical characteristics of their networks
- As a result, DSO services are inherently locational. Each service procured by each DSO is only tendered in the specific locations for which they are required
- Therefore, flexibility service providers will only be able to participate in the service(s) should they be situated in a location within the relevant DNO region being tendered for

A summary of the five new DSO services is provided on the following page. Accessing and participating in these services could support the overall revenue stack developed under Value Vertical 3 activities for HeatNet

DSO product summary

- Peak Reduction
    - The Peak Reduction (PR) service is where an FSP contracts to reduce its electricity usage during a set period or periods (usually times of overall peak demand) regularly the term of the contract. This response can soften the high peaks in daily demand and prevent networks going beyond firm capacity limits
    - FSPs likely to benefit: End-users or storage assets with capacity to reduce usage during typical peak demand periods on a regular basis
- Scheduled Utilisation
    - Scheduled Utilisation (SU) delivers pre-agreed flexibility for specific period or periods on an ad hoc basis. The service sees service parameters agreed the day- or week-ahead of delivery. Scheduled Utilisation has two distinct versions, “Settlement Periods” where the delivery period begins and ends aligned with a market standard settlement period, or “Specific Periods” where delivery period can begin and end at any time
    - FSPs likely to benefit: FSPs that cannot respond in real-time or near to real-time, alongside more flexible providers
- Operational Utilisation
    - Operational Utilisation (OU) offers flexibility in real time (same day) or week-ahead. This product allows for a DSO to agree on trade parameters (price and period of provision) ahead of time through monthly, weekly, or day-ahead tenders but with instructions issued either in real time, with a 2-minute or 15-minute response notice, or week-ahead response time. A DSO does not pay for flexibility it does not need (or an FSP does not provide an unnecessary reduction), compared to Scheduled Utilisation where reduction volume is set at the point of trade
    - FSPs likely to benefit: FSPs able to respond quickly (for 2 minute and 15 minute product variants). Week-ahead service may benefit FSPs less able to respond quickly
- Operational Utilisation + Scheduled Availability
    - This service is uses operational utilisation but with the added feature of procuring, ahead of time, the assured availability of an FSP to deliver operational utilisation for pre-defined periods if required. This availability will be defined at the point of procurement and cannot be modified once the contract has been agreed. This service helps ensure that a DSO only pays utilisation rates for flexibility procured for the need of the network, presenting overall cost savings even when paying for availability
    - FSPs likely to benefit: A wide range of FSPs may benefit
- Operational Utilisation + Variable Availability
    - This service builds further on Operational Utilisation by allowing DSO to procure a greater level of contracted available capacity and then refine the requirement closer to the event. Availability requirement can be refined by a DSO month or a week ahead of delivery
    - FSPs likely to benefit: A wide range of FSPs may benefit

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CREATING CLARITY

3.4 Wider Policy and Regulatory Developments

Wider market workstreams have direct impact on HeatNet's applications and routes to market

Here we set out the relevant elements from the wider policy and regulatory landscape that we consider relevant for the HeatNet project, either directly to the solution's development or indirectly by offering learnings and possible future considerations for its application in the market. We expect these policy areas to reach across the different value verticals set out in Section 2

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
Market Facilitator role	Creating the asset register, and liaising across industry to join up parties and develop flexibility market at local and national scale *See slide below*	The commercial offer for small-scale flexibility should become simpler, and engagement simpler, as a result of this piece of work	Confirmed July 2024 Implementation expected March 2026	3	3 Supports HeatNet to market, but also makes engagement in other opportunities easier	Compare commercial offer to other value for similar assets available
Delivering a Smart and Secure Electricity System	In March 2023, DESNZ *published its response* to the 2022 consultation; this included wide-ranging options for flexibility support	Licencing creates new hurdles, but also encourages consumers to engage in markets by providing protection and ensuring interoperability of smart devices, which has emerged as a key barrier to engaging in flexibility provision	Planned secondary legislation in 2024 with operationalisation in 2025 (now delayed)	3 Secondary legislation is progressing	3 The proposed load control licence could be a fundamental enabler or blocker for HeatNet. Key details delivered via PAS workstreams	Monitor ongoing work on Load Control licence creation and respond to consultations to represent the project. We understand that Passiv has been closely involved with the development of the PAS
Innovation in the Energy Retail Market	Ofgem *launched a consultation* in Oct 2024 to seek views on unlocking innovation and protect consumers in the evolving energy retail market. This *followed a similar*, 2023, DESNZ call for evidence.	The consultation concentrated on new tariff types and more flexible approaches to supply licencing, but also included consideration of more flexible innovation options and mention of a new licence type regime for load control, which could be fundamental to HeatNet	None set	2 We expect market reforms to emerge from this process. However, the likely scope may not extend to HeatNet actions	2 Although retail market changes may not directly impact HeatNet, consumer protections and licensing arrangements could impact business models	Monitor ongoing work on retail market reform

Improved registration information for low carbon technologies offers upside, with learnings available from wider voltage and flexibility activities

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
Flexibility Market Asset Register (FMAR)	Centralised record of all small-scale flexibility assets, with data made available to market participants *See slide below*	Data accessibility should considerably increase, in terms of what assets are connected in which locations. This should lead to more market accessibility	Decision expected winter 2024	2	2 Could provide much better information on existing assets	N/A – positive
Smart Systems and Flexibility Plan (SSFP)	DESNZ (then BEIS) launched the SSFP in 2017, with the *2021 update* to set a context for efforts to unlock flexibility. No more recent updates appear to have been forthcoming, though a raft of innovation studies did eventuate	The focus of the SSFP was to increase electrical flexibility, primarily by enabling consumers to get involved in flexibility provision. This included a principal that markets should be reformed to reward flexibility	No update since 2021	1 Impacts contained under subsequent policy developments	1 Minimal direct impact, although resulting workstreams may be important	N/A
NESO Voltage Services	Following a series of pathfinders, NESO is *launched a tender* for reactive power absorption in 2026. This is for transmission assets only and is looking to solve a problem caused by reduction in demand, not increase	NESO has historically procured dedicated new assets for service provision, able to provide 90% availability. This experience signals that high-reliability service provision requires assets not to engage with other revenue streams	Procurement complete – future rounds expected, depending on service need	1	1 Not directly impactful, but learnings can be taken from nature of service procured	N/A

Network charging and wider pricing reforms could impact values and routes to market, with learnings available from broader distribution network projects

Item	Summary	Key impact areas	Timelines	Likelihood	Materiality for HeatNet	Mitigants for HeatNet
Distribution Use of System charging Significant Code Review (DUoS SCR)	*Launched* in Feb-22, and re-enlivened Jan-25, the DUoS SCR will undertake a wide-ranging review of distribution charges, which could result in fundamental changes to how costs are recovered from generators and consumers	May flip generation/ consumption charges in generation-dominated zones, encouraging consumption at peak generation times Domestic consumers may be carved out (as they were in previous reforms like the Targeted Charging Review)	Re-commenced 2025; decision and implementation timelines not stated	2	3 May change incentives on consumers and create more complex local consumption patterns, which HeatNet will need to account for	Monitor progress and develop flexible tools to forecast new consumption patterns and how these will impact on network power flows
Review of Electricity Market Arrangements (REMA)	Fundamental review of wholesale power trading, potentially splitting current single GB market into multiple zonal markets	If zonal markets implemented, likely to drive high heat pump take-up in some regions (north, east) which may increase need for HeatNet-like solutions on local networks	Final update expected H125 Implementation timeline runs to early 2030s	2	2 Low direct materiality. If zonal pricing is implemented, we could see a high impact on need for HeatNet solutions	Monitor change decision
SECMP0046 *Allow DNOs to control EV chargers connected to Smart Meters*	A *similar mod* was raised in 2018 by SSEN, which would have allowed DNOs to undertake emergency slowdown or shutdown of EV chargers; the mod was withdrawn in 2023 due to implementation of commercial alternatives	This proposal, more limited than the above, might enable greater reliance on local flexibility markets by providing a guaranteed emergency backup. However, this could still deter emergence of potentially superior commercial alternatives4	Withdrawn in 2020	1	2 Precedent for a non-commercial signal overriding activity. Subsequent developments may deter commercial solutions emerging	N/A
International example – German LCT control	In 2018, the German government *mooted an approach* giving high degrees of LCT control to network operators, to curtail demand without compensation. Alternatively, consumers could pay much higher network fees	This would have created a principle that networks would override flexibility market offerings at key times. The proposal proved unattractive and was considered to both reduce consumer rights and also – by reducing innovation – increase consumer costs	The draft law was withdrawn, but see next note	1	1 Withdrawn foreign law offers insights on the principles in proposal and trade-off of customer control for lower costs	N/A

The Flexibility Market Asset Register sets out to increase visibility of domestic-scale assets to relevant parties, supported by the Market Facilitator role

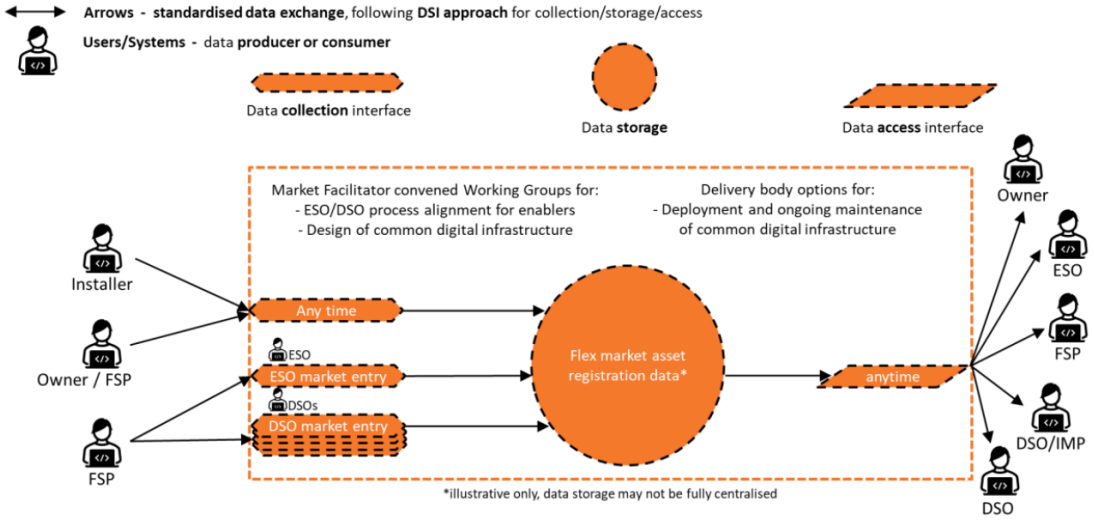
Ofgem held a consultation on a proposed *Flexibility Market Asset Register* (FMAR) July-September 2024. The FMAR aims to streamline the registration and integration of distributed flexibility assets into the electricity market. Proposed as part Ofgem's vision for a Flexibility Digital Infrastructure, the FMAR seeks to act as a single source of truth for small flexibility assets, particularly those under 1 MW, targeting heat pumps, EV chargers and domestic-scale batteries.

The register is intended to simplify market entry for flexibility service providers by replacing the current fragmented system, where providers must register with individual markets separately. The FMAR may play a role in enabling distributed flexibility by providing better visibility and coordination of small-scale assets, supporting participation in local and national energy markets.

Figure 4 shows the proposed structure. Installers, asset owners and Flexibility Service Providers (FSPs) registering the assets in various markets, or direct to the platform. This asset-level data is then passed through to a centralised system, which enables the asset owner, NESO, FSPs, DSOs, and independent market providers – which could include HeatNet – to access the data, within a consumer consent parameter.

Elexon, as the market facilitator (see next slide), will oversee the initial design and rules for the register, ensuring it supports innovation while providing transparency and standardisation for asset registration and market operations.

Figure 4: Proposed digital infrastructure for Flexibility Market Asset Registration



Source: Ofgem

Alongside the launch of the FMAR consultation in July 2024, Ofgem announced the *appointment of Elexon* as the Market Facilitator to support the transition to a more flexible energy system. Local flexibility markets are currently fragmented and uncoordinated, which creates barriers for providers and slows the development of a flexible energy system.

To address these challenges, Ofgem's appointment of a Market Facilitator aims to:

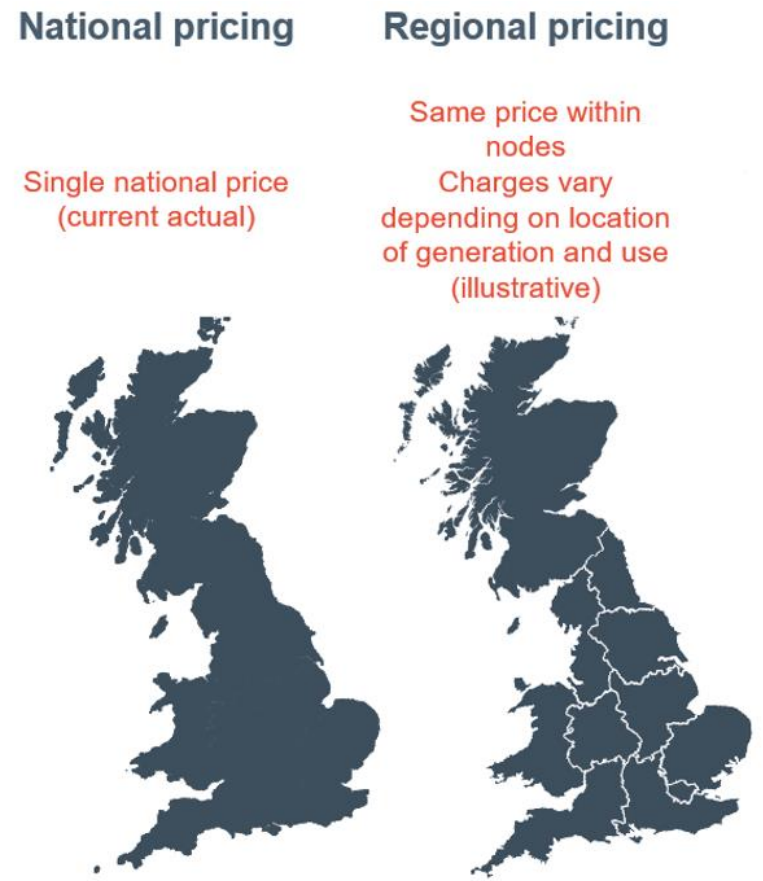
- Develop more open, coordinated, and transparent local flexibility markets
- Align national flexibility markets managed by NESO with local markets managed by Distribution System Operators (DSOs)
- Support the strategic and whole-system approach required to meet the ambitious clean power goals

This aligns with the broader goals of accelerating the UK's transition to a clean, flexible, and consumer-focused energy system. The Market Facilitator is expected to be operational by early 2026.

Review of Electricity Market Arrangements may bring second-order impacts for the HeatNet solution

- The Review of Electricity Market Arrangements (REMA) is a major review of non-retail elements of the market, launched in 2022. It aims to identify, assess, and implement options for reforming market arrangements to ensure they can enable electricity decarbonisation by 2035
- One of the key aims is to more closely align locational signals with network conditions, lowering constraints and reducing the need for network reinforcement
- The most significant and high-profile element is consideration of locational pricing
  - Nodal pricing has been ruled out, but zonal and national pricing are still under consideration
  - The introduction of zonal pricing would have consequential impact for network charging, with questions around the role of locational signals in a zonal world. Network charges could become purely about cost recovery or be used as a way of sending intra-zonal signals
- If a national market, DESNZ is minded to strengthen locational TNUoS signals
- A move to shorter settlement periods – reducing the current 30-minute period to 15-minute or even 5-minute – is also under consideration. This could lead to more granular network charges being implemented
- The policy development phase of REMA is due to be concluded in the first half of 2025, with the timetable for decisions to align with CfD AR7. We are therefore expecting a final decision in the next six months
  - The timeline for implementation of changes will depend on the options selected – reform of TNUoS, for example, would be relatively fast (2-3 years) while implementing zonal pricing could take longer (5-8 years)
- While distribution networks are not under consideration review in REMA, there could be consequential impacts. A zonal market, resulting in much cheaper power prices in some regions, could drive more rapid uptake of heat pumps in these regions, which could lead to a greater need for HeatNet-like solutions in these regions

Figure 5: Retained wholesale pricing reform options



Source: Cornwall Insight

DUoS SCR could bring fundamental changes to distribution network charges, but domestic consumers may be excluded

- The Distribution Use of System Significant Code Review (DUoS SCR) is a root-and-branch review of distribution charges in GB
- The overall objective is "*to ensure electricity networks are used efficiently and flexibly, reflecting users' needs and allowing consumers to benefit from the new technologies and services while avoiding unnecessary costs on energy bills in general.*"
- The DUoS SCR's scope includes:

A review of the charging methodologies for EHV, HV and LV users

Re-balancing between usage- and capacity-based charges, as well as charges that could vary by ToU

Improvements to signals about how network costs and benefits vary by location

Improved predictability of charges for EHV users

The potential need for mitigating measures such as a basic charging threshold to protect small users (and vulnerable customers) from sharper charging signals

- The SCR was paused in late 2022 in response to the energy cost crisis and at the time no date was given for a resumption
- In January 2025, Ofgem said that it was looking to further understand the subject before beginning work on the SCR again
  - It also noted that it was seeking more input on short-term fixes that could be undertaken, and structural changes that can take place whilst REMA is ongoing
- At present, there is no public timeline for the development or implementation of the SCR

Many innovation projects explore electrified heat, but voltage management under-represented area

Title	Dates	Summary	Relevant to HeatNet	Positive direct impact	Neutral or no direct impact	Negative direct impact
EQUINOX	2022-2025	Full spectrum heat flexibility project, examining flexibility services, commercial arrangements and supporting technologies	Large-scale test of a range of heat pump flexibility solutions; not looking at voltage control but providing wider learnings about LV demand side response			
D-Suite	2024	Thermal and voltage control on the LV networks	Addressing similar problem to HeatNet, but using static compensators, smart transformers and harmonic filters rather than in-home assets			
Automatic Asset Registration	2022-2024	Centralised, automated asset register	Asset register may make it more easy to identify and engage with heat pumps			
OBELISC	2025-2027	Installing three-phase meter cabinets on the boundary of properties, to reduce costs of providing these upgrades	Reducing cost of network upgrades, which are an alternative solution to reduce voltage deviation			
SHIELD	2023-2029	Distributed data-centres for heating, based on a Social ESCO to supply low-cost, low-carbon power to fuel-poor consumers	Non-heat pump based solution; could offer route to access large numbers of heat assets within a region			
PRIDE	2024-2027	Platform to assist in sharing low-voltage network data between DNOs and Local Authorities, to develop Local Area Energy Plans	Potentially increasing data availability of existing heat pumps			
CoolDown	2024-2025	Exploring DNO-impacts of summer-time cooling electricity demand, in a warming climate	Could develop an understanding of areas where summer demand creates a need for HeatNet solution, in addition to expected winter demand areas			
Electrification of the residential heat sector	2024-2025	Spatial and temporal analysis of half-hourly electricity demand profiles for heat pumps, on varying granularities	Additional data resource on inflexible heat pump dispatch			
CLIP	2024	Community planning approaches to creating local area energy plans, to support the energy transition	Potentially increasing data availability of existing heat pumps			
KnowMyFlex	2024	Creation of energy flexibility certificates concept to help homeowners engage in markets	Asset register may make it more easy to identify and engage with heat pumps			
Battery to Bypass Constraints for Smart Local Energy	2024-2025	Pairing local generation with heat demand to reduce impact on HV and LV networks	Potential identification of stressed network locations for HeatNet engagement			

Projects addressing heating impact on LV networks could reduce the opportunity for HeatNet's solution

Title	Dates	Summary	Relevant to HeatNet	Positive direct impact	Neutral or no direct impact	Negative direct impact
Net Zero Terrace	2023-2024	Scalable decarbonisation of mid-terrace housing with shared ground loop heat networks and community PV	Alternative solution to mass heat pump deployment, but which may still result in stressed networks required HeatNet-like solution			
Heat Risers	2023-2024	Heat decarbonisation of multiple occupancy dwellings, via centralising heat provision to heat networks	Improved heat networks reduces potential scope of issues on LV networks, with heat network energy centres more likely to be HV or EHV			
Watt Heat	2023-2024	Demonstrating flexibility from thermal storage, via DSO service incentives	Thermal storage assets could be rolled into HeatNet and offer greater demand flexibility than heat pumps			
Heatropolis	2023-2024	Joining up DNO network planning and heat network design, and heat network flexible operations	Improved heat networks reduces potential scope of issues on LV networks, with heat network energy centres more likely to be HV or EHV			
Full Circle	2023-2024	Potential for heat networks to recover waste transformer heat, increasing electricity network efficiency and decreasing heat cost	Improved heat networks reduces potential scope of issues on LV networks, with heat network energy centres more likely to be HV or EHV			
Net Zero Community Energy Hubs	2023	New technoeconomic methodology to model low carbon, flexible heat networks, plus repurposing gas networks for hydrogen	Improved heat networks reduces potential scope of issues on LV networks, with heat network energy centres more likely to be HV or EHV			
NeatHeat	2022-2024	Assessment of zero emissions boilers, particularly thermal storage technologies, in smaller homes	Non-heat pump based solution; could offer route to access large numbers of heat assets within a region			
Heat Balance	2022-2023	Use of large-scale thermal storage to meet variable renewable generation output, with benefits to heat networks	Improved heat networks reduces potential scope of issues on LV networks, with heat network energy centres more likely to be HV or EHV			
CrowdFlex	2021-2026	Unlocking domestic flexibility via forecasting demand and available flex from all LCTs and providing simple incentives	Improving and standardising access to flexibility revenues could support assets to engage with services, including HeatNet			
Equal LCTs	2024	Supporting vulnerable customers to obtain LCTs, and enter these into flexibility schemes	Could offer route to access large numbers of heat assets within a region			
Flexible Heat	2022	Unlocking flexibility from domestic thermal energy storage	Non-heat pump based solution; could offer route to access large numbers of heat assets within a region			

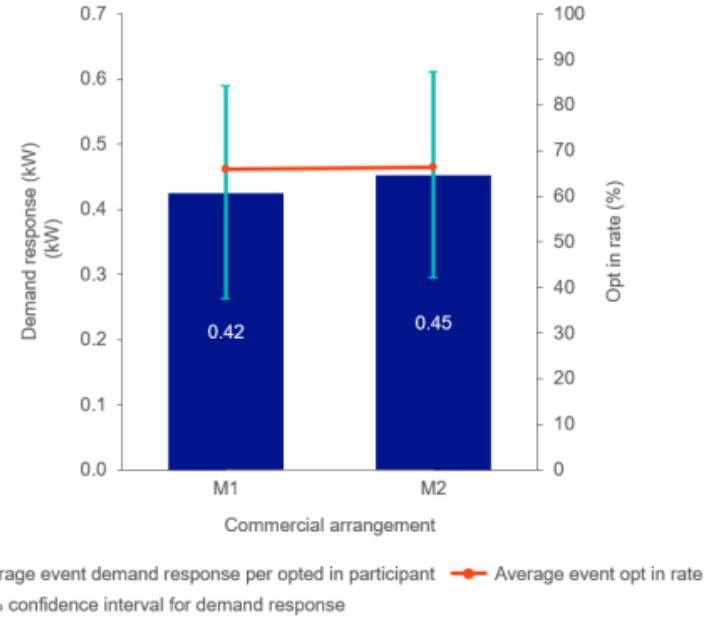
Alternative pathways to heat decarbonisation are receiving innovation project attention

Title	Dates	Summary	Relevant to HeatNet	Positive direct impact	Neutral or no direct impact	Negative direct impact
Right to Heat	2022-2025	Developing and demonstrating best practice for decarbonising heat in urban social housing estates	Could offer route to access large numbers of heat assets within a region			
Neighbourhood Green	2022-2024	Reviewing the impact of domestic LCTs on After Diversity Maximum Demand, particularly with regards to technology clustering	Offers more data to networks on how technologies could cluster and hence create more need for HeatNet-like solutions to manage future networks			
Emerge	2022-2023	Improving the DNO customer journey for LCT take-up	Could support faster/ wider uptake of heat pumps, increasing the need for HeatNet-like solutions			
Re-Heat	2021-2024	Trialling solutions to mitigate negative impacts of low carbon heat technologies, on rural clusters, and increase renewable power use	Large-scale test of a range of heat pump flexibility solutions, but not looking at voltage control			
Smart Heat	2021-2022	Desktop review of methods to mitigate impacts of electrical heat demand, via smart control	Study of a range of heat pump flexibility solutions, but not looking at voltage control			
Peak Heat	2021-2022	Desktop review of impact of heat pumps on LV networks, based on consumer archetypes and typical, peak and 1-in-20 peak forecasts	Study of a range of heat pump flexibility solutions, but not looking at voltage control			
CommuniHeat	2020-2022	Road-mapping for transition of off-gas-grid homes to electrified heating solutions	Study of a range of heat pump flexibility solutions, but not looking at voltage control			
HyCompact	2020-2022	Test of hybrid heat pump-gas boiler solutions to minimise carbon emissions and costs	Competitive solution to HeatNet in medium-term, although not offering fully decarbonised heating			

EQUINOX suggests that commercial offers are impactful on driving participation than perceived carbon benefits

- The Equitable Novel Flexibility Exchange (EQUINOX) project is National Grid Electricity Distribution's flagship project looking at heat decarbonisation and flexibility on the LV networks. The study is considering customer perceptions and ability to flex heating while remaining comfortable, rather than the source of requirements for flexibility
- Two trials have been conducted, dispatched participants during relatively infrequent, two-hour windows. As a simulated trial, participants have been offered a range of set payments, to test response
- Engagement with participants has revealed that environmental considerations were more important than financial, with this borne out by results. The level of payments, in particular, did not impact on level of response in Trial Two findings
    - This may pose difficulties for HeatNet, which is not looking to deliver active carbon savings, though customer messaging on embedded carbon in network upgrades, and the ability to facilitate reductions in emissions from earlier replacement of gas boilers, may prove valuable
- Participants already engaged with an electricity tariff which incentivised load shifting out of the peak window delivered lower levels of peak load reduction, than consumers not on one of these tariffs
    - This may be important to the commercial offer which HeatNet puts into place. Our understanding of technical limitations indicates that voltage control might need to be the lead service for participants, but other benefits delivered incidentally could be passed alongside these revenues
    - It may also signal that voltage control would be one of the services in a stack which a third-party optimiser looks to deliver, and need for voltage control could be rolled into a "bucket" of needs for which DSOs look to procure single services
- Automated control was not vital to delivery of flexibility, although we note that this was within regards to a relatively infrequent service opportunity
- EQUINOX is currently undertaking a third public trial, looking at demand turn-up services, which may be of less immediate relevant to HeatNet

Figure XX: Average opted-in participant demand response and participant opt in rate by commercial arrangement (M1 participants being offered double the value of M2 participants)



Source: National Grid

D-Suite is looking at other ways in which DNOs may manage LV voltage levels and provides a “cost to beat”

- D-Suite is another voltage control innovation project looking at voltage drop on the LV distribution network. Rather than demand-side response, it is looking at developing power electronics devices and control systems to address the challenge
- These technologies include:
  - Smart transformers, which could manage voltage levels more dynamically to manage the levels further into the network
  - Static compensators (statcoms), which can control current or voltage, by converting active to reactive power, and vice versa; these devices can be pole-mounted throughout the networks
  - Soft Open Points, which enable active control of power flow and voltage in distribution networks, mostly to manage the impact of renewable energy generation
- The D-Suite cost-benefit analysis found that, in the most beneficial scenario studied, power electronics could save 32% versus the business-as-usual counterfactual, based on a £250/kVA cost, or 55% at a future cost of £63/kVA, in a high-density urban setting. This used smart transformers to replace a split feeder cable reinforcement
  - This case was that with the most severe congestion, which required several upgrades to manage congestion
- These upgrades would be likely be installed by the DNO, which may influence decision-making regarding implementation of flexibility solutions by reducing the cost of upgrade works and reducing the business-as-usual costs against which HeatNet is judged

Figure XX: Cost-benefit analysis summary for current and future power electronics device costs

Ntwk. ID	Scenario							Investments for congestion mitigation compared	
	Reference case	D-Suite central case (£250/kVA for D-Suite costs)			D-Suite, future PED cost (£63/kVA D-Suite costs)			Reference case	D-Suite case
	NPV, £k	NPV, £k	ΔNPV, £k	(%)	NPV, £k	ΔNPV, £k	(%)		
SPM Urban	-147.3	-152.0	-4.7	-3%	-109.9	37.4	25%	New substation	2 D-STATCOMs, 180 kVA total capacity
SPD Urban	-98.5	-66.6	31.9	32%	-44.2	54.3	55%	Split feeder	D-ST
SPM Sburbn.	-100.0	-159.9	-59.9	-60%	-101.2	-1.2	-1%	Feeder overlay	2 D-STATCOMs, 240 kVA total capacity
SPD Sburbn.	-99.9	-154.7	-54.8	-55%	-93.3	6.6	7%	Split feeder & Tx uprate	2 D-SOPs, 120 kVA total capacity
SPM Rural	-72.5	-79.2	-6.7	-9%	-64.1	8.4	12%	Feeder overlay	D-STATCOM 60 kVA
SPD Rural	-11.0	-18.9	-7.9	-72%	-13.1	-2.1	-19%	Tx uprate	D-STATCOM, 24 kVA

Source: SP Electricity Distribution

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