Power Potential

(Transmission & Distribution Interface 2.0)

SDRC 9.7 DSO risk-reward framework for providing wider system services

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UK Power Networks
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Table of Contents

Executive summary

This report describes the commercial framework used for the Power Potential project, and provides recommendations for an enduring incentive framework for the Distribution System Operator (DSO). The report is known as SDRC 9.7 “DSO risk-reward framework for wider system services” and is the seventh reporting milestone for the Power Potential project.

The Power Potential project has successfully demonstrated a world-first regional reactive power market using a Distributed Energy Resources Management System (DERMS) to resolve transmission constraints. This automated technical solution was developed to support the technical and commercial optimisation and dispatch of Distributed Energy Resources (DER), and it enabled day-ahead procurement of reactive power services from DER through the coordination of UK Power Networks. The trials and potential developments for a BAU transition are covered in SDRC 9.6 “Trials Report”.

The trial adopted a simple commercial framework and back-to-back contractual mechanism with pass-through of service payments from National Grid Electricity System Operator (NGESO) to UK Power Networks, and then from UK Power Networks to DER. With this approach, the project team implemented and tested the dispatch logic for the service with minimum risk exposure for the project partners and the participating DER, while achieving the technical learning and the price discovery from DER.

NGESO reactive power requirements are currently met through a combination of balancing services and network asset investment. Network assets for reactive power have been very cost effective against market options so far. However increasing operational and cost challenges to manage the system highlight that there is a system need to be addressed.

Therefore, NGESO has increased the utilisation of balancing services to fill the gap when network assets are not available and/or when system requirements are higher. During these times, when there is not enough reactive capability on the system to manage voltage levels, NGESO may dispatch out of merit order synchronous generation via trades or the balancing mechanism to manage the locational nature of voltage constraints.

A DSO can help resolve these needs, with the appropriate incentives in place. Power Potential can provide a more economic and efficient way to access reactive capability via a coordinated procurement and dispatch method between UK Power Networks and NGESO, while respecting constraints in the distribution network.

The project has shown in SDRC 9.5 report “Cost Benefit Analysis” that there are potential savings to consumers if DER are able to deliver voltage constraint management services for the transmission network for consumers compared to building additional network assets. Additional benefits also include unlocking extra network capacity and potential cost savings for consumers from greater competition with existing market providers. These Power Potential savings result from DER market behaviour and increased effectiveness to resolve locational issues compared to other market options available to NGESO.

In order to achieve this, UK Power Networks needs to ensure that its distribution network is available and agile, so that DER are able to deliver system services without facing any network constraints. As a neutral market facilitator, UK Power Networks will continue leading the way in developing local DSO flexibility markets, while developing capabilities that allow for mitigation of conflicts of services and whole system coordination. For example, service co-optimisation with NGESO through the south-coast Regional Development Programme (RDP), and coordinating the dispatch of DSO ancillary services to resolve distribution and transmission constraints simultaneously.

UK Power Networks will explore enhancements to service delivery. Hence, it is crucial that the appropriate incentive framework is in place to drive performance that expands the coordination of DER services by the DSO. This coordination role will require UK Power networks to:

- facilitate the participation of more DER as evidenced by the exponential growth of local DSO flexibility markets
- facilitate DER to compete with existing market providers to NGESO, to enable potential cost savings
- resolve technical and economic complexities by optimising the dispatch of DER and mitigating service conflicts
- ensure that the distribution network will continue to be operated safely and reliably with no additional costs due to uncoordinated dispatch of system services.

This report describes options for an enduring incentive framework for the DSO, from cost pass-through to enhanced whole system coordination with a DSO performance incentive.

Under the pass-through option, the DSO recovers costs related to operating and maintaining DERMS. However, it does not take any corrective or optimisation actions outside the nominations from NGESO to mitigate for reduced service delivery, as it is only incentivised to increase DERMS availability and DER participation. This should be considered the minimum level of coordination between UK Power Networks and NGESO to enable the provision of whole system services.

Under the second option, UK Power Networks and NGESO continue to collaborate with increased exchange of data and network modelling information. UK Power Networks optimises DER dispatch in a cost-efficient way, while reconfiguring its network and using active network management measures. The above along with additional DER participation facilitated by the DSO can lead to reduced delivery risk and costs for NGESO. Hence, the DSO needs to recover the costs for these additional actions and system development, while being appropriately incentivised to enhance delivery of service through a dedicated DSO performance incentive. This enhanced whole system coordination creates an energy system fit for the future that helps the transition to Net Zero. This option could be incentivised in the future as an identified activity with suitable performance metrics as part of the ED2 DSO Output Delivery Incentive (ODI) framework.

Further variations between and around these options are being explored by the project partners.

This report on the DSO risk-reward framework is complemented by SDRC 9.5 (Cost Benefit Analysis) and SDRC 9.6 (Trials Report). These other SDRCs further explore the potential benefits, key learnings from the trials and considerations of transitioning to BAU.

ACRONYMS

ASDP	Ancillary Services Dispatch Platform
BAU	Business as Usual (after the innovation-funded trials)
CAM	Coordinated Adjustment Mechanism
CSA	Control Systems Automation
CSI	Control Systems Integration
DER	Distributed Energy Resources
DERMS	Distributed Energy Resources Management System
DNO	Distribution Network Operator
DSO	Distribution System Operator
DUoS	Distribution Use of System
ENA	Energy Networks Association
EPN	Eastern Power Networks
GSP	Grid Supply Point
GUI	Graphical User Interface
LPN	London Power Networks
MW	Megawatts (unit of active power)
Mvar	Mega-var-amperes (unit of reactive power)
Mvarh	Mega-var-ampere-hours
NGESO	National Grid Electricity System Operator
NGET	National Grid Electricity Transmission
NOA	Network Options Assessment
ODI	Output Delivery Incentive
ORPS	Obligatory Reactive Power Sources
PAS	Platform for Ancillary Services
PQ	Active Power v Reactive Power, capability envelope or permitted range for a DER
RDP	Regional Development Programmes
RIIO	Revenues = Incentives + Innovation + Outputs
RTM	Real-Time Metering
RTU	Remote Terminal Unit
SDRC	Successful Delivery Reward Criteria (Report to Ofgem)
SPN	South Eastern Power Networks
VPP	Virtual Power Plant

1. INTRODUCTION

1.1. SDRC 9.7 requirements and evidence

The purpose of this document is to provide evidence that the Power Potential project has delivered on the criteria required to successfully achieve the seventh reporting milestone for the project, known as SDRC 9.7 – DSO risk-reward framework for providing wider system services. Consistent with the original bid and project direction for the Power Potential (TDI 2.0) project, this Successful Delivery Reward Criteria report covers the scope set out in Table 1.

Table 1 – Evidence related to SDRC criteria

Milestone/SDRC	Description	Products
SDRC 9.7 DSO risk-reward framework for providing wider system services	DSO risk-reward framework for providing wider system services – a paper describing the incentive framework used for the project and recommendations for an enduring incentive framework for an active DSO	· Analysis of the costs, risks and revenues for the services included in the trial · Assessment of mechanism used within the trial and comparison against alternative incentive mechanisms · Assessment of the applicability of these incentive schemes to a DSO providing a broader set of system services and interaction with the wider SO incentives

Table 2 below illustrates where evidence for each one of the Successful Delivery Reward Criteria 9.7 can be found in the report.

Table 2 –- SDRC criteria evidence within the report

Evidence item	Relevant section of the report
Analysis of the costs, risks and revenues for the services included in the trial	*Chapter 2: Benefits, risks and costs in trial*
Assessment of mechanism used within the trial and comparison against alternative incentive mechanisms	*Chapter 3: Contractual mechanism* *Chapter 4: Incentive framework and policy direction* • *4.1 Trial commercial framework* • *4.2 Incentive framework options for BAU service*
Assessment of the applicability of these incentive schemes to a DSO providing a broader set of system services and interaction with the wider SO incentives	*Chapter 4: Incentive framework and policy direction* • *4.1 Trial commercial framework* • *4.2 Incentive framework options for BAU services*

1.2. Project overview

1.2.1. Power Potential (TDI 2.0) project approach

Transmission and Distribution Interface 2.0 (TDI 2.0), known as Power Potential, has aimed to give NGESO access to resources connected to UK Power Networks' south-east network to:

- provide additional operational tools for managing voltage and thermal transmission constraints,
- assess the relative capability of DER to provide dynamic voltage support at transmission level,
- assess the cost of the service offered by DER against transmission network assets and existing market providers.

The project aimed to create market access for DER to participate in ancillary service provision to NGESO via UK Power Networks' coordination. It was envisaged that the services provided by DER can provide dynamic voltage support to alleviate transmission constraints, while respecting constraints in the distribution network. This can unlock whole system benefits such as additional network capacity and operational cost savings to customers. The Grid Supply Points (GSPs) considered in this project were Canterbury North, Sellindge, Ninfield and Bolney.

This coordinated procurement and dispatch project has created a regional reactive power market for the trial, the first of its kind in the world, and if transitioned to BAU would help defer network reinforcement needs in the transmission system and could reduce reactive and active power service costs.

The project used an automated market and technical solution known as DERMS hosted and installed in UK Power Networks' control room. DERMS allowed:

- DER to offer dynamic reactive power services to NGESO
- DER to offer active power re-dispatch to manage transmission constraints
- technical and commercial coordination and dispatch.

This was conducted by collecting bids from DER and presenting the total reactive capability to NGESO through aggregated Virtual Power Plant (VPP) per GSP.

The services offered by DER to the system were coordinated by UK Power Networks through DERMS, as a centralised gateway to better manage DER, and formed part of its strategy to develop and embed DSO capabilities in order to facilitate the energy transition.

The trialled method can help enable more low carbon resources to connect in the south-east and give new and existing DER the opportunity of providing services to NGESO and allow them to access additional revenue streams. Services procured from DER were managed so that DER were operating within distribution network operation limits and constraints were not breached. When deployed, the Power Potential method is expected to remove barriers to 1,470 MW of additional generation in the area by 2050 and deliver savings of more than £100m[1] for Great Britain's energy consumers by 2050.

1.2.2. Trials

The Power Potential project trialled the provision of reactive and active power services from DER in the south east of England. It explored the use of DER to provide dynamic voltage support and constraint management services to NGESO, while investigating both the technical and commercial aspects of DER participation. It was designed to mimic the real-world situation in which a change in reactive and/or active power flows are required on the distribution network in order to manage voltage or thermal constraints on the transmission network.

The trials were further intended to ensure that trial participants receive appropriate compensation for their involvement, whilst also encouraging market bidding that mimics real-world behaviour.

[1] The SDRC 9.5 Cost Benefit Analysis report calculated more than £96m of benefits across GB by 2050, and identified several areas of additional benefit.

Participating DER were paid £392k in total. The trial approach and learnings are described in SDRC 9.6.

DER had the option to participate in either just the reactive power service trials, or both the reactive and active power service trials. After the commissioning and Mandatory Trial stages described in SDRC 9.6, there were two 'waves'. Wave 1 aimed to trial the technical aspects of Power Potential and allow DER to recover most of their upgrade costs. Wave 2 introduced competitive bidding between DER with accepted volumes linked to actual system scenarios.

The DERMS Web Interface provided DER with a web portal to communicate its interest in participating. The DERMS system, hosted and operated by UK Power Networks, also acted as the intermediary between NGESO and participating DER. The trials provided evidence on the performance of DERMS and NGESO's Platform of Ancillary Services (PAS) system.

1.3. The DSO role

UK Power Networks is developing and embedding DSO capabilities in order to operate its distribution network more effectively and efficiently. These capabilities include to:

- Plan efficiently in the context of uncertainty, taking account of the whole electricity system and promoting planning data availability to external stakeholders
- Promote operational network visibility and data availability
- Facilitate efficient dispatch of DSO flexibility services
- Provide accurate, user-friendly and comprehensive market information
- Develop simple, fair and transparent rules and processes for procuring DSO ancillary services, aligned with ESO markets where appropriate[2].

In a decentralised, decarbonised and digitalised energy system, UK Power Networks is determined to deliver these capabilities at the lowest cost for consumers. UK Power Networks' DSO strategy aims at enabling competition and markets, facilitating and expanding customer participation, using technological advancements in the operation and planning of distribution networks, while enabling whole system solutions.

UK Power Networks as a neutral market facilitator will continue to invest in flexibility services and smart solutions that reduce the significant expenditure to build new network infrastructure. At the same time, UK Power Networks will keep developing the necessary network upgrades to support a safe and reliable electricity distribution network and allow the increasing amount of DER to provide services to both UK Power Networks and NGESO.

By enhanced coordination through UK Power Networks, and effective collaboration among UK Power Networks, NGESO and DER, we can enable a more optimised and cost-efficient whole electricity system that delivers value for money for consumers and can achieve the transition to Net Zero.

UK Power Networks is currently developing its RIIO2 business plan in line with Ofgem's guidance and recent policy developments on the necessary market functionalities for the DSO, with initial submission to Ofgem in December 2021.

This report reflects UK Power Networks' emerging thinking on the development of a DSO risk-reward framework, and the agreement between UK Power Networks and NGESO to incorporate the Power Potential services into the RDP. Hence, the enduring DSO risk-reward incentive framework is still subject to further development and stakeholder engagement before its submission to Ofgem.

[2] See the activities in section 4.1.9 in Ofgem's RIIO-ED2 Business Plan Guidance

2. BENEFITS, RISKS AND COSTS IN TRIAL

2.1. Overview of trial benefits

At a high-level, Power Potential demonstrated that an integrated automated procurement and dispatch approach can be implemented to deliver end-end reactive power services from DER to NGESO, coordinated by UK Power Networks. The project also ran trials of simultaneous instructions from DERMS for both active and reactive power services – highlighting potential future system development. Hence, the Power Potential approach enables a new source of voltage control for NGESO.

From a safety perspective, we have demonstrated that reactive power services can be delivered in compliance with statutory voltage limits for the distribution networks. This was achieved by agreeing in advance a safe operational PQ envelope, appropriate 'failsafes' in the PowerOn network management system and the Remote Terminal Unit (RTU), and providing appropriate visibility to UK Power Networks' control engineers.

As set out in section 2 of SDRC 9.6, the trials enabled us to develop effective approaches to commissioning and capability test, with the DER Technical Requirements, DER Interface Schedule and DER commissioning procedure being the key output documents.

After the individual DER commissioning and their individual Mandatory Trials, the end-end technical and commercial trials ran for 20 weeks from October 2020 to March 2021. Through Power Potential, we have demonstrated a world-first regional reactive power market – a DERMS-enabled day-ahead offer of services by DER, and then NGESO nomination of those services against a trial budget[3].

Based on that day-ahead procurement, we then demonstrated automated delivery of reactive power services by DER for transmission voltage control. This was integrated with NGESO's PAS and UK Power Networks' PowerOn network management system, providing visibility for both licensees' control engineers.

As a result, NGESO, UK Power Networks and the DERMS developer, ZIV Automation, gained insight into how to deliver and operate the systems and processes required to enable these services, and how these can be integrated with other operational systems and procedures. This included learning related to system availability, expected and delivered response, commissioning processes, the contractual framework and settlements.

Participating DER gained important learning about operation in voltage droop control, how to interface for distribution network control, and how to deliver reactive power services alongside other services such as Firm Frequency Response, Enhanced Frequency Response, Dynamic Containment and any existing active power market obligations.

The price discovery principle in Wave 2 also allowed participating DER to freely bid on both availability and utilisation under a competitive environment amongst themselves, and reflect any risk or cost associated with the provision of reactive power services. This approach drove the commercial behaviour of DER and we observed different bidding strategies across the various GSPs. In summary, the average prices accepted for availability and utilisation were in the range of £1.18 - £4.58/Mvar/h and £5.19 - £9.35/Mvarh respectively at GSP level – signalling the locational cost of reactive power services per GSP, which is not available through the ancillary services reporting.

DERMS was also developed in a modular way, and therefore, could be adapted and redesigned to enable additional functionalities for reactive and active power services. For example, with some small DERMS-DER system changes, such as DERMS sending reactive power or power factor set-point instructions, the Power Potential approach can be expanded to cover static reactive power service requirements. The appropriate parameters are already calculated by DERMS and enabled in the DERMS-DER system integration, but functionalities for additional services were not developed PAS-DERMS. DERMS could also be applied to the resolution of distribution network voltage constraints by UK Power Networks, which at the same time could mitigate the need to resolve issues at the transmission network.

Based on trial experience, the project team delivered multiple DERMS improvements, for consistency and ease of service delivery, as well as some PAS changes. We also identified multiple system and process improvements for delivery in a BAU transition of Power Potential, as outlined in section 6 of SDRC 9.6.

[3] Note that SDRC 9.6 section 3 covers the commercial approach in trial in more detail, and SDRC 9.5 covers BAU commercial benefits.

2.2. Overview of trial risks and relevance for BAU

In order to achieve the aforementioned benefits, the project team managed to overcome and resolve a number of significant challenges, which highlighted areas for further consideration before transitioning to BAU service delivery.

Volume of DER recruitment

In order for the Power Potential trials to deliver representative and valid results, a minimum combined volume of 40 Mvar was required across all participating DER. We engaged with more than 80 DER (existing and new connections). However, as the project evolved, the number of DER who could commit to invest in meeting the trial specifications (equipment upgrades and integration costs prior to commissioning) was reduced. This was mainly due to the perceived risk of losing out on initial outlay costs associated with preparing for service. Following significant collaboration with DER during the recruitment stage, a total of five DER signed contracts for the trials. SDRC 9.4 set out the overall recruitment journey.

Despite our dedicated efforts and support to facilitate the participation of these DER, one of them failed to meet the necessary capability requirements within trial timescales. Hence, this DER was unable to participate after commissioning, reducing the eventual number of participants to four with combined total volume of 91.45 Mvar. As noted in SDRC 9.6 (p20) the specific site issues associated with this DER are expected to be solvable for BAU with additional analysis of the changes in site installation and in particular the operation of the step-up transformer on the customer's site, but highlights that site-specific issues can lengthen the on-boarding process even after contract signature. However, many other site-specific challenges, such as with metering polarity and exchange of service limits with DER controllers, were resolved in time for trial.

It should be noted that new connections to the distribution networks under EREC G99 from April 2019 (implementing EU requirements for generators) are required to demonstrate capability to operate in voltage control, reactive power control and power factor control. Trial recruitment was with customers connecting prior to Engineering Recommendation G99, so customers would not necessarily have had these capabilities required by Power Potential, and trial customers generally needed some element of site upgrade works for control and/or integration. Thus, while Power Potential faced some recruitment challenges with customers who had commissioned years earlier, it is not expected that this recruitment hurdle would be as significant in BAU, because of the new EREC G99 requirements and the experience and learning from a proven trial.

In recruiting DER for any DSO service (Power Potential and more widely as set out in section 7 of SDRC 9.6), Power Potential provided key understanding of DER service providers as a combination of asset owner and asset operator, both of whom must agree to and support the service provision. This also highlights the importance of consistency in approach, contracts, systems and processes across enabling this range of services.

Co-ordination of DER on-boarding

UK Power Networks is also committed to working with customers to improve the integration and commissioning approaches in a future BAU transition of Power Potential. Further detail of the integration, commissioning and capability tests was provided in SDRC 9.6, with section 6 providing detail of potential areas of improvement. In particular, system changes would be made to allow DER commissioning and capability testing (and any required elements of Mandatory Trial) to be delivered without interrupting delivery of the service from other customers. Thus, while DER on-boarding would be still a significant activity, addition of a new customer would have less impact than in trial on overall service delivery. On-boarding for Power Potential services could also be combined with commissioning for other DSO services using the same integration method. High-level visibility of the commissioning pipeline to NGESO and the wider market could show the future expected availability of reactive volumes.

DER performance management in case of service non-delivery/poor performance

In the last weeks of trial, one DER experienced problems with their site equipment and made changes on site, altered their speed of response, and needed to declare themselves unavailable for some service windows, and restrict their volume in others. This functionality worked well in DERMS, and there was good proactive communication with the customer and UK Power Networks. The customer did not fall below the 80% performance threshold in the contract (they were available for service more than 80% of available hours, see section 4.1), so no withdrawal of payment was triggered. The framework agreement also provided for UK Power Networks to request a repeat of any relevant part of the commissioning and capability

tests. No reassessment of capability was implemented, but the contractual terms and processes for management of non-delivery, reduced/changed capability would need to be reviewed for BAU. This would need to include appropriate visibility of changes in service at the GSP level.

DERMS development and reliability risks

The contract with ZIV Automation for DERMS supply and development included necessary liability clauses. No performance penalties were included on ZIV Automation for lack of service availability, as for an innovation trial it is noted that improvements would be made based on test and trial experience. A 'bronze' service level agreement was in place for trials, setting out the expected minimum defect and response level, without significant support out of office hours.

In a future BAU Power Potential service, the appropriate (higher) service level agreements would need to be in place to cover 24/7 operation and support. Additional performance metrics and monitoring would be implemented, and performance penalties would be considered on the DERMS supplier if defects affected system availability. DERMS would be expected to meet similar resilience and reliability standards as other UK Power Networks control systems described in the next section, with specific consideration of enhancing the backup and failover arrangements relative to the trial.

System development and support risks

The RTU and Network Management Systems for Power Potential were developed and supported by multiple teams within UK Power Networks, such as Operational Telecoms, Control Systems Automation (CSA) and Control System Integration (CSI) teams. However, despite the effective collaboration among all teams involved, the technical complexity of this world-first endeavour posed risks to the trial e.g. data traffic, data capture. The key was to manage and mitigate the risks affecting trial operation (requiring DERMS and supporting systems) amidst resource constraints, conflicting priorities such as network operational requirements and the development of other products such as flexible connections, particularly against the background of dealing with COVID-19 at the same time.

Support services were managed during the trials through a hypercare process, which was put in place to capture and allocate issues to the appropriate resolver groups. For a future BAU service, appropriate service level agreements for UK Power Networks and NGESO teams would need to be incorporated into the contractual mechanism.

Costs and revenues to clarify in future contract drafting

The trial also highlighted a range of other minor items to reflect in future service definition and contract drafting. They affect the scale and balance of costs between the different parties – DER, UK Power Networks and NGESO – and what activities are paid for and incentivised. These areas include:

- scope of work associated with signing DER to the service (in trial there were six contractual documents to prepare and sign in addition to the main framework agreement);
- agreement of thresholds to start the service delivery from DERMS (e.g. DER volumes and test criteria triggering when the service becomes available);
- separating the scope of commissioning, capability testing, and ongoing performance review of the voltage service across multiple active power levels;
- review of settlement timescales and credit cover between the parties in case of late payment, given trial experience;
- decision on payment for 'uninstructed' Mvarh delivered by the DER – the system design issues voltage setpoint instructions from DERMS which may request DER Mvarh response, even when NGESO instructs no response at GSP level; and
- clarifying customer participation in reactive and/ or active services.

2.3. Overview of trial costs

DER payments and NGESO costs

The total payments to DER were £392k, with the costs of the Wave 2 commercial service described further in SDRC 9.6. NGESO indicated day-ahead the accepted volumes, and the accepted availability and

utilisation prices. Actual utilised volumes depended on the instruction of the service on the day of service delivery.

NGESO total costs to deliver system integration activities were £866k. The following activities were done on the PAS side of NGESO during the trials. These activities were funded from the Power Potential project budget:

- PAS Ancillary Services Dispatch Platform (ASDP) system development for Power Potential components including availability, nominations and Real-Time Metering (RTM) data with new Graphical User Interface (GUI)
- Additional data requests utilising existing manual process of daily data extractions in FTP folder of ASDP dispatch reports for settlements
- Full internal code testing, NGESO change approval and release management
- Service support alignment and planning in conjunction with UK Power Networks and DERMS developer
- Control room support and training including documentation of a new training manual and creation of user accounts
- Collaborative PAS-DERMS end to end testing including connectivity check and go-live support.

UK Power Networks costs

UK Power Networks' total costs to deliver the commissioning, ongoing system development and trials from January 2020 to March 2021 were £1,181k.

The principal costs for UK Power Networks in delivering systems and trials for the project are covered in more detail in SDRC 9.6 (Section 4) but in summary were:

- System development, test and delivery (77%, reflecting multiple development and trial stages, system and improvements, and project reporting)
- Commissioning and mandatory trial delivery (8%, ~£12k for last entrant to trial)
- Regular costs during the collective Wave 1 and Wave 2 trials (15%, ~£30k/month).

The project development covers principal activities since detailed design and contract signing. Due to the staged approach to trial delivery with incremental increases in scope, system development and test. In addition to this, there were the commercial and contractual development aspects covered in SDRC 9.3 and 9.4 e.g. signing framework agreements, variations to connection agreements, and documentation related to how DER would be paid as new suppliers on a self-bill arrangement.

In addition, total costs for the DERMS system (development, delivery, support) for ZIV Automation were £1,966k.

2.4. DER perspective on costs, risks and revenues – relevance to DSO

The DER perspective on cost, risks and revenues was key to recruitment for trial, and will also be for a future BAU service. For Power Potential, the project team engaged with customers before, during and after trials, to gain their views on their learning and experience from the project, from trials preparation through to trials delivery.

Under a BAU service, the DSO will be required to facilitate the participation of DER through engagement and on-boarding, with a mix of technical and commercial contractual support. Thus, the future DSO risk-reward framework should specifically reflect the efficient funding of this support to facilitate DER participation. This is consistent with the Market Development, Operation and Planning roles that DSOs will have in RIIO-ED2.

More generally, feedback to UK Power Networks in the past year, also captured in the 2021 Stakeholder Engagement and Customer Vulnerability report, has highlighted the importance to DER customers of accessibility and visibility of opportunities for new flexibility services enabled by UK Power Networks. This included ways to connect, navigate complexity and access previously restricted markets. Power Potential will open up the opportunities for reactive power services.

Learning from the trial on encouraging DER participation informs the approach for encouraging participation in BAU. The post-trial feedback highlights the importance of clarity of the opportunities. Hence, as part of

UK Power Networks' work with the ESO through the rest of RIIO-ED1 and in RIIO-ED2 on a range of services, we will provide visibility of the revenues available to DER. These will help the DER overcome potential costs to provide the Power Potential service and others.

The trial experience suggests that a DSO would:

- Start with a wide engagement campaign on available services,
- Provide clarity on specific technical and commercial angles for the Power Potential service,
- Provide accessible summaries of the contractual agreement and commercial approach. In trials these were a direct result of feedback at a 2019 Regional Market Advisory Panel. These helped DER gain a good insight into the participation requirements and opportunities, particularly when a DER operator needed to liaise with a separate DER owner for agreement to proceed.
- Work to address customer-specific and site-specific issues for each customer

The trial learning working with 'first movers' is described in other SDRCs – both the initial phase with seven potential providers in SDRC 9.2 and supporting the full journey with 80 potential DER participants > 1MW in SDRC 9.4 and the final feedback from the contracted DER SDRC 9.6. Development of a nomination and assessment methodology as well as market reporting format and frequency in line with system balancing services will be important for an enduring service.

The actions above received positive feedback post-trial, providing support for the investment in this aspect of the DSO role.

> *'Great project…10/10 for communication with project team – extremely pro-active'*
>
> *'A worthwhile exercise… great strategic opportunity …has ability to open markets which have previously been closed to assets like ours'*
>
> *'Shows how co-ordination of transmission and distribution can happen'*
>
> *'Useful to be developing with DNO, not just meeting requirements'*
>
> *'We have found the project to be an extremely valuable learning opportunity'*
>
> *'We will increase focus on ancillary services'*

The project partners facilitated and supported participating DER to prepare for and deliver the service, and customers found the experience valuable in terms of understanding the challenges and identifying any barriers to entry for the future provision of reactive power services from embedded generation. This is seen to be reducing the trial participants' future barriers to entry (costs and risks). Ultimately, following their experience in the trials, all trial participants were very interested in plans for developing the service into BAU, how and when this will be rolled out and also how the markets will change when not operating within the confines of trial with budget limitations.

3. CONTRACTUAL MECHANISM

3.1. Trial contractual mechanism

To provide a framework for the delivery of the Power Potential trial, a simple back-to-back arrangement was adopted, with pass-through of service payments from NGESO to UK Power Networks, and then from UK Power Networks to DER (i.e. delivery of services coordinated by UK Power Networks). Contracts were required between DER and UK Power Networks, and between NGESO and UK Power Networks to capture the details of operational and commercial processes between parties.

The Inter-operator Agreement between NGESO and UK Power Networks referenced the agreed form of the DER Framework Agreement between UK Power Networks and DER. The completed DER Framework Agreements held between UK Power Networks and DER then captured bespoke details of each participant.

The DER Framework Agreement can be found on the project website.

The trial contractual approach highlighted the key obligations between NGESO – UK Power Networks, and UK Power Networks – DER. This back-to-back approach facilitated the evolution of the DSO to support whole electricity system arrangements, with UK Power Networks directly contracting with DER and having a cost pass-through model to NGESO.

In addition, the simplicity of the back-to-back contractual mechanism accelerated the resolution of issues directly with the relevant counterparty, without the need to involve both of the project partners and DER.

For example, through the DER participant workshops, it was noted that the UK Power Networks connection agreements may require update to enable participation in the trial (e.g. to allow different technologies or operating profiles, to remove the impact of Distribution Use of System (DUoS) charges related to the trial). UK Power Networks reviewed the materiality of these risks and, in order to remove barriers to participation, adapted the participants' connection agreements in line with the development of the trial to reflect their necessary operational PQ envelopes, on condition that these changes continue to protect the network and customers.

Furthermore, the DER Framework Agreement allowed DER to provide the Power Potential service in conjunction with an active power balancing service to NGESO, or a flexibility service to UK Power Networks. The project partners developed the contractual mechanism in a way that was attractive for DER participation. It allowed them to participate in Power Potential trials alongside meeting any other existing service commitments.

UK Power Networks and NGESO also produced a summary that acts as an informal introduction to the DER Framework Agreement.

In overall, the trial contractual mechanism performed well, with the minimum recruitment target met for the trials, trial learning delivered, and all DER payments made in the settlement approach defined.

Learnings from this contractual mechanism are currently being used to develop RDP arrangements. Further consideration may be required on the evolution of the contractual framework for services procured via the Distribution Network Operator (DNO), i.e. whole system services. Variations may be determined by the scope of changes to the range of commercial and technical issues identified within the trial and evolving reactive power DNO needs.

3.2. BAU transition & links to other industry developments

As explained in section 3.1, the contractual mechanism within the trial to access reactive power services from DER was structured as an Inter Operator agreement between NGESO and UK Power Networks alongside a Framework Agreement between UK Power Networks and DER.

Further consideration and review will be required to inform the transition of the Power Potential trial into the BAU procurement of active and reactive power services for NGESO via UK Power Networks. This review process will also reflect the commercial and technical learning from the trial, any feedback provided by DER, as well recent policy developments (e.g. RIIO2) and whole system industry developments.

In addition, standardisation of contracts for procuring services will be another step in aligning network companies and NGESO, and the Energy Networks Association's (ENA) Open Networks Project is playing a significant part in this endeavour.

Some aspects of the trial contractual mechanism to inform a BAU contract include:

- referencing and testing a revised set of technical requirements for DER;
- business process pre-requisites for PAS and DERMS to go-live and start service delivery; and
- bi-directional exchange of data between NGESO and UK Power Networks via an Inter Control Centre Protocol link to implement the control instructions from DERMS.

3.2.1. ENA Open Networks

The ENA's Open Networks project is a major industry initiative that is helping to transform the way the energy networks operate and supporting the delivery of the smart energy systems of tomorrow. This initiative has brought together the network companies and system operators in the UK and Ireland to collaborate, standardise customer experiences and align processes.

As more and more DER are developed and become flexible, their contribution to balancing the system by controlling or scheduling their demand and/or generation is of crucial importance. Accordingly, providing a standardised customer experience enables an easier navigation in the available markets, facilitates market participation and incentivises more low-carbon generation.

As part of the Open Networks project, Workstream 1A Product 4 is dealing with standardising framework agreements for service provision among DNOs, including further improvements that will enable the alignment with NGESO. UK Power Networks and NGESO are leading these developments with the aim to produce a whole industry standard framework agreement by the end of 2021.

3.2.2. Regional Development Programmes (RDPs)

Regional Development Programmes (RDP) are initiatives that look at the complex interactions between distribution and transmission networks in areas with large amounts of transmission connections and DER, which are leading to capacity shortfall. The RDPs that are being developed by NGESO and DNOs to facilitate whole system electricity coordination, are implementing data exchanges between transmission and distribution, similar to the exchanges put in place for the trial, while considering and contributing to the associated ENA Open Networks project workstreams.

RDPs are designed to look at the whole electricity system and assess a variety of options to resolve specific network needs. They can be triggered by customer connections or wider changes to the electricity system. The south-coast RDP between NGESO and UK Power Networks is developing new markets for transmission thermal constraint management services in a similar geographic location to Power Potential. This is a ground-breaking whole system programme, which examines the future operability of the South East coast area over the next 10 years, and will involve the development of a co-ordinated IT solution that will deliver:

- Visibility and data exchanges in both directions to facilitate efficient service coordination
- Management of DER to allow constraints on transmission and distribution networks to be managed efficiently, whilst ensuring the safe operation of the distribution network
- A coordinated service and dispatch methodology allowing DER to participate in new markets and ensure that we have identified the cheapest solution for the GB consumer
- Coordination and service conflict resolution methodologies

The south-coast RDP has been running for almost five years, and NGESO's and UK Power Networks' experience working on Power Potential will be extremely relevant in delivering the future RDP, ensuring that both parties understand ways of working and IT infrastructure needs. While the RDP's primary focus is on thermal (MW) constraint management, the project is also considering the option to build in voltage management. The triggers for doing so will be a specific service requirement emerging from customer connections (both distributed and transmission connected), general requirements that are identified through the network planning process or developments in wider reactive power and voltage control markets, currently being progressed under NGESO's "Future of Reactive" work.

Accordingly, to leverage the technical and commercial learnings and solutions identified within the trial, we are keen to explore which elements of functionality and transferable processes from Power Potential

can be further developed to fulfil the needs of, and expand the scope of, the UK Power Networks and NGESO RDP.

4. INCENTIVE FRAMEWORK AND POLICY DIRECTION

NGESO reactive power requirements are currently met through a combination of balancing services and network asset investment. Network assets for reactive power have been very cost effective against market options so far. However due to the increasing levels of renewable generation and DER on one hand and the decrease in conventional reactive providers on the other, there are emerging operational and cost challenges to manage the system. However, increasing operational and cost challenges to manage the system highlight that there is a system need to be addressed.

As patterns of generation and demand have changed on the system, the availability of Obligatory Reactive Power Sources (ORPS) at the times when they are needed most has become more challenging. This leads to some regions of the country not having enough ORPS providers available when needed, making those areas more challenging to manage and potentially giving rise to a voltage constraint.

Therefore, NGESO has increased the utilisation of balancing services to fill the gap when network assets are not available and/or when system requirements are higher. During these times, when there is not enough reactive capability on the system to manage voltage levels, NGESO may dispatch out of merit order synchronous generation via trades or the balancing mechanism to manage the locational nature of voltage constraints.

These operational challenges are increasing the cost to manage the system, which is also highly volatile due to the locational nature of voltage constraints and because of the growing levels of intermittent renewable generation and DER at distribution level. These voltage constraints costs have increased almost three times since 2018, from £3.2m to £9.2m[4] for the South East of England (Power Potential area).

Power Potential can provide a more economic and efficient way to access reactive capability as coordinated procurement and dispatch between UK Power Networks and NGESO, while respecting constraints in the distribution network. The project has shown in SDRC 9.5 report “Cost Benefit Analysis” that DER are able to deliver constraint management services for the transmission network at reduced costs for consumers compared to building additional network assets. Additional benefits also include unlocking extra network capacity and potential cost savings for consumers from greater competition with existing market providers. These savings result from DER market behaviour and increased effectiveness to resolve locational issues compared to other market options available to NGESO.

UK Power Networks will explore enhancements to service delivery, and as a result, it is crucial that the appropriate incentive framework is in place to drive performance that expands the coordination of DER services by the DSO. This section explores options for an enduring incentive framework for the DSO.

4.1. Trial commercial framework

Power Potential is a world-first innovation project, and apart from the main objectives to create regional reactive power markets for DER and generate additional capacity on the network, there are many variables we explored to develop its technical and commercial design. The basic contractual framework was decided by the project partners (back-back inter-operator plus DER framework agreement). Insights from Cambridge University and Imperial College, feedback from potential participants and consumers, and industry best practice proved to be significantly important in our decision to proceed with the detail of a simple pass-through commercial framework for the trial.

This commercial framework adopted for the trial enabled us to implement and procure the service with minimum risk exposure for the project partners and the participating DER. For example, to mitigate concerns from potential customers due to the uncertainty of this new market and create confidence in the trial, we implemented a more lenient approach with performance factors at 80%, while the equivalent for existing and established services is around 90-95% (e.g. Firm Frequency Response).

[4] NGESO voltage system costs

In line with the dispatch instructions from NGESO, DERMS dispatched available DER based on the day-ahead nominations to absorb or inject reactive power onto the network and increase or decrease active power output. However, the automated system did not take any corrective or optimisation actions outside the nominations to mitigate for underperformance against the expected service delivery, since this was not in scope for the trial. In addition, for the purpose of the trial, the nominated DER were not considered a system resource, but a surplus to the network requirements, and therefore were not used to secure the system.

For the trial, given the focus on demonstration and learning, it was appropriate that there were no risk, incentives or penalties on UK Power Networks, NGESO or ZIV Automation for the PowerOn, PAS or DERMS system performance.

Overall, the trial commercial framework helped us test the service and facilitate the price discovery principle, while collecting actual operational data on service provision from DER. The trials provided a valuable learning outcome for project partners, which will inform our approach to manage any volume risks associated with service forecasting and delivery, as we explore the transition of Power Potential into BAU.

4.2. Incentive framework options for BAU service

As explained in SDRC 9.5, Power Potential can provide a more economic and efficient way to access reactive capability as coordinated procurement and dispatch between UK Power Networks and NGESO. In order to achieve this, UK Power Networks needs to ensure that its distribution network is available and agile, so that DER are able to deliver system services without facing any network constraints.

As a neutral market facilitator, UK Power Networks will continue leading the way in developing local flexibility markets, while also developing capabilities that allow for mitigation of conflicts of services and whole system coordination. For example, service co-optimisation with NGESO through the south-coast RDP, and coordinating the dispatch of DSO ancillary services to resolve distribution and transmission constraints simultaneously.

This coordination role will require UK Power networks to:

- facilitate the participation of more DER as evidenced by the exponential growth of local DSO flexibility markets
- facilitate DER to compete with existing market providers to NGESO, to enable potential cost savings
- resolve technical and economic complexities by optimising the dispatch of DER and mitigating service conflicts
- ensure that the distribution network will continue to be operated safely and reliably with no additional costs due to uncoordinated dispatch of system services.

UK Power Networks is currently developing its RIIO2 business plan in line with Ofgem's guidance and recent policy developments on the necessary market functionalities for the DSO, and will continue to act as a neutral market facilitator and whole system enabler for active and reactive power services, while providing benefits to consumers at the lowest cost.

On the basis of the above, we set out two options for a BAU incentive framework.

4.2.1. Cost pass-through with DSO performance incentive

This incentive framework approach is similar to the commercial framework implemented as part of the trial to minimise risk exposure for project partners and the participating DER. Under this option, DERMS dispatches available DER based on the day-ahead nominations from NGESO to absorb or inject reactive power onto the network and increase or decrease active power output. However, the automated system does not take any corrective or optimisation actions outside the nominations to mitigate for underperformance against the expected service delivery. This should be considered the minimum/baseline level of coordination between UK Power Networks and NGESO to enable the provision of whole system services.

This option should pose no risk to UK Power Networks for any under-deliveries related to service provision, and UK Power Networks can be compensated for its coordination of the service in a straightforward manner to cover any costs related to DERMS maintenance, settlement and customer

management systems, as well as additional staffing. Nonetheless, UK Power Networks needs to ensure appropriate levels of DERMS availability to facilitate service provision, and that its customer recruitment efforts lead to increase DER participation.

The cost recovery could come through the following mechanism:

- an ex-ante allowance through RIIO-ED2 to operate and maintain DERMS, while coordinating service provision, i.e. the enablers of the service, plus
- performance incentives for DERMS availability, DER recruitment, DER participation, etc.

4.2.2. Enabling whole system solutions with DSO performance incentive

Under this incentive framework, NGESO and UK Power Networks will continue to work in a collaborative way, with increased coordination regarding data exchanges and network modelling information. UK Power Networks will optimise DER dispatch to enhance service delivery in a cost-effective way, while ensuring that NGESO has access to the maximum volume that can be provided by the available DER and while keeping the distribution network secure.

UK Power Networks could also reconfigure the network by optimising distribution network assets (e.g. transformer taps) and through active network management measures. These actions will further reduce the service costs, minimise service conflicts, and enhance NGESO's access to DER. SDRC 9.5 noted this optimisation could bring a £23m benefit by 2050, but the potential costs for enabling such DNO optimisation were not identified as part of the Power Potential project.

In addition, UK Power Networks will continue to lead the way in developing local DSO flexibility markets and will coordinate the dispatch of DSO ancillary services to resolve distribution and transmission constraints simultaneously.

The enhanced coordination by the DSO allows NGESO to deal with a reduced risk of service under-delivery whilst at a reduced service cost. As UK Power Networks will facilitate additional service delivery by taking optimisation actions and reconfiguring the distribution network, the continuous network modelling, load flow analysis and data exchanges with NGESO would indicate whether and when the above corrective actions need to take place. This approach fully enables whole system optimisation and maximises the value of the coordinated approach to procure reactive and active power services.

In addition to the improved visibility and data exchanges in both directions to facilitate efficient service coordination, UK Power Networks will keep enabling the participation of additional DER in the service, which can be evidenced by the exponential growth of DER participating in local DSO flexibility markets. Accordingly, the increased visibility along the with improved market liquidity and the ongoing competition with other options available to NGESO can result in reduced service delivery risks and reduced service costs i.e. more effective and cost-efficient services for consumers.

However, as UK Power Networks facilitates NGESO's enhanced access to DER reactive capacity, UK Power Networks would incur additional operating costs. UK Power Networks will also need to operate its network assets under new and more complicated operating profiles in order to achieve the necessary network reconfiguration and whole system optimisation. The latter includes any design and development work required to deploy the appropriate active network management processes and systems, such as load flow analysis.

Therefore, the increased operating costs due to network reconfiguration and active network management measures with DERMS should be added to the costs of service optimisation and data exchanges, and the costs related to DERMS maintenance, settlement and customer management systems, as well as additional staffing.

These costs could be compensated in line with guidance from Ofgem on RIIO-ED2 DSO allowances and incentives and could form part of the outputs under the DSO Output Delivery Incentive (ODI) mechanism for DSO in RIIO-ED2.

4.2.3. Interaction with NGESO's Incentive Framework

As explained in section 1.3, UK Power Networks is currently developing its RIIO2 business plan in line with Ofgem's guidance and recent policy developments on the necessary market functionalities for the DSO, with initial submission to Ofgem in December 2021.

This report reflects UK Power Networks' emerging thinking on the development of a DSO risk-reward framework, and the agreement between UK Power Networks and NGESO to incorporate the Power Potential services into the RDP. The enduring DSO risk-reward incentive framework is still subject to further development and stakeholder engagement before its submission to Ofgem.

To best enable whole system outputs, the enduring DSO risk-reward framework would need to be aligned in its objectives with NGESO's incentive framework. Hence, the assessment of this interaction would require further consideration and development, as well engagement with NGESO in the near future e.g. through the development of the UK Power Networks and NGESO RDP.

Under RIIO2 NGESO has an incentive scheme along with its RIIO2 delivery schedule. The RIIO2 framework sets out price controls to determine the amount that can be earned from projects delivered, and services provided by NGESO. The regulatory period runs from April 2021 for five years. NGESO is incentivised under three roles, associated with control centre operations; markets development and transactions, and system insight, planning and network development. Under the incentive scheme NGESO has several areas where it will seek to outperform the scheme by demonstrating the behaviours and outputs expected by Ofgem when the ESO fulfils its roles.

Procuring an enduring reactive power service from DER as a result of the output and learning from the Power Potential trial could have alignment in roles two and three of the incentive scheme. Particularly with metric 2B 'Diversity of Service Providers' measuring the diversity of technologies that provide services to the ESO in each of the relevant markets for competitive procurement of services. Similarly, there is also alignment with metric 3A 'Future Savings from Operability Solutions' where NGESO may be able to display benefits from new operability measures such as saved balancing costs and saved infrastructure costs.

Prior to procurement of this enduring service it would need to be considered technically capable to meet the NGESO technical requirements with the appropriate contracting and funding arrangements to deliver value for the end consumer.

4.2.4. Enabling whole system solutions in RIIO2

RIIO (Revenues = Incentives + Innovation + Outputs) is Ofgem's regulatory framework to set the price controls for companies that have a monopoly on the operation of Great Britain's gas and electricity networks. These price controls are designed to ensure that these companies act in the best interests of energy consumers when making investment decisions.

The next set of RIIO price controls (RIIO2) will operate from April 2021 for electricity and gas transmission, gas distribution and the electricity system operator, and from April 2023 for electricity distribution.

In order to facilitate the energy transition and meet the Net Zero objectives, RIIO2 requires additional features in addition to the traditional investment approach. These features relate to newer, more flexible solutions, including smart grid technologies and increasing use of flexibility services. In addition, coordinated actions between licensees could increasingly deliver much lower whole system costs to consumers.

DSO

As mentioned in section 1.3, UK Power Networks is developing and embedding DSO capabilities in order to operate its distribution network more effectively and efficiently. In line with Ofgem's guidance on DSO transition, these capabilities include:

- Planning efficiently in the context of uncertainty, taking account of the whole electricity system and promote planning data availability
- Promoting operational network visibility and data availability
- Operating an economic and efficient distribution system
- Providing accurate, user-friendly and comprehensive market information

- Developing simple, fair and transparent rules and processes for procuring DSO ancillary services, aligned with ESO markets where appropriate[5].

The UK Power Networks DSO strategy is aimed at enabling competition and markets, facilitating and expanding customer participation, using technological advancements in the operation and planning of distribution networks, while enabling whole system solutions. UK Power Networks is determined to deliver these capabilities at the lowest cost for consumers.

Whole system solutions

According to Ofgem's definition, whole system solutions are "*solutions arising from energy network companies and system operators coordinating effectively, between each other and with broader areas, which deliver value for consumers*"[6]. For UK Power Networks and NGESO, whole system includes identifying these interactions between previously discrete systems and developing collaborative and coordinated solutions to effectively manage wider sets of needs at the lowest cost for consumers.

Hence, with effective collaboration among UK Power Networks, NGESO and DER, we can enable a more optimised and cost-efficient whole electricity system that delivers value for money for consumers and can achieve the transition to Net Zero.

For example, the south-coast RDP between NGESO and UK Power Networks is developing new markets for transmission thermal constraint management services in a similar geographic location to Power Potential. This is a ground-breaking whole system programme, which examines the future operability of the South East coast area over the next 10 years, and will involve the development of a co-ordinated IT solution that will deliver whole system benefits as explained in section 3.2.2.

The Coordinated Adjustment Mechanism (CAM)

To ensure that the optimal whole system benefit is derived, UK Power Networks has worked with Ofgem and other licensees to find ways of encouraging greater collaboration and outcomes that meet the needs of all parties across the energy system. This has focused on ensuring there is a level playing field between different licensees who can potentially deliver the same outputs at a different whole system cost. An outcome of this is a new Coordinated Adjustment Mechanism (CAM) that is being introduced by Ofgem.

The CAM aims to protect consumer interests by enabling the reallocation of responsibility for, and revenue associated with an output, to another licensee who can deliver with greater benefits for the consumer. Through proactive engagement licensees can use the CAM to reduce their individual costs whilst delivering benefits across the whole system.

For example, in line with SDRC 9.6, we demonstrated that DER are able to deliver voltage constraint management services for the transmission network. In SDRC 9.5, we concluded that DER are able to deliver these services at reduced costs for consumers compared to building additional network assets, and there are other potential benefits in accessing reactive power services from DER in the trial region and across the whole GB.

Under current arrangements, NGESO is not a party to the CAM. NGESO proposes transmission investment needs e.g. to National Grid Electricity Transmission (NGET) and other transmission owners through the Network Options Assessment (NOA) process. Once a BAU market solution has been established, in future through proactive engagement with UK Power Networks, NGET and NGESO, the NOA process could explore whether there would be savings to transmission asset investments.

[5] See the activities in section 4.1.9 in Ofgem's RIIO-ED2 Business Plan Guidance
[6] RIIO-ED2 Methodology Consultation: Overview

5. Summary and Conclusions

The Power Potential project has successfully demonstrated a world-first regional reactive power market using a DERMS to resolve transmission constraints. This automated technical solution was developed to support the technical and commercial optimisation and dispatch of DER, and it enabled day-ahead procurement of reactive power services from DER through the coordination of UK Power Networks.

The trial adopted a simple commercial framework and back-to-back contractual mechanism with pass-through of service payments from NGESO to UK Power Networks, and then from UK Power Networks to DER. This approach enabled us to implement and test a simple dispatch logic for the service with minimum risk exposure for the project partners and the participating DER, while achieving the technical learning and the price discovery principle from DER.

This is a new means of NGESO procuring reactive power services using DER capability within a competitive market environment. By introducing significant additional Mvar capability onto the system, DER could be used to displace or delay network reinforcement and also provide an additional source of reactive power services competing with other market options available to NGESO such as transmission connected generators providing ORPS.

Further consideration and review will be required to inform the transition of the Power Potential trial into the BAU procurement of active and reactive power services for NGESO via UK Power Networks. This review process will also reflect the commercial and technical learning from the trial, any feedback provided by DER, as well recent policy developments (e.g. RIIO2) and whole system industry developments.

For example, in order to leverage the technical and commercial learnings and solutions identified within the Power Potential trial, we are keen to explore which elements of functionality and transferable processes from Power Potential can be further developed to fulfil the needs of, and expand the scope of the UK Power Networks and NGESO RDP.

Power Potential can provide a more economic and efficient way to access reactive capability via a coordinated procurement and dispatch method between UK Power Networks and NGESO, while respecting constraints in the distribution network.

In order to achieve this, UK Power Networks needs to ensure that its distribution network is available and agile, so that DER are able to deliver system services without facing any network constraints. As a neutral market facilitator, UK Power Networks should continue leading the way in developing local DSO flexibility markets, while developing capabilities that allow for network reconfiguration, mitigation of conflicts of services and enhanced whole system coordination. For example, service co-optimisation with NGESO through the south-coast RDP, and coordinating the dispatch of DSO ancillary services to resolve distribution and transmission constraints simultaneously.

UK Power Networks will explore enhancements to service delivery. Hence, it is crucial that the appropriate incentive framework is in place to drive performance that expands the coordination of DER services by the DSO. This coordination role will require UK Power Networks to:

- facilitate the participation of more DER as evidenced by the exponential growth of local DSO flexibility markets
- facilitate the competition of DER with existing market providers to NGESO, to enable potential cost savings
- resolve technical and economic complexities by optimising the dispatch of DER and mitigating service conflicts
- ensure that the distribution network will continue to be operated safely and reliably with no additional costs due to uncoordinated dispatch of system services.

This report describes options for an enduring incentive framework for the DSO, from cost pass-through to enhanced whole system coordination with a DSO performance incentive.

Under the pass-through option, the DSO recovers costs related to operating and maintaining DERMS. However, it does not take any corrective or optimisation actions outside the nominations from NGESO to mitigate for reduced service delivery, as it is only incentivised to increase DERMS availability and DER participation. This should be considered the minimum level of coordination between UK Power Networks and NGESO to enable the provision of whole system services.

Under the second option, UK Power Networks and NGESO continue to collaborate with increased exchange of data and network modelling information. UK Power Networks optimises DER dispatch in a cost-efficient way, while reconfiguring its network and using active network management measures. The above along with additional DER participation facilitated by the DSO can lead to reduced delivery risk and costs for NGESO. Hence, the DSO needs to recover the costs for these additional actions and system development, while being appropriately incentivised to enhance delivery of service through a dedicated DSO performance incentive. This enhanced whole system coordination creates an energy system fit for the future that helps the transition to Net Zero.

This report reflects UK Power Networks' emerging thinking on the development of a DSO risk-reward framework, and the agreement between UK Power Networks and NGESO to incorporate the Power Potential services into the RDP. Hence, the enduring DSO risk-reward incentive framework is still subject to further development and stakeholder engagement before its submission to Ofgem.

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