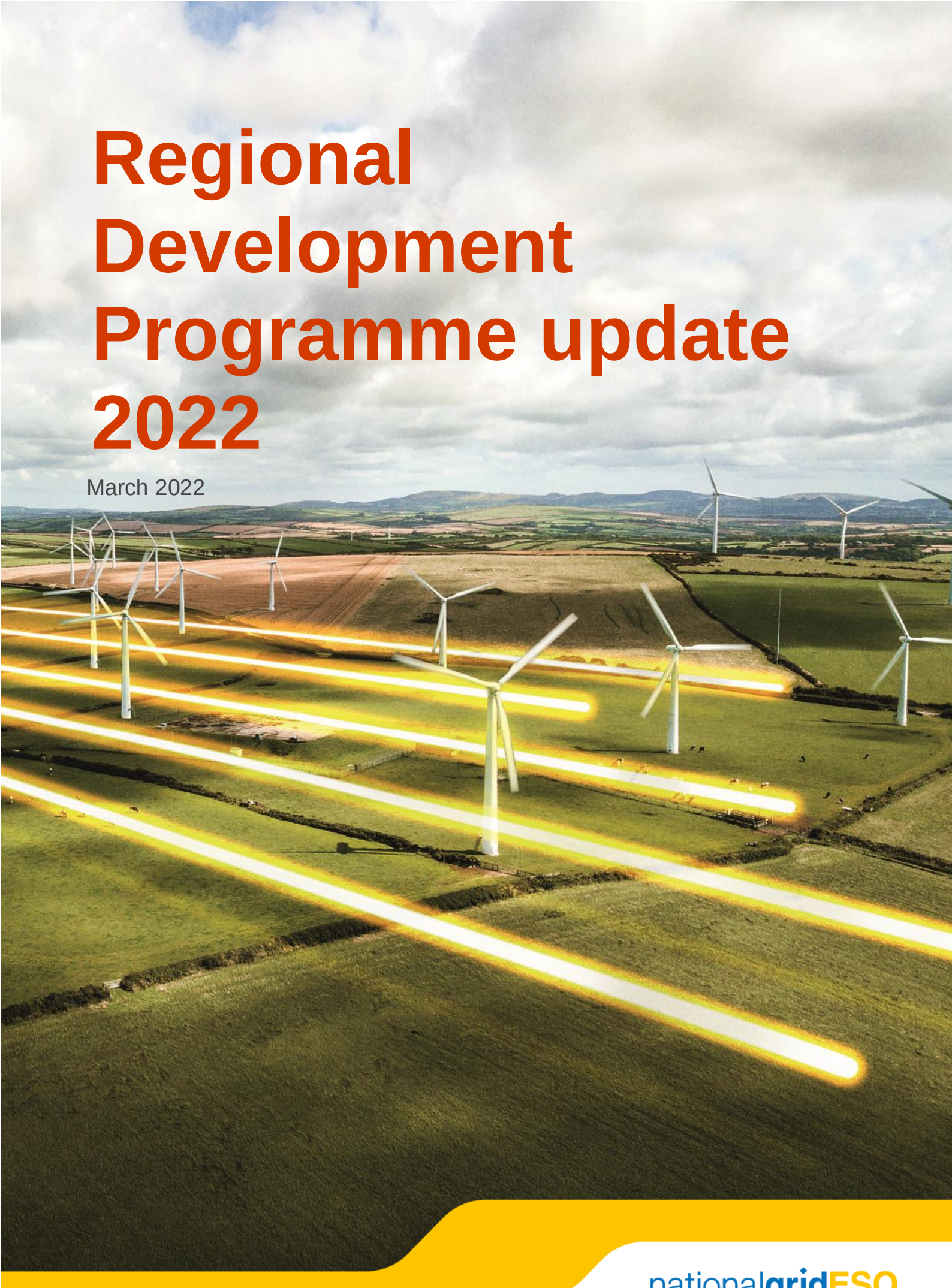
Regional Development Programme update 2022

March 2022



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Executive Summary

Regional Development Programmes (RDPs) were first introduced as a co-ordinated response to the challenge of connecting new distributed energy resource (DER). Working with local network organisations we have facilitated earlier connection of new DER at lower cost to the consumer.

With the drive to decarbonise the electricity system by 2035, and increased volumes of new connection applications, the need for RDPs has never been greater. In the last 12 months we have significantly expanded our RDP discussions with other network organisations and are now in active conversation with all GB DNOs and TOs to explore the feasibility of non-build alternatives that will get customers connected.

Our earlier projects are now in delivery. Building on the work of Open Networks, we have made significant progress in developing our MW dispatch local flexibility markets and held regional webinars with service providers. We are constructing high speed data links between our control centre and those of DSOs on the south coast and designing the detailed IT functionality in our first MW dispatch project in the south west.

We are also defining important learnings that will inform both the ESO more broadly and also the transition to DSO. Many of these are in the design phase of our work, but we are also understanding more about the functionality we will need in our future projects.

These learnings are also informing any broader roll out of functionality required. We have identified four key areas of functionality: connection and design of future RDPs, market design for co-ordinated DER markets, trialling GB primacy rule implementation, and enabling communication pathways. In the next 12 months we will build on this initial work, enhanced by further learnings, to build an overall roadmap of the broader roll out which will be implemented from April 2023.

Details of our specific projects can be found at the end of this report. For further details please see our website[1]. We welcome your views so if you have any specific feedback or questions for us, so please contact us at: box.WholeElectricitySystem@nationalgrideso.com.

[1] https://www.nationalgrideso.com/research-publications/regional-development-programmes

1. Introduction

The last decade has seen significant volumes of smaller generating technologies seeking connection to their local distribution networks. This trend is forecast to continue into the future with FES projections indicating that there may be over 60GW of DER connected by 2030[2].

Smaller generating units, whether solar, wind or even battery storage, can often connect more quickly than their transmission counterparts. This presents new challenges for the industry as required infrastructure build may lag behind generation connection timescales. Such challenges first manifested themselves in the south of England. In these regions, we had to work closely with the local Distribution Network Operators (DNOs), UKPN and WPD, to understand in more detail the relevant details of each other's networks and develop new methodologies that would help facilitate the connection of Distributed Energy Resource (DER). We discussed opportunities to connect parties via non-network solutions at lower cost to the consumer. It was from these discussions that the first Regional Development Programmes (RDPs) were borne and are in implementation.

As DER connections have continued to grow, the use of the RDP ethos has spread across GB and we have ensured that the learnings from the initial programmes have informed new challenges. We have a number of development discussions in progress across different areas of GB which are discussed in more detail within this report, along with the processes around their development.

RDPs are potentially multi-year undertakings. This paper provides an overview of our RDPs and an update of the work we have done, in collaboration with stakeholders, over the last twelve months.

[2] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021/documents

2. Regional Development Programme overview

A Regional Development Programme (RDP) is a project or study that looks at the complex interactions between distribution and transmission networks in areas with large (or potentially large) volumes of DER. This section provides an overview of our work on RDPs from initial development through to delivery in our control centre.

RDPs are designed to apply a whole electricity system lens and assess a variety of options to resolve specific network needs that can facilitate the connection of new DER. These projects are significantly enhancing transmission and distribution systems coordination and control which is key to enabling DSO. This will create efficiencies for the whole electricity system and provide new tools and resources to manage system constraints – ultimately reducing costs for customers.

Recognising the increasing maturity of DSO flexibility markets, RDPs are building on the work of the ENA Open Networks project. RDPs make sure standardised approaches are used wherever possible. In turn learnings from RDPs are fed back into the Open Networks project, shaping its work and facilitating wider roll out of best practice.

RDPs resolve issues in specific regional areas of the transmission system, often smaller than the granularity used in the NOA process. As such they are complementary to the ESO's NOA process ensuring that more local issues are resolved efficiently and facilitate the connection of DER.

In some cases, RDPs can be time limited, facilitating non-firm connections of DER ahead of transmission infrastructure build. In other cases the resolution of some RDPs will be through the development of regional constraint markets. Once delivered these solutions can be used to help resolve broader constraints through the provision of DER flexibility markets (i.e.RDP solutions can be used as a tool for initiatives such constraint management pathfinders and can help enable the deployment of additional tools such as the new Local Constraints Market[3] being developed by the ESO).

RDPs can be considered as a two-stage process:

- A development process consisting of issue verification and option development; and
- A delivery process where the detailed IT solution, tools and processes are developed and implemented. This process will be initiated where required.

Engaging with stakeholders

RDPs are collaborative programmes of work requiring frequent engagement with prospective service providers as well as DNO project partners and Transmission Owners on areas requiring their expertise. Supporting this are requirements for broader engagement, which ensure RDPs develop consistently across GB.

[3] https://www.nationalgrideso.com/local-constraint-market

Network organisation engagement

ENA Open Networks project

RDPs are closely connected to the ENA Open Networks project. This relationship works both ways with RDPs both informing Open Networks policy as well as utilising policies developed through Open Networks. Our RDP team are actively involved across the project including leading the development of primacy rules and representing the ESO on its transmission – distribution workstream.

Whole System Joint Forum

Established in 2020, this forum brings together all DSOs along with other network organisations. The ENA also attend to ensure co-ordination with Open Networks deliverables. The forum provides opportunity for DSOs to input into ESO projects affecting the DSO transition, and the RDPs have a standing item on the agenda. Through presentation and discussion on the steps we have taken in specific geographic areas we are able to ensure that solutions are sufficiently rounded that they can be used elsewhere in GB where appropriate.

DER provider engagement

Engagement with DER service providers is critical to the successful development and delivery of RDPs. For RDPs under development we have supported DNOs with communications and ongoing engagement with their customers. For RDPs in delivery, in 2021 we have jointly hosted 3 webinars with partner DNOs on our proposals for MW dispatch, ensuring that service arrangements work for providers and they are kept informed of our progress. As we conclude our IT development work, we will be further engaging with providers to keep them appraised of progress and begin to sign parties up for an initial roll-out of functionality.

RDPs and the ESO thermal constraint 5-point plan

In March 2021 we published a 5-point plan[4] for how we intended to manage network constraints in the years ahead. The elements in this plan included:

- Clearer forecasts for BSUoS costs
- Developing intertripping capability through our pathfinders
- Continuing to improve our existing network
- Exploiting storage potential in a heavily constrained network
- Working with regional networks on a whole-system approach

The whole-system aspect of our plan encompasses implementation of a Local Constraint Market (LCM) in the short term incorporating required functionality developed through RDPs in the longer term as a solution to rising thermal constraint costs. The LCM is a tactical solution specifically targeted at reducing constraint costs associated with managing the B6 Anglo-Scottish boundary. The LCM is looking to employ a third-party platform solution to be able to instruct, monitor and pay DER for providing a constraint management service. It is anticipated to be in place by the earliest of FY Q2 2023.

This type of solution, by its nature, is light touch in terms of BAU process integration to facilitate a quicker implementation time. In contrast, RDPs are being delivered in co-ordination with DNOs and seek to fully integrate any new tools / services developed through the RDP into all aspects of both ESO and the partner DNO's processes. This greater level of co-ordination was something that we highlighted was core to supporting the DSO transition in our 'Enabling the DSO transition' consultation5 last year and should be more sustainable in the longer term. The third party platform approach is something that we will look to explore as a dispatch solution for RDPs in future.

[4] https://www.nationalgrideso.com/news/our-5-point-plan-manage-constraints-system
[5] https://www.nationalgrideso.com/document/190271/download

3. ESO learnings from RDPs

RDPs have been established as 'design by doing' projects and are driving the development and implementation of a whole system philosophy. As such we are continuously learning from initial development work on RDPs through to final delivery of IT solutions into our Control Centre. This section highlights some of the lessons learnt over the last 12 months and how we are taking these forwards both internally and with stakeholders.

From a development perspective RDP are informing future whole system policies on:

- DER connection planning assumptions;
- Use of cost-benefit analysis;
- Development of non-build solutions; and
- RDP process steps.

These are explained further in the table below.

Function	Learnings	How we're taking forwards
DER construction planning assumptions	Increased volume and diversity of DER applications mean a greater value is placed upon more granular / accurate assumptions going into connection application studies undertaken by TOs. This should ensure that the most efficient solution is taken forward.	The ESO's Construction Planning Assumptions (CPA) for embedded connections are exploring: • Regional scaling factors based upon engineering knowledge of a region and prevailing technology types, including batteries • Monitoring the proportion of number of contracted projects that progress to completion • Diversity and relative volumes of technology types
Use of cost-benefit analysis	It is beneficial to ensure all required inputs are understood and requested from relevant parties before carrying out a CBA and that we apply a consistent approach.	• We have developed a standard approach to collating and documenting CBA inputs • Consistent and transparent use of CBA tools
Development of RDP solutions	Development of options can raise wider policy questions and challenge current methods which can take time to resolve.	• Be as transparent as possible about the issue and timelines to resolve – engage stakeholders on possible solutions to policy issues • Progress policy related activities in parallel within the project where possible • One specific policy issue that we are taking forward is whether and how DERMS can be employed at sites that are not solely used by one DNO.
RDP process steps	It can be difficult to know where to start and how to tackle a potentially very large problem, particularly when working across a number of organisations.	• We are now working to a more structured process as set out above which also provides more transparency to DNOs / customers on progress • Provides ability to standardise approach to different projects as much as it possible

From a delivery perspective RDPs are developing co-ordinated functionality with DSOs in four areas:

- Communications - establishing inter-control room communication (ICCP) links and providing real time visibility of DER
- Control - utilising the DSO's ANM and DERMs equipment to provide dispatch functionality to DER.
- Co-ordination - developing and implementing primacy rules for dispatch co-ordination.
- Contractual arrangements - building on the work of Open Networks to develop tri-partite framework agreements for transmission constraint management services.

Function	Learnings	How we're taking forwards
Communications	• Whilst overall IT system requirements can remain consistent, detailed specifications may need to differ between different DNO control centres. • There is value beyond the RDPs in installing ICCP links to DNO control centres.	• Earlier engagement with individual DNOs to understand their IT requirements. • Inclusion of ICCP functionality with other DNO control centres in our business plan proposals.
Control	• ESO control engineers and DER prefer consistent systems and processes that can be called upon in different regions. • We have learnt lessons regarding the infrastructure and security required to deploy web services. • Automation of data flows in the future will be required to enable full scalability.	• We are seeking to combine requirements for similar services to enable more consistent roll-out of functionality. • To improve resilience and security of our new data flows, we are considering alternative approaches to our enduring web services architecture. • We are building data flows and fields that can easily be migrated to a web service, when appropriate systems can support this.
Co-ordination	• We have identified the need to coordinate data sharing and decision making across various time horizons. • We have already identified areas where further improvements on data consistency could be made. • Work undertaken so far through delivery is helping to inform the requirements for new ESO platforms.	• Our initial deployment will trial a simple approach with a view to automating in future releases • We are deploying control room processes that actively consider Primacy Rules as part of core decision making. • More detailed consideration of DNO and DER needs in the ESO's new, strategic platforms.
Contractual arrangements	• Common contract development through the ENA has helped to ensure parties are familiar with the basis of the agreement • Service providers are value transparency and want clarity on the contractual process	• In the interests of transparency and efficiency of alignment of documentation, a trilateral approach has been adopted

4. Broader roll out of RDP functionality

As well as providing specific learnings RDPs as 'design by doing' activities are informing wider ESO and DSO processes and frameworks. These are broader learnings that we believe will inform and enhance existing ESO processes, making them appropriate to support DSO. Currently RDPs are informing four areas of functionality:

- **Connection and design of future RDPs** – embedding processes such as Appendix G and moving from a reactive process for RDP initiation to pro-active development
- **Market design for co-ordinated DER markets** –including the broader roll out of tri-partite contractual arrangements as well as leveraging experience of facilitating market access for DER connected to ANM and DERMS schemes. This also includes how we can widen market access to RDP markets through the use of third party platforms.
- **Trialling GB primacy rule implementation** – our MW dispatch programmes will implement the first IT functionality in GB utilising primacy rules.
- **Enabling communication pathways** – establishing the protocols and systems that facilitate greater visibility of DER.

These areas are described in greater detail below. In all four areas we will continue to develop our thinking over the next 12 months to develop an overall roadmap for broader roll out which will be implemented from April 2023.

Connection and design of future RDPs

Early elements of RDP design work have already been adopted in our Business as Usual (BAU) processes. This includes the 'Appendix G' process now established across GB and being formalised in code through the Connections Use of System Code (CUSC) modification process. Other elements of the RDP design process are still in development and earlier in the paper we highlighted learnings from our work on connection planning assumptions, cost benefit analysis and development of non-build options.

Further work is needed to bring these areas into mainstream industry connection and development processes. In part this is due to the specific nature of each RDP, where different challenges require different solutions. However, as we move forward we are finding increased areas of commonality. Over the next 12 months we will be working with others to produce a plan to embed RDP development activities into industry BAU processes. We believe we need to go further than simply embedding the current process which is reactive to specific connections by moving towards a more strategic view of future system needs.

We believe that a new ongoing process could be established within the ESO to routinely and proactively examine the data from DNOs to determine future need for new solutions or identify where to implement an existing RDP tool. These forecasts of future needs would be for each GSP (potentially similar to the WPD D-NOA) and would allow us to be more transparent with connecting customers as to what to expect when connecting in different areas.

In 2022/23 we will be working with stakeholders to further develop our thinking in this area, pulling in learnings from our current development RDPs. We would then be looking to roll out processes from the start of 2023/24.

Design of co-ordinated DER markets

Contractual arrangements

Through the MW dispatch projects we have worked with partner DNOs to develop the contractual frameworks which facilitate DER provision of transmission system services whilst also acknowledging the key roles of the DSO in both facilitating market access and ensuring operational co-ordination through primacy.

These tri-partite framework agreements, which build on and utilise the ENA Open Networks common framework agreement (WS1A P4), can then be used more broadly to provide clarity to contractual roles and responsibilities in the delivery of DER services for transmission system needs.

Use of DERMS to enable market participation

A number of Distributed Energy Resource Management Systems (DERMS) are being rolled out across DNO areas to manage local DNO constraints and / or to manage constraints at the Grid Supply Point (GSP) where such sites are classified as 'connection' sites. We believe that these schemes provide an opportunity to facilitate transmission-based MW dispatch market access for parties already connected to such schemes for the management of distribution constraints. This would result in larger, more liquid markets for managing local transmission constraint issues, whilst making use of existing infrastructure in a cost effective and coordinated manner. Wider roll out of RDP functionality could facilitate greater DER entry into constraint management services including from parties within current ANM zones, where these systems can be technically linked together to provide additional operational visibility and service coordination. It would also facilitate co-ordinated market access and the development of ESO-DSO co-ordination processes.

Utilising other routes to market

We are aware that the use of DNO infrastructure as a means of facilitating transmission constraint instructions does not work as a solution for all service providers. We received feedback through our MW dispatch work in the South of England that while it seemed pragmatic to employ DNO systems for the current projects, there should be a solution developed that does not solely rely on such systems for dispatch. We are therefore keen that while DERMS can provide low-cost solutions, we are looking to develop web-based means to dispatch services through the RDPs. Our Local Constraints Market[6] (LCM) is also looking at the use of third-party platforms as another alternative and all solutions should also be comparable with BM participants. This should ultimately result in higher numbers of service providers and more liquid markets including those within RDP areas.

Trialling GB primacy rule implementation

Our MW dispatch projects with WPD and UKPN will be the first programmes in GB to deliver operational systems and coordinated processes to begin to manage service conflict in control room timescales. Going forwards these systems will inform policy work on primacy rules within the ENA Open Networks project (WS1A P5), which in turn will lead to a greater roll out of the IT infrastructure needed to embed primacy rules between ESO and DSO control centres from 2023. Furthermore, the ESO will actively feed learning from these initial roll-outs into the design of our new IT platforms across a variety of our core processes.

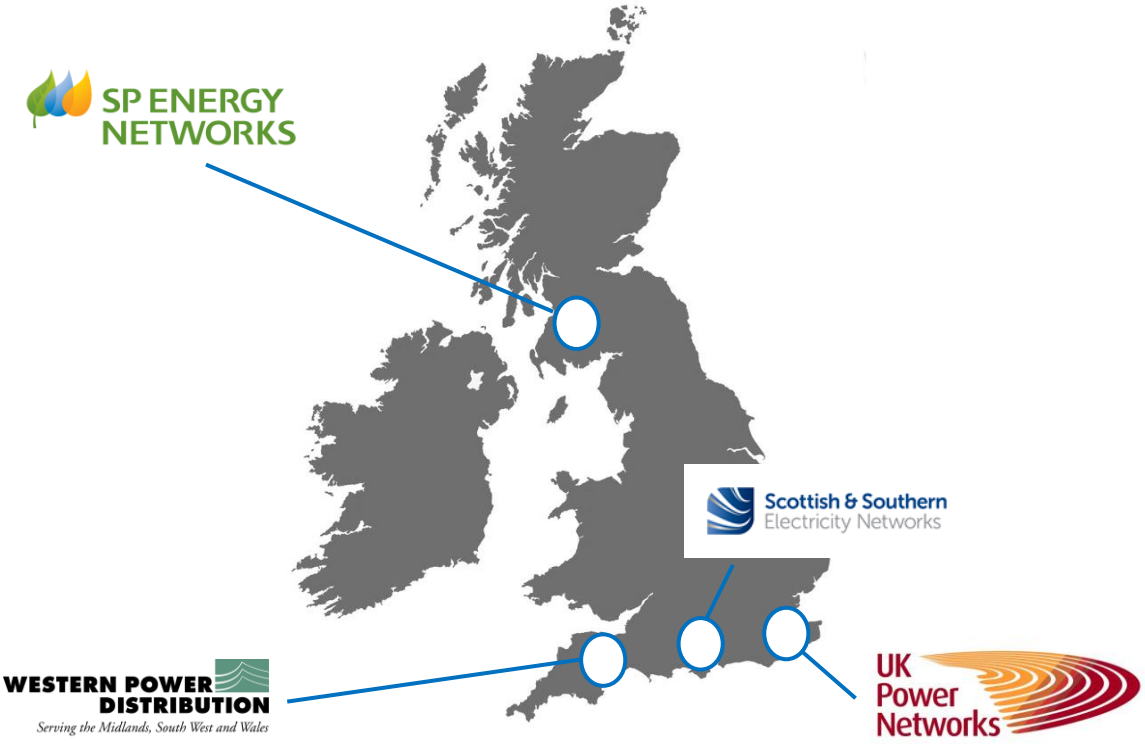
Enabling communication pathways

We will shortly be publishing a paper, 'Greater DER Operational Visibility', that discusses the ESO's need for greater visibility of DER and the benefits that this would bring for the ESO and therefore consumers. We have identified up to £150m per annum in consumer benefits from a national roll out of greater visibility. This includes the ability to more widely adopt an RDP approach to operability issues. Learnings from existing RDPs set a blueprint for establishing real time operational visibility into our control room operating systems allowing us to deliver a national roll-out more efficiently. A key step will be the installation of ICCP communication links to all DSO control centres which is something that is already underway.

[6] https://www.nationalgrideso.com/local-constraint-market

Annex 1 - Update on inflight RDPs

In this section we provide an update on the RDPs that are currently in delivery across GB. We have provided a progress chart for each project (current status is in light blue).



N-3 intertripping

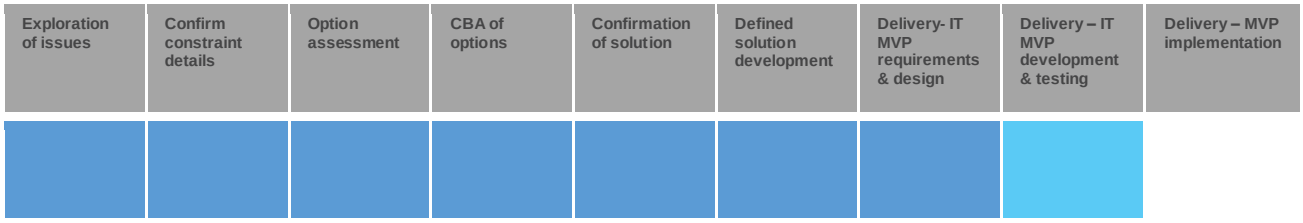
These projects are delivering DER intertripping functionality along the south coast of England. N-3 intertripping is used in the rare occasion when a double circuit transmission fault occurs during a planned network outage period. In such circumstances the N-3 intertripping works to quickly disconnect (or de-load) DER, removing any system overloads from the transmission network. The first stage of this work, with UKPN, is now complete and the operational system is live in our Control Centre. ESO works with WPD and SSE-N are now in delivery. The SSE-N work takes this basic functionality and develops it further, using ANM to reduce a distributed generator's output rather than provide a basic intertrip signal.

A critical element of the work is to install (ICCP) communication links with WPD and SSE-N control centres however, we have experienced some internal challenges with enabling works required to deliver the new ICCP links. We are working with our internal IT teams and external vendors to remedy this and we expect both of these rollouts to conclude later in 2022.

Exploration of issues	Confirm constraint details	Option assessment	CBA of options	Confirmation of solution	Defined solution development	Delivery- IT MVP requirements & design	Delivery – IT MVP development & testing	Delivery – MVP implementation

Generation Export Management Scheme (GEMS)

GEMS is delivering an automated dispatch capability for transmission and connected parties in South West Scotland. This will enable a series of nested thermal constraint boundaries to be managed autonomously, and in accordance with network capability. Throughout 2021, we have supported SPT with their procurement activities for the vendor of the core GEMS functionality, following the submission of the ESO Technical Specification. In addition, we have completed further internal work to refine some of the ESO-specific requirements in preparation for the joint design process with SPT and their chosen vendor. SPT have also advised the ESO that needs case for GEMS has moved out to June 2023 and have recently provided a revised plan. The procurement process has recently completed and the ESO is now commencing detailed design and development activities with the successful vendor, in conjunction with SPT.



MW dispatch programmes

Our MW dispatch programmes are developing new thermal constraint management service for DER, Host DNOs are key project partners in this work providing DER visibility and dispatch functionality. A further key aspect is the introduction of primacy rules embedding DSO co-ordination.

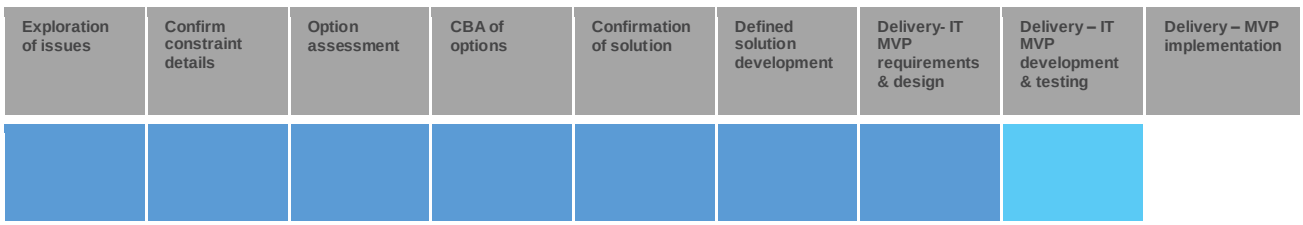
Specific updates are provided on our two in-delivery projects listed below.

RDP 1 – South West

Our MW dispatch project in the South West of England is facilitating the connection of additional 1900MW of DER to the region. This project, with WPD, has taken great strides forward in 2021 and is now well into delivery with service terms being defined and contractual structures being drafted between NGESO and WPD, we will be sharing more information on these with providers in the coming months. The overview of the project scope can be found in our published Project Initiation Document (PID).[7]

In addition, the project has now completed a large amount of the development work required to implement its dispatch functionality and we expect to see demonstrations of this shortly.

In conjunction with the IT development work, the delivery team have been working closely with a number of internal business teams and WPD to refine data flows and additional tools required to ensure the delivery of the Minimum Viable Product is successful across our end-to-end processes. As a result of this work, our detailed design document is nearing conclusion which will then enable a more detailed information pack to be shared with providers. We are also working through the implementation details for the sharing of some web services and are now starting to draft our internal and external testing strategy and associated plans. We will initially begin testing with test data but will then substitute this with live provider information as parties start to sign-up for the service.

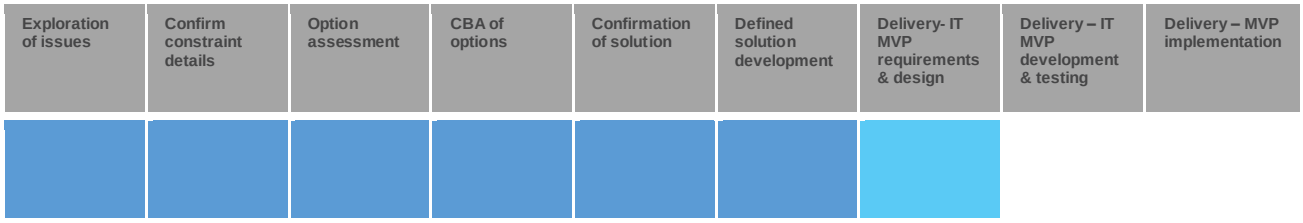


[7] https://www.nationalgrideso.com/document/224726/download

RDP 2 – South East

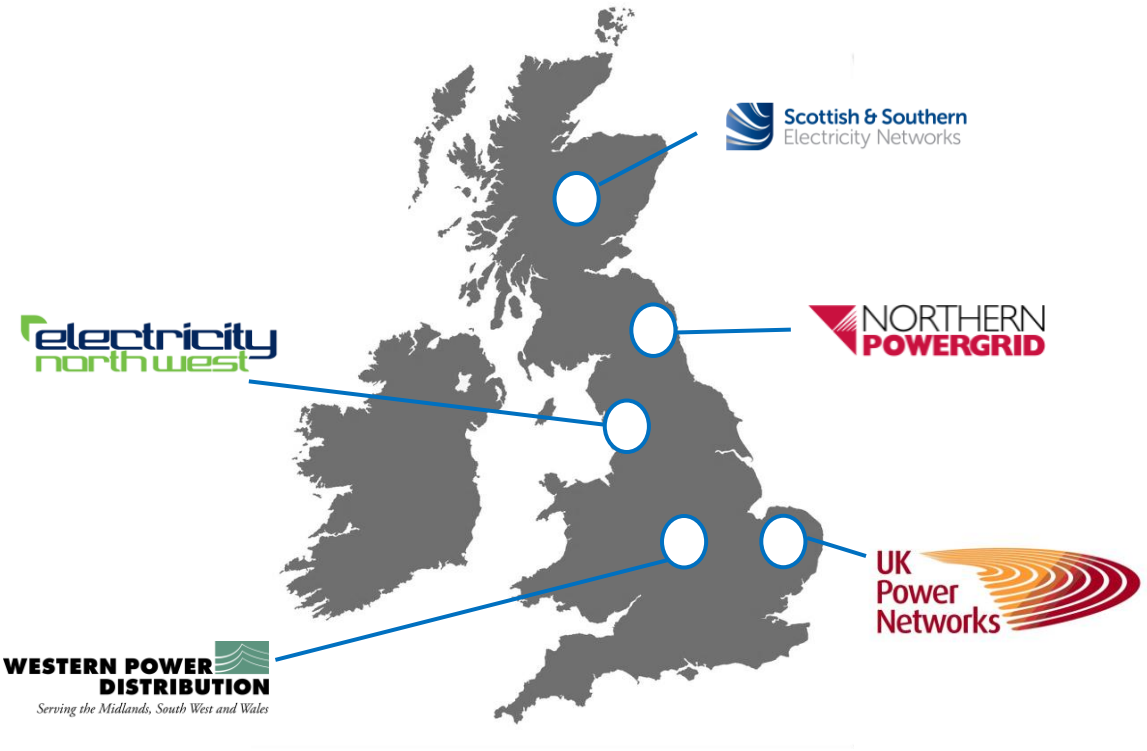
Our work with UKPN in the South East of England is facilitating the connection of an additional 1500MW of DER. In accordance with our Business Plan deliverables, we have focused on the refinement of the scope for our Minimum Viable Product, taking learning and experience form our work with WPD. We have held a number of joint meetings over the course of 2021 to refine the scope across each of the core project areas and UKPN are keen to build on their ambitious DSO strategy meaning that this work has yet to conclude. It is anticipated that we can utilise much of the work we've already developed in the south west however, we are now focusing our efforts on the scheduling and dispatch phases of the end-to-end process due to the additional complexities that the highly interconnected nature of the transmission and distribution networks create in this area.

Once these detailed discussions have concluded, we will capture these outputs in the Project Initiation Document and proceed to assess how any additional requirements from UKPN could be delivered, taking account of functionality already developed, scalability considerations and integration with ESO legacy systems (in such cases where new platforms are not yet fully available)..



Annex 2 - Developing RDPs in response to new network needs

In this section we provide an update on the RDPs that are currently in development across GB. We have provided a progress chart for each project (current status is in light blue). In addition to these projects, we are also having early discussions with WPD in the broader South West / South Wales region to understand which sites may benefit from examination through the RDP process.



Midlands Storage

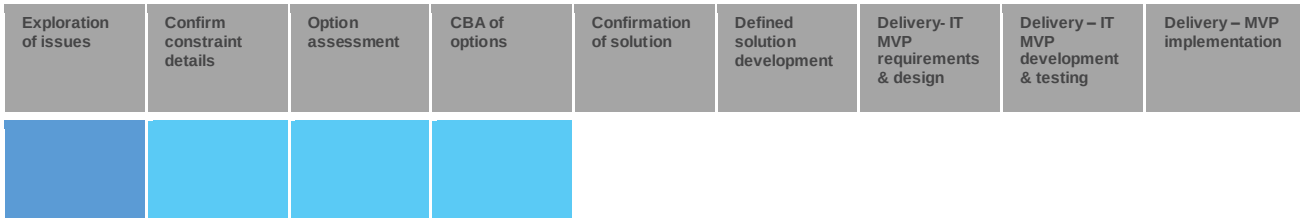
In late 2018, we started to work with WPD to explore options to manage the output of battery storage to avoid the need for further transmission investment at importing GSPs in the Midlands. When we produced our RIIO-2 Business Plan in December 2019, we committed to undertaking this project with WPD as our third RIIO-2 RDP. At that time, it was projected that volumes of battery storage would increase due to the closure of old plant and traditional industrial load on the DNO network in that region. However, the system need has not materialised as anticipated and therefore we have deferred this RDP to 2022/23. We propose to align delivery with one of the other project developments listed below in the interest of consumer value and to enable discussions to be taken forward on the broader South West / South Wales region. We believe that this will greatly reduce the burden and cost on our IT and business support functions whilst delivering the project when needed.

Exploration of issues	Confirm constraint details	Option assessment	CBA of options	Confirmation of solution	Defined solution development	Delivery- IT MVP requirements & design	Delivery – IT MVP development & testing	Delivery – MVP implementation

East Anglia

UKPN have received a large number of connection applications for new distributed energy resource to connect in the broader East Anglia area. This is a challenging area of the network with the TO, NGET, already working to deliver additional transmission infrastructure by 2028. Until then there are a variety of different operational constraints in the area depending on the generation mix which include voltage and stability.

Since Autumn 2021, we have been working with both UKPN and NGET to understand the limitations of the network and develop options to get parties connected ahead of 2028 wherever possible. This has included jointly hosting a number of DER webinars. We are also focussing on solutions related specifically to a growth in battery storage technology.

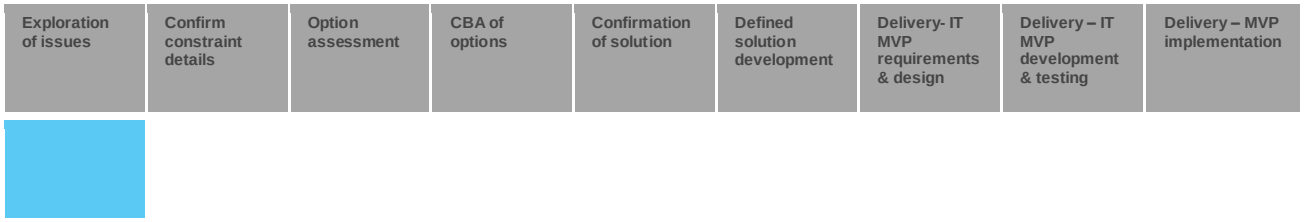


Heysham and Lancaster

Electricity North West (ENWL) have received a number of new applications for the connection of DER in the Heysham and Lancaster area, across a mix of technologies including energy storage. These will potentially connect into Heysham GSP which is a complex site effected by the proximity of a nearby nuclear power station as well as several contracted transmission-connecting offshore windfarms. We are working with NGET and ENWL to explore non-build/reduced build solutions for these DER projects.

North East

We have recently started to work with Northern PowerGrid in the north east of England to explore options to connect DER sooner than timescales identified to deliver additional transmission infrastructure, and have started to identify which GSPs may benefit most from an RDP solution.



North of Scotland

We are working with SSE-N in the north of Scotland to explore options to connect battery storage at two GSPs, Abernethy and Burghmuir, ahead of wider system asset replacement. These GSPs connect onto 132kV circuits that form part of the main interconnected transmission system. We will be working with the TO and DNO to conduct a whole system CBA to consider the appropriate option to progress.