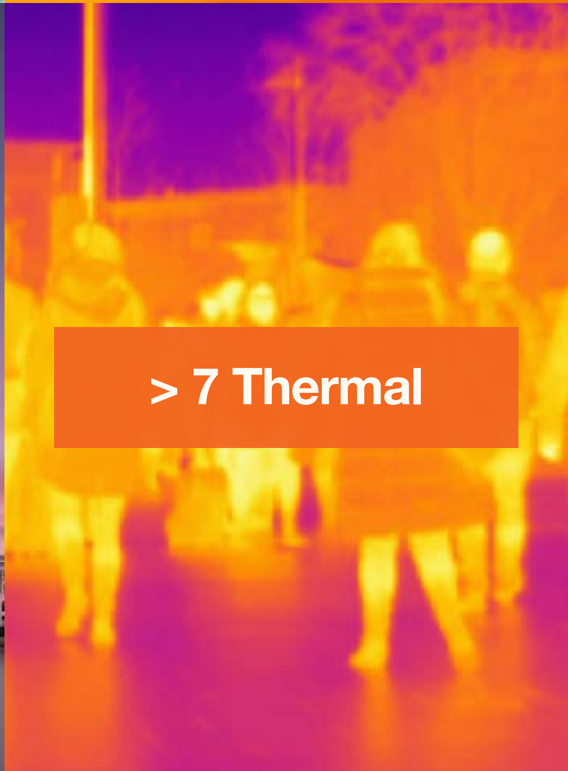
Operability Strategy Report

2019

December

Operability Strategy Report 2019

How to use this interactive document



1 Executive summary

Introduction
Executive summary

This Operability Strategy Report explains the future challenges we face in maintaining an operable electricity system and what we are doing about them. Framed by our zero carbon 2025 ambition, it explains how our work aligns with our 'operability milestones'. Opportunities for engagement are highlighted, as well as where to look for more information.

Decarbonisation, decentralisation and digitalisation are driving significant change across the electricity network. These changes are impacting how we operate the system now and into the future. We facilitate these changes while ensuring system operability in a way that delivers the biggest benefits to end consumers.

By 2025, we will have transformed the operation of Great Britain's electricity system and put in place innovative systems, products and services to ensure that the network is ready to handle zero carbon energy. This means a fundamental change in how our system is operated – integrating newer technologies right across the system – from large scale off-shore wind to domestic scale solar panels and increased demand side participation.

Our operability strategy ensures system operability while dealing with these future challenges. It will also enable us to deliver other benefits. It will improve safety and reliability of the network by ensuring it is secure in different scenarios. It will drive lower bills by changing the way we operate the network and seek out better solutions. It will minimise environmental damage while promoting overall societal benefits by reducing our reliance on services from carbon emitting sources.

The **frequency** chapter explains how we need new response services that can deliver quickly, dynamically and proportionally, and how significant changes to response and reserve markets and products are imminent.

The **voltage** chapter highlights how we are removing barriers for new providers to provide reactive services through Power Potential and the Pathfinders, and recent developments in our assessment of system need.

The **restoration** chapter explains how we are on the cusp of a new GB restoration standard which will drive new industry requirements. It also explains how innovation will facilitate vital new service providers and the continued growth of competitive procurement in this area.

We have delivered a world first with our recent tender for a **stability** service and we are looking to develop this further as we shift towards enabling zero carbon system operation. Our loss of mains change programme has generated considerable industry interest and we continue to engage with stakeholders on the development of industry codes relating to the specification for virtual synchronous machines.

We are working with industry to create new ways of managing **thermal** constraints by increasing the visibility and control of embedded units, and by exploring new post-fault constraint management services. This increases network capacity and benefits providers by increasing system access.

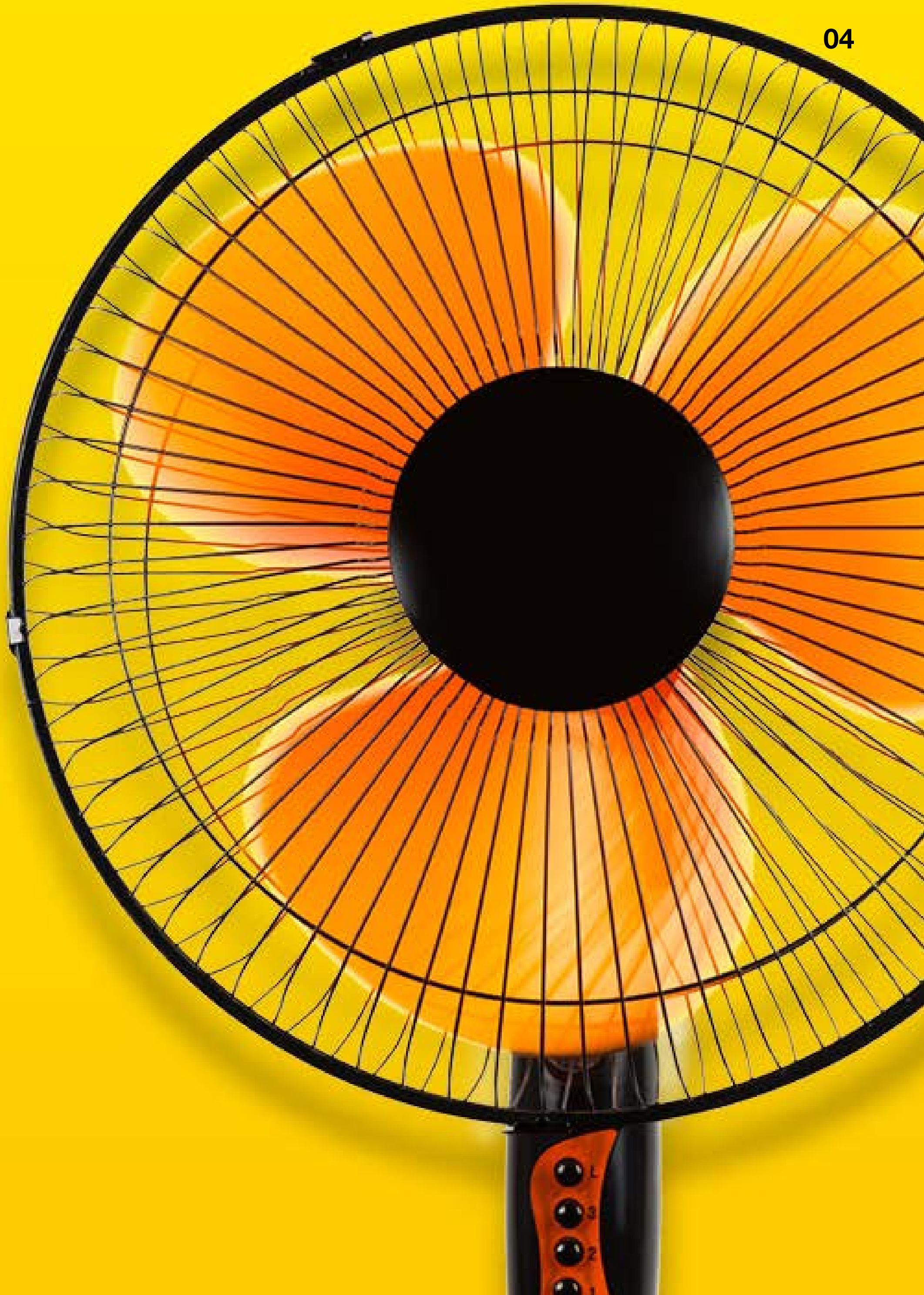
This is an ambitious strategy and is an important milestone to ensuring system operability while maximising benefits for end consumers.

Operability milestones

Executive summary

	2020	2021	2022	2023	2024	2025
Voltage	Reactive services from non traditional and embedded providers trial		Long-term contracts come online trial New reactive only providers (0 MW)	New market for reactive services		
Thermal	Post-fault constraint management services trial	Visibility and control of new distributed energy resources trial	Whole system optimal dispatch trial	Whole system visibility and control of new embedded connections		
Stability	Loss of Mains relay change programme	New stability only providers (0 MW)		Stability market launches paying new and existing providers Long term contracts from a range of providers trial		
Frequency	Faster acting post fault response and greater standardisation of reserves	New response products maintaining pre-fault frequency	Barriers removed for all technologies to provide response and reserve Full suite of new response products procured close to real time	Real time procurement and dispatch of response	Full suite of new reserve products procured close to real time	
Restoration	GB restoration standard and implementation	First embedded restoration providers come online	Services sourced through competitive procurement come online			Complete productionisation of Distributed ReStart project
Operational highlights	Increased efficiency of system operation on a low inertia system	First low demand periods where no extra generators are synced to provide response and/or voltage support	Increasing reduction in generators synced at periods of low demand	First low demand weekends with no additional generators synced	First full week during the summer with no additional machines synced	Extended periods of zero carbon operation

2 Stakeholder engagement



Key publications relating to this report

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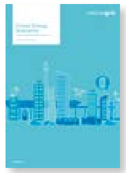
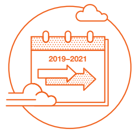


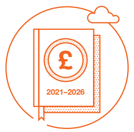
Future Energy Scenarios
July
A range of credible pathways for the future of energy from today to 2050. Scenarios are unconstrained by network issues.

The operability publications consider the unconstrained scenarios in *FES* to explore operability risks and associated requirements of the transmission networks and services.

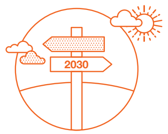
Future of the whole energy system



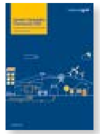
Our Towards 2030 document sets the scene with a high level long-term view of the energy landscape in 2050 and the whole energy system and its enablers for 2030.



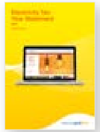
Our RIIO-2 Ambition is a consultation that sets out our ambition for the ESO and a first proposal of our activities for the next price control (from 2021 onwards).



Our 2019-21 ESO Forward Plan sets out our immediate steps until the start of RIIO-2 to achieve our ambitions as set out in the Towards 2030 document. It details our deliverables, performance metrics and how the outcomes we drive deliver consumer benefit.



System Operability Framework
How the changing energy landscape will impact the operability of the electricity system.



Electricity Ten Year Statement
Describes the likely future transmission requirements for bulk power transfers across the national transmission system over the next decade.

Publish the Operabilty Strategy Report and update every 6 months.

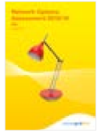
Operability Strategy Report
Details the challenges we face in maintaining an operable system, summarises the work we are doing to meet those challenges and highlights how stakeholders can get involved.

Each year we publish reports that explore future operational challenges.

Winter Review and Consultation
June
A review of last winter's forecasts versus actuals and an opportunity to share your views on the winter ahead.

Summer Outlook Report
April
Our view of the gas and electricity systems for the summer ahead.

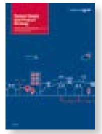
Winter Outlook Report
October
Our view of the gas and electricity systems for the winter ahead.



Network Options Assessment
January
Recommends investment options for the TOs which meet the requirements as set out in the *Electricity Ten Year Statement*.

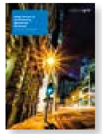
We also produce ad-hoc reports that develop shorter-term plans for more specific elements of the operational challenges, where the need arises.

Capacity Report
Capacity Market auctions for delivery in 2019/20 and 2022/23.



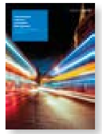
System Needs and Product Strategy
Our view of future electricity system needs and potential improvements to balancing services markets.

Product Roadmap for Restoration
Our plan to develop restoration products.

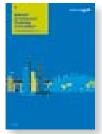


Wider Access to the Balancing Mechanism Roadmap
Our plan to widen access to the balancing mechanism.

Product Roadmap for Reactive Power
Our plan to develop reactive power products.



Transmission Thermal Constraints Management
Our plan for the management of thermal constraints.



Network Development Roadmap
Describes the direction of travel for the ESO's network planning activities over the next three years.

Opportunities to get involved
Stakeholder engagement

Frequency

- The second phase of our frequency response auction trial is in progress and we will soon be releasing details about the next stage on our **dedicated webpage**[1].
- We will engage with industry early in 2020 on the design of the new dynamic frequency response product suite and on the future of static frequency response in our portfolio of ancillary services. Details will be shared on our website and via industry forums. Stakeholders can also sign up to receive the latest updates **here**[2].
- We will soon consult on our plans to move some optional reserve services into the competitive fast reserve market. Details of the consultation will be published on our **website**[3].
- We expect that our current implementation of the **Wider Access**[4] to the balancing mechanism project, as well as the European-wide **Project TERRE**[5], will significantly change our requirements for reserve services, and we will therefore wait to observe the impact of these projects before consulting on the further reform of reserve services.

Voltage

- **Pathfinder learning**[6] – We will run industry workshops in Q4 2019/20, present our learnings and collate industry feedback on the Mersey tenders to inform how we design and shape the future of reactive power services.
- **Pennines long-term**[7] – We will be commencing the project in Q1 2020/21, seeking potential solutions to a high voltage need in the North and North-East of England.
- **Historic voltage costs –** We will be publishing the historic reactive power costs associated with solving voltage needs by voltage region for the past five years. We invite your feedback on the data once it is published in Q4 2019/20.

Restoration

- If you would like to register for updates on our Distributed Restart project you can sign up **here**[8].
- You can find updates on our competitive procurement events **here**[9].
- Further information on the Restoration Standard, and subsequent consultation opportunities, will be available once timescales for implementation are agreed.

Opportunities to get involved

Stakeholder engagement

Stability

- **Accelerated loss of mains change programme –** Relevant generators can now use the portal on the **ENA website**[10] to apply for payment for changing their loss of mains protection. This will become a compliance requirement by September 2022. Generator owners who can make the changes sooner can apply for payment.
- **Stability pathfinder next steps –** The tender process for phase one of the stability pathfinder will continue through to January 2020. The expressions of interest for phase two will commence in early 2020. If you can meet the technical requirements and would like to apply, you can find the latest information and subscribe to updates on the **Network Development Roadmap webpage**[11].
- **Virtual synchronous machines code modifications –** If you would like to help shape the code specification for virtual synchronous machines please participate in the **change modification process**[12].

Thermal

- **Constraint Management pathfinder –** We will shortly be publishing a **request for information**[13] seeking industry views on post-fault commercial solutions, with a specific focus on Scotland and Northern England boundaries.
- **NOA Methodology –** Following the use of a new probabilistic methodology in the ***Electricity Ten Year Statement***[14] studies, we are seeking industry views on the inclusion of this methodology in the *Network Options Assessment*.

System operability framework

Stakeholder engagement

What can I expect this year?

Throughout the year, we will be releasing our operability publications.

These will be published through our System Operability Framework.

How can I get involved?

We are keen to hear your comments and feedback on our approach to these operability challenges.

You can get in touch with us at **SOF@nationalgridESO.com**

All our past publications, plus the option to sign up to our mailing list can be found on our **webpage**[15].

Reports	Overview	When to expect
Past system events	Past system event data with commentary about the frequency operability challenges.	Completed
Virtual synchronous machines (VSM)	Update from the VSM Battery project work group including analysis and case studies of the benefits of VSM.	January 20
Operating a low inertia system	Explanation of the technical challenges associated with operating a low inertia system. We will outline the operability limitations and how we are managing them.	January 20
Herding behaviour of storage and EV	The operability impact of generation and demand responding to price and other signals.	January 20
Trends and insights	Commentary on the the operability impact of the latest FES scenarios.	February 20

3 Frequency

Key messages and opportunities

Frequency

Key messages

- We will split our new frequency response products between pre/post-fault to allow a more transparent assessment of procured volume against our operational requirements.
- Faster acting frequency response products are needed because system frequency is moving away from the target frequency more rapidly in low inertia situations.
- The objectives of our new frequency response services are described in terms of system needs relating to pre-fault and post-fault frequency.
- Our end state vision for frequency response includes transparent provision nearer to real-time, this can enable providers who can accurately forecast their capability at short lead times to participate.
- The same factors that impact our operability gap for response are also important when we assess our needs for reserve, such as declining inertia, increased loss sizes and increasing proportion of variable generation.
- The implementation of the replacement reserve (RR) product and the opening of the BM through Wider Access are two of the most significant developments in reserve and balancing in GB for several years.
- We remain committed to our principles of standardisation, simplification and rationalisation across all balancing and ancillary services. A future suite of reserve products would adhere to these principles.

Opportunities to get involved

- The second phase of our frequency response auction trial is in progress and we will soon be releasing details about the next stage on our **dedicated webpage**[1].
- We will engage with industry early in 2020 on the design of the new dynamic frequency response product suite and on the future of static frequency response in our portfolio of ancillary services. Details will be shared on our website and via industry forums. Stakeholders can also sign up to receive the latest updates **here**[2].
- We will soon consult on our plans to move some optional reserve services into the competitive fast reserve market. Details of the consultation will be published on our **website**[3].
- We expect that our current implementation of the **Wider Access**[4] to the balancing mechanism project, as well as the European-wide **Project TERRE**[5], will significantly change our requirements for reserve services, and we will therefore wait to observe the impact of these projects before consulting on the further reform of reserve services.

Response
Frequency

Figure 3.1

Response

Driven by the operability gap and informed by consultation with stakeholders, NGESO has signalled the need to review and reform frequency response services.

Our approach to closing the operability gap starts with a clear definition of system need, from which we derive service design principles. This section expands on three of the key considerations that influence our system need and service design principles for new frequency response products:

- Distinction between pre-fault and post-fault services.
- Operational need for faster acting services.
- Requirement for dynamic and proportional delivery.

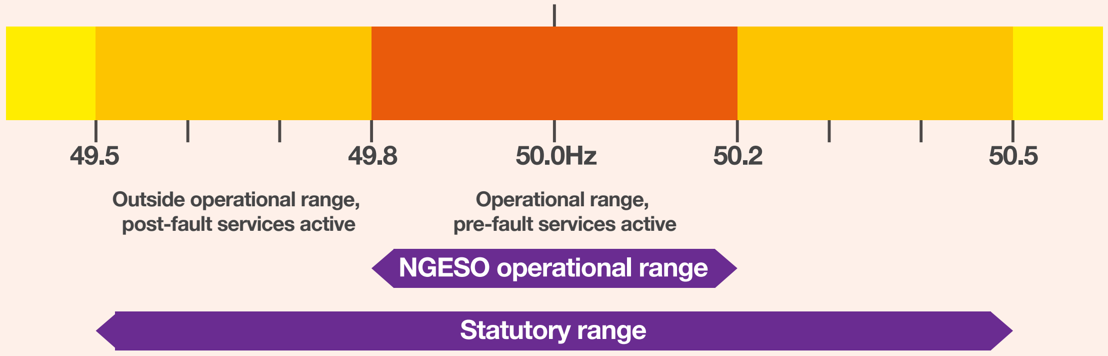
Pre-fault and post-fault services

Design of new frequency response services is informed by our needs 'pre-fault' and 'post-fault'.

- Pre-fault services manage frequency during times of normal operation, when frequency is in the 'operational range'.
- Post-fault services are required when frequency moves outside of the operational range, this can occur, as the name implies, because of a sudden fault such as the rapid loss of a large generator.

The existing dynamic frequency control services available to us are often required to manage both pre-fault and post-fault needs simultaneously. Static response services provide us with post-fault frequency management.

Figure 3.1
Pre and post-fault frequency



We have opted to split our new frequency response products between pre/post-fault to allow a more transparent assessment of procured volume against our operational requirements. For example, the volume of post-fault services we procure will have a direct and clear relationship to the scale of large losses that we need to secure. Pre-fault services can be optimised to deliver a predictable level of frequency quality. Also, by splitting pre/post-fault we enable our services to be more effective as they can be tailored precisely to the operational need, ultimately reducing cost to the end consumer.

Response

Frequency

Figure 3.2

Need for faster acting services

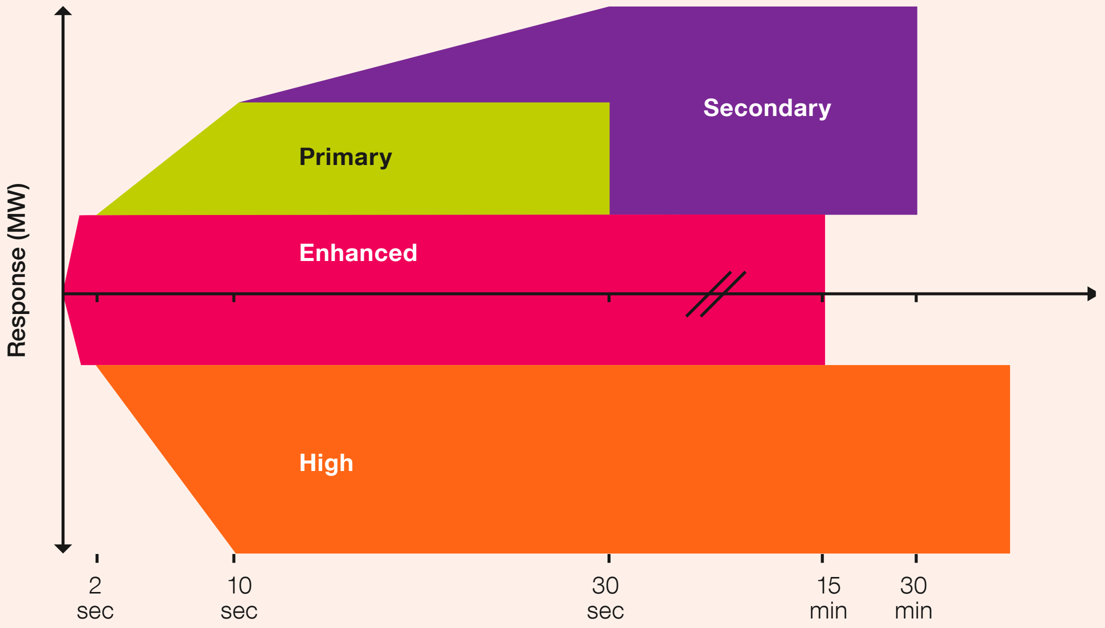
Faster acting frequency response products are needed because system frequency is moving away from 50Hz more rapidly as a consequence of imbalances. This is most evident in the rate of change of frequency (RoCoF). The relationship between the RoCoF and the size of imbalance and inertia is shown below:

$$\text{RoCoF}\left(\frac{\text{Hz}}{\text{s}}\right) = \frac{50}{2} \times \frac{\text{Imbalance (MW)}}{\text{Inertia (MVA.s)}}$$

- System inertia counteracts changes in frequency. It reduces the speed of frequency movements.
- This interaction occurs in steady-state as well as during a disturbance from a transient imbalance.
- The RoCoF is inversely proportional to system inertia.

The variables that can be controlled in this equation are the size of imbalance and the inertia.

Figure 3.2
Existing dynamic frequency response services



Response

Frequency

Managing a low inertia system will be a key element of our 2025 zero carbon ambition. The **Stability** chapter of this publication explains our expectations and plans for stability, including inertia. In simple terms, we know inertia will continue to decline as the penetration and proportion of non-synchronous generation increases.

We also know that the number of significant losses and their absolute size will increase over the years to 2025, as interconnection, new nuclear and large offshore wind generators connect to the system. However, an unfeasible amount of intervention would be required to manage these losses (i.e. reduce their size) to avoid an unacceptably high RoCoF.

The effect of these two variables, (decreasing) inertia and (increasing) imbalance size, equates to a high RoCoF and a high RoCoF has two significant consequences:

1. Above a threshold of 0.125 Hz/s some protection relays can trip, causing a loss of generation. If triggered by a loss of generation, this further loss can exacerbate the absolute change in frequency to an unacceptable level.

   Our accelerated loss of mains change programme (ALoMCP) is coordinating appropriate changes to these relays to reduce the volume of generation at risk, see the **Stability** section of this report for more details.

2. Operational, statutory and other frequency limits can be very quickly reached if the change is not arrested.

   From a starting point of 50Hz, a sustained RoCoF of 0.125Hz/s could reach the demand disconnection levels within ten seconds if not arrested.

When the existing frequency response services (e.g. primary, secondary and high) were specified our electricity system exhibited relatively high amounts of inertia (because of the generation mix, predominantly coal and gas) and correspondingly lower RoCoF and therefore it was reasonable for primary response to be fully delivered within ten seconds.

On the electricity system today, and for the reasons outlined above, frequency services that can respond more quickly are necessary to arrest the change before limits are exceeded. As our expected RoCoF increases, so must the speed at which frequency response services can deliver.

This work supports our operability milestone: Faster acting post fault response.

Response
Frequency

Requirement for dynamic and proportional delivery

All our frequency response services measure the frequency as their input signal and act automatically based on their settings. Services that continually monitor the input signal and change their action thus can be described as 'dynamic'. Services where the delivery is related to the difference between frequency and a set point can be described as 'proportional'.

Static frequency response services measure frequency and take a single pre-defined action when frequency reaches a 'trigger level' set point. For example, in the case of our 'low frequency static' service procured as part of an auction trial, the set-point is 49.6Hz at which point the service will deliver in full within one second.

The rapid speed at which static services can deliver a change in power is of benefit to operational security, especially considering the general increase in RoCoF, both experienced and forecast. The 'arming' of static services requires careful planning because their delivery is not dynamic or proportional. As ESO, we are tasked with securing a range of potential loss sizes on the system, both large and small losses can result in frequency reaching a 'trigger level' depending on the system conditions. Proactive planning steps ensure that whenever static services are activated the resulting delivery does not cause an overcorrection in frequency.

Designing new services

Soon, we will publish detailed design documents that describe the new services as well as further consultation with stakeholders and providers. The direction of travel for these designs has already been signalled in previous communications, see **Future of Frequency Response**[6], and **System needs and product strategy**[7]. The objectives and basic elements of these new services are outlined below:

Post-fault service

- The objective of this service is to contain frequency within statutory limits for a range of loss sizes.
- Delivery will only be required when frequency is outside of the operational range.
- The product will need to respond proportionally to deviation in frequency, to avoid the risk of overcorrections.
- Rapid delivery will be necessary to ensure that frequency can return to the operational range within the rules set out in our licence condition (the service must be fast).
- The expected delivery of this service will be infrequent as for the majority of the time the frequency will be within the operational range.

Pre-fault services

- The purpose of these services is to manage frequency whilst it is close to the target (e.g. 50Hz).
- These services will be active (delivering) when frequency is within the operational range.
- A continuously delivering but 'slow' service is suitable for managing general imbalance.
- A 'fast' but not continuous service is required to manage larger imbalances and demand/generation swings resulting from variable output of intermittent generation, rapidly ramping interconnection and rapid demand pick-ups.
- These services should fully deliver when frequency reaches the boundary of the operational range (past this point the post-fault service will be active).

Response
Frequency

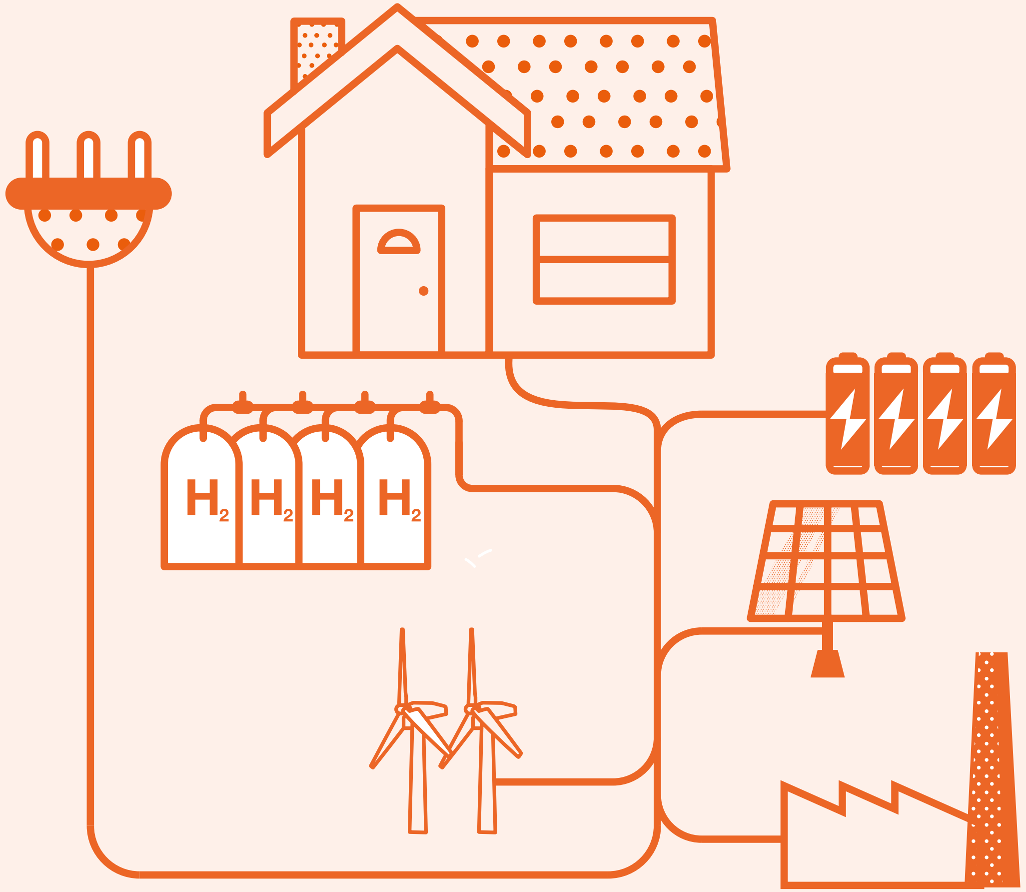
This work supports our operability milestones:

- **New response products maintaining pre-fault frequency.**
- **Full suite of new response products procured in short timescales delivering all frequency requirements.**

Buying new services

Our trial to procure frequency response services via an auction platform is already well established. The next milestone is the procurement of a standardised version of existing response services, more detailed information can be found on our **website**[8].

Our end state vision for frequency response includes transparent provision nearer to real-time, this can enable providers who can accurately forecast their capability at short lead times to participate. We will continue to develop the auction functionality in parallel to the new response products.



Reserve
Frequency

Figure 3.3

Reserve

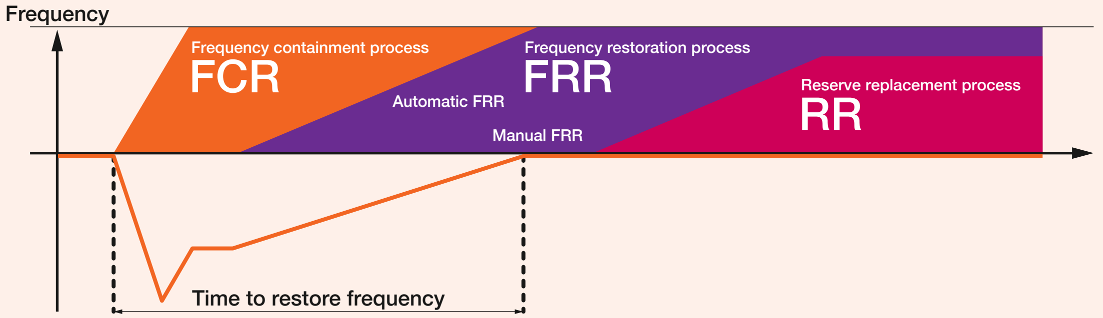
Response and reserve can both be described as the access to a change in delivered power, either up or down. While response is activated automatically using a measurement of frequency to determine its action, reserve is dispatched manually. This dispatch instruction is issued by an operator in the control room and can be reactive following an observed event on the system or proactive in anticipation of an imbalance or system need.

The same factors that impact our operability gap for response are also important when we assess our needs for reserve, such as declining inertia, increased loss sizes, increasing proportion of variable generation.

Response is activated automatically as a consequence of an imbalance; its aim is to arrest the change in frequency. Following this, the frequency must be restored to the target (e.g. 50.0Hz) and the imbalance corrected by the activation of reserve. The response service must be able to sustain for long enough before the reserve service can replace it.

The end-to-end process, using terminology defined in the energy balancing guideline (**EBGL**[9]) is shown above. For NGESO, the frequency containment process consists of our frequency response products (both dynamic and static). The balancing mechanism, fast reserve and STOR are key tools in the frequency restoration and reserve replacement process.

Figure 3.3
Frequency restoration process



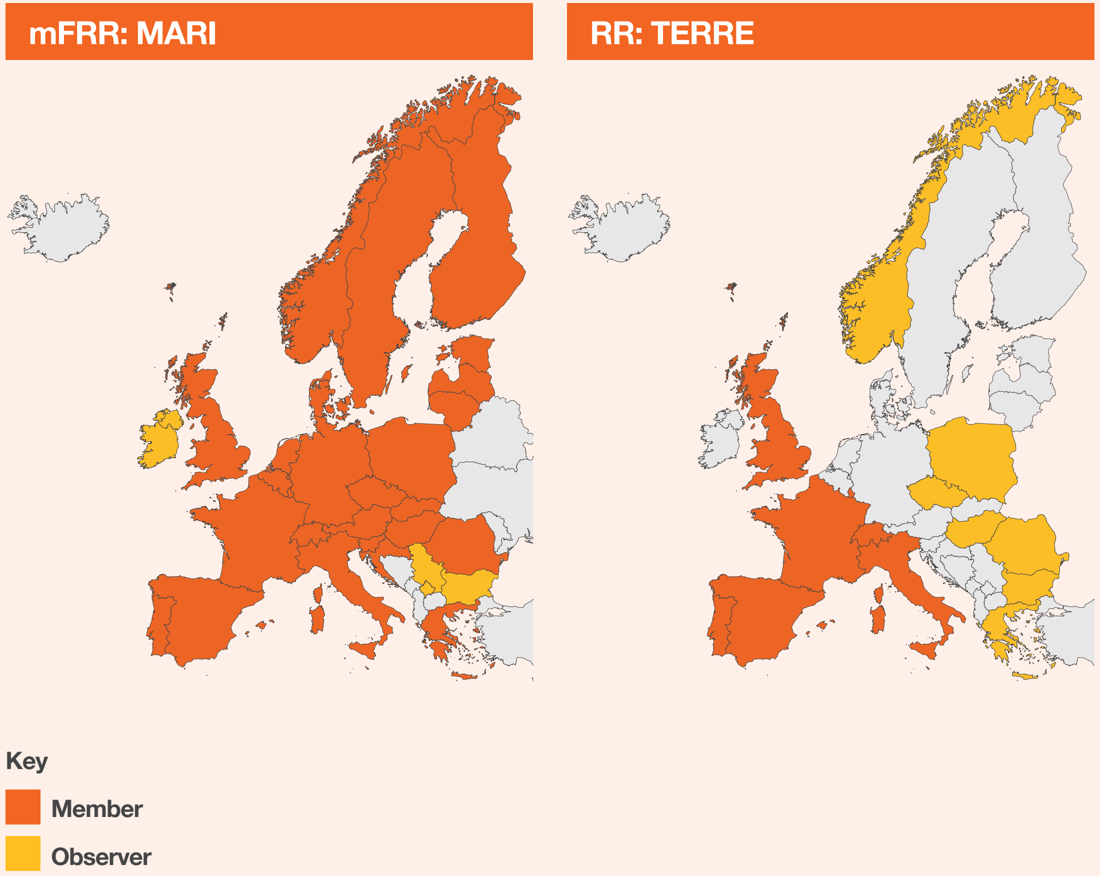
Reserve
Frequency

Figure 3.4

This process is replicated across European TSOs and has led to the creation of standardised products; manual frequency restoration reserve (mFRR) and replacement reserve both of which are more recognisable by their project acronyms **MARI**[10] (for mFRR) and **TERRE**[11] (for RR). These products can be delivered and shared across borders and between control zones, bringing benefits to consumers through increased competition plus a more efficient allocation of reserves between system operators. National Grid ESO is a member of both these projects and expects to deliver the necessary developments to enable go-live of the RR product in GB by the middle of 2020. Many of the changes required by TERRE have been delivered through the Wider Access to the BM project. Both of these initiatives will increase the range of reserve providers available to NGESO.

The regulatory framework requires that participating TSOs implement the mFRR service in their control areas by 30 months after approval of the implementation framework (IF). A decision on the IF is expected from the Agency for the Cooperation of Energy Regulators (ACER) in January 2020. The TSO participation in MARI is greater and more diverse than in TERRE, as shown in the figure below.

Figure 3.4
Cooperation on EU standard products[12]



Reserve

Frequency

The implementation of the RR product and the opening of the BM through Wider Access are two of the most significant developments in reserve and balancing in GB for several years. In addition, the obligations placed on European TSOs by EU regulation 2019/943 shall have an impact on procurement of reserves. Given the expected impact on operational activity and balancing markets, we will wait until after their deployment before committing to further developments in reserve services and products.

We remain committed to our principles of standardisation, simplification and rationalisation across all balancing and ancillary services. A future suite of reserve products would adhere to these principles.

This work supports our operability milestone: Full suite of new reserve products procured close to real time.

4 Voltage

Key messages and opportunities

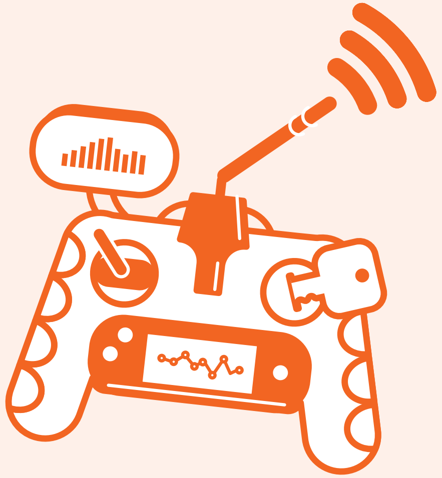
Voltage

Key messages

- We have completed our first tender and technical assessment to deliver reactive service availability from non-traditional and embedded sources in a test area in 2020.
- We have published our first **tender**[1] which aims to deliver long-term contracts with non-traditional and embedded sources in a test area from 2022.
- **Embedding voltage assessment into *Network Options Assessment* –** we will publish the results of our first horizon scanning in spring 2020.
- We are collaborating with the DNOs to gain greater access to distributed providers and understand the implications of these providers solving transmission issues.

Opportunities to get involved

- **Pathfinder learning**[2] – We will run industry workshops in Q4 2019/20, present our learnings and collate industry feedback on the Mersey tenders to inform how we design and shape the future of reactive power services.
- **Pennines long-term**[3] – We will be commencing the project in Q1 2020/21, seeking potential solutions to a high voltage need in the North and North-East of England. This will adopt learning from the Mersey 2022 tender process.
- **Historic voltage costs –** We will be publishing the historic reactive power costs associated with solving voltage needs by voltage region for the past five years. We invite your feedback on the data once it is published in Q4 2019/20.



We are collaborating with the DNOs to gain greater access to distributed providers

Identifying requirements

Voltage

In our previous report, we highlighted the challenges of managing voltage levels on a zero carbon network. Our approach to defining the requirement and seeking alternative solutions will take a two-pronged approach. We are first taking a 'learn by doing' approach to identifying alternative solutions through the pathfinder projects borne out of the *Network Options Assessment (NOA)*. We will then develop our long-term strategy for delivering a zero carbon solution to voltage management in 2025.

In our **Network Development Roadmap**[4], we outlined our ambition to apply a *NOA* type approach to regional voltage challenges on the transmission network. The process used to identify the Mersey and Pennines requirements shaped the proposed methodology, which is now being tested for the current Mersey 2022 pathfinder tender. The pathfinder projects for Mersey and Pennines have identified requirements for ensuring efficient management of system operability; and are testing the principle of commercial solutions against traditional regulated assets.

Following Ofgem approval of the proposed methodology, we are conducting the first screening process to identify and prioritise the voltage regions to take through to detailed power system studies. The process will involve working collaboratively with transmission and distribution owners to prioritise areas and confirm required timelines for seeking solutions. The process will include analysis of historic costs in the relevant regions, a review of the impact on these regions that Future Energy Scenarios and planned/potential network changes may have, and provision of our view on the likelihood of these events occurring in the future. Our aim is to progress the right regions at the right time. Greater detail of the process is available in the **methodology document**[5]. We will publish the results of our first screening process in spring 2020 and invite industry views on how we have prioritised the regional requirements.

The approved methodology initially contributes to delivering long-term contracts with embedded and non-traditional sources of reactive power in a test area and will then expand to deliver the approach across all voltage regions as required.

Identifying requirements
Voltage

Figure 4.1 – Top   Middle   Bottom

Voltage requirements vary by location, depending on system conditions. We have developed this set of standardised regions, which defines areas where there are typical operational requirements, to ensure consistent messaging to industry. The publication of historic voltage costs by region commitment made in the Forward Plan 2019/21 has been delayed; however, the data will be made available in Q4 2019/20 and will show historic costs for the regions shown in the graphic.

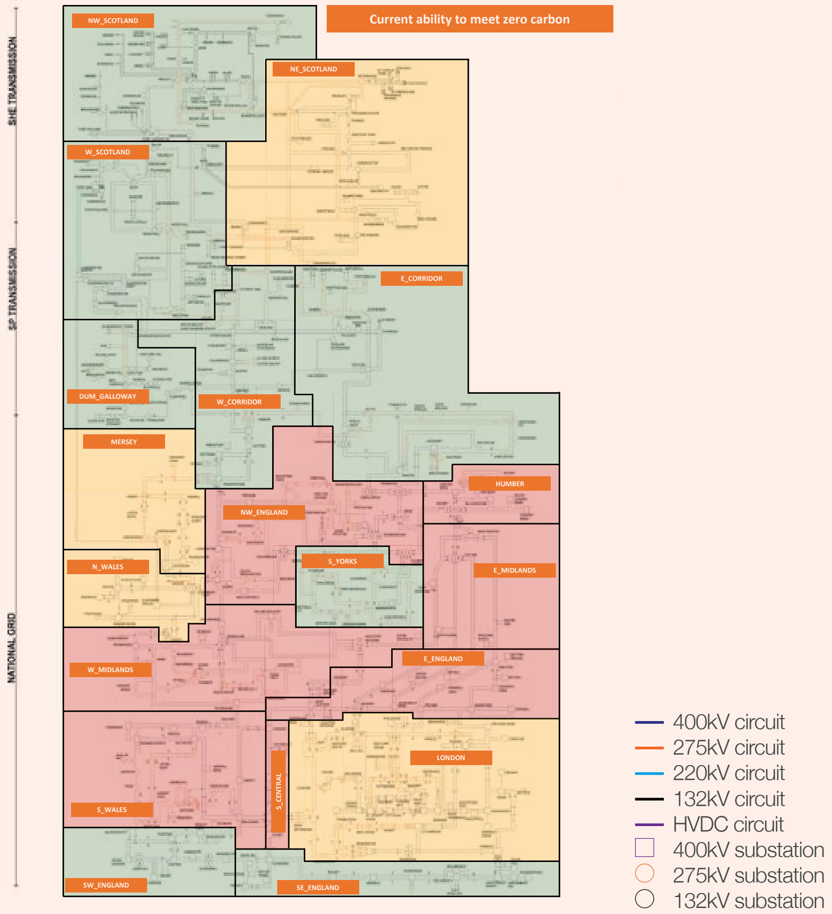
Initial work to identify voltage requirements for summer 2020 is almost complete; early indications show that tenders may be required to help meet these requirements:

- SW England in April 2020.
- E England in April and May 2020.
- W Midlands in July 2020.
- S Central in July 2020.
- S Wales in August 2020.

To ensure we can manage voltage levels at zero carbon by 2025, we need to identify which areas are most reliant on fossil fuel generation now and in the future. The graphic illustrates which of the voltage regions are largely able to be operated at zero carbon now.

Green represents regions which can largely be operated at zero carbon, amber represents regions which can be operated at zero carbon under certain **scenarios**, and red represents regions which cannot be operated at zero carbon.

Figure 4.1
GB existing transmission system



Identifying solutions
Voltage

Voltage management has traditionally involved regulated reactive compensation equipment and conventional generators. Moving to a zero carbon network requires the identification of alternative solutions to traditional thermal plant. Already we have sought reactive power services from providers who can operate at < 20 per cent of their maximum export limit (MEL); thus increasing the ability for variable generation to provide reactive power more often and for longer, and reducing the potential for any active power to create or exacerbate other system issues.

Elsewhere we are working with transmission and distribution network owners to investigate the challenges associated with reactive power transfers between high and low voltage networks. We have extracted historical transfer data for the network boundaries (also known as grid supply points – GSPs) and conducted international benchmarking. We are continuing to work with the DNOs to assess the effectiveness of all solutions.

Other alternative solutions could connect to, or be connected to, distribution networks. We are testing the concept of reactive power provision at distribution level to solve a transmission need through both the innovation funded **Power Potential**[6] project and a recent **tender in the Mersey region for 2020**[7].

Power Potential is a world first, looking to create a new reactive power market for dynamic voltage support to the transmission network from distributed energy resources (DER). It is currently preparing for wave one which trials the technical aspects of the service, network configurations and operating conditions. Wave one has experienced delays with the development and integration of the required systems between NGESO and UKPN.

Identifying solutions

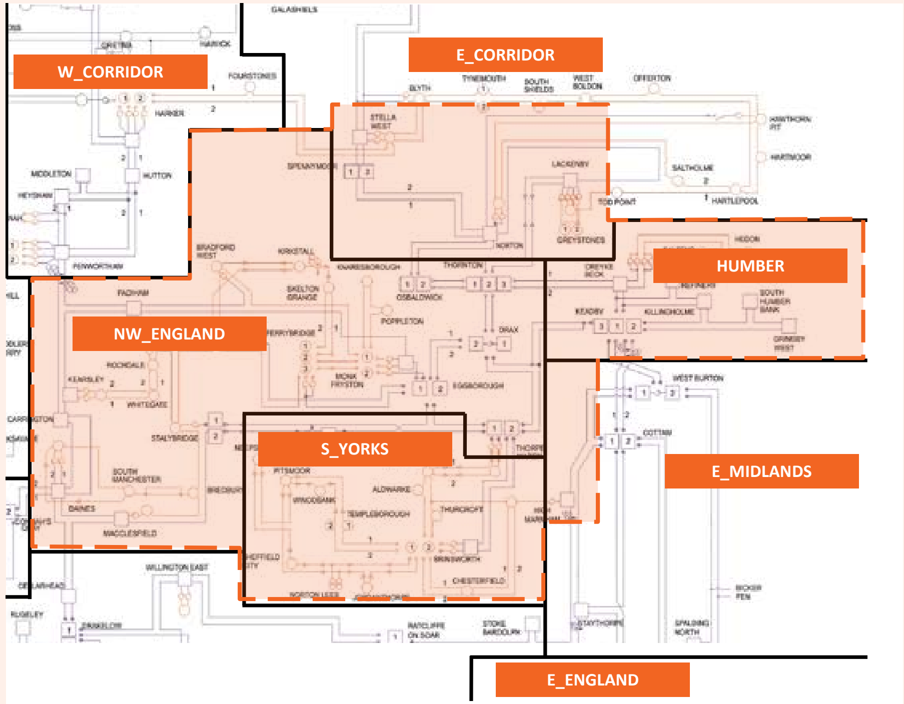
Voltage

The Mersey 2020 tender was to meet a requirement from April 2020 for 12 months. Adopting our 'learn by doing' approach, responses from the **Mersey pathfinder RFI**[8] and our ambition to operate a zero carbon network, we developed a reactive power service to enable distributed providers to participate in solving a transmission system need. We received 8 tenders (7 from new providers) and are currently conducting technical and economic assessments.

Whilst 4 embedded providers submitted tenders, during development of the service the DNO informed us that the nature of distribution network operation has tougher reactive power restrictions on the ability for providers to deliver flexible reactive power services. For example, providers were required to have an active power element in order to provide reactive power, yet at the same time providers in the Scotland enhanced service could operate at 0 MW.

Following the RFI for the Mersey pathfinder published earlier this year, we have taken the next steps in identifying alternative solutions to a regulated asset build by publishing a **tender**[9] on 25 November 2019. This tender is for a contract from April 2022 until April 2031. The pathfinder approach is helping us understand market appetite and alternative solutions for reactive power service provision. The tender was open to any connected or connecting provider at 33kV or higher and can provide reactive power absorption. The service is for 24/7 availability year-round for nine years and payment is on a £/settlement period availability basis. The learnings from this tender will inform the Pennines pathfinder project which is due to begin in Q1 2020/21.

We previously communicated that we would be running a request for information covering the Pennines region earlier this year. This has been delayed due to the challenges encountered with delivering the Mersey tender for 2020 and the pathfinder tender for 2022. We will be reengaging with industry in Q1 2020/21 for reactive power services in the Pennines region. The graphic represents the current definition for the Pennines region.



Wider areas

Voltage

We highlighted in our last report that we needed to develop our internal strategy and prioritise our deliverables so that we could appropriately consider the way forward for developing new reactive services and review the current market arrangements.

Our priority has been on developing a service that could meet a requirement from April 2020 and, following that, deliver the next steps for the pathfinder work.

Delivery of the Mersey tenders for 2020 and 2022 have provided the first set of learning points for further developing our thinking on the approach to review and reform reactive power services.

We will share this learning with industry in Q1 2020/21, and engage on ways forward in solving the significant hurdles to meeting voltage challenges on a whole system basis.

Our priority has been on developing a service that could meet a requirement from April 2020

5 Restoration

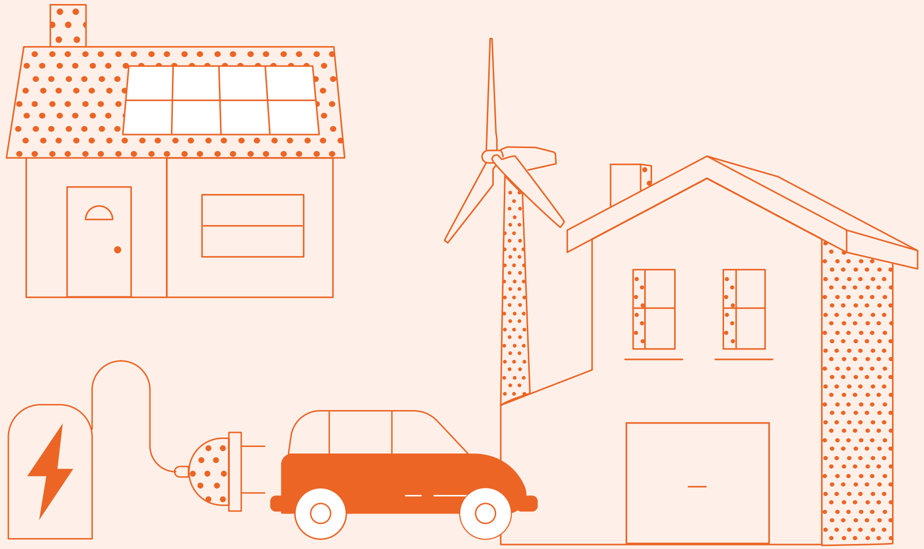
Key messages and opportunities
Restoration

Key messages

- The GB restoration standard will require the ESO to articulate and cascade requirements to the industry to enable a standard to be met by the electricity industry.
- We are driving forward innovation projects to find alternative approaches both to system restoration and identifying suitable procurement options for these opportunities.
- We have made significant progress towards procuring current restoration services via competitive procurement exercises.

Opportunities to get involved

- If you would like to register for updates on our Distributed Restart project you can sign up **here**[1].
- You can find updates on our competitive procurement events **here**[2].
- Further information on the restoration standard, and subsequent consultation opportunities, will be available once timescales for implementation are agreed.



Network code
Restoration

Network code for electricity emergency and restoration (NCER)

The NCER was devised and agreed following learning from the European blackout events in 2006. We are currently implementing this code into the UK electricity industry through changes to relevant GB plans and industry codes. The aim of this is to ensure GB has sufficient capabilities embedded within the electricity industry to perform a Black Start following electricity system shutdowns.

We published our System Restoration Plan in 2018 and this explains the way we would carry out a restoration for GB following the highly unlikely event of a total or partial shutdown. We've also used the plan to signpost the main requirements and obligations of NCER that apply to the industry and are making sure these are translated into the relevant codes. Through 2019, we've engaged with the industry and regulator to make sure we get it this document right.

Translating the NCER into Grid Code has been delivered via two specific Grid Code Changes (GC0125 & GC0128). Both are in final stages of the Grid Code change procedures.

- **GC0125 –** codifies the ability of interconnectors and HVDC systems (batteries and wind farms) to provide Black Start services to ESO.
- **GC0128 –** places additional obligation on battery storage and significant grid users required to implement parts of the System Restoration Plan.

During 2020, we will be looking to consult on our test plans and procedures, update resynchronisation procedures in SO/TO Code Procedures, and ensure further resilience across communications through an update to the Electrical Communications Standard.

The NCER was devised and agreed following learning from the European blackout events in 2006

GB restoration standard

Restoration

Over the past 3 years we've been working with industry, regulators and government to research and develop a GB restoration standard, which will specify required timescales for a restoration from a total shutdown for the country. Once agreed by the Secretary of State, Ofgem will carry out an industry consultation for a new licence obligation on us to implement the standard.

A successful restoration requires the whole industry to be aware and responsible for their part, and as such we'll look to cascade requirements for restoration through industry code updates and potentially using commercial solutions. We see this as an enhancement on the existing system restoration plan which will be amended to reflect these changes once in place.

Consultation on requirements and subsequent changes to be implemented will be undertaken in 2020, and a more detailed timescale provided when a standard is in place.

Once a restoration standard is in place, it is important that it can be monitored and measured. It will be measured using the probabilistic modelling tool we have developed with inputs validated by the Electricity Task Group and industry forum discussions.

Subject to the specifics of the new licence condition, it is likely that the monitoring framework will become an additional document alongside our current Black Start strategy and procurement methodology. This assurance framework is currently being developed and trialled with a small industry review panel.

Over the final quarter of this year, ESO will be working closely with Ofgem and BEIS to further develop the required processes and documentation in order to support a restoration standard. This will enable us to move quickly to implementation of a standard, and to articulate the requirements for other industry parties to be met.

This work links with our milestone to implement a new restoration standard.

Innovation
Restoration

Figure 5.1

System restoration is one of the pillars of our innovation strategy. We have recently completed an innovation project looking at Black Start from alternative technologies and we are moving forward with our innovation project to look at how distributed energy resources can support restoration.

Black Start from alternative technologies

The Black Start from alternative technology innovation project concluded in June with the publication of three reports outlining the findings.

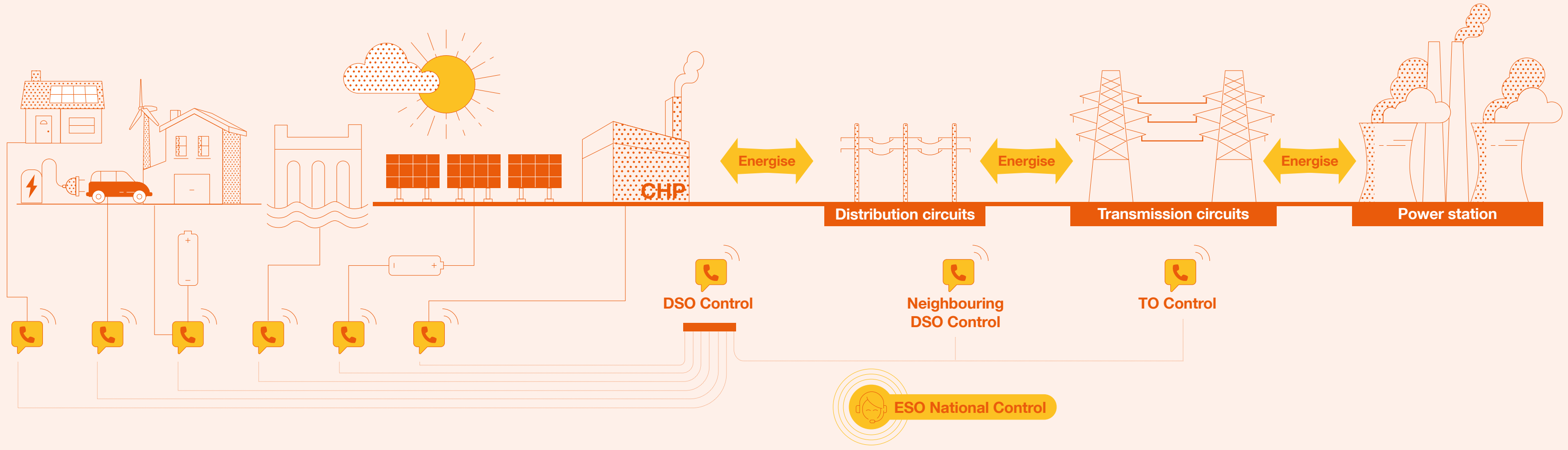
- **Report 1:** Overview of the capability of non-traditional technologies to provide Black Start and restoration services;
- **Report 2:** Investigation of the challenges around power system strength and stability, specifically in relation to power islands with high penetrations of renewables and converter-based technology; and
- **Report 3:** A sophisticated planning tool specifically designed to simulate distributions for the reliable output of wind over periods of hours to days, and how these distributions vary on timescales of months and years.

We're using the learnings from this project, and the three reports, to support the consideration of alternative technologies in our Black Start procurement activities. We're also using findings from the Distributed Restart project to inform the progress of both telecommunications and procurement workstreams.

Distributed ReStart[3]

This project is exploring how distributed energy resources can be used to support restoration. This will involve collaboration across the system as illustrated in figure 5.1.

Figure 5.1
Distributed ReStart



Innovation
Restoration

Distributed ReStart

In June, we published our first bi-annual progress report and in July we published our report on the viability of restoration from DER. A key finding, as presented in that report, is that there are no insurmountable power engineering challenges yet identified which would act as blockers to Black Start from DER. Key issues are highlighted but are not considered prohibitive to project continuation.

In November, we published a further two reports: an ‘Organisations, Systems and Telecommunications’ viability report; and a ‘Procurement and Compliance: Functional Requirements’ report, both represent key milestones in the options phase of our project. These reports will be followed by our second bi-annual progress report in December 2019.

As we move into 2020, we will continue our analysis and refine our options in preparation for further industry consultation and testing of proposals.

This work links with our milestone to have restoration services from embedded providers.

> 1 Executive summary
> 2 Stakeholder engagement
> 3 Frequency
> 4 Voltage
> 5 Restoration
> 6 Stability
> 7 Thermal
> 8 Index of links

Competitive procurement

Restoration

Figure 5.2 Figure 5.3

We are currently running two competitive procurement events to deliver the services we require for restoration in different regions. Feedback for this approach has been positive and we have received a number of submissions from varying provider technologies, as can be seen in the results from both expression of interest submissions (figures 5.2 and 5.3).

You can find the details of the events **here**[4].

- **South West and Midlands –** Our competitive procurement exercise in the South West and Midlands is now at the detailed feasibility stage. Final service offers will be provided by the end of April 2020. Following assessment, any contracts will be awarded in July 2020.
- **North East, North West and Scotland –** The expression of interest stage of this exercise closed on 15 October and we will invite those who meet our criteria to participate in the tender process starting in November.

We have adopted a continuous improvement approach with the development of the competitive procurement events, and learnings from the initial South West and Midlands event have been implemented for the North East, North West and Scotland event. This includes publishing received queries and offering webinar sessions to potential providers.

We will continue to improve the competitive procurement events as we gain more experience of individual stages and will be sharing details of additional opportunities for service requirements in 2020.

Figure 5.2
South West & Midlands – submissions eligible for Invitation to Tender (ITT) two

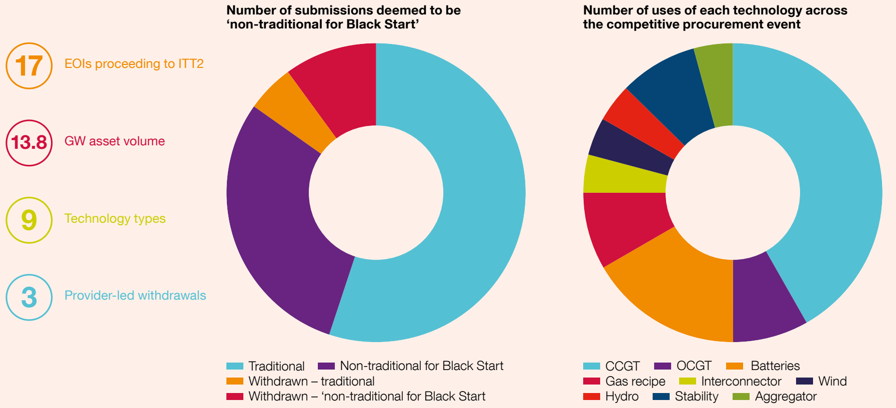
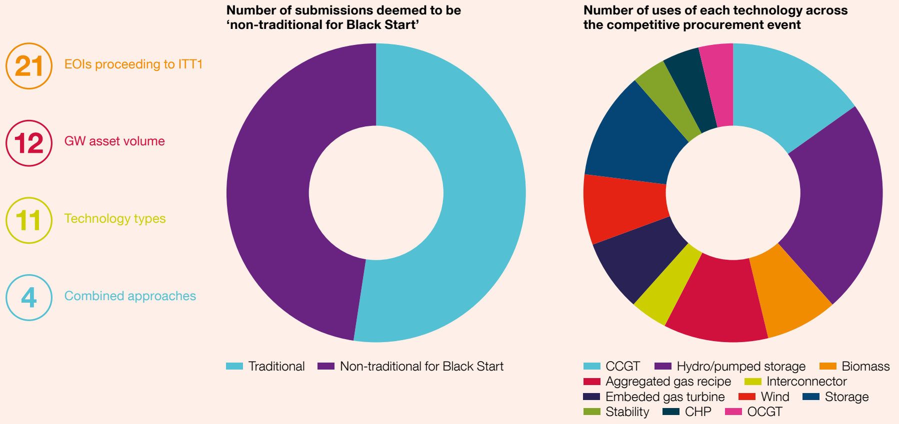


Figure 5.3
North East, North West & Scotland – submissions eligible for Invitation to Tender (ITT) one



6 Stability

Key messages and opportunities

Stability

Key messages

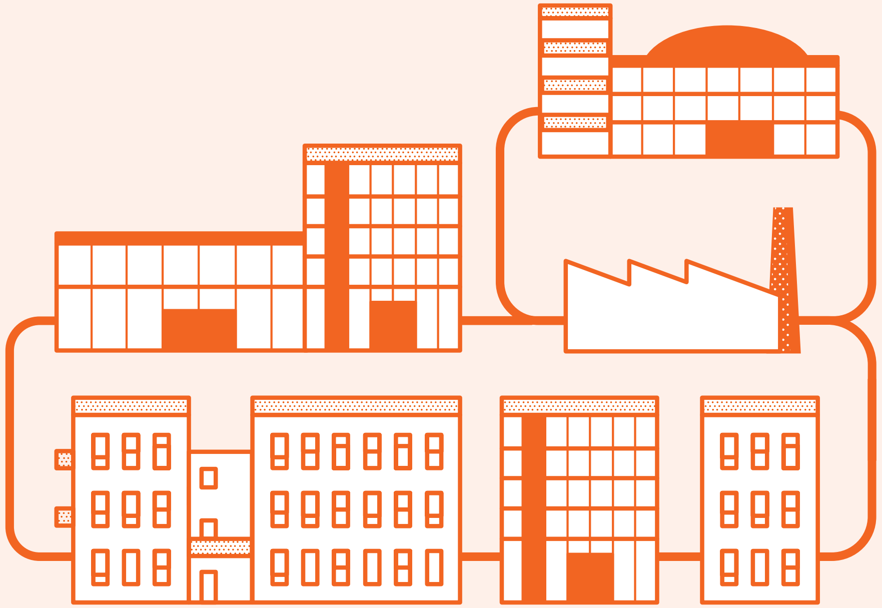
- The accelerated loss of mains protection change programme has gone live.
- Following our stability pathfinder request for information we have set out our plan to run procurement exercises.
- Proposals for a specification for virtual synchronous machines (VSM) are now progressing into the code modification process and will be developed as a non-mandatory requirement.

Opportunities to get involved

Accelerated loss of mains change programme – Relevant generators can now use the portal on the **ENA website**[1] to apply for payment for changing their loss This will become a compliance requirement by September 2022. Generator owners who can make the changes sooner can apply for payment.

Stability pathfinder next steps – The tender process for phase one of the stability pathfinder will continue through to January 2020. The expressions of interest for phase two will commence in early 2020. If you can meet the technical requirements and would like to apply, you can find the latest information and subscribe to updates on the **network development roadmap webpage**[2].

Virtual synchronous machines code modifications – If you would like to help shape the code specification for virtual synchronous machines, please participate in the **change modification process**[3].



Loss of mains protection relays

Stability

Accelerated loss of mains change programme

Reducing the number of generators with inappropriate loss of mains protection settings will reduce the volume of generation at risk of disconnecting in response to a large loss (and subsequent high rate of change of frequency) or electrical fault (and subsequent vector-shift) on the system. This change will alleviate the RoCoF and vector shift constraints, which are now the dominant factor when managing system inertia, and reduce the cost of balancing the system. This will also allow us to operate the system with lower levels of inertia which is a key step to enable operation with zero carbon in 2025.

We have been working closely with the distribution licensees to deliver a payment programme to accelerate loss of mains protection changes. The distribution code modification was approved by Ofgem in August and a portal for asset owners to apply for payment to make changes to their loss of mains protection settings earlier than the compliance deadline went live at the start of October. The first set of applications will be assessed during December.

The data we receive through this process will help us gain more information about the size of the risk of loss of mains protection tripping. Firstly, we will gain more information about the volume of generation at different RoCoF trigger levels and vector shift settings and secondly, we will know when each generator has changed their protection.

This data will be used to inform the actions we take in the control room and ultimately result in a reduction in actions and cost required to manage this constraint.

Once we have removed loss of mains relays as the key factor limiting the rate of change of frequency we can allow on the system, faster frequency response services will become key to containing frequency. Rather than speed of change (RoCoF), it will be the absolute change that becomes the constraining factor. Faster response services will be required to arrest the change before frequency limits are reached.

See the Frequency section of this report for more detail on how this system need influences our service design principles.

This programme supports the delivery of our milestones to change loss of mains relays and broaden the operating envelope.

Operational policy

Stability

We continuously review our operational policy to look at the balance of cost and risk of the actions we take. The power outage on 9 August this year, was only the third trip since 2008 where the rate of change of frequency has exceeded 0.125Hz/s. This event has given us additional real-life data to demonstrate how generation responds to a large loss of generation on the system. During the event, 500MW of embedded generation disconnected from the system following suspected triggering of their loss of mains relays. The volume disconnected was lower than we had forecast.

One likely reason for this is that the loss of mains settings at some sites may be less sensitive than we have assumed. We currently assume that generation will disconnect from the system when the rate of change of frequency is greater than 0.125Hz/s. The maximum rate of change of frequency measured during the loss on 9 August was 0.18Hz/s. This would mean that generators with protection set at 0.125 Hz/s would have been disconnected, but generators with protection set at or above 0.2Hz/s would not have disconnected.

The information we gather from the accelerated loss of mains change programme will tell us the current settings of the generators and enable us to better forecast the volume of generation at risk of disconnecting at different RoCoF trigger levels. This in turn will enable us to update our operational policy and maintain the same high standard of security at lower cost.

Inertia monitoring
Stability

We have signed contracts with both GE and Reactive Technologies to provide real-time inertia monitoring of the GB system inertia. We are the first System Operator to adopt either of these systems as both are first of their kind systems that will measures the combined inertia-like effects of conventional synchronous generation, power-electronic converted generation (such as wind and solar) and passive load responses. Deploying an accurate inertia measurement application is critical in our plans to manage the system frequency in the future.

The GE system is non-intrusive, continuously monitoring boundary activity and using machine learning to forecast the inertia up to 24 hours ahead. The Reactive Technologies solution includes one of the world's largest ultracapacitors which will be used to 'inject power' into the grid, while Reactive Technologies' measurement units directly measure the response, enabling the full system inertia to be established.

These approaches will be built and tested during 2019/20. Once there is sufficient confidence in the output of the measurement, the data will be used to inform our operational policy. By 2020/21, we aim to implement a first of a kind system to measure system inertia in real-time and use it to optimise real-time operation, service procurement and network development.

These projects support our milestones to develop markets for stability and faster response products by improving our understanding of the requirement close to real-time.

Accessing stability solutions

Stability

Currently, our main route to access any additional stability capability we require on the system is to instruct out of merit synchronous generation to run via payments through the balancing mechanism. We are developing approaches which aim to access stability capability in a more economic and sustainable way.

The network development roadmap is looking at including a wider range of requirements and solutions in our *Network Options Assessment (NOA)* methodology. One of the requirements we are investigating is stability, including inertia, short circuit level and dynamic voltage support. We are using pathfinder projects to enable us to learn how we can include requirements in NOA and consider network and market solutions.

In August, we published a request for information outlining our requirement for stability and requesting feedback on our proposals and what solutions might be possible. We received 28 responses. A summary of the responses has been published online alongside our next steps to take forward two initial procurement exercises – stability pathfinder phase one and phase two. These publications can be found on the **network development roadmap webpage**[4].

Stability pathfinder phase one is delivering our first tender for a stability service. The initial tender is a short procurement exercise looking to see if any economic solutions can be delivered quickly across GB. This is an important first step in finding solutions to a range of technical challenges identified through the System Operability Framework.

The next step will be stability pathfinder phase two which will allow a longer tender process to support new technology types participating. Phase two is seeking to fulfil a specific locational requirement in Scotland, we will expand this approach to other areas of the network based on our prioritised view of requirements. This pathfinding process is informing the updates we make to the NOA methodology and we will be including stability in the methodology developed during 2020/21 to ensure an enduring approach for procuring solutions is delivered. This will also enable us to review our requirements for stability alongside our requirements for voltage and identify areas where we may consider combining requirements.

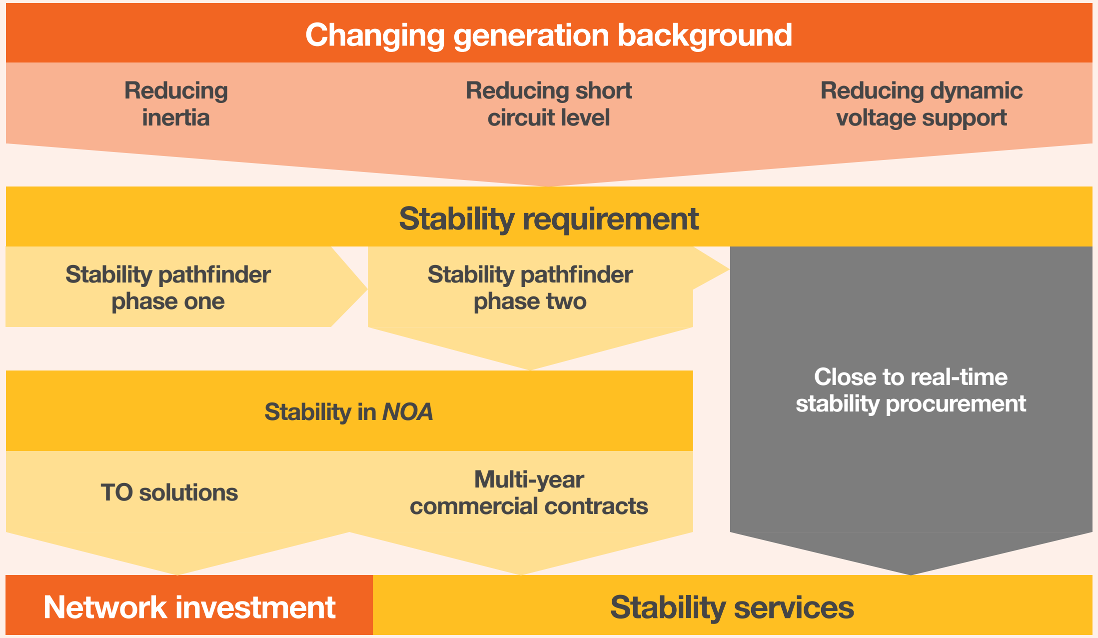
The NOA process will identify requirements for stability across multiple years and facilitate investment over time. We are also developing our requirement for a closer to real-time procurement approach.

We are developing approaches which aim to access stability capability in a more economic and sustainable way.

Accessing stability solutions

Stability

Figure 6.1
Stability: System need drives solutions



Stability pathfinder phase one will support our milestone to have stability capability at 0 MW in 2021.

Stability pathfinder phase two will support our milestone to have a range of technologies providing a stability service in a test area of the network.

The learning we are getting from these projects is supporting our milestone to develop a stability market.

Virtual synchronous machines

Stability

Virtual Synchronous Machine (VSM) technology enables non-synchronous assets (eg. wind generation, batteries, HVDC) connected to the system via converters to behave more like a synchronous machine. With this technology, non-synchronous assets are able to deliver stabilising qualities which we require on the system.

Through a variety of innovation projects, and working with the VSM expert group, we have determined a specification for VSM technology which once agreed and progressed as a code modification can be written into the Grid Code. It is important to have a specification so that manufacturers and developers are able to design their equipment to deliver this capability in a way which is most beneficial to the system, and to participate on an even basis in any stability procurement approach that is developed.

VSM is an important solution to investigate as it should be possible to deliver using existing assets; however, it is not, by any means, the only answer and we remain technology-neutral to other solutions.

Having a standard for VSM will support broadening the range of technologies which can provide a stability solution. This supports our milestone to have a range of technologies in a test area and to develop a stability market.

7 Thermal

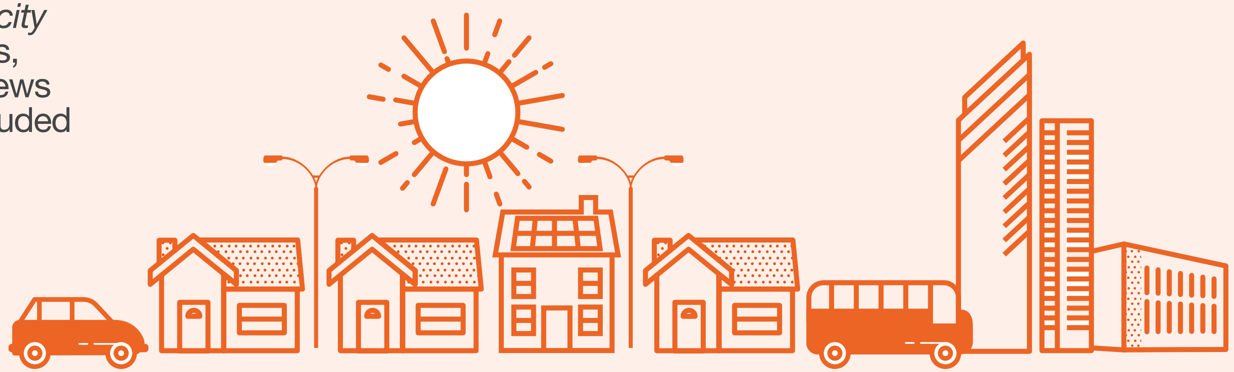
Key messages and opportunities
Thermal

Key messages

- Following the success of the 'Commercial Opportunities for Network Challenges' event we have identified the next steps and are seeking solutions to post-fault network constraints.
- We continue to progress the **Regional Development Programmes**[1] which enable greater visibility and control of embedded providers and inform our aim for whole system optimal dispatch.
- We are working with distribution owners on the south coast to implement a post-fault, zero cost solution on new connections.

Opportunities to get involved

- **Constraint Management Pathfinder –** we have recently published a **request for information**[2] seeking industry views on post-fault commercial solutions, with a specific focus on Scotland and Northern England boundaries. A webinar is scheduled for January 2020 and responses to the RFI are required by 28 February 2020.
- ***NOA* methodology –** Following the use of a new probabilistic methodology in the *Electricity Ten Year Statement* studies, we are seeking industry views on how this should be included in the *Network Options Assessment* methodology.



Identify future constrained areas of the network Thermal

In our role as ESO, we publish the *Network Options Assessment (NOA)*. The *NOA* process identifies future constrained areas of the network and where current constraints may worsen. The *NOA* then recommends where network investment by transmission owners (TOs) would help to deliver network capability and consumer benefit. Alternatively, *NOA* will consider commercial services, which can be used to manage pre and post-fault constraints. This approach is set out in our Network Development Roadmap to increase consumer value through competition by expanding the *NOA* process to include network and non-network solutions.

Widening the scope of *NOA* is increasing the potential for constraint management services, particularly post-fault services.

We are already seeing changing network constraints resulting from new forms of generation being connected at different network locations. In our May 2019 report, we highlighted the work to improve our study capability and develop a probabilistic approach to facilitate year-round analysis of network needs and capability.

We have improved our tools and processes and completed year 1 probabilistic studies for all boundaries. The results for selected boundaries have been published in the ***2019 Electricity Ten Year Statement (ETYS)***[3]. We will be selecting further boundaries for year-round analysis across all *NOA* study years to publish in Q4 2020/21. We are seeking industry views on the inclusion of this approach in future NOAs. Please provide feedback to **transmission.etys@nationalgrideso.com**.

In the 2019 *ETYS*, we show how we've used the probabilistic methodology to validate the deterministic network assumptions used in the boundary analysis. We also present the next steps to further develop our capability to assess thermal constraints and find better ways to alleviate network thermal constraints.

We are also running several Regional Development Programmes (RDPs) to develop systems and processes, which enable efficient coordination of transmission and distribution system operation. We are currently developing our processes for identifying further regions suitable for the RDP approach.

Visibility and control

Thermal

Physical limitations of network assets require the management of power flows across constraint boundaries to prevent overloads on the transmission assets and ensure wider system operability. To do this efficiently and preserve the integrity of the equipment, we must forecast the potential power flows. As the volume of variable generation has increased, with the majority connected to the distribution networks, management of power flows has become more difficult due to lack of ESO visibility of this generation behaviour.

Our RDPs in the South East (with UKPN) and South West (with WPD) are focused on the provision of visibility and control for NGESO. Visibility and control of new connected parties increases our ability to manage the effects of variable generation and its impact on system operability.

Developing the IT systems for these complex projects has proved challenging and has delayed the implementation phase of the RDP.

A further benefit of visibility and control means we are able to run the network closer to asset ratings, resulting in reduced constraint volume and increased consumer benefit. The success of these RDPs will continue to facilitate the connection of variable generation in these areas, whilst also contributing to our zero carbon ambition.

These RDPs are directly contributing to delivery of visibility and control of new distributed energy resources in trial areas.

Post-fault solutions

Thermal

In our **Future of ENCC**[4] chapter for thermal constraints, we detail the post-fault actions available to manage thermal constraints for unplanned faults. These actions are limited to automatic intertrips with providers who have the required systems and are available for the specific fault, and manual bids and offers issued in the balancing mechanism. The volume of available actions and speed of manual instructions post-fault determines the allowable pre-fault power flow across the boundary. Where we can increase the volume of actions or the speed of volume delivery post-fault, we can increase the pre-fault power flows.

The Constraint Management pathfinder is building on the successful 'Commercial Opportunities for Network Challenges' industry event earlier this year. The pathfinder is currently seeking new solutions to thermal constraints for unplanned faults i.e. post-fault services. A **request for information**[5] (RFI) was recently published to seek industry views on what technologies are available, what a service might look like and how it would operate, what contractual arrangements could be used and any other thoughts on thermal constraint management.

The RFI presents the concept of delivering post-fault constraint management services simultaneously on both sides of a constraint boundary using a dual location approach. Our studies have shown that a dual location approach can have a greater benefit following an unplanned fault than a traditional single location intertrip scheme. In some scenarios, the pre-fault limit can be raised by more than 100 per cent of the post-fault action, delivering significant consumer benefits through reduced pre-fault actions. The term 'dual location' refers to the service being delivered both sides of the boundary and does not imply that both locations need to be delivered by the same provider(s).

The RFI is seeking solutions to constraints in Scotland and Northern England, but we are keen to hear from across the industry to inform service development and its ability to be migrated to other network areas.

The outcome of the RFI will inform the decision whether to tender for post-fault services in wider areas.

Post-fault solutions

Thermal

We are also collaborating with South Coast DNOs (WPD/SSE/UKPN) to implement automatic post-fault actions on new distributed connections. This solution is for unplanned double circuit faults occurring whilst another circuit is on planned outage (in accordance with the Security and Quality of Supply Standards – SQSS). The national electricity system's historical data shows that a double circuit fault on the transmission system is a 1 in 100-year event. The double circuit fault happening during another single circuit planned outage (which leads to an N-3 scenario) makes it an even smaller probability event, and therefore would be infrequently armed, and even less so activated. The solution would benefit the end consumer both through reduced volume of pre-fault actions and would be zero cost as it exceeds the generation security standards in the SQSS.

This project aims to deliver new post-fault solutions in a test area.

The ability to increase pre-fault power flows requires less pre-fault actions, resulting in benefit to consumers. Additionally, it reduces the need to synchronise conventional generation thus contributing to our zero carbon ambition.

Whole system optimal dispatch

Thermal

There are some parts of the network which have high volumes of connected generation but, due to limitations of the transmission network, some generators are heavily constrained in order to manage the local boundary power flows. South West Scotland is one such area where a load management scheme (LMS) is in place. Such a scheme is designed to trip generation off the system when assets approach their thermal limitations. These schemes often operate in areas where NGESO does not always have visibility or control of the individual generating units. Improved control of this generation would allow us to utilise more of the available transmission network capacity, allow new providers to connect, and benefit both the generators and the consumer.

The SW Scotland RDP aims to deliver these benefits in two phases. The first phase will increase controllability of generation by regulating MW output based on real-time available network capacity, instead of hard-tripping units to zero MW. This will be accomplished through a scheme known as active network management (ANM).

For NGESO to fully utilise the network in SW Scotland, phase two will widen the ANM to transmission connected generation in the area. This will allow distributed energy resources (DER) to compete on a fair and equitable basis for connections and constraint management services along with transmission connected generation.

We are collaborating with SP Transmission and SP Distribution on the necessary commercial frameworks and service definitions for this to be implemented.

The SW Scotland RDP is delivering visibility and control of new DER in trial areas and whole system optimal dispatch in a trial area.

Our ‘Connecting Storage in the West Midlands’ RDP has seen collaboration with WPD lead to a proposed change which would see storage providers treated as flexible generation instead of consumer demand. The level of demand (which included these providers) modelled over the demand peak had been triggering the need for network reinforcement. This proposed change would enable providers to participate in provision of commercial services, allow additional storage connections and can be included in the assessment of commercial services against asset build.

We have been working with ENW on our ‘Heysham GSP’ RDP to analyse the transmission and distribution system issues in order to identify the best whole system solution which will continue to allow distributed connections. Phase 1 of the project has completed with the report currently being finalised and will be published in Q4 2019/20. Phase 2 aims to identify the necessary future whole system solutions to continue to economically and efficiently allow the connection of more DER.

Both these RDPs are contributing to delivering whole system solutions, potential post-fault services and visibility and control of new embedded connections where required.

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