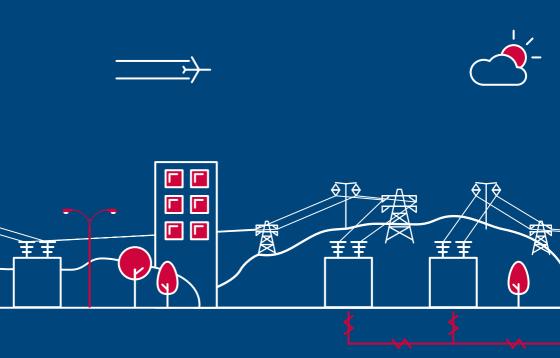nationalgrid

# Product Roadmap
## Restoration

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# Foreword
Today we are publishing a roadmap of actions to shape the future of system restoration.

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**This is the next step in our ongoing work to develop a more flexible and efficient electricity network fit for the future. It follows last year's publication of our System Needs and Product Strategy document, where we asked for your feedback on how we could simplify and improve our balancing services.**

The world of energy is changing around us; as our industry moves towards a low carbon future, this presents us with challenges. Fewer traditional providers of system restoration services, also known as Black Start services, are now available to us.

This calls for us to look at the future approach to Black Start. Therefore we believe there are two key strands we need to look at, which you can read about in this document:

The first is greater transparency in the way we communicate and buy the services we need.

The second is a more flexible approach to how the Black Start service can be provided, to attract a wider range of participants and technologies.

As always, we are keen to hear your views and feedback on what you read in this publication. We'll be holding engagement events later this year, but you can also send us your thoughts and comments via our Future of Balancing Services email address: *box.futureofbalancingservices@ nationalgrid.com*

**Cathy McClay**
Head of Commercial, Electricity

# Contents

# Executive summary

**As System Operator our vision is for a more flexible electricity system that makes the most economic and effective use of all available resources to meet the continuing needs of the electricity network.**

The changing generation mix in Great Britain means we need to evolve our Black Start strategy to ensure we can always restore the system effectively and economically. We believe this is best achieved through creating services that are accessible to a wide range of technologies, using an approach that puts stakeholders at the heart of our decision-making.

Within this roadmap, we set out our commitments and actions to:
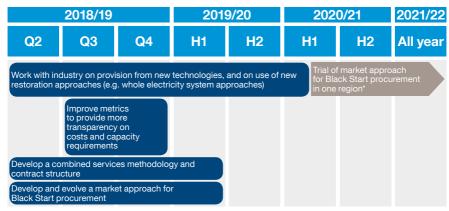- improve transparency around Black Start services, including service requirements and costs
- remove barriers to entry to allow improved market access to a broader range of potential participants, including interconnectors, wind, distributed energy resources and storage
- explore alternative methods for procuring Black Start services, to enable a more flexible approach to meeting service requirements.

Our vision is that by the mid-2020s, we will be running a fully competitive Black Start procurement process, providing there is sufficient competition to enable a market-based solution. This would include submissions from a wide range of technologies connected at different voltage levels on the network, with DNOs playing a more active role in the restoration approach. Industry feedback and collaboration is vital in achieving this vision and will underpin our reform of Black Start and balancing services.

# Executive summary

*Figure 0.1*
*Roadmap of actions*

| 2018/19 | | | 2019/20 | | 2020/21 | | 2021/22 |
|---|---|---|---|---|---|---|---|
| Q2 | Q3 | Q4 | H1 | H2 | H1 | H2 | All year |

Work with industry on provision from new technologies, and on use of new restoration approaches (e.g. whole electricity system approaches)

Trial of market approach for Black Start procurement in one region*

Improve metrics to provide more transparency on costs and capacity requirements

Develop a combined services methodology and contract structure

Develop and evolve a market approach for Black Start procurement

\*    This is an agile project which will retain flexibility on which features to deliver
     and in which order, depending on service priorities and technical considerations.

Our vision is that by the mid-2020s, we will be running a fully competitive Black Start procurement process with submissions from a wide range of technologies connected at different voltage levels on the network, with DNOs playing a more active role in the restoration approach.

# Chapter one

Chapter **one**

# Background to restoration

**Electricity System Restoration**
In the unlikely event that the electricity system fails and the lights go out, we as the System Operator (SO), have a robust plan to restore power to the country as quickly as possible.
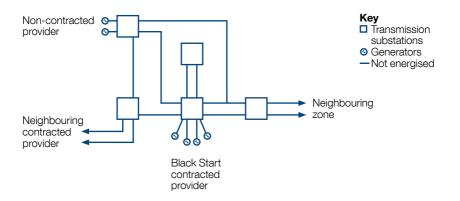
This plan is made up of two elements:

1. Commercial contracts with a number of providers for them to be on constant standby. These will have the capability to:
   a. Self-start without needing external electrical power.

b. Energise the local transmission network by providing 'block loading'.
   This means they can increase load rapidly in blocks; currently somewhere between 30 MW and 50 MW at a time.

2. A restoration strategy agreed and tested by those key providers, local distribution network operators (DNOs) and ourselves.

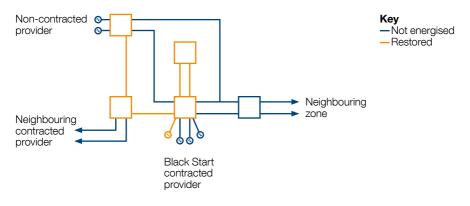In the event of a black-out, the following plan will come into effect:

*Step 1: Review and instruct*
*Initially we will assess the status of the network, establish the appropriate approach for restoration for the scenario and contact providers to instruct actions.*
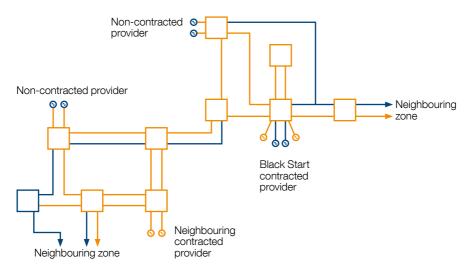


Non-contracted provider

Neighbouring contracted provider

Black Start contracted provider

Neighbouring zone

**Key**
☐ Transmission substations
⊙ Generators
— Not energised

## Step 2: Start up

*As the electricity network is unavailable, the contracted Black Start provider must start up without any external power supply from the network. During the initial stage of restoration, they must also energise their local network, which means providing power supply to local networks and demand.*



**Key**
— Not energised
— Restored

Non-contracted provider

Neighbouring contracted provider

Black Start contracted provider
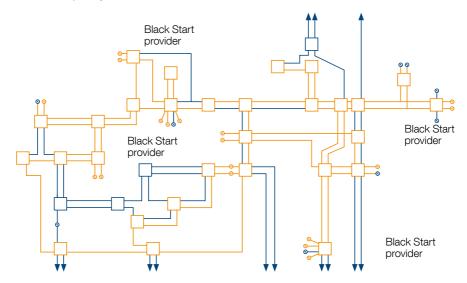
Neighbouring zone

## Step 3: Power island

*Customers are reconnected area by area by the DNO. While this is happening the Black Start provider needs to carefully match their output to the amount of demand in their area. Each individual group with a Black Start provider and local network operates as a power island; at this stage they are not connected to each other or the wider network.*



Non-contracted provider

Non-contracted provider

Neighbouring zone

Black Start contracted provider

Neighbouring zone

Neighbouring contracted provider

# Background to restoration

### Step 4: Skeletal network
*Once the power islands are established, we join them together to start energising more sections of the transmission network with low levels of non-Black Start generation. We call this limited restoration of the system a skeletal network.*



Black Start provider

Black Start provider

Black Start provider

Black Start provider

### Step 5: Restored network
*Once a skeletal network has been created we can add more generation and reconnect more customers, until all customers have power.*

All of these actions are pre-agreed with contracted Black Start providers and local DNOs, in Local Joint Restoration Plans (LJRPs). These details are both commercially and security sensitive and are not made publicly available.

### Our contracting approach
Currently Black Start services are mainly provided by large transmission-connected generators that can:
- start-up independently following a shutdown
- provide power to the transmission network
- provide block loading of local demand.

We ensure there is a spread of Black Start providers across the system so multiple areas can be restored at the same time. We do this by splitting the country into six zones and contracting with up to three stations in each zone as per our published Black Start Strategy[1].

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[1] https://www.nationalgrid.com/sites/default/files/documents/High%20Level%20Black%20Start%20Strategy.pdf

*Figure 1.1*
*Black Start provider zones*



As this is such a crucial activity, we will only enter a new Black Start contract if the potential provider can prove they can deliver the service. To establish this, we use a two-stage feasibility study:

- The **Stage One study** considers whether the provider has the potential to meet the three requirements of a Black Start service and whether a more detailed study should be carried out. This study is self-funded by the provider.
- If Stage One is successful, we will commission a more detailed **Stage Two study**. This determines the level of Black Start capability and it will also identify any testing needed to demonstrate this

capability. It will also identify the cost of any work required and the timescale for the service to be available. We support the funding of Stage Two feasibility studies as part of our overall Black Start costs.

This assessment also considers other factors:
- How the new service improves the restoration time of the transmission network.
- How it improves the level of resilience of the restoration plan. It may not improve the overall time to re-energise the network but it may provide us with more options in the event that another provider is not available.
- How it compares in value to nearby competitors.

# Background to restoration

- We spent approximately £55m on 18 Black Start contracts in 2017/18.
- The number of individual services we need is expected to remain the same in the short to medium term.
- Contracts last between 3–6 years with an expected minimum annual availability of 85–90%.

**A changing market**

The generation mix on the system is changing significantly with an increase in both renewable generation and smaller thermal generation connected to the distribution system.

A number of our existing Black Start providers are large conventional fossil fuel power stations. In order for them to be ready to re-energise in two to three hours, they need to maintain a certain amount of warmth within their assets. In previous years they would have been generating fairly constantly throughout the year, so would have remained in such

a state of readiness. This is no longer the case and there are periods of the year when some providers only retain a state of readiness through further actions we take. This can involve periodically instructing the providers to generate power and so retain warmth in their assets.

This means we need to evolve our Black Start Strategy to ensure we can always restore the system effectively and economically. We believe that encouraging a wide range of technologies to provide this service is the best way forward.

# Chapter two

# Next steps

We plan to give new and current providers a better understanding of how the Black Start service works, and the opportunities for them to take part. These include:

1. Improving transparency around Black Start services.
2. Opening up restoration to a broader range of participants.
3. Alternative approaches for procuring Black Start services.

Of course, it is vital to get the views of our industry partners and, over the next 12 months, we plan to do this through our forums and dedicated engagement workshops.

You can see an overview of when further detail on these developments will be shared in Figure 0.1 – our roadmap of actions out to 2021.

Our vision is that by the mid-2020s, we will be running a fully competitive Black Start procurement process with submissions from a wide range of technologies connected at different voltage levels on the network, with DNOs playing a more active role in the restoration approach.

## 1. Improving transparency

### Service costs
We currently publish Black Start costs through the Monthly Balancing Services Summary. These do not include the costs of warming units.

We are limited in the information we can share due to commercial and security sensitivities. However, we know we can do more to help potential service providers understand what we need from them. So by Q4 2018/19 we intend to provide more details around:
● the costs needed to maintain Black Start capability
● the range of required block load capability.

### Service value comparison
No two Black Start providers are ever identical. However, when there are two or more providers competing for the same contract we will undertake a comparative assessment to ensure that we contract the most economic and efficient service. Cost will be a key component but there are other criteria which will also determine the outcome. So we will publish the different criteria we use to potential service providers. Examples of these non-price criteria include the weighting we assign to block load capability, the offered minimum annual service availability and time to start up.

## 2. Broadening participation

Increasing renewable generation, interconnected flows, and distributed energy resources (DER) are driving increased interest in our balancing services, including Black Start.

This brings a number of benefits, including increased competition, reduced risk and greater innovation. So we are evaluating and introducing several new solutions into our restoration plans. These include:
● **developing combined services**, so that a potential provider is no longer expected to meet all requirements by itself, but can combine with other providers
● removing barriers to entry to accommodate a **wider range of technology participation** focusing on interconnectors, DER, wind technologies and storage/batteries.

We will take a whole electricity system approach, consider future trends in generation, and adapt to new technologies to ensure a robust and reliable Black Start service. For this to happen, some parts of the network may need upgrading (for example to handle embedded generation at low voltage levels).

Some market participants may not be suited to assist with the early stages of restoration, however they may still provide an important role in our strategy. We will work with industry to understand if and how they can be incorporated into any restoration plans, be that through changes to European or GB code rules, other contracted structures or other means.

## Developing arrangements for combined services

When generation was mainly in the hands of large conventional fossil fuel power stations, it made economic sense to secure all of the requirements of a Black Start service from a single provider. The number of providers who could provide this full service was sufficient to maintain a competitive pressure on prices. The relatively small number of Black Start units made our restoration strategy less complex. However, the arrival of so many different types of potential providers means we need to be more flexible. Some providers may be able to meet one or two of the requirements of a Black Start service but cannot meet all three.

For example, some providers can keep themselves in a state of readiness following a shutdown, meaning they have a head start when external supplies are regained, to provide faster restoration. However, they may not be able to start up by themselves. If this provider was coupled with a 'start up' provider they could offer a full service.

To make the combined services solution happen, there are a few actions we need to take:
- Identify the value of each part of the service, so we can compare different combinations.
- Work with the industry to understand how best to separate the requirements between neighbouring providers. This is already

happening and we've agreed for a provider to energise a larger station which can then accept block-loads of demand.

How combining services affects contracts – for example, should we buy a full combined service in a single agreement from a consortium of providers or should we contract separately with different providers for each component of the service? The former would provide a full solution in a particular region but the complexity may deter potential providers. The latter approach may encourage potential new providers but could be potentially costly if one of the parties drops out and we cannot find a cost-effective replacement. We'll work closely with our industry partners to achieve the best balance of cost and reliability of service.

## Increasing participation by different technologies

The current Black Start provider portfolio is made up of coal stations, OCGT and CCGT gas stations, and hydro stations. We are looking to expand the mix of providers and technologies and here we highlight some of those offering the best potential, with the dates from which we'll start to explore service provision. These dates are driven by a combination of operability dependencies and practical considerations.

### Interconnectors from Q2 2018/19

Black Start capable interconnectors will increase diversity and flexibility and provide great resilience to our restoration plans. We are talking to interconnector owners to understand how they could be considered as potential Black Start providers. Issues include:
- the type of agreements needed with the SO at the remote end of the interconnector
- understanding their capabilities and expectations under a restoration event
- working within the guidelines in the European network code for Emergency Restoration. This defines a 'top down re-energisation strategy' as a restoration that needs help from other SOs.

# Next steps

## Distributed Energy Resources (DER) from 2019

Generation connected to the distribution networks has the potential to provide a Black Start service. We believe the combined services approach will be a key enabler for some forms of embedded generation to contribute to the service.

To explore the potential of DER in more detail, we will:
- consider the current challenges preventing DER being part of our restoration plans (these were most recently described in the *System Operability Framework 2018* report)[2]
- work with potential DER providers to demonstrate their restoration capabilities under single and combined approaches
- work with DNOs to understand how a more sophisticated restoration programme including a larger number of smaller providers could work
- work with potential DER providers to design an appropriate commercial service
- we are currently working with partners to secure NIC funding to develop this innovative approach to system restoration.

## Wind from Q1 2019/20

The high level of wind generation on the GB system offers a real opportunity for wind providers to be part of the restoration approach.
- We are currently working with the wind industry to explore how the technology can meet the technical requirements of the Black Start service.
- We recognise that wind generation will not always be available so we will explore with providers how this uncertain availability might be valued and accommodated in our restoration strategy.
- We will test the potential for wind generators to carry out a Black Start to understand the contribution they might offer to a restoration strategy.

## Storage/batteries from Q3 2019

The growth in large scale storage solutions provides an opportunity for us to examine whether these technologies can provide Black Start services. Coupled with the concept of combined service provider solutions, they may be able to offer one or all of the elements of a full Black Start. While still very much at an early stage, we continue to explore potential solutions in this area.

## 3. Improvement in procurement approaches

We currently procure Black Start services based on the principles outlined in the Black Start Procurement Methodology[3], which state:
- there must be a clear and transparent requirement
- we should enable competition where appropriate
- we must not unduly discriminate against the technology type.

We will highlight the regions where we have current or upcoming Black Start opportunities and approach the market to gain expressions of interest for the service.

Interest may come from a variety of parties including current providers, those that have completed a stage two feasibility study but are not currently contracted to those who are considering the market for the first time and are yet to complete those studies.

If there are a number of potential providers in a zone we will undertake a competitive procurement activity.

If there is not sufficient competition, then it may be more economic to contract with potential
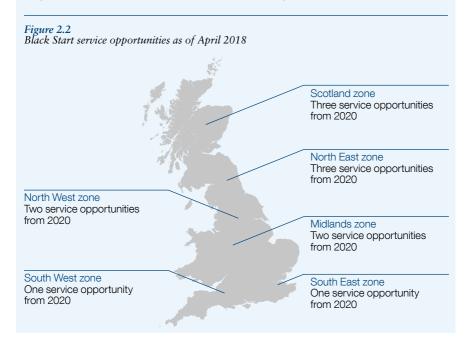
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[2] https://www.nationalgrid.com/sites/default/files/documents/SOF%20Report%20Black%20Start%202017.pdf

[3] https://www.nationalgrid.com/sites/default/files/documents/Black%20Start%20Procurement%20Methodology.pdf

## Current opportunities to provide Black Start services

We are currently considering providers for new opportunities from 2020 as highlighted in Figure 2.2. This map summarises the contractual zones and future opportunities for new Black Start provision. These dates are based on the length of current contracts. Once a contract expires the service(s) will be replaced, either through renegotiating with the current provider, or by replacement with a new provider. The geographical zones are indicative, which may allow for flexibility for some providers as to which zone they can support.

*Figure 2.2*
*Black Start service opportunities as of April 2018*



Scotland zone
Three service opportunities
from 2020

North East zone
Three service opportunities
from 2020

North West zone
Two service opportunities
from 2020

Midlands zone
Two service opportunities
from 2020

South West zone
One service opportunity
from 2020

South East zone
One service opportunity
from 2020

providers directly. Our approach will be guided by our view of how we can procure the service for the best value for the end consumer.

When there is competition in a particular region we will set out our approach clearly and transparently. Specifically, we will:

- **Standardise and publish our value assessment in competitive approaches:** Where there is competition, we will compare objectively against our published parameters to establish the value of the Black Start service. We will document this approach and make it available to the market in Q3 2018/19.

# Next steps

- **Designate timeframes for the procurement of services:** Potential providers need to demonstrate that they have the capability to provide a Black Start service through our two feasibility stages. This can take some time to complete and providers are understandably keen to secure a Black Start service contract as soon as possible after stage two has been completed. However it is unlikely that providers are ready to bid for a service at the same time. This makes it difficult to promote competition and drive value for the end consumer. So we are looking at how we can provide early warning of Black Start service opportunities to give all potential bidders enough lead time. We believe this will allow providers to better plan their stage one and two feasibility study activities.

## Summary – next steps
- We will continue to work with industry on the potential for Black Start provision from new technologies (including interconnectors, DER, wind and storage) and on the use of new restoration approaches.
- We will improve metrics to provide better transparency on restoration costs and capacity requirements by Q4 2018/19.

- We will integrate a combined services arrangement into current contracts and approaches by Q2 2019/20, subject to commercial agreements with providers.
- We will assess the merits of different procurement models, and agree timeframes in our procurement methodology by Q4 2018/19.
- This will lead to the development an appropriate market-based mechanism for Black Start procurement later in 2019, with the ambition of trialling this new approach in 2020.

## Getting involved
Your feedback is vital in ensuring all stakeholder perspectives are represented and views heard. We invite everyone to share your views on this document, as well as the type and format of information that would be most useful for your businesses, via email: *box.futureofbalancingservices@nationalgrid. com*.

For further information and updates please refer to the Black Start webpage on our website: *https://www.nationalgrid.com/uk/electricity/ balancing-services/system-security-services/ black-start*.

# Continuing the conversation

**Email us with your views on the Future of Balancing Services on:**
futureofbalancingservices@nationalgrid.com
**and one of our experts will get in touch.**

**Access our current and past documents, data and multimedia at:**
https://www.nationalgrid.com/uk/
electricity/balancing-services/
future-balancing-services

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