Three priority areas

Priority 1: Digital Transformation

What's driving this?

Rapid digitisation and decentralisation of the energy sector come with many challenges. On the electricity system, there is a huge increase in the data available through the proliferation of market players. New decentralised assets are often inherently unpredictable, so being able to harness this data is extremely important. Legacy systems and processes struggle to cope with the rapid increase in participants, emerging IOT data and technological advancements.

What do we need to do?

We need to harness the power of Big Data through new systems, capabilities and processes. We also need to understand and test new technologies such as artificial intelligence, machine learning, cloud computing and blockchain, to extract additional insights and share these in a transparent way.

With everything we need to maintain the highest standards of security and resilience which are required by the Critical National Infrastructure status of our systems.

Our projects: Take a look at one of our Digital Transformation projects below, which also appears in our ESO Innovation Annual Summary 2018/19

How projects are linked to our new strategic priorities

Future markets

It is increasingly important to explore markets for new services that can meet changing system needs – as well as markets for new products, such as stability. We also need to create a level playing field for all those taking part in these markets. By working with other networks and all market participants, we will stimulate a cost-effective, whole-system approach, where new participants in the electricity market can expect better access and price signals.

£320k per year

expected savings by introducing more competition into the market

Frequency Response Weekly Auction Trial

We're trialling a fairer and faster system for procuring frequency response services, which is set to increase competition – and ultimately drive down consumer bills.

Project overview

One of our goals as the ESO is to offer equal access to all providers of balancing services. Frequency response is one such service.

We keep system frequency within a set range by continuously balancing the national demand for electricity with the total output of all the generators in Great Britain.

To help us do that, we buy frequency response services from a wide range of generation, demand-side providers and electricity storage. When system frequency is too high they reduce their output or increase their demand; when it's too low they increase their output or reduce their demand. This keeps the system in balance.

Operators of non-traditional energy resources – like renewable generation, storage and demand side response – have told us that our current monthly tender process doesn't work for them, since they can't confidently predict their availability that far into the future.

To address this concern, we're experimenting with making a fundamental change to how we buy frequency response by designing and trialling a weekly pay-as-clear auction. This will help create a more level playing field that will allow a wider range of technologies to participate in frequency response markets.

Results

We've been working with project partner EPEX SPOT to develop the main elements of the new procurement route – both the algorithm that will run the auction and the platform that will act as the link between service providers and ourselves. We'll shortly publish a document on how the auction platform and process will work for providers.

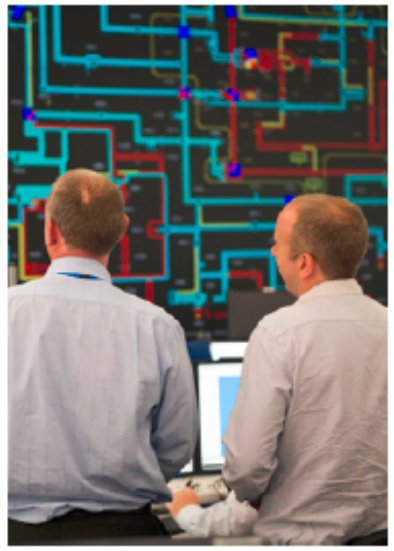
We're also developing new processes and arrangements that will make sure service providers are paid quickly and accurately. This will give greater peace of mind about being part of this market.

Once the auction platform has been developed and tested internally and with stakeholders, we'll run a live trial for two years. This will help us understand how procuring frequency response much closer to real-time than ever before impacts the market. The auction with EPEX SPOT is due to go live in September 2019, and ahead of that we launched a simplified weekly auction in June to trial buying one service.

Benefits

Reducing timescales from a month to a week ahead means more non-traditional service providers will be able to confidently predict their availability. This should increase both the number and diversity of energy businesses taking part in the market.

More participation will create more competition, which we expect will drive down the price our business pays for these services. These savings will ultimately flow through to consumers' bills, while creating new revenue streams for some of the market's newest energy providers.



Project Name:
Frequency Response Weekly Auction Trial

NIA reference:
NIA_NGSO0017

Suppliers:
EPEX SPOT

PEA Cost:
£1,142,000.00

Start TRL:
5

End TRL:
7

Priority 2: System Stability

What's driving this?

Synchronous generation supports the stability of the electricity system. As we transform to a low-carbon energy system synchronous generation capacity is decreasing and the system is becoming less stable. This results in faster system frequency changes, less voltage and fault ride-through stability and makes it more difficult for both synchronous and non-synchronous generators to operate safely.

What do we need to do?

We need to explore new ways to enhance system stability, as well as support the safe and efficient operation of the system in times of lower stability.

Our projects:

Take a look at some of our System Stability projects below, which also appear in our ESO Innovation Annual Summary 2018/19

How projects are linked to our new strategic priorities

System stability

Synchronous generation supports the stability of the electricity system. As we transform to a low-carbon energy system, there is a reduction in traditional synchronous generation, resulting in effects such as fast system frequency changes and lower voltages. These make it more difficult for both synchronous and non-synchronous generators to operate safely. We must find new ways to understand and improve system stability into the future, ensuring we operate safely and efficiently when stability is reduced.

50Hz
the frequency which a balanced electricity system remains close to

Investigation and Modelling of Fast Frequency Phenomena

We're improving our understanding of a new characteristic on the GB power system: fast frequency phenomena. This will help us connect more renewables in a secure and cost-effective way.

Project overview

All conventional generators across GB are synchronised so that their rotating masses all spin at the same speed (50 times per second), which means that a balanced system has a frequency of approximately 50Hz. Any event on the system – such as the loss of a large generator – causes a change in that frequency which ripples through the system. Not unlike dropping a stone in a pond, these can cause issues if the frequency change is too large and too fast.

Fast frequency phenomena are increasing from the connection of more renewables and can result in two main consequences. Firstly, disturbances on the system are causing a larger ripple effect on the frequency. Secondly, the renewable generation itself is more likely to trip (disconnect from the network) as a result of the frequency fluctuation.

In this project, we're trying to accurately observe and predict how these fluctuations impact the system.

Results

We've developed a 3D visualisation tool, which gives us a remarkably clear picture of how frequency events ripple across the country. This is a significant step forward in how we understand fast frequency phenomena.

We're now developing new modelling techniques that will allow us to better predict frequency fluctuations. We're also building a real-time replica of the GB system, where we can virtually connect sensitive equipment and see how it's affected.

Benefits

By understanding how events unfold and accurately predicting their effects on the system, we'll be able to manage risk better and integrate more renewables securely and cost-effectively.

Project Name:
Investigation and Modelling of Fast Frequency Phenomena (“F2P”)

NIA reference:
NIA_NGSO0007

Suppliers:
Brunel University

PEA Cost:
£340,000

Start TRL*:
3

End TRL*:
6

** For an explanation of Technology Readiness Levels (TRL) see page 16.*

Priority 3: Whole Electricity System

What's driving this?

New decentralised energy resources are connecting to distribution networks, turning them into active networks and transforming the role of Distribution Network Operators (DNOs). Many of these new resources can provide valuable services to us, increasing liquidity and thus competition in our markets as well as to those of emerging Distribution System Operators (DSOs). In addition, smart technologies mean many consumers won't just passively use power – they can become active players in the system too.

What do we need to do?

We need to explore innovative ways of designing and operating transmission and distribution networks. We need a whole electricity system approach with our customers and stakeholders to ensure the delivery of services and the operation of networks are done efficiently and effectively as well as to further promote competition in our markets.

Our projects

Take a look at one of our Whole Electricity System projects below, which also appears in our ESO Innovation Annual Summary 2018/19

nationalgridESO

Power Potential

This year, we made significant strides towards creating a world-first system that unlocks more power and flexibility from smaller distributed generators – and could save consumers £400m by 2050.

Central to the project is the creation of a world-first regional reactive power market.

Project Name:
Power Potential

NIC reference:
NGET_UKPN_TDI2.0

Partners:
UK Power Networks

Initial Budget:
£9,560,113

https://www.nationalgrideso.com/innovation/projects/power-potential

Project overview

Today's energy network includes large volumes of power from distributed energy resources (DERs). These are smaller power generators, such as wind and solar, that are connected to distribution networks.

Through the Power Potential project, we're working with UK Power Networks to create new opportunities for DERs to contribute to the overall efficiency of the electricity system.

Central to the project is the creation of a world-first regional reactive power market. We're developing a distributed energy resource management system (DERMS), which will allow DERs to export more of their energy onto the transmission network, while enabling us, the ESO, to make more efficient decisions on how to manage the grid.

The three-year project is focused on the South of England. Distributed generators involved run from Bolney in Sussex to Canterbury in Kent.

Results

We have been finalising the testing of DERMS, the technical solution, and preparing to integrate new hardware and software with our existing business systems, getting ready for the Power Potential trials. We also recruited DERs to take part in these trials, beginning in summer 2019.

We have received a National Technology Award in the category 'Internet of Things' Project of the Year, which is a great achievement for our team, as it recognises the innovation we are undertaking to deliver a complex but important project for the future.

Benefits

Power Potential could save energy consumers more than £400m by 2050 and allow the connection of a further 3.72 GW in the South East of the UK. It could be rolled out to 59 other transmission sites within the UK, and countless more around the world.