nationalgridESO

2020-21 End of Year Report Evidence Chapters

7 May 2021

Contents

Operating the electricity system through the COVID-19 Pandemic

Introduction

The 2020-21 financial year was notable for the COVID-19 pandemic, which has impacted on all areas of life in the UK. Lockdown restrictions changed the level and pattern of energy usage, meaning that the ESO needed to develop new tools to ensure that the system remained operable. Social distancing restrictions changed the ESO's ways of working, with the majority of colleagues working from home. This meant that the ESO had to innovate, finding new ways to collaborate with colleagues and stakeholders to ensure that we could continue to operate the electricity system safely and economically through the COVID-19 pandemic and beyond.

Changing energy usage

The UK experienced three national lockdowns during the 2020-21 financial year. Although each lockdown has had some impact on energy usage, the first lockdown (beginning in March 2020) had the largest effect on energy usage, with many businesses being closed. This coincided with the spring/summer period, where energy usage is typically lower as less energy is required for lighting and heating. During this period, electricity demand in Great Britain was up to 20% lower than would otherwise be expected, and on 28 June it dropped to its lowest ever level of 13.4GW (prior to 2020 the lowest national demand figure observed was 15.8 GW).

Over the summer period, lockdown restrictions were gradually eased, and demand levels returned to approximately 5% below what would otherwise be expected. During September and October, pupils returned to school and many employees returned to their workplaces, resulting in demands returning closer to normal levels.

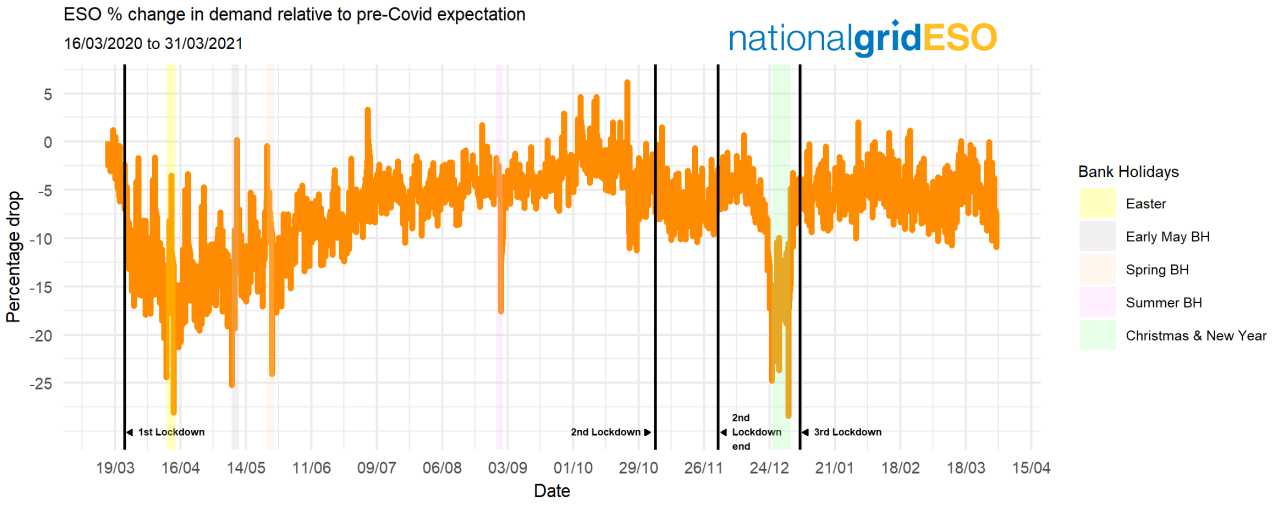
In November, another national lockdown was introduced. This lockdown was less strict than the one introduced in March, with pupils continuing to attend school and some businesses (such as manufacturing) remaining open which had been closed in the previous lockdown. During this lockdown, demand levels were 5-7% lower than would otherwise be expected.

This lockdown was eased in December, although many businesses remained closed under the regional tier system. This meant that demands continued to be slightly lower than would be expected at this time of year. Changing restrictions led to uncertainty over the Christmas period, with large parts of the country being placed into the new stricter Tier 4, but with restrictions being relaxed on Christmas Day, leading to difficulties in forecasting levels of electricity consumption.

January saw another national lockdown, with schools and many businesses being closed. Since January, demands have been approximately 5% lower than would otherwise be expected.

Although the various restrictions during the year have impacted on electricity consumption, and caused difficulties in forecasting daily demand profiles, it was the first lockdown introduced in March 2020 which had the greatest effect on system operability. This is due to the greater extent of the restrictions, as well as the fact that it coincided with a time of year where energy consumption is typically lower.

The graph below shows the average daily drop in demand, relative to what would have otherwise been expected in the absence of the effects of COVID-19.



Addressing operability challenges

For the electricity network to operate securely the requirements for voltage, stability, frequency, thermal and restoration must be met. These historically have been provided by large transmission-connected generation. As the demand has decreased the number of power stations which are providing these services also decreases, this combined with a changing energy mix results in fewer power stations able to provide the key system requirements.

In order to ensure the network operates securely during periods of low demand the ESO has to take more actions, more frequently and for longer to ensure that the needs of the system are met. These actions have involved removing power from the system that cannot provide services, to bring on power stations that are able to provide the system services whilst balancing the network while demands were lower. The size and scale of these actions required more analysis, modelling, planning and actions to be carried out. These low demand levels were unprecedented, and creating models and analysis to understand the characteristics of the system was essential and challenging.

As the pandemic hit, the ESO had to deal with new operability challenges due to the low demand levels, as well as implementing new ways of working due to social distancing. Our priorities during this period were firstly to keep our people safe, followed by keeping the lights on, financial management, meeting our licence obligations, managing and meeting expectations, and carrying out activities to prepare for the upcoming RIIO-2 price control. Our Mid- Year Report[1] describes the actions we took to ensure that we safeguarded our teams. Actions were also taken to ensure that the system remained secure and operable. These actions included working closely with the market on a range of activities:

- Optional Downward Flexibility Management (ODFM)
- Sizewell Contract
- Super Stable Export Limit (SEL) contracts
- Battery trial
- Fast tracking the Accelerated Loss of Mains Change Programme (ALoMCP)
- Code Modification for Emergency Disconnection of Embedded Generation
- Code Modification for Deferring Balancing Services Use of System (BSUoS) charges
- Future Energy Scenarios update to support analysis for the Capacity Market auctions.

We recognised that it was important to keep our stakeholders informed during this period, and introduced weekly webinars (now known as the ESO transparency forum) where we have ensured that there is a shared understanding across the whole industry of the operability challenges caused by COVID-19. This also provides a weekly forum for the industry to provide feedback on what and how we are doing.

[1] https://www.nationalgrideso.com/document/178351/download

As described in the Mid-Year Report, the new activities required to manage the operational challenges resulting from COVID-19 led to the ESO needing to re-prioritise its activities. This resulted in the ESO agreeing regulatory flexibility with Ofgem for a number of projects, and producing the Forward Plan Addendum[2] to provide transparency of these revised timelines. However, the impact of COVID-19 on the ESO's activities is not limited to these specific projects, and the challenges of social distancing, remote working and home-schooling will have had both a direct and indirect impact on the ESO's ability to collaborate effectively with its stakeholders and deliver its ambitious plans. Despite these challenges we have still successfully delivered over three-quarters of the activities set out in the Forward Plan Addendum for 2020-21.

Impact on balancing costs

As described in the Mid-Year Report, the key challenge during the Summer months related to the low demands experienced due to the COVID-19 lockdown. Ensuring enough downward flexibility whilst meeting all other system requirements (thermal, frequency, voltage, stability and restoration), drove the use of a number of additional tools including the Sizewell contract and the ODFM service.

The costs of ODFM and Sizewell were captured through the constraint categories and can be seen in the Monthly Balancing Services Summary reports[3]. While the services were put in place to manage the low demands resulting from COVID, the Sizewell de-load also mitigated response and energy balancing costs through the period.

As we moved into the higher demand periods, the challenge shifted to tight margins. The financial impact of COVID-19 accelerated the loss or closure of some providers which in turn exacerbated plant unavailability. During tight margin periods, the scarcity of energy drove high offer prices from the market which in turn drove high balancing spend.

An independent review of balancing costs has been carried out by DNV and found ESO has "acted efficiently and effectively to address the system need" using "agile, yet robust processes". The full report will be made available to Ofgem, with an Executive Summary published on the ESO website.

More information about Balancing Costs can be found in Metric 1A.

Learning points for future business continuity planning

The ESO had already in place pandemic processes and procedures which were used during the COVID-19 pandemic. These were used, and combined with an agile approach to implementation supported what we believe to be a successful business continuity outcome:

- No disruption in the operation of the electricity system.
- Very low absenteeism.

It is worth highlighting some of the key lessons learnt in continuity throughout this pandemic:

- Maintaining strong and regular stakeholder engagement, to share the latest statuses and best practice.
- Removing barriers to IT systems and tools, which allowed the vast majority of ESO employees to work safely from home.
- Supporting the adoption of a flexible approach to working hours to aid employee wellbeing.
- Defining and monitoring 'COVID Bubbles', for staff deemed critical for the operation of the system.
- Implementing a COVID-19 lateral flow testing scheme, initially for critical staff only but now available to all those working from an office.

ESO will continue to learn from this pandemic: it has validated various assumptions and added clarity to many others that, until now, had never applied in a real event. With that in mind the ESO:

- Continuously re-assesses assumptions and updates its Business Continuity arrangements.

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[2] https://www.nationalgrideso.com/document/173131/download

[3] https://www.nationalgrideso.com/industry-information/industry-data-and-reports/system-balancing-reports

- Established a Build Back Better working group, looking at how to build back better from this pandemic and, working collaboratively with employees, develop new ways of working, optimise space and working environments, enhance IT as an enabler of flexibility, and assess further opportunities to support employee wellbeing.
- Is maintaining existing momentum with stakeholders to think about resilience and business continuity with a whole system view.

Applying our learning to operating the system

The low demands observed during the summer of 2020-21 meant that a large proportion of the generation on the system was low carbon. This has provided a valuable insight into the challenges we will face as the energy system decarbonises, and as part of our Operability Strategy Report[4] we have considered how we will ensure that we are well placed to face such challenges in the future.

Operability Challenge	Actions taken by ESO to manage challenge during 2020-21	How this challenge will be met in future years
Frequency	Introduced Optional Downward Flexibility Management (ODFM) service and Dynamic Containment (DC) product. Our Frequency Risk and Control Report (FRCR) analysis establishes a clear, objective, transparent process for assessing reliability vs. cost to ensure the best outcome for consumers.	If approved, we will implement the FRCR proposal. We will take the lessons learned from the development of DC and ODFM, and apply these to our plans to develop a new suite of reserve reform products. This includes reaching new providers, and benefitting from the accessibility improvements resulting from Wider Access to the Balancing Mechanism.
Stability	Took actions to replace zero carbon plant with stability-providing synchronous plant, to manage the risk of disconnecting embedded generation	The outcome of the Loss of Mains and Stability Pathfinder projects will reduce the need for operational interventions of this type. We are using the learnings from the Pathfinder to support the development of a new industry-agreed specification for stability via our consultation on GC0137[5], and will investigate the need for a short-term stability market through an innovation programme, working together with industry.
Voltage	The short-term Mersey Voltage Pathfinder has been used extensively during 2020-21 to negate the need to run fossil-fuelled generation for reactive support. However, it was also necessary for ESO to instruct some synchronous generators onto the system to provide reactive power, displacing renewable generation.	We are progressing the Pennines Pathfinder and Power Potential projects, which should reduce the need to take actions to displace renewable generation in the future. We are also conducting a holistic review of reactive power, working closely with industry to understand the issues with the current market.
Thermal	Took actions to reduce the zero-carbon generation in Scotland and the North of England due to thermal constraints	We have set out our 5-point plan for managing constraints. The Constraint Management Pathfinder will help to find commercial solutions which will help increase the amount of power that can be exported from Scotland and the North of England. We are also working with Distribution Network Operators on the Regional Development Programmes, which will increase the visibility and control of embedded generation units. We are also continuing to improve the existing network by

[4] https://www.nationalgrideso.com/document/183556/download

[5] https://www.nationalgrideso.com/industry-information/codes/grid-code-old/modifications/gc0137-minimum-specification-required

		recommending improvements via our Network Options Assessment (NOA) process.

Role 1

Control Centre operations

Role 1: Control Centre Operations

Evidence of consumer benefits

- We went live with Power Available phase 2, optimising our systems to enable wind power to be used for response services (approximate consumer saving £1.5m per year)
- We have continued to enable BM participation from smaller parties, increasing competition in the Balancing Mechanism which should lower prices and lead to lower balancing costs than would otherwise be the case
- We have trialled a new tool, the Transmission Network Topology Optimisation tool, which will optimise our transmission network to relieve constraints, using recommendations from an algorithm to reconfigure our network (approximate consumer saving £21.8m - £65.5m per year)

Stakeholder views

We work closely with our stakeholders and have listened to their views. A few examples are:

- Weekly webinars introduced during initial COVID-19 lockdown, and subsequently evolved to provide greater transparency on key topics
- Shared our 5-point plan for managing constraint costs via a webinar and sought feedback
- Acted on stakeholder feedback to improve our engagement for project TERRE, forming the GB TERRE implementation group
- Worked closely with interconnector stakeholders for IFA2 commissioning
- Transparent coverage of winter margin challenges
- Technology Advisory Council (TAC) formed to guide digital, data and technological transformation

Plan delivery

- Reacted quickly to the COVID-19 pandemic: ensuring colleague safety, and security of supply, and deferring charges to protect our customers
- Delivered Wider Access to the API, and expanded dispatch facility to accommodate a large number of small BMUs
- Completed phases 1 and 2 of Power Available
- Improved transparency via weekly ESO transparency forum and meeting commitments in our transparency roadmap
- Delivered all Platform for Energy Forecasting deliverables

Performance metrics and indicators

Metric/ Performance Indicator	Performance	Status
1a Balancing cost management (metric)	The balancing costs were £1779m outturn against the £1209.7m benchmark	●
1b Energy forecasting accuracy (metric)	The annual performance in the 2020-21, the Mean Absolute Error (MAE) of the day ahead demand forecast is 596MW which is in-line with expectations. The Mean Absolute Percentage Error (MAPE) of the day ahead wind forecast is 4.9% which has exceeded expectations	● ●
1c Security of supply (metric)	There were no excursions on both voltage and frequency	●
1d System access management (metric)	There were 2.35 delays or stoppages per 1000 outages	●
1e Customer value opportunities (metric)	In total we have achieved 16,940 GWh of extra generation capacity (worth approximately £1,171m)	●
1f CNI system reliability (performance indicator)	During 2020-21, the BM experienced 7 minutes of unplanned outages, and the IEMS experienced 100 minutes of unplanned outages	N/A

● Exceeding expectations ●Meeting expectations ●Below expectations

A.1 Evidence of consumer benefits

We present three case studies for role 1, to showcase some key areas where we have delivered significant consumer benefit. It would not be practicable to approximate the consumer benefit of all of the deliverables in role 1, although we would expect each of these deliverables to deliver benefits to today's consumers, future consumers, or both. We have included the following case studies for role 1:

- Power Available phase 2
- Small participants in the Balancing Mechanism (BM)
- Optimising our transmission network to relieve constraints

We have used the following areas of consumer benefit, as defined by Ofgem:

- Improved safety and reliability
- Reduced environmental damage
- Lower bills than would otherwise be the case
- Improved quality of service
- Benefits for society as a whole

A.1.1 Case Study: Power Available Phase 2

Activity	Power Available is a real-time signal from intermittent generators (currently all wind farms) that indicates the amount of power they can generate. This is important for calculating the amount of "headroom" that an intermittent generator can provide, which increases the opportunities for them to be used for frequency response when it is economic to do so. Making better use of intermittent generation to balance the system is a critical step in enabling our zero-carbon operation ambition and achieving the UK's legislated net-zero targets. Phase 1 went live in May 2020 and presented the real-time signal to the control room. Phase 2 went live in March 2021 and comprises two main deliverables: • Blending the Power Available signal with our real-time wind forecasts to improve their accuracy • Incorporating the Power Available signal into response calculations across a number of future time horizons, allowing better use of intermittent generation for response services. There are currently around 120 wind farms that provide the Power Available signal, up from 90 a year ago.
Role	1. Control Centre operations
ESO Ambitions	• An electricity system that can operate carbon free
Key Forward Plan Deliverables	Support access for intermittent generation: deliver second phase of Power Available integration
Is the consumer benefit mainly this year or in future years?	The consumer benefit will be realised in future years, as per the sections below.
Calculation of monetary benefit to consumers	Consumer bills will be reduced in situations when it is cheaper to use wind for response than existing providers (high wind, low demand scenarios). To model the consumer benefit, we have modelled the cost savings of replacing conventional machines with wind during overnight periods, where such system conditions (high wind, low demand) are often encountered. We assume that wind has already been bid down for energy reasons. We first calculate the cost of bringing a conventional unit on for response: • Typical time to run: 23:00 – 07:00 • Typical unit stable export limit (SEL): 250MW (In other words, we need to bring the unit from 0MW to 250MW to "unlock" the available response) • Indicative offer price in high wind / low demand periods: £50/MWh Cost of running machine: 8 hours x 250MW x £50/MWh = £100,000 Because we have brought a conventional unit on for response, we need to *further* reduce the amount of wind to ensure the system remains balanced: • Typical period wind is bid down for energy: 02:00 – 05:00 • Reduction: 250 MW • Typical wind bid costs: £70/MWh Cost of reducing wind output: 3 hours x 250MW x £70/MWh = £52,500 Total cost: £100,000 + £52,500 = £152,500 Next, we consider how often we will have high wind / low demand periods. During 2020, we used Optional Downward Flexibility Management five times. We make the reasonable assumption that, in the near future, there will be 10 such overnight periods of high wind / low demand. **Total benefit: £152,500 x 10 times per year = £1.525m per year**

	We expect the consumer benefit to increase as we gain more operational experience of using wind for response services and the level of wind generation increases. For example, there is currently around 10GW of offshore wind capacity – under the government's 10-point plan this is forecast to rise to 40GW by 2030 and 75GW by 2050.
Assumptions made in calculating monetary benefit	• Intermittent generators provide the Power Available signal (it is mandated for all Power Park Modules with a completion date on or after 1 April 2016) • Power Available signal data is accurate • Wind farms hold frequency response contracts • In low wind, high demand scenarios, wind has already been bid down for energy reasons.
How benefit is realised in the consumer bill	Using cheaper providers for response services lowers balancing costs. This reduces BSUoS charges that are ultimately passed on to the consumer bill.
Non-monetary benefits	**Improved safety and reliability**: implementing Power Available Phase 2 will improve our ability to accurately hold positive and negative response on wind power, particularly during high wind / low demand periods. This provides another "tool in the toolkit" for ensuring a safe and reliable system, and is one that will be increasingly important as levels of wind generation increase. **Reduced environmental damage:** In addition, as increasing amounts of intermittent generation come online, it is essential we can use them for balancing services if we are to meet our zero-carbon operation ambition. The carbon intensity of our balancing actions will be lower than would otherwise have been the case, because using wind for upward response does not add carbon onto the system.
Assumptions made in calculating non-monetary benefit.	• Intermittent generators provide the Power Available signal (it is mandated for all Power Park Modules with a completion date on or after 1 April 2016) • Power Available signal data is accurate

A.1.2 Case Study: Enabling BM participation from smaller parties

Activity

Since 2017-18, the ESO has been committed to delivering improved access to the GB Balancing Mechanism (BM). We're removing barriers to entry, by improving existing routes to market, developing new cost-effective routes to market, and enhancing IT systems. Throughout these activities, our goal is to ensure that the BM is open to all technologies, facilitating increased competition in the BM market, and driving down costs for consumers. Over the past year, we've seen a notable increase in participation from smaller units, both in the number and capacity of active units.

One example of a new cost-effective route to market is the Virtual Lead Party (VLP) route. A Virtual Lead Party (VLP) is an independent aggregator that controls (potentially on behalf of a third party) power generation and/or electricity demand from a range of assets for the purposes of selling Balancing Services to National Grid ESO.

Following the go-live of Wider Access arrangements in December 2019, we have worked closely with market participants to enable them to participate in wider access via the current routes to market. The table below shows the number of wider access applications including VLPs in 2020-21.

Date	No of applications	No of BMUs	Total MWs
April-October 2020	6	12	139.93
October 2020-April 2021	8	15	169.42
Total for 2020-21	**14**	**27**	**309.35**

- 6 applications were submitted between April-October 2020, all completed the pre-qualification process. 109MW of the 139.93 MW are actively participating in the BM. The remaining MWs will be going live imminently.
- 8 additional applications were submitted between October 2020 and April 2021, these are all currently at different stages of the wider access process, these should all be active in the BM by July/August 2021.
- 3 of the 8 applications are from providers who have already completed the process and have come back with further applications
- There are currently another 2 applications due to be submitted to NGESO imminently.
- There are approximately another 6 providers actively showing interest in the process, who will be looking to submit applications throughout 2021.

Our Wider Access Application Programming Interface (API), which was implemented in September 2020, has also made it easier for new parties to enter the BM. The new API infrastructure uses web services across the internet to enable access to the BM. The API is currently sized to cater for 25 Control Points and 150 BMUs and can be incrementally expanded as demand for the API service increases. We have promoted Wider Access through industry events, and all interest is directed to the website which has detailed guidance and supporting documentation detailing wider access requirements and processes. Website improvements are currently underway which will help users to clearly navigate and highlight documents of interest.

There has also been a significant growth in aggregated units. The number of aggregated units registered was 13 in the calendar year 2018, 34 in 2019, and 58 in 2020. There were 12 units registered so far in 2021 and 7 aggregated units have subsequently deregistered. We currently have a total of 110 aggregated units connected to the system.

Role

1. Control Centre operations

ESO Ambitions

- An electricity system that can operate carbon free
- Competition everywhere

Key Forward Plan Deliverables	Widen access to API (Application Programming Interface) System Expand dispatch facility to handle a large number of small Balancing Mechanism Units, subject to market take-up
Is the consumer benefit mainly this year or in future years?	Some smaller participants have already entered the Balancing Mechanism, benefitting today's consumers. However, we expect the changes we have made so far to facilitate entry for many more small participants, delivering significant benefit for future consumers.
Calculation of monetary benefit to consumers	Increasing participation in the Balancing Mechanism will increase the ESO's options for balancing supply and demand. This will allow the ESO to further optimise its balancing decisions and incur lower balancing costs than would otherwise be the case. As balancing costs are influenced by a range of factors, it is not possible to provide a realistic estimate of the monetary benefit to consumers.
Assumptions made in calculating monetary benefit	We have assumed that increased competition would lower prices in the Balancing Mechanism.
How benefit is realised in the consumer bill	A reduction in Balancing Costs feeds through into lower BSUoS charges.
Non-monetary benefits	**Reduced environmental damage/ benefits for society as a whole:** Wider access and smaller providers would support participation from providers who have low or zero carbon emissions, which would deliver against the UK carbon intensity targets. **Improved quality of service:** these activities are making it easier for our customers and stakeholders to participate in the Balancing Mechanism.
Assumptions made in calculating non-monetary benefit.	The assets which are coming through the VLP routes are typically those with a lower carbon footprint e.g. batteries.

A.1.3 Case Study: Optimising our transmission network to relieve constraints

Activity	Transmission Network Topology Optimisation with NewGrid Supply and demand on Great Britain's National Electricity Transmission System (NETS) must be balanced continuously. It can suffer from congestion, meaning that power cannot always be transmitted to where it is needed. The resulting constraint costs are ultimately passed on to consumers. Thermal constraint costs for 2020-21 totalled £ 546million. As the generation mix changes, finding new ways to optimise the network is increasingly important, both to increase system capacity and to reduce costs to consumers. The project builds on research work undertaken in the United States by consultancy firm NewGrid in collaboration with Boston University. By applying algorithms to parts of the US transmission network, the study improved thermal capacity by 4-12% across critical network boundaries. If similar improvements were made on the GB electricity transmission network, substantial constraint savings could be achieved. A year-long trial began in April 2020 to check if the benefits of the NewGrid transmission network topology optimisation could be replicated on the GB system. We ran this as a service, to allow us to determine whether the NewGrid tool would be helpful in providing recommendations to re-configure the network to reduce congestion, before considering whether to invest. The trial consisted of taking snapshots of the offline GB transmission model at times of predicted system congestion to NewGrid, who would run their algorithm and respond with recommendations for optimisation actions, such as alternative running arrangements at substations. Our control room would then assess whether the recommendation would cause any further issues, and could then implement the recommendation if it was suitable. Several findings emerged from the trial: • The NewGrid algorithm was able to provide helpful recommendations for re-switching the network, which had the potential for reducing constraint costs • Looking at system-wide flows (rather than just the area of congestion) had the potential to reveal cost-efficient actions to increase network capacity • The timings of the process are important: under the trial, there would be a delay of 2 days between taking the snapshot and receiving the recommendations, due to the process described above. In some cases, this mean that the recommendation was no longer valid. In other cases, the recommended actions caused other issues, for example reducing system security, meaning that they could not be implemented. Going forward, we are considering integrating this optimisation algorithm as part of our real-time systems. This would alleviate the timing issue described above (as the algorithm would have access to the latest outage patterns and generation output), and mean that the recommendations could easily be assessed from a security of supply perspective.
Role	1. Control Centre operations
ESO Ambitions	• A whole system strategy that supports net zero by 2050
Key Forward Plan Deliverables	N/A: this relates to our overarching role in operating the transmission system economically and efficiently.
Is the consumer benefit mainly this year or in future years?	Although there are examples of the trial reducing constraint costs during 2020-21, the main benefit would be in future years when the algorithm is integrated with our real-time systems.
Calculation of monetary	Benefit this year: for example, re-configuring a particular substation was able to relieve a constraint on flows from the South East of England, leading a reduction in constraint costs of

benefit to consumers	approximately £425k. This is based on calculations from our Constraints Strategy team, who are responsible for sanctioning the cost of outage requests. Future benefits: the tool is expected to lead to a 4-12% reduction in constraint costs. Constraint costs during 2020-21 were £ 546million. This suggests that the potential future benefit of this tool, once integrated within our systems, is £546m x 4-12% = £21.8m - £65.5m per year.
Assumptions made in calculating monetary benefit	The figure of 4-12% is based on improvements in thermal capacity observed on parts of the US transmission network[6]. We have assumed that the constraint costs experienced during 2020-21 are representative of constraint costs in future years. We have assumed that the recommendations provided by the NewGrid tool can be implemented: this will be ensured by integrating it within our real-time systems.
How benefit is realised in the consumer bill	Constraint costs form part of balancing costs, which we discuss in further detail in metric 1A. Balancing costs feed into BSUoS charges, which are eventually passed on to end consumers.
Non-monetary benefits	**Reduced environmental damage/ benefits for society as a whole:** increasing transmission system capacity through optimising the network configuration, allowing more energy to be supplied from renewable sources.
Assumptions made in calculating non-monetary benefit.	We have assumed that increasing the capacity of the transmission network will result in fewer bids being required on wind generation.

[6] http://newgridinc.com/wp-content/uploads/2020/06/Topology-Optimization_Ruiz-Caspary-Butler_FERC_20200624.pdf

A.2 Stakeholder views

- We introduced weekly webinars to regularly engage with our stakeholders during the initial COVID-19 lockdown. These weekly webinars have evolved to provide greater transparency on topics such as balancing costs, our control room's decision-making process, and trading
- We held a webinar in March 2021 to share with industry, and get feedback, on our five-point plan[7] to manage constraint costs, which includes clearer forecasts on BSUoS costs, developing intertripping capability including through our Pathfinder, working with regional networks on a whole-system approach, exploring storage potential in a heavily constrained network, and continuing to improve our existing network.
- We recognise and share the frustrations of stakeholders in the delay to project TERRE. Reacting to this feedback we formed the GB TERRE implementation group, chairing a regular dialogue with industry
- We worked closely with interconnector stakeholders during the commissioning of the IFA2 interconnector
- We were transparent about the margin challenges we faced over the winter
- The Technology Advisory Council (TAC) (previously known as the Design Authority) was formed to help guide our digital, data and technological transformation

Upgrade of Information Systems

Produce plan for widening access to API (Application Programming Interface) system

We have worked with industry to deliver the Wider Access API system and, on 17 September, we successfully connected the first party to the Balancing Mechanism through the API. The project team have engaged with industry over the last year to raise awareness of the potential benefits of this project, and to support the API development work. We have received very positive feedback on our wider access work:

Market participant: *'We are delighted to be working with [fellow market participants] and to be the first project to come into the GB balancing mechanism using National Grid ESO's new wider access API. The API creates a new opportunity to lower costs and barriers to market participation and we are excited about the role this can play in unlocking the full power of battery storage and renewable energy in achieving a decarbonized society*.'

Engineering, Procurement and Construction (EPC) company: *'Opening of the BM to new participants through the new API is an exciting moment for renewable and zero carbon flexibility technologies*.'

Engineering, Procurement and Construction (EPC) company: *'With the increasing market demand for flexibility services, continued progress on National Grid ESO reforms and technological improvements are the best way to allow the participation of new technologies in the BM and other flexibility services.*

Feedback received from a market participant via our Customer Satisfaction Survey for Wider Access was:

'Interactions at senior management level is frequent with very encouraging conversations, however at a practical (operational) level the biggest issue is the joined up communications around the Balancing mechanism processes in particular, were additional support and interaction would be much appreciated, it seems lack of resource is likely to be the contributing factor'

We have since provided a single point of contact for stakeholders and we will share timescales of delivery when requests for support come in.

Interconnector programmes

In January 2021, electricity started flowing at full capacity through IFA2. This is the second electricity interconnector linking the UK and France and is a joint venture between National Grid Ventures and French Transmission System

[7] https://www.nationalgrideso.com/news/our-5-point-plan-manage-constraints-system

Operator RTE. We supported IFA2 throughout go-live to ensure a smooth transition from commissioning to go-live for all parties. We assisted in ensuring all commissioning tests could be completed by IFA2, whilst ensuring security of supply. During commissioning, we continued to collaborate with NGIFA2 and RTE to ensure the IT systems and operational processes were enabled in order to send and receive communications with IFA2 and RTE, and to keep the market updated post go-live. Updates were also agreed and made to IFA2 documentation to reflect changes caused by Brexit.

The 'Road to 2025' is a NGESO-led strategy project to develop the interconnector model needed for net zero enabled system operation by 2025 and beyond. During Q3 2020-21, bilateral engagement sessions were held with each of the current and imminent TSOs to confirm the strategic objectives. In Q4, similar sessions were held with both BEIS and Ofgem and four workshops were held with the interconnector community focusing on the specific deliverables identified under Trusted Partnerships, Operability, Industry Frameworks and Interconnectors into Markets.

We have received good feedback from our interconnector stakeholders:

Interconnector: '*The support we had through commissioning has been brilliant*.'

Interconnector: *'Please pass on our appreciation to all in ESO involved in IFA2.'*

The 'Road to 2025' engagement has received broad, positive support from those involved including BEIS, interconnectors and remote end System Operators.

Significant upgrading of IT systems to prepare for European Network Codes

Implementation of Project TERRE

On 4 September 2020, we published an update[8] stating that go-live for TERRE would not be achieved before December 2020. In November, Ofgem published an open letter[9] highlighting industry feedback at frustration at the delays, lack of certainty regarding implementation timelines and the levels of engagement from the ESO. Ofgem requested the ESO convene a GB TERRE Implementation Group[10]. This group has met from November onwards to discuss the implementation of Replacement Reserve (RR) in GB.

During November and December, we worked with the group to develop a number of scenarios for GB RR implementation, dependent on credible outcomes from the Trade & Cooperation Agreement (TCA). The eventual TCA was consistent with one of the scenarios, and we have moved onto the next stage which is to commission a third-party to carry out an independent cost-benefit analysis of a GB-only RR product.

Key points of feedback from the group include:

- Concern about committing resource to TERRE while legal status of GB participation in TERRE is uncertain and post-TCA, while balancing timescales are not considered a priority[11].
- A desire for the ESO to focus on its response and reserve reforms, rather than RR

Asking a third party to conduct a CBA is a proportionate next step that balances this feedback. It respects the fact that the original CBA indicated benefit of €17 million per year to GB consumers, but also allows us to consider the outcome of the UK–EU Trade & Cooperation Agreement and changes to the energy market since the pre-EU exit CBA was carried out. Moreover, a CBA carried out by a third-party will also ensure independence and reflect feedback

[8] National Grid ESO: TERRE project GB announcement https://www.nationalgrideso.com/document/176006/download 4 September 2020

[9] Ofgem: Open letter on the delays to the implementation of TERRE in GB https://www.ofgem.gov.uk/system/files/docs/2020/11/open_letter_on_the_delays_to_implementing_terre_in_gb_0.pdf 6 November 2020

[10] Outputs from the group are available here: https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/replacement-reserve-rr

[11] See, for example, guidance from BEIS which focuses on day-ahead arrangements https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/958195/secretary-of-state-electricity-trading-arrangements-guidance.pdf

from the group including that other parties such as market participants and interconnectors are unable to commit resource to TERRE at present.

We are committed to maintaining dialogue with industry, and in March 2021 we published an update[12] on the next steps, including how we intend to engage in the short-term.

Technology Advisory Council (TAC)

The Technology Advisory Council (TAC), referred to in the Forward Plan as the Design Authority, was launched in December 2020. Its role is to help guide the ESO's digital, data and technological transformation to support the carbon-free operation ambition. The group has broad stakeholder expertise from inside and outside the energy industry and from UK and abroad, including in the networks, markets, technology, academic and consumer sectors. On the new TAC page of the ESO website[13], you can find out about the individual TAC members. Minutes of the group's meetings are also linked to from the page.

The programmes that will deliver our new control systems and markets over the RIIO-2 period will be engaging with the TAC during the life cycles of the projects to help us:

- Shape future process and technology decisions
- Benefit from best practice
- Ensure that our deliveries meet market requirements

Chair: *'The TAC brings together a wide range of industry stakeholders who are helping ESO develop its huge and exciting programme of technological transformation. The insight, constructive challenge and creativity of council members is already proving invaluable and will be vital to the delivery of benefits to consumers and market participants in the years ahead'.*

Consultancy*: 'More EVs, more wind and solar, more heat pumps, more demand-side actions- the journey to net zero is changing how National Grid ESO operates the electricity system, and digital transformation is critical to enabling these new capabilities. I feel privileged to be part of the TAC (who represent many of the drivers of change and the new capabilities) and input into National Grid ESO's plans.'*

Supplier: *'Whilst still in its infancy, the TAC brings together an impressive array of technology and industry experience and expertise, very ably chaired by Vernon. I expect it to be an effective forum for the ESO to test, develop and challenge its plans for building the technology required to operate and optimise a modern net zero electricity system. I'm really looking forward to future sittings of the TAC and getting into the meat of the problems.'*

Provider: *'I'm encouraged by the early TAC engagement. There have already been insights from leading digital companies, particularly around close alignment of the tech & ops teams to increase speed of development. I would like to see some quick wins delivered this year to build confidence, momentum and trust that the ESO & TAC combination can deliver results. I'll be pushing for clear direction and an increased pace of development. With that, I hope the ESO can not only keep up with the fast-evolving system, but help to accelerate the twin transitions of going digital & Net Zero.'*

Increased transparency through improved access to our information and data

Over the past year, we have made significant strides to improve access to ESO data through the Data Portal. During the year, we have added 36 datasets to the portal, which includes new datasets (such as Non-BM dispatch Instructions and Interconnector Requirements), migrated datasets (including the Connections Registers and Upcoming Trades), and improved datasets (such as the machine-readable System Operator Plan). Where appropriate, all new datasets have been provided in a machine-readable format and are accessible via the Data Portal API.

[12] National Grid ESO: Project TERRE Programme Update https://www.nationalgrideso.com/document/188721/download 24 March 2021

[13] https://www.nationalgrideso.com/who-we-are/stakeholder-groups/technology-advisory-council

We have held over 25 stakeholder engagement sessions throughout the year and have used the feedback from these sessions to inform improvements to the portal, such as the introduction of the registration and notification feature. Throughout these sessions, feedback has been uniformly positive, which is reflected in the average 94.12 Net Promoter Score from the most recent engagement sessions. The ESO Data Portal continues to deliver on several of the Energy Data Task Force (EDTF) best practices, and the success of the portal has inspired an electricity distribution network operator to adopt the same software, and replicate the features built for the ESO portal when building their own data portal. Quotes from the latest sessions (December) include:

University: *'Great Progress', 'Fantastic Achievement', 'Easy to find data'*

Energy Company: *'Great to have everything in one place', 'Having Categories is useful'*

Service Provider: *'You're moving faster than we can keep up with', 'Everything in one place', 'Really big fan', 'Updated regularly'*

Energy Storage: '*Perfect', 'Specific', 'Simple to Use'*

Generator: '*Right Direction', 'Significant Change', 'Increased Transparency', 'Clarity'*

Supplier: *'Clear', 'Easy to Navigate', 'Comprehensive AP', 'Everything in one place'*

TO: '*Very well structured', 'Easy to access'*

Transmission Outages, Generation Availability (TOGA) replacement

There are two main parts of the TOGA replacement project: eGAMA and eNAMS. eGAMA (electricity Generator Availability and Margin Analysis) is externally a tool provided to generators/interconnectors to meet their Grid Code OC2 requirements for providing outage data to NGESO, if we cannot take their data from the Elexon REMIT Portal. It allows for Margin calculation and planning. The system along with the REMIT data collection replaces the old TOGA-GOAMP. eNAMS (electricity Network Access Management System) is an NGESO developed tool created to effectively manage asset owners' electricity system outage requests and to give visibility of those outages to affected users. It replaces the Outage Management capability within TOGA (Transmission Outage & Generator Availability).

We have delivered eGAMA. However, eNAMS was delayed accommodating stakeholder requirements and by availability of Subject Matter Experts (SMEs) during a busy outage year to undertake User Acceptance Testing (UAT) and provide training needed to deliver a viable system. In general, the TOs have been concerned about the amount of time it is taking to test all the functionality, and the number of further requirements that have been raised from User Acceptance Testing (UAT) has been more than they and we had envisaged. However, we have also received some positive feedback from TOs:

'Many thanks for the comprehensive responses!'

"I do appreciate your efforts in trying to make this project work.'

"Many thanks for this eNAMS update – it's really useful to send round the business at this end.'

'I have no concerns around this. Thanks for the clarity'

'Overall a very informative session which covered everything I think we need to know'

'The course was well prepared and delivered by the project team who did a great job'

'The ability to continue to access the UAT platform for people to refresh on the training material is great, well done.'

Transparency of data used by our ENCC in our close-to-real-time decision making

More clarity of operational decision making

Keeping stakeholders informed of tight margins

Although last summer's challenge related to the risks associated with extremely low demand, this winter saw the converse of this- with six Electricity Margin Notices (EMNs) issued to notify the market of operational margins being lower than our requirements. Each EMN was met by an appropriate response: prices rose, generation made itself available, and interconnectors flowed into GB. We were transparent about the challenges we faced, keeping stakeholders informed of the latest position and providing feedback via the Operational Transparency Forum.

Transparency of operational decision making

In the Forward Plan we made a commitment to improve the transparency of our operational decision making. We have developed a Dispatch Transparency Tool which publishes a dataset onto the Data Portal on a weekly basis to provide additional insight into the actions taken in the Balancing Mechanism (BM).

Throughout this delivery period we have kept industry informed of our progress through the Operations Forum and the Operational Transparency Forum.

Transparency of trading decisions

In the Forward Plan we made a commitment to improve the transparency of our trading decisions. Making more information available will allow stakeholders to make better informed decisions, increase competition and ultimately benefit consumers by reducing costs.

In August 2020, we engaged with industry at the Operational Transparency Forum where we presented our ambitions for transparency and how industry could help guide us on what information they would like to see in relation to our trading activity. We identified a number of options that could help improve the transparency of our trading actions, including changes to the presentation, location and accessibility of existing published information, as well as additional information that is not currently made available.

We asked the industry about areas of transparency that could be improved, including providing more detail about our trades, such as the name of the counterparty, the BMU ID and the system reason for our trades, improving the presentation of our trades, such as having a list of trades with start and end times instead of volume by settlement period, making historic trade downloads available, having the data available in different formats, making the information available in universal time format, and making more information available by publishing more of the actions taken by the trading team, such as including balancing service contracts used for solving thermal and voltage constraints, SO-SO actions, Stable Export Limit (SEL) reduction contracts (Super SEL) and upcoming requirements.

A survey was made available to our counterparties and market participants, in which we asked them for feedback on the items above and asked participants to rank them in order of importance, with 1 being most helpful and 12 being least helpful. We received 29 responses: these are shown in the heat map below.

Question																													
More Detail: CP name	8	5	4	8	8	8	6	9	2	12	7	12	8	12	9	3	10	12	2	7	5	6	12	10	7	3	8	7	12
More Detail: BMU id	7	6	5	2	3	1	5	7	1	7	8	1	1	1	1	2	1	2	1	6	8	1	11	7	8	4	1	1	7
More Detail: Reason (voltage/thermal)	3	4	6	4	6	6	8	6	3	11	1	4	5	2	2	1	2	4	5	5	6	7	9	1	1	11	2	6	6
Better format: each trade in one line rather than time span	9	7	9	3	7	12	7	3	4	8	10	9	9	3	8	8	9	8	8	11	9	12	4	12	9	2	9	4	11
Better format: Historic trades	11	8	10	5	5	9	9	5	8	5	9	7	11	4	10	4	3	9	6	9	1	2	6	4	10	7	10	2	8
Better format: Different download formats	12	9	11	12	9	10	11	1	12	6	6	10	10	8	11	7	8	11	7	12	2	10	7	5	11	5	11	3	9
Better format: Using Universal Time (UTC)	10	10	12	11	1	11	10	12	9	10	12	11	12	11	12	9	12	10	9	10	3	11	8	11	12	1	12	5	10
More information: Balancing services contracts	6	1	1	1	10	2	2	11	6	4	5	3	3	5	3	6	4	5	10	4	7	4	5	9	4	8	3	9	3
More Information: Include SO-SO actions	5	2	7	6	4	7	12	4	10	9	2	5	2	9	7	11	11	6	11	3	10	5	1	2	6	6	4	10	2
More information: Super SEL	4	3	8	7	11	5	4	8	5	3	11	6	7	10	6	12	7	3	12	8	4	9	3	6	5	9	5	11	4
More information: Upcoming interconnector requirements	2	11	3	9	2	4	3	2	11	1	3	8	4	7	5	10	6	1	3	1	11	3	2	3	2	12	6	8	5
More information: Upcoming voltage requirements	1	12	2	10	12	3	1	10	7	2	4	2	6	6	4	5	5	7	4	2	12	8	10	8	3	10	7	12	1

Based on the information received, we were able to prioritise our focus for the remainder of the year. The prioritised plan is summarised in the table below:

Priority	Deliverable	Planned delivery date	Delivery details

1	More Detail: BMU id	In line with P399 (expected Nov 2021)	Subject to approval of P399 – information will be provided on the Balancing Mechanism Reporting Service (BMRS). The trade information on the Data Portal will be updated to include this information
2	More Detail: Reason (voltage/thermal)	Q4 20-21	In March 2021 we started publishing our upcoming trades on the Data Portal. At the same time, we began publishing additional information about the system reason for trading. This includes if the trade is for a RoCoF constraint, thermal constraint or a voltage constraint and the location of the constraint it helps to solve
3	More information: Balancing Services contracts enactment	Q3 20-21	We have been publishing details of all contracts enacted by the trading team onto the Data Portal since December 2020
4	More information: upcoming interconnector requirements	Q3 20-21	We have been publishing our upcoming requirements to trade with interconnector counterparties onto the Data Portal since December 2020. Following our trading activity, this is updated with the results of our auctions (prices, volumes and interconnectors)
5	More information: Upcoming voltage requirements	Q4 20-21	In March we began publishing our week ahead voltage requirement by location on the Data Portal
6	More Information: Include SO-SO actions	Q1 21-22	Very few actions take place between us and our neighbouring TSOs. We will be looking at how this information can be made available during Q1 2021-22
7	More information: Super SEL	Q2 20-21	SuperSEL contract enactments have been published on the Data Portal since July 2020
8	Better format: Historic trades	Q3 20-21	We have published all our previously executed trades back to April 2015 onto the Data Portal. Trades are currently updated on a monthly basis
9	More Detail: Counterparty (CP) name	In line with P399 (expected Nov 2021)	Subject to approval of P399 – information will be provided on BMRS. The trade information on the Data Portal will be updated to include this information
10	Better format: each trade in one line rather than time span	Delivered as part of 8	Historic trades (8 above) are provided in this format while upcoming trades (mentioned in 4 above) retain the format of information on a settlement period basis
11	Better format: Different download formats	Ongoing	All data on the Data Portal can be accessed via an API and is downloadable as a CSV file
12	Better format: Using Universal Time (UTC)	Ongoing	All data published on the portal is in this format

Throughout this delivery period we have kept industry informed of our progress through the Operations Forum and the Operational Transparency Forum.

Examples of feedback received in our survey in August

'We need this information to allow us to better compete for Balancing Services. All the options have merit so please implement them ASAP.'

'More transparency around Interconnectors and So-So would be good as currently only those with interconnector capacity knows Grid's requirements which leads to asymmetric information in the market.'

'Interconnectors are increasingly influencing GB market levels, and the CMN on 15th September shows just how influential they can be. Understanding i/c requirements, and also constraints placed on GB plant due to SO requirements, will help increase transparency and data flow on these critical drivers of UK power price.'

'Knowing the reason behind a Schedule 7 trade and the location of this unit is important information for traders in the market.'

'Greater information in the market place would better inform market participants.'

'Increased transparency will allow me to make more competitive market decisions that will benefit NGC.'

'Allow better understanding of ESO requirements and how to try and meet them.'

'The publication of upcoming requirements would give the market advance warning of actions that NGESO are likely to take and therefore factor these in to future market price / cash out scenarios.'

Next steps

Our outlook for the next quarter is to review the deliverable in relation to SO to SO actions to see if and how this information can be made available. We are investigating other improvements to the above data to improve the frequency of updates to the information, for example the publication of historic trade information.

We would like to give industry a sufficient period of time to make use of the additional data that we have made available on the Data Portal. We then plan to re-engage with them to understand if the information is useful and if it has helped address the requirements they had identified. We will also be asking if there are any improvements industry would like to see to this data, or other data sets that they would like us to explore making available.

Publishing Non-BM trade data

BSC modification P399, which relates to NGESO publishing more transparent Non-BM data such as unit IDs and Interconnector trades, is currently pending approval from Ofgem. This is a modification that has strong support from industry, several standard industry work groups were held between January 2020 and August 2020 which allowed us to engage with industry on the changes they would like to see and allow us to be transparent with our response in terms of cost to achieve those requests. Although engagement was largely positive through this process, unfortunately we had to increase the cost of the selected option due to scope changes from other projects. We received negative feedback in relation to this cost increase. We engaged with industry through the standard workgroups to explain why the cost has increased, providing a breakdown of the costs for them. Although this was ultimately accepted, we recognise that we need to be more accurate with our impact assessment costs.

Support access for Intermittent Generation

Deliver second phase of Power Available integration

Power Available Phase 2 was delivered on 30 March 2021. We have been engaging industry through the Wind Advisory Group, which is convened by RenewableUK. We have held three meetings with them this year – in June, February and March. In those meetings, we have provided progress updates and had productive discussions about how to resolve challenges such as ensuring the data that is provided by the wind farms meets the needs of the control room. One point of feedback from the group was the lack of engagement between June and February. We accept this and have committed to meet with the group every 2-3 months in the future.

Implement State of Energy signal

A project team has been set up to perform an impact assessment of State of Energy signal implementation. We are now defining a signal which works from both a National Grid ESO and Market Participant perspective. The next phase involves engagement with the industry on the definition of the signal and to find participants to be involved during the development stages of the project. The existing plan is to implement a signal in Q3 2021-22.

Whole system operability

Inertia measurement

Development continues on our two Inertia Measurement systems, with the GE system now receiving phasor data from SPEN and being calibrated. We have received several requests for information regarding their development and provided updates to the NGESO Operational Transparency Forum on 3 March and the Global Power Systems Transformation Consortium (GPS-T), a group of worldwide power system operators, on 23 March. Both were well received. In addition to these forums, we have provided information to a number of TSOs who are looking at the same solutions to overcome future inertia issues.

ISO: *'Very interested in the inertia monitoring presentation. I would like to find out more information.'*

TSO: *'Thank you for the discussion on Inertia Monitoring, could we please keep in touch for updates.'*

Deliver competitively tendered Black Start contracts

Black Start Strategy and Procurement Methodology 2021-22

The ESO launched a consultation on the latest Strategy and Procurement Methodology on 4 February 2021, seeking feedback on the short, medium and long term approach including focus on a revised Strategy for the South East tender and a proposal for the next tender in the Northern Region, in both cases looking at including a Distributed Re-Start, some of the responses are below:

Energy Company: *'We are pleased to observe that NGESO are seeking to remove barriers to entry, be transparent in their procurement and specification methodologies and recognise the changing landscape of UK power generation.'*

Energy Company: *'We are pleased to see recognition of some of the delays and issues caused by the current ongoing pandemic.'*

Consultancy: '*We note the intention for the procurement methodology scope to widen to cover distributed resources as part of Distributed ReStart Project which is a good start and must be the way forward in including other such areas beyond that which NGESO is currently aware.'*

Black Start South West and Midlands Tender

On Monday 9 November we announced contracts with six providers for Black Start services in the South West and Midlands, the result of a new approach and tender process for awarding such contracts. The six contracts, five of which are new, total £84 million with each bid offering commercial benefits compared to other bidders and Black Start options. The South West and Midlands tender was launched in February 2019 and these new agreements, which will run instead of bilateral agreements, will provide services from July 2022 for five years, with an incentive to commence earlier if possible and at the discretion of the ESO. Feedback received was:

Consultancy: '*The EOI (Expression of Interest) and the industry engagement process undertaken by NGESO was found to have attracted established participants in providing ancillary services such as black start in the past as well as new participants. This showed that the engagement process worked well and helped to ensure that the tendering process would be competitive.'*

Consultancy: '*The documentation requirement set out as templates by NGESO, from the participants throughout the tendering process were deemed to be clear and easy to follow in terms of what information needed to be provided. In terms of the overall evaluation undertaken by NGESO, it was found to be of a high standard, with only a small number of areas where improvements could be made.'*

Black Start Northern Tender

We also reached out to the tender participants for the Northern Black Start tender in June 2020 after considering the impact of the COVID-19 Pandemic. We suggested a revised timeline in light of the known and anticipated delays to providing the information to complete the Invitation to Tender (ITT) Part 2 Feasibility Study. After listening to feedback we amended the timelines and this was very much welcomed, some of the comments received as follows:

Energy Company: '*Thank you for the update on the tender timescales. On behalf of my company, I can confirm that we have understood and accepted the approach which seems a sensible and pragmatic way forward.'*

Energy Company: *'Thank you for providing an update on the new approach for Black Start Northern tenders. We appreciate that National Grid have accommodated our request in light of the Covid-19 situation. We have read, understood and accept the new approach.'*

We also engaged with an Independent consultant, who were tasked to review the tender processes for the South West and Midlands in October 2020 and the Northern Tender more recently and in both cases were very pleased with the approach to the tenders and the timeliness of information presented to the participants throughout the process, specific feedback was:

'In terms of the overall evaluation undertaken by NGESO, it was found to be of a high standard and a consistent approach applied across all the participants.'

Electricity Operational Forum and stakeholder engagement

Electricity Operational Forum

On Wednesday 11 November we held our Operational Forum. This forum aims to provide visibility and awareness for our customers, providers and stakeholders to help understand and discuss the operation and performance of our balancing services. We received great feedback from stakeholders regarding the improved transparency. During the live event we had 149 people attend, covered six hours of material, and answered over 100 questions. The agenda was a mix of what the ESO had delivered along with a view of some our longer-term deliverables. All the material, including a recording of the event, is available on our website[14].

After each session there was an opportunity for the audience to ask questions, plus there was a general Q&A session at the end of the day. We received and answered 68 questions during the day which were later published on the ESO website along with the recording of the event. Holding the forum online this year allowed for increased attendees. We received an overall score of 8.0 out of 10 for the Operational Forum this year and received the following feedback:

'Excellent and concise summary of the key events so far this year.'"

'It's always great to hear from ENCC. Thanks for wrangling all of the questions.'

NGESO Operational Transparency Forum

Initially set up to provide wider industry with confidence that the control room operational procedures had been appropriately adapted to the COVID-19 situation, the Operational Transparency Forum quickly evolved into a weekly opportunity for subject matter experts from across the business to directly interact with a diverse set of stakeholders, with over 1000 unique attendees. Across these forums we have continually sought to provide timely insight and transparency into our operational decision-making processes both through presenting core information on demand forecasts, costs of actions and outages; and responding to audience questions, directly answering over 1700 questions and providing detailed analysis for more complex issues arising from post event feedback.

The format of this, and future transparency forums is entirely guided by the feedback provided to us both in terms of content and presentation format. We will continue to invite subject matter experts to provide greater clarity where there are large volumes of connected questions or where post event feedback has a request for this information. This forum is an ongoing opportunity to guide our wider work on transparency, highlight issues or opportunities and ask us questions. Some of the feedback we have received is below:

'It's really good to understand why actions taken over an event where made, and to understand how certain events/issues were created in the first place e.g. regarding NRAPM etc. so just to keep going through them.'

'I think the level of transparency you are showing and your engagement with the industry is very valuable. Please continue these webinars.'

'Examples of challenges are really helpful. e.g. the GALLEX slide for example. And in ops forums the "difficult day" presentations. I would welcome more such examples. E.g. outages affecting Scotland exports during recent high winds.'

'Really like the responses to previous questions. Maybe there could be a standard section for key product updates like TERRE/MARI, Dynamic Containment, Arenko test etc.'

'The slides today on constraint info were terrific. Very interesting. This is a really useful session and great to hear ESO benefit too.'

'This is a very useful session, thank you. Perhaps in the future session you could provide some information on the Pathfinders process with the ESO.'

'I really enjoyed the insights on wind speed causing control systems to switch off turbines. It'd be great to see more of these kinds of sessions that provide information on the challenges to ESO - and perhaps how these could change in light of net zero.'

'Excellent presentation on warming requirements and considerations + very good & prompt feedback on the 11th Frequency excursion'

On Thursday 10 December 2020 we published our ENCC Transparency Roadmap which details the steps being taken to increase the transparency of our operational decision making and the data flows used to inform those

[14] https://www.nationalgrideso.com/industry-information/balancing-services/get-involved

decisions. It highlights the data we plan to share with our stakeholders, when and how. We have met all of the commitments to date within this roadmap.

Operational Liaison Meeting

The Winter Operational Liaison Meeting held on 10 November 2020 provided an opportunity to ensure the industry is kept updated on the actions the ESO are taking to prepare for the operability challenges the winter. We had 39 attendees from ESO, DNOs, OFTOs, BEIS and Ofgem. This webinar shared our views on the outlook the winter. It also provided an update on some of our longer-term activities, such as the Regional Development Programme, as well as some individual projects and initiatives. The Q&A session provided an opportunity to raise concerns, and for DNOs, OFTOs, BEIS and Ofgem to share ideas. Feedback has indicated that attendees have found the meeting useful and the content relevant. The next Operational Liaison Meeting will be held in 2021 Summer.

Some highlights of the feedback we received:

- 4.6/5.0 overall rating for the meeting.
- 5.6/6.0 for how relevant this meeting is to your organisation
- 4.8/5.0 for ESO responses to your questions
- 4.5/5.0 for the content of the meeting.
- 80% rated the duration of the meeting just right.

A.3 Plan delivery

A.3.1 Highlights

- Reacted quickly to the COVID-19 pandemic, ensuring the safety of our colleagues as well as security of supply, and deferring charges to protect our customers
- We have delivered Wider Access to the Application Programming Interface (API) and expanded our dispatch facility to accommodate a large number of small Balancing Mechanism Units (BMUs)
- Phases 1 and 2 of Power Available completed, improving our control room's visibility of wind generation
- We have focussed on improving transparency, meeting all the commitments within our Electricity National Control Centre (ENCC) transparency roadmap[15] and introducing a weekly transparency forum
- We have delivered all of our Platform for energy forecasting (PEF) forward plan deliverables, giving additional, improved & frequent forecasts to market participants

This section reports our performance against the deliverable descriptions and dates set out in the Forward Plan Addendum[16]. The Forward Plan Addendum sets out our revised view (as of July 2020) of what we would deliver during 2020-21. During the period of regulatory flexibility, we shared with Ofgem a number of our deliverables where there were known impacts of COVID-19; these are clearly identified in the Addendum. However, we note that the impact of COVID-19 has been felt across many areas of the ESO's work.

We have defined the status of our deliverables as follows:

- Complete: the activity has been fully completed
- Complete for 2020-21: the activities planned for this year have been completed, but the deliverable will carry on into future years
- Ongoing: the activity is still in progress
- Deprioritised: the activity will not be delivered, we explain the reasons for this in the commentary.

For deliverables which continue into future years, we provide a reference to the relevant part of the RIIO-2 Delivery Schedule.

A.3.2 Deliverables

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Upgrade of information systems			
Widen access to API (Application Programming Interface) System	Q1-Q2 2020-21	Complete	API Go-Live occurred on 17 September 2020 Additional capability was added into existing systems in Q1 2021-22 to deal with an increased number of market participants. There will also be continuing scaling requirements - as and when required - which form an ongoing process to allow a wider range of connections for market participants. Communication Standard which defines the capacity limits was approved at December Grid Code panel and has now been issued.

[15] https://www.nationalgrideso.com/document/182566/download

[16] https://www.nationalgrideso.com/document/173131/download

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Expand dispatch facility to handle a large number of small Balancing Mechanism Units, subject to market take-up	Q1-Q4 2020-21	Complete	We have increased data storage capability in 31 March 2021 onwards, from 600 to 2000 BM Units. We will continue to ensure the systems are able to handle the future pipeline of new participants. The programme is moving into the foundation stage which starts in May 2021 for six months. The phase takes the high-level requirements and will produce a prioritised roadmap. In the meantime, we are continuing to ensure our existing systems are able to handle the future pipeline of new participants. As part of the activities building towards RIIO-2 we are gaining an in depth understanding of the requirements to replace our existing systems to ensure these are adaptable and compatible with the transformation for carbon free operation in 2025. This will ensure efficient IT CAPEX spend across the portfolio of IT work and avoid regret spend. An extensive planning exercise to deliver this transformation is currently underway. In the meantime, we will continue with incremental development, in line with operational requirements.
Interconnector programmes	Ongoing	Complete for 2020-21 (see RIIO-2 Delivery Schedule D1.1.5)	Completed: Industry stakeholder engagement has been completed. In Q3 2020-21 six bilateral onboarding sessions were held, covering all current and imminent interconnector parties. Additional sessions were held with both Ofgem and BEIS. During Q4 2020-21, four interconnector workshops were held to assess, confirm and prioritise ESO's initial Road to 2025 work packages. A workshop was held for Operability, Trusted Partnerships, Cross border markets and Frameworks. Ongoing: IT programmes for new interconnectors continue to progress in line with interconnectors' expectations. Net Transfer Capacity (NTC) work has been impacted by both EU Exit (Trade and Cooperation Agreement) and retained elements from the Clean Energy Package. Final regulatory route being currently agreed with Ofgem - current expectation is that NTC will be implemented by the end of Q2 2021-22.
Significant upgrading of IT systems to prepare for European Network Codes	Q3 2020-21	Ongoing	Completed: We continued to work with industry through the GB TERRE Implementation Group to consider the next steps on TERRE Implementation. The Trade and Cooperation Agreement (TCA) indicates that GB will not have access to EU balancing platforms. This was supplemented in January by guidance from BEIS that, while not ruling out the potential for cross-border balancing in the future, indicated that progressing day ahead agreements was the priority. We have engaged the group on the potential for the ESO leading a cost-benefit analysis on a GB-only Replacement Reserve (RR) product, in line with our previously published scenarios. Feedback from the group is that it may be better to wait until the priority items in the TCA are progressed to avoid any duplication or overlap, and that work on TERRE should be paused. Ongoing: We have discussed the group recommendations with Ofgem and agreed to carry out, via a third party, a CBA on a GB only replacement reserve product. The outcome of the CBA will be used to inform the frequency reform programme and can also be used should future technical agreements with the EU afford. No further work with industry will continue at this stage
Frequency and Time Equipment version 3 (FATE-3) Project	Q4 2020-21	Complete	Upgrade was completed on 1 April 2021.
PI gateway refresh	Q2 2021-22	Ongoing (see RIIO-2 Delivery Schedule D1.3.1)	The existing PI link is being maintained until we further upgrade our systems. Activity will resume in 2021-22

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Platform for Energy Forecasting (PEF)	Q1-Q4 2020-21	Complete	New version of Strategic Roadmap published on 25 June. • 2 - 14 Day Ahead Demand Forecast being published on the Data Portal as of 23 September. • 2-52 weeks ahead national demand forecasts were delivered in Q3. • Within day-14 Day Ahead Wind Forecasts were delivered in Q4. Please refer to the ESO Data Portal.[17]
Technology Advisory Council[18]	Q3 2020-21	Complete	We launched the Technology Advisory Council in December 2020. This includes representatives from energy networks, market participants and service providers, technology and transformation experts and academia. Agendas, minutes and slides from all meetings published on website.[19] The group met for a second time in March 2021 and will now meet on a quarterly basis. We will also set up working groups to discuss specific elements in more detail. During the first meetings, we have shared the early transformation visions and roadmaps for our Balancing, Network Control, open data and digital market enablement, with positive feedback received.
Improving information access	Q4 2020-21 - Q4 2025-26	Complete for 2020-21 (see RIIO-2 Delivery Schedule D17.1)	Completed: The Data and Analytics Platform project was mobilised in September 2020 and has completed scoping works in March 2021. A strategy paper has been completed, which includes: • Data Roadmap / Investment Plan • High Level information regarding options for the Data and Analytics Systems Architecture • Overall requirements of the new platform, as determined by workshops with subject matter experts. A Digital and Data Strategy was delivered in December 2020[20]. Foundational requirements of the Data and Analytics platform have been reviewed and prioritised ready for deployment from Q1 2021-22.
Transmission Outages, Generation Availability (TOGA) replacement	Q3 2020-21	Ongoing (see RIIO-2 Delivery Schedule D16.4.2)	Completed: Our original proposal was to replace TOGA (Transmission Outage and Generator Availability) with two new systems by w/c 30 Nov 2020: electricity Network Access Management System (eNAMS) and electricity Generator Availability Margin Analysis (eGAMA). eGAMA was successfully delivered and went live on 18 March 2021 as agreed with Elexon, BSC Panel and Grid Code Panel. Ongoing: eNAMS has experienced further delays during User Acceptance Testing (UAT), leading to ESO revising its timeline. Throughout February and March 2021, the Agile project has carried out further project sprints and concluded that go-live with full eNAMS functionality requires further time for the following reasons: • User Acceptance Testing had taken longer than planned due to availability of internal and external users' and time taken to implement corrections to critical functions identified during UAT • Data validation and migration had taken longer than planned due to the need to review and align existing data structures

[17] https://data.nationalgrideso.com/data-groups/demand

[18] Following discussion with ERSG, we have renamed the group to better reflect its role. It was previously called the Design Authority.

[19] https://www.nationalgrideso.com/who-we-are/stakeholder-groups/technology-advisory-council/documents

[20] https://www.nationalgrideso.com/document/186426/download

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			The project has undertaken a re-planning exercise and streamlined delivery to minimise risk of further delays to go-live. The pilot release of some eNAMS functions went live on 9 December, and the final release of eNAMS and Go-Live is planned for week commencing 31 May 2021. Lessons learned sessions have been undertaken for both eNAMS and eGAMA and actions implemented to minimise any further delays.
Transparency of data used by our ENCC in our close-to-real-time decision making			
More clarity of operational decision making	Q2-Q4 2020-21	Complete	Machine readable version of the System Operating Plan (SOP) went live on 30 September The Super Stable Export Limit (SEL) tool has been created and publication has gone live. A Trading transparency webinar was held and feedback from this has been reviewed. Industry were updated as to plans and progress at the Ops Forum in November and a further update was provided at the Operational Transparency Forum on 9 December 2020. We have now started to publish our historic trades between 2015 and November 2020, IC requirements and auction results, and balancing services contract enactment data. Also GALLEX contract enactments, voltage requirements and any addition system reasons for trades are all being published via the Data Portal. We are currently in the process of reviewing the information for thermal and ROCOF requirements to be able to publish these also. We have started publishing skip rate (now referred to as Dispatch Transparency) data and a supporting methodology under our Forward Plan deliverable "Data to support better understanding our dispatch decisions" on 31 March 2021. The methodology was shared with Ofgem on 28 January. The Dispatch Transparency publication provides details on the reasons actions were taken out of price merit, which therefore supports understanding system needs and how the market operates.
Publishing the BMU ID for trades	Dependent on P399 code change	Ongoing (see RIIO-2 Delivery Schedule D17.4)	This is being covered by the P399 mod, and impacts all cash out files (Trading, N-BM STOR, N-BM FR etc). Completed: The modification went back out for consultation on 8 December 2020, responses were due by 22 December. Responses were collated and presented to the Panel at its meeting on 14 January 2021 and the Modification Report was subsequently sent to Ofgem on 19 January with a recommendation for approval. Ongoing: An Ofgem decision is expected shortly, and the deadline to have the change implemented is November 2021. The recommendation from the BSC panel is that the party IDs are not published prior to the BSC change which is likely to be in November 2021.
Support access for Intermittent Generation			
Deliver Power Available integration phase 1	Q1 2020-21	Complete	Power Available (PA) phase 1 has now been completed. There is a case study in our mid-year report to demonstrate the consumer benefits we have achieved.
Deliver second phase of Power Available integration	Q3 2020-21	Complete	Power Available phase 2 was delivered on 30 March 2021.
Implement State of Energy signal	Q2 2020-21 (Publish outcome of operational trial)	Complete	Three phases of BM Reserve from Storage trial were undertaken and reviews published.

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
	Q3 2021-22 (define and implement signal)	Ongoing (see RIIO-2 Delivery Schedule D1.1.5)	Project will build upon Power Available, and the impact analysis has been delayed as a result of COVID-19 (reference FP addendum). Impact Assessment has now commenced in Q4 2020-21 with planned go-live in Q3 2021-22.
Whole system operability			
Inertia measurement	Q2 2020-21 (first supplier)	Complete	The first supplier GE's inertia metering system is live, PMU data has been provided for the Scottish region and a demo for initial key users has been delivered in March, enabling initial assessment of the results data to now take place across the summer. NGET are continuing to roll out PMUs which will enable additional regions to be added to the Inertia metering system over 2021. The GE Inertia forecasting testing is ongoing. Model training is planned from May with the aim of going live in summer 2021.
	Q1 2021-22 (second supplier)	Ongoing (see RIIO-2 Delivery Schedule D1.2.2)	Second supplier, Reactive Technologies' system is planned to go live in August 2021 (Q2 2021-22) following an extended tender process for the modulator. Work started on the modulator design and build. Initial site works are complete ahead of modulator delivery in May 2021. As the new tools are embedded, we will evaluate them against our existing techniques: this will allow us to assess the benefit of the new tools.
Product Roadmap for Restoration implementation			
Deliver competitively tendered black start contracts	Q1-Q2 2021-22	Complete for 2020-21 (see RIIO-2 Delivery Schedule D3.1.5)	South West/Midlands tender: On Monday 9 November 2020 we announced contracts with six providers for Black Start services. The six contracts, five of which are new, total £84 million with each bid offering commercial benefits compared to other bidders and Black Start options. Historically - dates for tender reviewed with participants in light of COVID-19, amendments made to procurement timelines and service commencement date. Early delivery has been incentivised. Northern: Procurement timeline amended following consultation with providers – may impact on commencement dates for contracts. Current/revised contract award date (delayed due to COVID-19 and following a consultation with all Tender Participants) was 30 April 2021. South East: We have reviewed our strategic approach for the South East, and shared our plans in the Black Start Strategy and Procurement Methodology 2021-22 which was published for consultation on 5 Feb 2021 and submitted for Ofgem's approval in early April 2021.
Electricity Operational Forum and stakeholder engagement			
Electricity Operational Forum	Changed format and delivered throughout the year.	Complete	Weekly ENCC webinars have been held to maintain stakeholder engagement while social distancing measures are in place and have been well received by industry. An online version of the Operational Forum was held in November.
ENCC visit days	Changed format and delivered throughout the year.	Complete	Weekly ENCC webinars have been held to maintain stakeholder engagement while social distancing measures are in place.

A.4 Outturn performance metrics and justifications

Metric/ Performance Indicator	Performance	Status
1A. Balancing cost management	The balancing costs were £1779.0m outturn against the £1209.7m benchmark.	●
1B. Energy forecasting accuracy	For 2020-21, the Mean Absolute Error (MAE) of the day ahead demand forecast is 596MW (in line with expectations) The Mean Absolute Percentage Error (MAPE) of the day ahead wind forecast is 4.9% (exceeding expectations)	● ●
1C: Security of supply	There were no excursions on both voltage and frequency.	●
1D. System Access Management	There were 2.35 delays or stoppages per 1000 outages	●
1E. Customer Value Opportunities	In total we have achieved 16,940 GWh of extra generation capacity (worth approximately £1,171m).	●
1F. CNI system reliability	Throughout this financial year, the BM has experienced 7 minutes of unplanned outages, and the IEMS has experienced 100 minutes of unplanned outages.	N/A

Table 1: Summary of metrics and performance indicators for Role 1

● **Exceeding expectations**

● **Meeting expectations**

● **Below expectations**

1A Balancing cost management

2020-21 Performance

The approach we use for measuring our Balancing Costs performance is based on a linear trend in a five year rolling mean, based on annual Balancing Services Costs (excluding Black Start). In order to meaningfully employ a linear trend, the data points need to handle one-off permanent changes to the system network which would not be captured by the five-year trend. So far, the only change modelled in this way has been the Western Link. We also make adjustments for significant events which we expect to have an impact on balancing costs, whether this is an upwards or downwards adjustment. These are trends which we would not expect to be captured in the 5-year rolling average, because they relate to either new assets or new trends in market behaviour. Additional information regarding balancing costs calculation and benchmark adjustment can be found on our website[21].

Low demand periods are challenging to manage and the volume of actions required by the ESO to ensure the system remains secure lead to higher costs. During the period where demand is impacted by the COVID-19 pandemic, the ESO's balancing costs spend is expected to be significantly higher than the benchmarks stated here. During this period, we will continue to report our performance in comparison to the benchmark, but will focus on providing a detailed narrative which explains the costs we have incurred. We have also provided information to support Ofgem's review of the high balancing costs incurred over Spring and Summer 2020.

Please note that the benchmarks were re-calculated in July 2020 to remove the ElecLink adjustor since the interconnector go-live date has been delayed.

	Apr	May	Jun	Jul	Aug	Sep
Benchmark cost (£m)	67.0	48.2	82.6	65.5	102.0	103.7
Additional cost forecast due to WHVDC fault (£m)	0	0	0	0	0	0
Benchmark adjusted for WHVDC (£m)	67.0	48.2	82.6	65.5	102.0	103.7
Outturn cost (£m)	122.4	159.1	135.6	136.0	117.7	135.6
Status						

Table 2: Apr-Sep 2020 Monthly Balancing Cost Benchmark and Outturn

	Oct	Nov	Dec	Jan	Feb	Mar	Total
Benchmark cost (£m)	126.9	82.8	126.6	133.2	142.5	118.3	1199.3
Additional cost forecast due to WHVDC fault (£m)	0	0	0	0	5.2	5.2	10.4
Benchmark adjusted for WHVDC (£m)	126.9	82.8	126.6	133.2	147.7	123.5	1209.7
Outturn cost (£m)	142.4	197.4	162.0	136.9	168.9	165.1	1779.0
Status							

Table 3: Oct 2020-Mar 2021 Monthly Balancing Cost Benchmark and Outturn

[21] https://www.nationalgrideso.com/document/166231/download

Supporting information

Our balancing costs performance was “below expectations” for 2020-21. In the Mid-Year report, we explained the operability challenges associated with very low demand as experienced during the summer of 2020. We talked about the additional and innovative actions we took alongside our regular optimisation activities designed to minimise the impact on balancing costs.

As we moved into the higher demand periods later in the year, the challenges due to low demand lessened and other challenges began to become more prevalent. Periods of very high wind with depleted network boundary capacities due to network upgrade outages, the fault on the Western HVDC Link and a number of periods of tight margins and associated high costs were the key drivers of this half year.

It is worth highlighting that the benchmark for the year was set prior to any knowledge of COVID-19 and the impacts of the demand suppression experienced. We have proactively acted to minimise cost throughout the year and provided additional examples and evidence for this in the Mid-Year report.

DNV have independently reviewed the commercial activities undertaken by ESO between April 2020-January 2021. The DNV report highlights the actions taken to minimise cost over the year were proportionate to the challenges faced and that “NGESO has acted efficiently and effectively to address the system need within the boundaries of information and tools that were available to it, as well as given the high degree of uncertainty at times when actions were taken”.

In November heavily depleted constraint boundaries due to network upgrade outages, combined with very high wind levels resulted in large volumes of constraint management actions and associated high costs. As the outage being taken to deliver significant network upgrades were long, inflexible outages, there was limited opportunity to move these to a low wind period as would be attempted as part of optimisation work. Optimisations were still sought wherever possible such as profiling the emergency return to service time in order to mitigate the cost exposure should another circuit fault during the long outage, encouraging the Transmission Owner to work extended hours to reduce the total outage period and continually reconfiguring the network to maximise constraint capacity for the outage plan and system conditions.

In December, many outages were returned to service and the boundary capacities across most of the pinch points of the system were returned to their intact levels. Extremely high wind levels for large periods of the month meant that action was still required to resolve constraints and as such the cost was driven high. Network reconfigurations and enhanced ratings on specific circuits meant that we were able to get every last MW from the constraints when these were active.

In February, the Western Link faulted, depleting the boundary capacity over the Anglo-Scottish border. During the high wind days which followed large volumes of actions were required which contributed to high costs. Although the benchmark adjustment has been applied, the impact of the Western Link being unavailable is likely to be higher than the adjustment due to the volume of generation connected above the Anglo-Scottish border since this being derived. The outage plan was revised following the fault and any outage that could create further depletions were considered for postponement. In some situations, taking an additional outage in another area can take advantage of already restricted flows and this was the case for some of the outages considered at that time.

March costs remained above the benchmark with high volumes of actions required to manage constraints on the system, particularly in high wind conditions and with the Western Link out of service for the early part of the month.

From November through to March when wind was low and demand was high resulting in tight margins, scarcity pricing in the market drove operating reserve costs high. We are a price taker so have little ability to impact the options available to us to synchronise generation to meet demand or reserve. However, there are actions we take to mitigate how tight the system is. During the period November to March, there were a number of Electricity Margin Notices (EMNs) which are a system warning issued to encourage generation to make themselves available. The issuance of these will always trigger a price signal to the market and as such is not a decision that is taken without due analysis and process. During the margin strategy meetings, any outages which are constraining generation are considered for recall, any constraints that are active are considered for optimisation and a market-wide view of generation about to go on outage or just coming back from outage is considered to build a picture of the likely scenarios that could occur. This whole system view allows a robust decision making and communication process to happen which will mitigate the price signals sent to the market unnecessarily. High offer prices when margins are tight, driven by scarcity of energy in that moment, are an indication that the market is working as it should be.

Performance benchmarks

- **Exceeding expectations:** at least 10% lower than the figure implied by the benchmark
- **Meeting expectations:** within 10% of the figure implied by the benchmark
- **Below expectations:** at least 10% higher than the figure implied by the benchmark

1B Energy forecasting accuracy

2020-21 Demand Forecast Performance

As outlined in the Forward Plan Role 1 Energy Forecasting Accuracy metric (Metric 1b), the ESO's forecasting performance will be assessed at the end of the performance year. Annual performance targets have been calculated with exceeding, in-line with and below expectations values set out. To allow transparency of our performance during the year, each month we report an indicative performance for both metrics.

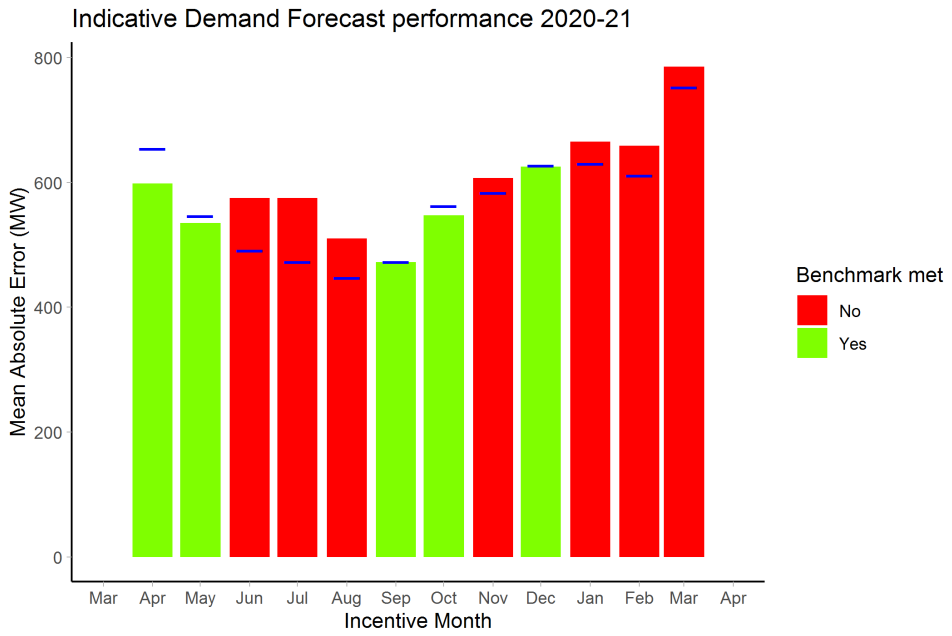


Figure 1: Demand Forecasting , shows our performance for 2020-21

Day ahead demand forecast benchmarks for financial year 2020-21			
Month	**Benchmark (MW)**	**Month**	**Benchmark (MW)**
April	654	October	562
May	546	November	583
June	491	December	627
July	473	January	630
August	447	February	611
September	473	March	752

Table 4: Demand Forecasting Benchmarks

This translates into the following criteria for exceeding, in line with and below expectations:

Energy forecasting metric	Day ahead demand forecasting
Performance measure	Annual mean absolute error (MW)
Exceeding expectations	<542
In line with expectations	542 – 599
Below expectations	> 599

Supporting information

DA Demand Annual Performance: 596MW: in line with expectations

Demand forecasting performance during 2020-21

The 2020-21 performance year was entirely dominated by the additional uncertainty due to the pandemic. Each time a lockdown was introduced and then followed by relaxation measures, demand levels were subject to greater fluctuations, related to people adapting to new conditions. In the case of the second national lockdown, businesses had learnt how to operate within the lockdown restrictions and levels of activity were expected to be higher than in the first lockdown, but it was not possible to assess in advance the quantitative effect. This made the level of underlying demand driven by the impact of human behaviour due to the pandemic less predictable.

People's holiday plans were significantly altered due to the pandemic and the alteration in normal seasonal patterns from holiday effects has led to increasing uncertainty and greater errors. With people staying at home their responses to the weather were more pronounced compared to "normal" times. Hence the element of the underlying demand that is driven by human behaviour was more impactful during the pandemic and less predictable.

During the triad season, it was uncertain how the triad avoidance market participants would plan their activity. As the annual peak demand was suppressed due to the pandemic, it was challenging to gauge the maximum level of the avoidance during the earlier part of the triad avoidance season. Further explanation of triads can be found on our website.

Demand forecasting improvements during 2020-21

The Platform for Energy Forecasting (PEF) project aims to re-design the ESO's forecasting processes, using advanced modelling techniques, automation and machine learning. The PEF project is relevant to both the Demand Forecasting and Wind Forecasting metrics.

During 2020-21, the improvements delivered by this project have enabled additional forecasts to be produced, providing an improved service for the market. Improved granular and frequent forecasts are now being published to market participants through our Data Portal, including:

- Wind power generation forecasts for 14 days ahead
- National demand forecasts for 2-14 days ahead
- Long term national demand forecasts for 2-52 weeks ahead

We have also improved the user interface for our Control Room users, creating a "PEF dashboard" to ensure that they can easily access the information they need to make real-time decisions.

The PEF project has also created new machine learning models, which can forecast both active (MW) and reactive (MVar) power flows at a Grid Supply Point (GSP) level. This analysis is used in our offline transmission analysis, and is particularly valuable on low-demand days. These techniques have led to improvements both in resolution and certainty:

- It is now possible to produce 24 forecasts per day, rather than 4
- We have increased the number of sites contained within our model from 380 to 464
- We have moved from 380 models to 4640 fully automated models

We are currently trialling fully automated machine learning for national demand forecasting. Our results to date show that this could lead to a significant improvement in an increasingly volatile environment.

New techniques have shown the potential for our forecasts to improve continuously based on observed outturn data. The time taken for our model to "re-train" has been reduced from 55 hours to around 20 hours, making it possible for the model to train itself daily in the future. We are also exploring new research relating to self-attention, language modelling and protein folding, which have the potential to improve the accuracy of our models in the future.

It is worth noting that this year's demand forecasting improvement activities have focussed on the provision of additional information to the market, as well as the development of new techniques which will be rolled out in the future.

Future demand forecasting improvements

We are continuing to improve our forecasting models, and plan to integrate the latest developments into our operational systems. Our planned activities include:

- Integrating the national demand machine learning model into our operational energy forecasting systems, control room operations, and the information provided to market participants via the Balancing Mechanism Reporting Service (BMRS)
- Integrating the additional weather data described above into our forecasting systems
- Integrating the new GSP demand forecasts into our balancing systems
- Publishing new GSP-level solar and wind forecasts to market participants through the Data Portal.

Ongoing demand forecasting challenges

Despite the improvements described above, demand forecasting continues to be challenging. As well as the increasing penetration of renewable generation, much of which is connected to the distribution network, factors external to the energy industry are likely to impact on demand.

Weather and climate have been increasingly volatile: for example, March 2021 saw the warmest March day in 50 years, snow, and the lowest Carbon Intensity day on record, all within a 2-week period.

We also anticipate that the uncertainty caused by the economic consequences of both COVID-19 and Brexit will mean that demand patterns will continue to be challenging to forecast in the coming years. As COVID-19 has impacted on demand patterns during 2020-21 to varying degrees, it may be more difficult to make use of this data to forecast demand in future years. Our improvement projects are therefore necessary to maintain our current levels of accuracy.

Research so far has demonstrated the potential to use new techniques to improve our forecasting performance in an increasingly volatile energy landscape. We continue to strive to implement these state-of-the-art developments into our legacy critical national infrastructure.

2020-21 Wind Generation Performance

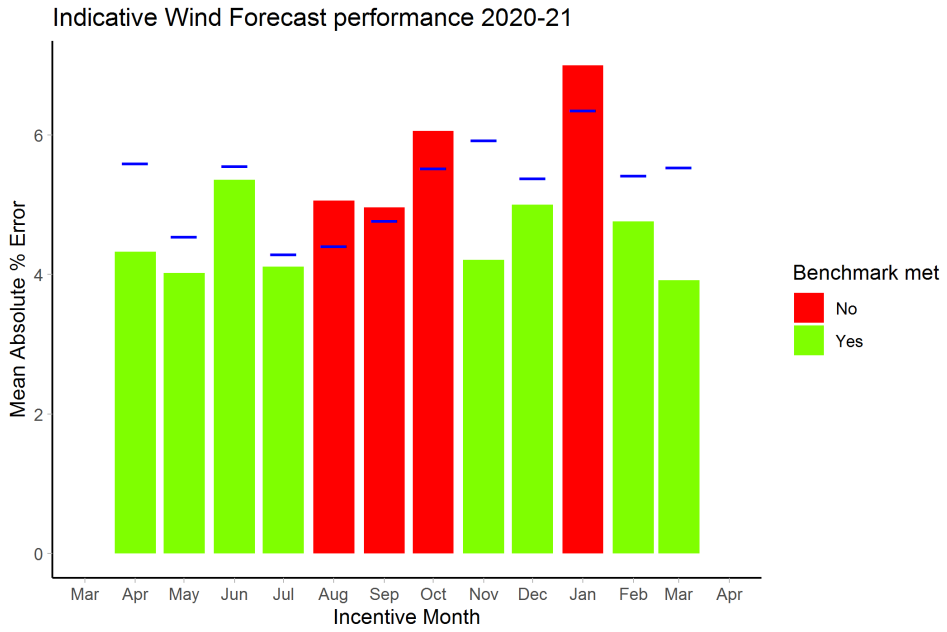


Figure 2: Wind generation forecasting, shows our performance for 2020-21

BMU wind generation forecast benchmarks for financial year 2020-21			
Month	**Benchmark (%)**	**Month**	**Benchmark (%)**
April	5.60	October	5.53
May	4.54	November	5.93
June	5.56	December	5.38
July	4.29	January	6.36
August	4.41	February	5.42
September	4.77	March	5.54

Table 5: Wind Forecasting Benchmarks

This translates into the following criteria for exceeding, in line with and below expectations:

Energy forecasting metric	Day ahead wind forecasting
Performance measure	Annual mean absolute percentage error (%)
Exceeding expectations	< 5.01
In line with expectations	5.01 – 5.54
Below expectations	> 5.54

Supporting information

DA Wind Annual Performance: 4.9%: exceeding expectations

Wind forecasting performance during 2020-21

The indicative monthly benchmark for forecast accuracy was met for 8 months out of the 12. Occasions of inaccurate forecasts were usually caused by periods of unsettled weather which caused atmospheric conditions which were difficult to forecast.

Wind forecasting improvements during 2020-21

In addition to the PEF project activities described as part of the Demand Forecasting metric, we have also carried out analysis of the main drivers of wind forecasting performance, looking at the impact on the current year and the potential impact on future years.

The largest contribution to accurate wind power forecasts is accurate weather forecasts, which we source from an external provider. We have worked with this provider to use our experience to help to improve these forecasts, for example feeding back information to the provider to determine if there is anything that can be learned from particular weather scenarios that will improve weather forecasting accuracy more generally.

We have also sought to improve the other variables which contribute to accurate forecasting. This has included:

- Engaging with Renewable UK for the latest information on the installed wind farm fleet. This has allowed us to ensure that we set up new wind farms in the forecasting system before they commence their first MW of generation.
- Monitoring of the capacity of wind farms that are under construction to ensure that capacity is correctly represented in the forecasting system.
- Monitoring of planned outages on wind farms and the declarations of those outages to ensure that the information is included in the forecast when sufficient confidence has been gained.
- Revising wind farm models to ensure the best mapping between the weather forecast and wind power output.
- Giving particular attention to cut-out and taking the opportunity to improve the forecasting accuracy under stormy wind conditions, taking learnings from storms Ciara and Dennis, which revealed the behaviour of large offshore wind farms during high winds.
- Monitoring system conditions to provide warnings to the Control Room if negative electricity prices will cause wind farms with Contract for Difference (CfD) contractual arrangements to stop generating.
- Monitoring the quality of metering data that is provided by wind farms so that future performance analysis and improvement can be maintained.
- We have engaged with the International Energy Agency Task 36 on Wind Power Forecasting to learn about techniques employed by other Electricity Operators and forecasting companies.

Future wind forecasting improvements

In addition to the activities which form part of the PEF project, we have planned several improvements for the coming financial year, which we hope will further improve our forecasting accuracy:

- Developing techniques for using ensemble data for forecasting and risk management
- We have acquired an additional 3 years' historical weather data, and wind farm sites' forecasts, to validate and improve our wind power forecasting models
- Implementing the learning from the newly-developed machine learning models of embedded wind generation, and applying it to forecasting of Balancing Mechanism Unit wind generation output
- Using enhanced models which take account of wind direction to represent the wake (shadowing) that can take place when wind turbines are directly downwind of others
- Using Cubic Splines modelling to better represent the behaviour of wind farms

- Developing rate of change models, to improve performance under conditions when wind conditions are forecast to change rapidly
- Developing multiple-input models that will respond to wind speed forecasts from a number of nearby locations, rather than just considering wind conditions at the location of the wind farm
- Developing a blending algorithm, to bring together different forecasting methods using appropriate weighting

Ongoing wind forecasting challenges

Despite the improvements described above, wind forecasting continues to be increasingly challenging. We have observed in recent years that wind output is increasingly influenced by market behaviour, as well as weather conditions which are outside of our control. Detailed turbine-level data would be needed to improve our forecast accuracy. In addition, the precise timing of the wind generation profile is hard to predict with limited information which is currently available from wind farms. With larger wind farms coming on line, which cover vast geographical areas, a single wind forecast may not be sufficient to predict the output of the entire wind farm.

It is hoped that, once they are integrated into our operational systems and processes, the improvement activities described above will allow us to maintain our current wind forecasting accuracy.

Performance benchmarks

- **Exceeding expectations:** Error which is at least 5% lower than the benchmark
- **Meeting expectations:** Error which is within 5% of the benchmark
- **Below expectations:** Error which is at least 5% higher than the benchmark

1C Security of Supply

2020-21 Performance

Quality of service delivered in running the electricity network by providing the number of reportable voltage and frequency excursions that occurred during the previous month, and a total for the year to date.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Voltage excursions	0	0	0	0	0	0	0	0	0	0	0	0
Frequency excursions	0	0	0	0	0	0	0	0	0	0	0	0

Table 6: voltage and frequency excursions over 2020-21

Supporting information

There were no reportable excursions (as defined in Standard Licence Condition C17[22]) for voltage and frequency on the National Electricity Transmission System (NETS) in 2020-21. Our Security of Supply performance was exceeding expectations for 2020-21.

Less onerous system incidents/events will be reported on as part of this metric in the RIIO-2 period, and can also be found on the NGESO website.

Performance benchmarks

- **Exceeding expectations:** 0 excursions for both voltage and frequency over 2020-21
- **Meeting expectations:** 1 excursion for either voltage or frequency over 2020-21
- **Below expectations:** More than 2 excursions in total over 2020-21

[22] https://www.nationalgrideso.com/research-publications/transmission-performance-reports

1D System Access Management

2020-21 Performance

Publishing this metric encourages the ESO to investigate the causes of outage cancellations and amend processes where appropriate to prevent a repeat. We ensure that we seek to minimise costs across the whole system and all timescales when making a decision to recall or delay an outage on the transmission system.

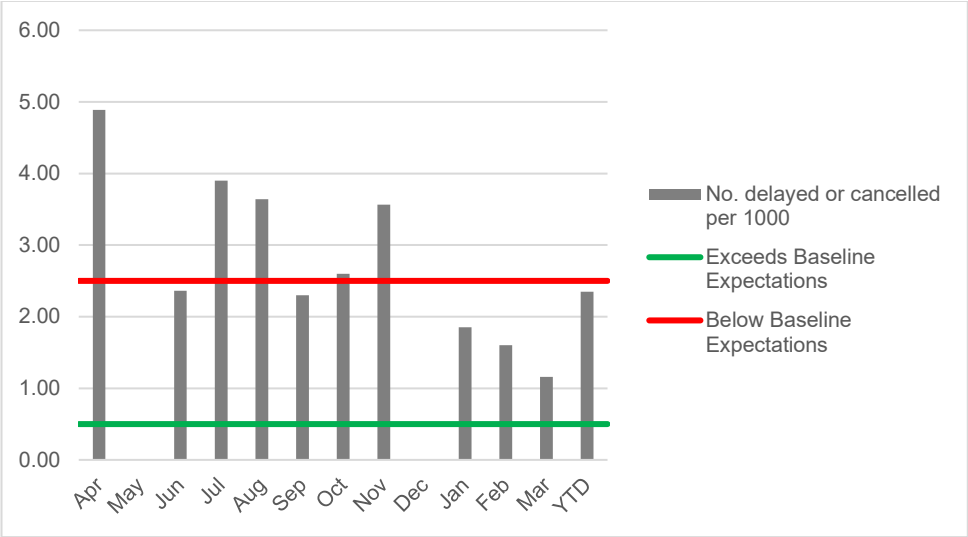


Figure 1: Number of outages delayed by > 1 hour, or cancelled, per 1000 outages

	Number of outages	Outages delayed/cancelled	Number of outages delayed or cancelled per 1000 outages
Apr	409	2	4.89
May	629	0	0
Jun	847	2	2.36
July	769	3	3.9
Aug	824	3	3.64
Sep	870	2	2.3
Oct	770	2	2.6
Nov	842	3	3.56
Dec	524	0	0
Jan	540	1	1.85
Feb	625	1	1.6
Mar	864	1	1.16
YTD	8513	20	2.35

Table 7: Number of outages delayed by > 1 hour, or cancelled, per 1000 outages

Supporting information

For 2020-21, the ESO has successfully released 8513 outages and achieved the 'Meeting Expectations' target with 2.35 cancellations or delays per 1000 outages. This is an improvement on the performance compared to 2019-20 where we saw 2.92 cancellations or delays per 1000 outages. When comparing the overall outages released, the ESO has almost released as many outages in 2020-21 as in 2019-20 of 8560, despite the early disruption to the plan caused by COVID-19 and further changes needed to manage a type-fault identified on the

network in February 2021. The ESO has facilitated 4165 outages in Q3 and Q4 which is an increase from 3796 in the 2019-20 year.

The 2.35 cancellations or delays per 1000 outages can be broken down into 18 events:

- Three of these events were due to modelling discrepancies between the Offline Transmission Analysis software used by the planning team, and the real-time analysis carried out by the control room. The real-time analysis identified unacceptable voltage step changes and the outages were delayed pending reassessment. Learning documents were written, and discrepancies investigated with on-going actions to resolve. The circuit rating process which contributed to two events, has been reviewed and a number of steps added as corrective measures.
- Two further events were passed to the control room that could not be secured overnight due to unacceptable voltages and were therefore re-planned independently of the conflicting outage(s).
- Three events were delays by the control room due to system security concerns not identified by the planning team. The control room carefully re-assessed these outages to ensure the system could be secured and was compliant. Further investigations showed that the root causes were driven by varying interpretations of the Security and Quality of Supply Standards (SQSS).
- Six events were caused by human error. Conflicting outages had either not been fully assessed or customers were not notified adequately in planning timescales. Several corrective measures have been implemented such as changes to the circuit description codes (to include all assets impacted), notifications to customers even if the outage request is 'embedded', and ensuring all constraint boundaries are assessed for each outage.
- Another event which led to a delay was an outage combination which would island a large demand group for a double circuit fault. The TO and DNO had been consulted about the demand at risk which was not fully communicated to the control room during the handover. As a result, the control room had to review the outage and required confirmation from the TO of the demand at risk.
- A similar event occurred where the demand at risk to a sensitive demand group had been missed for a maintenance outage that had previously been embedded with a scheme outage but was no longer. The control room delayed the start of the second circuit outage (which would have put this group at single circuit risk) however it was released at a later date.
- One outage had been aligned with a planned generator shutdown and therefore the generator's stability was not considered within planning timescales. The planned generator shutdown was changed at midday the day before the outage was due to start but not noticed by the planning team. Stability was assessed by the control room but following release of the outage, it was identified that post-fault generator instability could potentially occur overnight. The outage was re-planned at a later date and under more suitable voltage conditions. An Operational Learning Note (OLN) was written which captured the need for further checks when there has been an Electricity Margin Notice issued, which may impact a generators' planned shutdown.
- The final event was delayed due to the concern around an ONCOM[23] outage of the Transient Over Voltage which may have restricted an interconnector flows for the next system fault. As this would have a large impact on the system security and large cost exposure, precautions were taken to ensure the outage had been fully assessed and it was identified that the Transient Over Voltage was within acceptable limits and no restrictions would apply. The circuit was eventually released and a work instruction is being written to include guidance on managing these type of outages for the future.

Overall, despite the disruption caused earlier in the year due to COVID-19, the ESO has worked effectively with the TOs and DNOs through frequent meetings and prioritising the major schemes to recover as much as possible of the original outage plan. This has been demonstrated through releasing an additional 369 outages in Q3 & Q4 of 2020-21 compared to 2019-20 and recovering a large number of outages that had been delayed in Q1 & Q2. Furthermore, all the above events have been investigated, with a number of corrective actions implemented, which has resulted in fewer delays or cancellations than in 2019-20.

[23] ONCOM refers to on completion. In terms of planning, we consider an emergency return to service, e.g. if a fault occurred, a circuit/asset is re-called to re-secure the network. As the outage was ONCOM, there were concerns that without the appropriate study confirming the system was secure, this option is unavailable.

Performance benchmarks

- **Exceeding expectations:** < 1 outage cancellations per 1,000 outages
- **Meeting expectations:** 1 - 2.5 outage cancellations per 1,000 outages
- **Below expectations:** > 2.5 outage cancellations per 1,000 outages

1E Customer Value Opportunities

2020-21 Performance

The TOs need access to their assets to upgrade, fix and maintain the equipment. They request this access from the ESO and we then plan and coordinate this access. This metric will sharpen our focus on creating and capturing added value for the customers and stakeholders as part of the network access process.

We will look for ways to minimise the impact of outages on energy flow and reduce the length of time generation is unable to export power into the network. We will measure the outcome of the metric in terms of avoided MWh lost (or constrained 'off').

This work can benefit end consumers if we spend less managing system constraints, and can benefit connected customers (e.g. generators) if the volume of MW and/or duration they are constrained off is reduced (particularly if they have non-firm connections agreements). There are indirect benefits to the end consumer as a result of the direct customer benefits, for example the less time a wind generator is constrained off then the less time it is being prevented from providing low-carbon energy to the system. Another indirect consumer benefit of minimising constrained generation is that it reduces the impact on market liquidity and competition.

Ofgem's Formal Opinion feedback indicated that some of our metric benchmarks should be more ambitious. We have reviewed the feedback provided by Ofgem, and made changes to our benchmarks for this metric to take account of last year's performance, and make the benchmarks more challenging.

The total outturn customer value created from both direct and indirect savings in 2019-20 was 11,518 GWh. We add a 10% increment of 11,518 GWh to work out our baseline of 12,500 GWh. We further stretched this target to 15,000GWh as the benchmark for exceeding expectations.

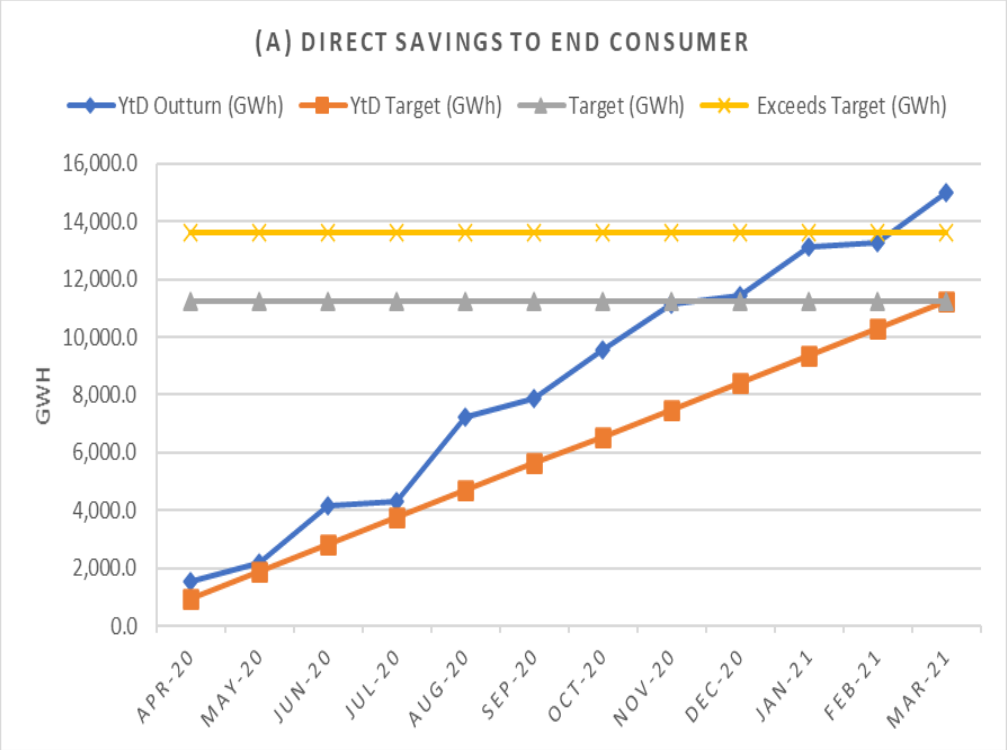


Figure 2: Direct Savings to End Consumer

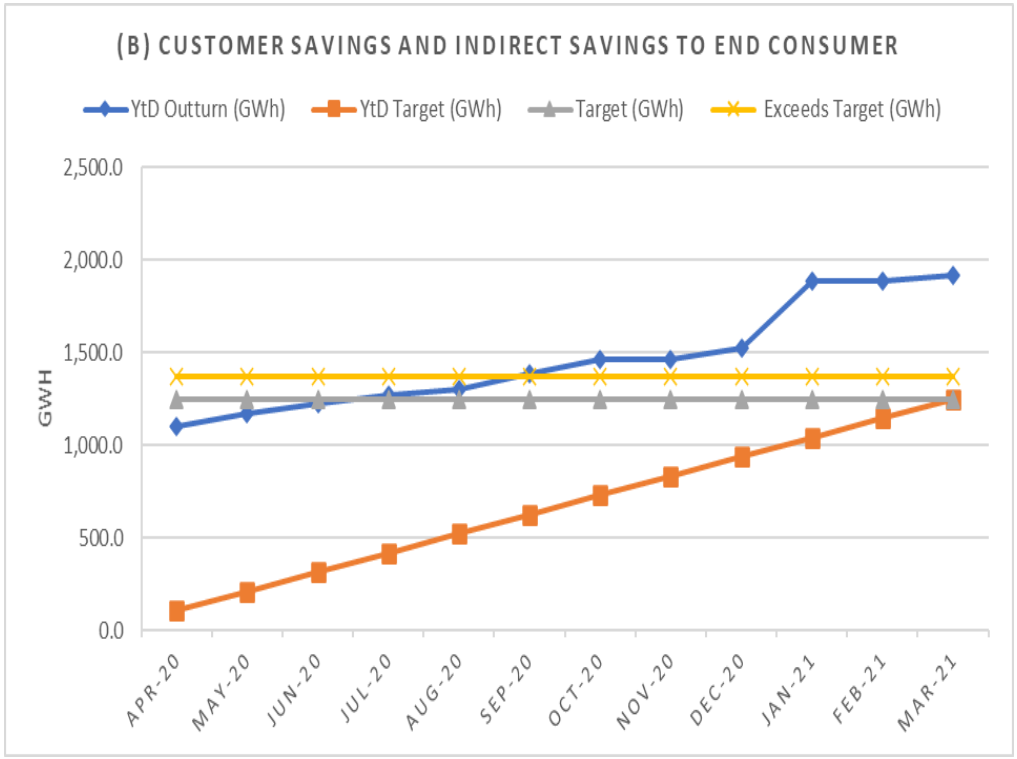


Figure 3: Customer Savings and Indirect Savings to End Consumer

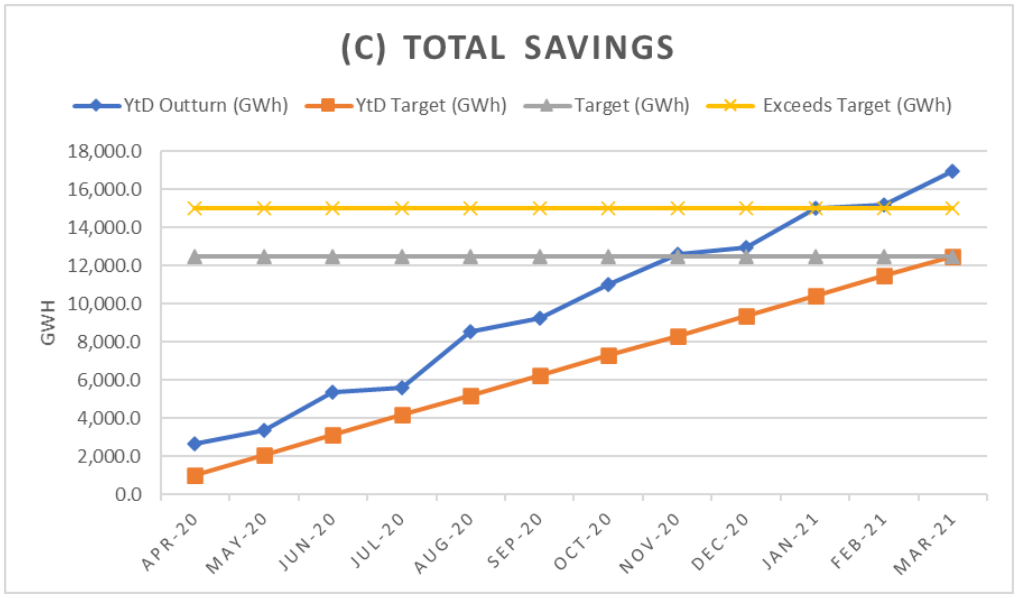


Figure 4: Total Customer and End Consumer Savings

Supporting information

We have exceeded expectations in 2020-21 with 16,940,000 MWh (approximately £1,171m) of extra generation capacity created from direct and indirect savings by continuing the trend and improving the way we add value. The Network Access Planning team exceeded the metric benchmarks for both direct savings to the end consumer (figure 2) and indirect savings to the end consumer (figure 3).

Following Network Access Planning's (NAP) success with the Customer Value Opportunities metric in 2019-20, all teams in NAP have continued to improve and find more innovative ways of planning system access to deliver savings and benefit to the end consumer.

In 2020-21, NAP increased engagement with stakeholders (TO, DNO, Connected Customers), for example by organising new weekly tri-party outage optimisation meetings with SHEPD (as part of our deeper outage planning trial), and facilitating regular weekly catchups with TOs. This collaboration with our stakeholders enabled us to identify and record around 170 instances (17% increase from last year) where our actions directly resulted in adding value to the end consumer, and innovative ways of working facilitated increased generation capacity to connected customers.

In the last year, NAP also increased the visibility of the metric and its benefits within the department. This has resulted in greater awareness of the value that can be delivered, and the team is more focused on proactively looking for ways to deliver value.

NAP engineers continued to use their engineering expertise and judgement to come up with innovative ways of adding value, such as:

- Requesting rating enhancements
- Reducing outage durations and splitting outages to minimize constraint costs
- Identifying and facilitating opportunity outages
- Proposing and facilitating alternative solutions for long outages that impact customers
- Re-evaluating system capacity
- Aligning outages with customer maintenance and generator shutdowns

At the end of 2020-21, NAP had 15,023,700 MWh of direct savings to the end consumer and 1,916,300 MWh of indirect savings to the end consumer. In total we have exceeded expectations with 16,940,000 MWh (approximately £1,171m) of extra generation capacity, which would have otherwise been constrained at a cost to the consumer[24].

Performance benchmarks

Total Savings:

- **Exceeding expectations:** Greater than 15,000GWh
- **Meeting expectations:** Total savings between 12,500GWh and 15,000GWh
- **Below expectations:** Less than 12,500GWh

Direct savings to end consumer:

- **Exceeding expectations:** Greater than 13,630 GWh
- **Meeting expectations:** Between 11,250 GWh and 13,630 GWh
- **Below expectations:** Less than 11,250 GWh

Customer savings and indirect savings to the end consumer:

- **Exceeding expectations:** Greater than 1,370 GWh
- **Meeting expectations:** Between 1,250 GWh and 1,370 GWh
- **Below expectations:** Less than 1,250 GWh

[24] We used average values of £78/MWh for wind and £55/MWh for other generation to estimate the cost.

1F CNI System Reliability

2020-21 Performance

This is a Performance Indicator to report on unplanned outage minutes, for a subset of the CNI (Critical National Infrastructure) systems, as an indicator of our control system performance. Reporting this on a quarterly basis allows us to establish a suitable benchmark level, ahead of RIIO-2 where it could be used as a metric to measure our performance.

Unplanned CNI System Outages (mins)				
	Q1	**Q2**	**Q3**	**Q4**
Balancing Mechanism (BM)	0	7	0	0
Integrated Energy Management System (IEMS)	10	40	20	30

Table 8: Unplanned CNI System Outages

Supporting information

Throughout this financial year, the BM has experienced 7 minutes of unplanned outages, and the IEMS has experienced 100 minutes of unplanned outages.

In Q1, we had a total outage time of 10 minutes consisting of 1 outage across the systems.
In Q2, we have an outage time total of 47 minutes, consisting of 3 outages across the systems.
In Q3, we have an outage time total of 20 minutes, consisting of 2 outages across the systems.
In Q4, we have an outage time total of 30 minutes, consisting of 3 outages across the systems.

In all cases, the cause of the unplanned outage was identified and appropriate measures, and controls have been implemented to help monitor the systems and prevent reoccurrence.

On the IEMS, many of the outages this year have been as a result of the same recurring system maintenance activities. As a result, we have reviewed those activities, and the controls required to carry them out. We have now identified a change to procedure which, moving forward, will allow continued access to the IEMS system during such maintenance activities.

Appropriate, equivalent historical data from which to draw a direct comparison year on year of system performance and reliability is not available. The system reliability has not been monitored in exactly this way until the current year. Going forward this comparison data will be available.

However, no significant increase or decrease in overall system outage time has been observed throughout this year, and the data captured here is intended to establish a suitable benchmark for system availability in readiness for RIIO-2.

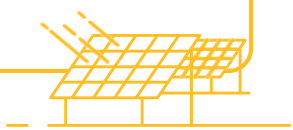
Role 2

Market development and transactions

Role 2: Market development and transactions

Evidence of consumer benefits

- We set out in our first ever Frequency Risk and Control Report (FRCR) clear and objective criteria to balance cost and risk to ensure the end consumer receives efficient security of supply, and reduced security of supply risks via the Dynamic Containment project and Accelerated Loss of Mains change programme. We now anticipate spending £244m on frequency control in 2021-22, compared to £275m-£360m in previous years. The FRCR work sits across all 3 role areas.
- We raised Grid Code modification GC0131 to streamline code governance, improving the efficiency of the code modification process and removing blockers to the energy transition
- We trialled the use of Reserve from Storage, with a potential value of £0.7m (during the trial) and significant future savings from the experience gained



Stakeholder views

We work closely with our stakeholders and have listened to their views. A few examples are:

- Our stakeholders were unclear on how our market initiatives and wider reforms linked together. We published our ESO Markets roadmap to 2025 and held a stakeholder event to "join the dots" between different market reforms in response to stakeholder feedback.
- Stakeholder feedback informed the evolution of the Dynamic Containment product
- We're working closely with industry on reactive reform, and collaborated with UKPN for the Power Potential technical trials
- We're co-creating new products for reserve reform, which we've accelerated in response to industry feedback
- Worked closely with stakeholders to develop and implement solutions to COVID-19 operability challenges
- Improved stakeholder satisfaction with code administration

Plan delivery

- Delivered new Dynamic Containment product, and introduced day-ahead procurement ahead of schedule
- Published Frequency Response auction trial report
- Progressed reforms for Reactive Power and Reserve
- Progressed urgent activities as a result of the low demands associated with the COVID-19 lockdown, such as new services and urgent code modifications
- Provided thought leadership on significant charging reforms and technical understanding of the transmission system and charging methodologies to provide qualitative and quantitative policy inputs
- Improved our code administration activities, resulting in a step change in overall satisfaction

Performance metrics and indicators

Metric/ Performance Indicator	Performance	Status
2a Reform of balancing services markets (metric)	This shows the overall performance for 2020-21: Frequency response Reserve Reactive Black start Constraints	● ● ● ● ●
2b Code admin stakeholder satisfaction (metric)	The average score for 2020-21 is 8.8	●
2c Charging futures (metric)	The average score for 2020-21 is 8.4.	●
2d Year ahead forecast vs outturn annual BSUoS (metric)	The year ahead BSUoS forecast was £3.52/MWh, and the outturn was £4.77/MWh, giving an APE of 26%	●
2e Month ahead BSUoS vs outturn monthly BSUoS (metric)	6 months of Absolute Percentage Error (APE) greater than 20%; 2 months between 10% and 20%; 4 months below 10%	●

● Exceeding expectations ● Meeting expectations ● Below expectations

B.1 Evidence of consumer benefits

We present three case studies for role 2, to showcase some key areas where we have delivered significant consumer benefit. It would not be practicable to approximate the consumer benefit of all of the deliverables in role 2, although we would expect each of these deliverables to deliver benefits to today's consumers, future consumers, or both. We have included the following case studies for role 2:

- Security and Quality of Supply Standards (SQSS) modification and Frequency Risk and Control Report (FRCR).
- Streamlining Code Governance
- Reserve from Storage Trial

We have used the following areas of consumer benefit, as defined by Ofgem:

- Improved safety and reliability
- Reduced environmental damage
- Lower bills than would otherwise be the case
- Improved quality of service
- Benefits for society as a whole

B.1.1 Case Study: Security and Quality of Supply Standards (SQSS) and Frequency Risk and Control Report (FRCR)

Activity

The Frequency Risk and Control Report (FRCR) is a new requirement of Security and Quality of Supply Standards (SQSS) modification GSR027. This put in place a transparent process through which a periodic report will be developed to demonstrate value for end consumers in achieving an agreed level of security of supply and mitigating operational risks.

Following the power disruption on 9 August 2019, the Ofgem and the Energy Emergencies Executive Committee (E3C) final reports into the disruption recommended that a review of the SQSS should take place, and in particular that the ESO, in consultation with the industry, should undertake a review of the SQSS requirements for holding reserve, response and system inertia.

It was recommended the review should consider:

- the explicit impacts of distributed generation on the required level of security, whether it is appropriate to provide flexibility in the requirements for securing against risk events with a very low likelihood, for example on a cost/risk basis
- the costs and benefits of requiring the availability of additional reserves to secure against the risk of simultaneous loss events.

SQSS modification GSR027[25] was duly raised at the SQSS Panel meeting in April 2020 and was developed through the standard industry process, including an industry workgroup, two consultations and decisions from the panel on completeness of the solution and approval for its submission to Ofgem for a decision.

This modification made proposals in two main parts as follows:

- Changes to the SQSS legal text to amend certain definitions and provisions including unacceptable frequency conditions and Loss of Power Infeed, and to give standing to the FRCR.
- Creation of a Governance framework to set out a requirement for the ESO to develop a FRCR methodology and, in line with this, to periodically produce a FRCR in accordance with an agreed process. The FRCR methodology and FRCR will be regularly reviewed and updated in consultation with interested parties and will be subject to recommendation by the SQSS panel and, for the FRCR, approval by the Authority

Together, these changes put in place a process that allows the ESO to agree, through an engaged, flexible and transparent process, how consumers' money is going to be spent by determining the right level of security of supply for society as a whole. The new process allows the value of risks and cost-effectiveness of mitigations to be assessed in coming to a transparent conclusion based on a consumer value proposition.

The FRCR includes an assessment of the magnitude, duration and likelihood of transient frequency deviations, forecast impact and the cost of securing the system and confirms which risks will or will not be secured operationally by NGESO under paragraphs 5.8, 5.11.2, 9.2 and 9.4.2 of the SQSS, and the expectations for unacceptable frequency conditions.

In their decision approving GSR027 on 6 December 2020, Ofgem required the first version of the Frequency Risk and Control Report[26] on 01 April 2021.

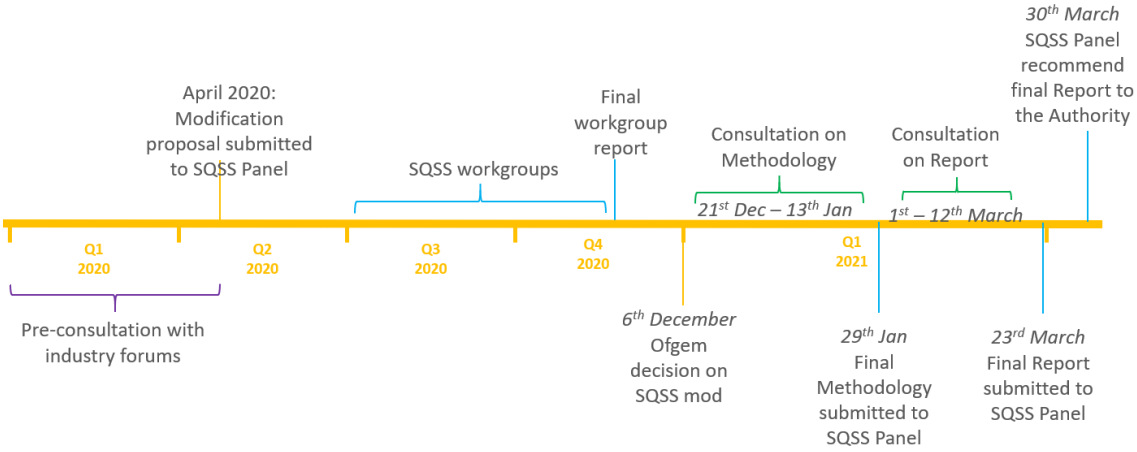
Once the SQSS modification was approved the ESO moved quickly to consult on both a Methodology and set of recommendations for the first version of the Report.

The FRCR Methodology was published for consultation with industry from 21 December 2020 to 13 January 2021. The feedback was summarised into themes which the ESO addressed in the final version of the Methodology. This included suggestions for increasing the scope of the first

[25] https://www.nationalgrideso.com/industry-information/codes/security-and-quality-supply-standards-old/modifications/gsr027-review

[26] https://www.nationalgrideso.com/document/189566/download

version of the report which will be addressed in future versions. A final version of the Methodology was recommended by the SQSS Panel on 29 January and a draft Frequency Risk and Control Report was issued to industry for consultation on 1 March.



The first edition of the FRCR was focussed on the following key areas:

- establishing the FRCR process to deliver a clear, objective, transparent process for assessing reliability vs cost to ensure the best outcome for consumers
- assessing the risk from the inadvertent operation of Loss of Mains protection
- identifying quick, short-term improvements for reliability vs cost, including:
    - Delivery of the Dynamic Containment frequency response service and Accelerated Loss of Mains Change programme.
    - assessing the frequency standard that various size loss risks are held to, and
    - the impact of transmission network outages on radial connection loss risks

The FRCR made four proposals, which once implemented, will result in the following tabulated risks of frequency deviation:

- 48.8Hz is 1-in-270 years (Activation of Low Frequency Demand Disconnection)
- 49.2Hz is 1-in-22 years (Frequency Standard set out in System Operator Guidelines)
- 50.5Hz is 1-in-1,100 years (Frequency standard set out in the Grid Code)

Feedback from the consultation on the first version of the Report was encouraging with broad support for the recommendations and suggestions as to what to consider in future version of the Report. The final Report incorporated this feedback and was issued to the SQSS Panel ahead of the Panel meeting on 29 March, where they voted in majority to recommend the Report to the Authority. As of 7 May 2021, the Report is with the Authority awaiting approval, with implementation planned to enable savings to be realised as quickly as possible once a decision is made.

The indicative frequency risk management cost for 2021-22 after adopting the proposals in the Report is £244m. The cost of frequency control in recent years has ranged from £275-360m[27]. This FRCR also identifies the current value of the Accelerated Loss of Mains Change Programme and clarifies how the ESO manages the risk of inadvertent operation of the Loss of Mains protection. In addition, the FRCR confirms the value of the continuing growth of fast acting response through Dynamic Containment, a product launched in October 2020, and presents a suite of proposals which will reduce the requirement for the ESO to intervene in the market dispatch of power stations (NGESO actions to curtail RoCoF risks totalled 3.8TWh in 2019, and 7.4TWh in 2020. Under the FRCR proposals for 2021, this drops significantly to 0.2TWh).

The first version of the Report was a significant piece of analysis and delivers a step change in transparency in the ESO's approach to frequency risk management, specifically with regard to treatment of inadvertent tripping of embedded generation. The framework now in place as a result

[27] Data source NGESO monthly balancing services statement: https://data.nationalgrideso.com/balancing/mbss?from=30#resources

	of the change to the SQSS will allow the ESO to engage with industry on the appropriate cost risk balance for managing transient frequency deviations at a critical time as the power system decarbonises and new larger losses connect to the system. Having the ability to review this on at least an annual basis enables a route for the ESO to work with industry to identify and implement opportunities that will both deliver consumer benefit through reductions in BSUoS as well as improving the safety and reliability of the system.
Role	Covers all three role areas
ESO Ambitions	• An electricity system that can operate carbon free • A whole system strategy that supports net zero by 2050 • The ESO is a trusted partner
Forward Plan Deliverables	• Provide progress reports and plans to address actions raised in the E3C report into the GB Power Disruption Event of 9 August 2019 • Whole system operability • More clarity of operational decision making • Implement the first new frequency response product • Market design and implementation plan for reformed reserve products • Lead code modifications • Loss of Mains Protection setting programme
Is the consumer benefit mainly this year or in future years?	The benefit is in future years, as this is when we will use the report's recommendations to ensure an optimum balance for the management of transient frequency deviations and reducing costs incurred by consumers.
Calculation of monetary benefit to consumers	The cost of frequency control in recent years has ranged from £275m to £360m. The combined impact of the recommendations, delivery of the Accelerated Loss of Mains Change Programme and the introduction of Dynamic Containment is a reduction in risk. The recommendations will for the first time establish a clear benchmark which will allow us to measure the costs and risks of frequency control from now and into the future. The indicative cost for 2021-22 after adopting the proposals is £244m.
Assumption made in calculating monetary benefit	Data source for historic costs: NGESO Monthly Balancing Services Summary (MBSS)[28] The indicative cost for 2021-22 has been calculated as per the Frequency Risk and Control Methodology[29]. This methodology defines a range of scenarios, using a combination of the controls of Dynamic Containment, a frequency limit for generation loss risks, and the Loss of Mains loss size. For each scenario, the required quantity of additional controls is calculated, the expected loss size is calculated, and then the baseline scenario risk is assessed. The requirement for additional controls is assessed and costed, alongside the residual risk once these controls are applied. This leads to an overall cost vs risk impact curve for each scenario, which allows us to draw conclusions about the effectiveness of each scenario in providing a baseline level of reliability and costs, and narrow down options to identify which controls should be pursued, from a value-for-money perspective. This is done by applying the metrics for reliability vs cost, as defined by the industry in response to the consultation on the FRCR methodology.
How benefit is realised in the consumer bill	Reducing spend on balancing costs will result in lower BSUoS charges.

[28] https://data.nationalgrideso.com/balancing/mbss?from=30#resources

[29] https://www.nationalgrideso.com/document/183421/download#:~:text=The%20aim%20of%20the%20Methodology,of%20controls%20to%20mitigate%20them.

Non-monetary benefits	**Benefits for society as a whole:** The FRCR process will allow us to agree how consumers' money is going to be spent by determining the right level of security of supply as the electricity system to low carbon sources whilst facilitating access for high capacity connections. **Improved safety and reliability:** It agrees the limits for frequency to stay within, giving the right balance of cost and risk. **Improved quality of service:** The FRCR process will demonstrate a clear, objective, transparent and engaged process to ensure the best outcome for consumers.
Assumptions made in calculating non-monetary benefit.	As we work towards decarbonising the system, this will allow the ESO to engage with industry on the appropriate cost risk balance for managing frequency deviations. This enables a route for the ESO to work with industry to identify and implement opportunities that will both deliver consumer benefit through reduced balancing costs as well as improving the safety and reliability of the system.

B.1.2 Case Study: Streamlining Code Governance

Activity	Open Governance arrangements were implemented into the Grid Code in February 2017. Our experience of working with these new processes have highlighted that further improvements could be made to ensure the smooth and efficient running of workgroups, and the progressing of changes to the code making the best use of industry time. In advance of any outcome of the Energy Codes Review, the ESO raised a modification to the Grid Code (GC0131) in September 2019. This was developed during 2020-21 with the help of an industry workgroup to make a number of 'quick win' improvements to the Grid Code Governance Rules to address these points and to improve the efficiency of the process. The areas identified for improvement in this modification were: • Initial assessment of proposals - putting some more steps in place to improve the quality of proposals which will speed up their development and improve outcomes. • Quoracy – allowing certain workgroups to proceed with fewer than the normal limit of five members, which can frequently be a barrier to progress, due to limited industry resources. Several checks and balances were developed to ensure that control and quality are still maintained. • Assessment of alternatives – changed to require a workgroup only to develop alternatives that may be better than an original proposal thus giving them more discretion to make better use of industry time (the previous test was against the baseline which sometimes led to alternatives with no prospect of success being developed). • Titles and summaries of proposals – to be developed and agreed between the proposer and Code Administrator to improve clarity and engagement. • Role of the Code Administrator Consultation – clarifications in how final changes could be made giving a more efficient route to make final improvements to a solution before approval is sought. • Production of draft legal text – clarifications made to responsibilities (ultimately this is the ESO as the licensee) and timings. The modification went through two consultations and was broadly supported by industry. It was approved by Ofgem in November 2020; in their decision letter[30] they noted that *'the proposals should all lend themselves to positively impacting* [the Grid Code objectives] *because they should all improve the administration and efficiency of the code change process.'* A subsequent modification (CMP365) was raised in March 2021 to implement similar improvements to the Connection and Use of System Code (CUSC) which employs similar governance.
Role	2. Market development and transactions
ESO Ambitions	• A whole system strategy that supports net zero by 2050 • Competition Everywhere • The ESO is a trusted partner
Forward Plan Deliverables	• Customer focussed communications • Improving industry confidence in ESO Code Governance
Is the consumer benefit mainly this year or in future years?	The benefit will mainly be delivered in future years by improving the efficiency of the code modification process thus allowing quicker, better quality changes to be made and making better use of industry resources to do this. It will remove blockers for smaller renewable market participants which will support the energy transition to net zero. The modification has not had long enough for its impact to be measured in practice, however quotes from the Grid Code Panel in approving it for submission to Ofgem included: **Trade association** - *'It is clear that GC0131 will save industry time and resource by improving the efficiency of the Grid Code change process.'.*
Calculation of monetary	While there will be a cost saving to industry in facilitating a more efficient modification process this is not the main benefit; it will enable faster changes to take place, will allow more work to be done

[30] https://www.nationalgrideso.com/document/179871/download

benefit to consumers	on an opportunity basis and will also help in improving the quality of changes. As highlighted in the Energy Codes Review, the code change process is a barrier to progress so in implementing this ahead of the review we have sought to proactively make improvements wherever possible on a no regrets basis.
Assumptions made in calculating monetary benefit	The nature of the process is inexact and is difficult to quantify as the main benefit is not directly monetary.
How benefit is realised in the consumer bill	With lower resources needed, savings to industry will ultimately filter down to consumer bills through network and operability reductions.
Non-monetary benefits	**Improved quality of service:** The main benefit is overwhelmingly in achieving a more agile, higher quality code change process also leading to the ability to progress more changes with greater speed. **Benefits for society as a whole:** Improves the ability to adapt to changing market conditions and to achieve net zero; aligns with Energy Codes Review ambitions.
Assumptions made in calculating non-monetary benefit.	Non-quantifiable or non-monetary benefits are achieved by making the code governance process more streamlined and easier to navigate, which in turn improves stakeholder engagement, makes better use of industry time and helps to remove barriers to participation.

B.1.3 Case Study: Reserve from Storage Trial

Activity

On 30 April 2020 we published a letter[31] to industry market participants to engage in a temporary service, Optional Downward Flexibility Management (ODFM) to help the Electricity National Control Centre (ENCC) manage the unprecedented levels of low demand that we were experiencing during the COVID-19 pandemic. We also asked whether there was any additional flexibility that was available. This letter, and the subsequent activities, led to a suite of new tools being implemented, which are described in more detail in our Mid-Year Report[32].

Arenko's response to the letter proposed a battery storage solution, and a trial was undertaken during the year (in several phases) to determine whether NGESO could access additional flexibility from storage providers, looking to access both upward and downward energy reserve.

Storage assets such as batteries have traditionally been used for frequency control (receiving bids and offers through the Balancing Mechanism (BM)), resulting in short utilisation periods. This has led to higher prices for these units, meaning that it is not economic to use them to provide reserve services, which require longer-duration instructions. The purpose of the Reserve from Storage trial was to understand whether, with the necessary price signals, storage assets could be used to provide reserve services, and receive instructions of a longer duration at an economic cost.

To date, the ESO has had the following options for accessing upward and downward reserve:

- sending BM start up instructions to conventional plant ahead of time, ensuring that the unit is available to provide reserve
- sending bid/offer instructions via the Balancing Mechanism, to re-position units which are already operating, to position them so that reserve can be delivered
- enacting a super Stable Export Limit (SEL) contract (reducing the minimum output of a unit) to position a unit to provide more reserve.

These actions all take place ahead of time. Once these actions have been taken, in real time the control room can issue additional utilisation instructions at a marginal additional cost, having already paid to secure the reserve.

The trial investigated whether the ESO can request the availability of sustained upward and downward reserve from batteries, using existing operational arrangements to achieve the same effect - enabling the ESO to access reserve at marginal pricing at a comparable cost to existing methods. This would not only promote competition in the provision of reserve, but also allow for better planning across all assets. The purpose of the trial was to build experience and knowledge, which could be factored into future reserve reform activities.

The following activities have been completed:

- First phase of trial on 22 May 2020
- Review of first phase of trial, published[33] on 6 July 2020.
- Design of a second trial over a longer period to allow the full testing of the proposal
- Second phase of trial between 22 July 2020 and 28 July 2020
- Review of second phase, published[34] on 14 August 2020
- Third phase of trial between 4 September 2020 and 24 September 2020 with four participants
- Review of third phase of trial, published[35] on 10 February 2021.

The assets which participated in the most recent trial are shown in the table below:

[31] https://data.nationalgrideso.com/plans-reports-analysis/covid-19-preparedness-materials

[32] https://www.nationalgrideso.com/document/178366/download

[33] https://data.nationalgrideso.com/plans-reports-analysis/covid-19-preparedness-materials/r/trial_review_-_reserve_from_storage_in_the_bm

[34] https://data.nationalgrideso.com/backend/dataset/b3c55e31-7819-4dc7-bf01-3950dccbe3c5/resource/4d373002-b0e3-41d2-bcb0-d7409ddbd893/download/reserve-from-storage-in-the-bm-phase-2-trial-review.pdf

[35] https://data.nationalgrideso.com/backend/dataset/b3c55e31-7819-4dc7-bf01-3950dccbe3c5/resource/3efdf448-e5c2-4e41-98fe-ca0c98aa1af8/download/reserve-from-storage-trial-in-the-bm-phase-3-review-20210210.pdf

BMU	Operator	Trial Start Date	Trial End Date	Capacity	Approximate Storage Capability
ARNKB-1	Arenko	04/09/2020	24/09/2020	41MW Export 41MW Import	60 Minutes
AG-HEL00G	Habitat	04/09/2020	24/09/2020	49MW Export 49MW Import	90 Minutes
AG-HEL01H	Habitat	04/09/2020	24/09/2020	20MW Export 16MW Import	60 Minutes
AG-MFLX02	Flexitricity	21/09/2020	24/09/2020	49MW Export 49MW Import	90 Minutes

Over the 3-week period of the trial, a range of operational and market conditions were experienced, presenting potential savings of £0.7m for consumers, when compared to alternative actions in the Balancing Mechanism. Recognising the potential value that has been shown in the trial, we are now considering the next steps in realising these savings for the end consumer on an enduring basis:

- Consult with industry, to co-create fully the next steps and future product design.
- Future Product design to be cognisant of the contents of the phase three review
- The findings of the review will be included within future Reserve Reform activities.

Role	2. Market development and transactions
ESO Ambitions	• An electricity system that can operate carbon free • Competition everywhere
Key Forward Plan Deliverables	• Product Roadmaps for Response and Reserve implementation
Is the consumer benefit mainly this year or in future years?	The trial took place in the 2020-21 year, and we have assessed the potential value of the trial to the end consumer to be approximately £0.7m: our assumptions and calculations are set out below. However, the main purpose of the trial was to gain experience, which will be factored into our reserve reform activities and our co-creation of reserve products with industry. This is expected to deliver significant consumer benefit in future years.
Calculation of monetary benefit to consumers	An assessment of potential value for the end consumer, under the market and operational conditions of the trial was approximately £0.7million. Our assessment of potential value considered the use of the service for: • Value allocated to upward reserve, where it is not utilised but ready to respond if required • Balancing energy to resolve upward energy imbalance (offers) when demand is greater than generation, and when there is a need to address low frequency • Value allocated to downward reserve, where it is not utilised but ready to respond if required • Balancing Energy to resolve downward energy imbalance (bids) when generation is greater than demand and when there is a need to address high frequency Throughout the period there were 796 out of 992 (80%) settlement periods where the service would have delivered value to the end consumer. The Weekly breakdown of potential trial value is shown in the table below:

Week	Potential Value
04-10 September	£0.20 million
11-17 September	£0.25 million
18-24 September	£0.23 million
Total	£0.68 million

The potential value was assessed as follows:

1. Determine costs and volumes of spinning assets for allocation of upward reserve. We have not included offers taken for allocation of upward reserve for assets in the BM.

2. Determine costs and volumes of spinning assets for allocation of downward reserve. We have not included bids taken of downward reserve for assets in the BM.

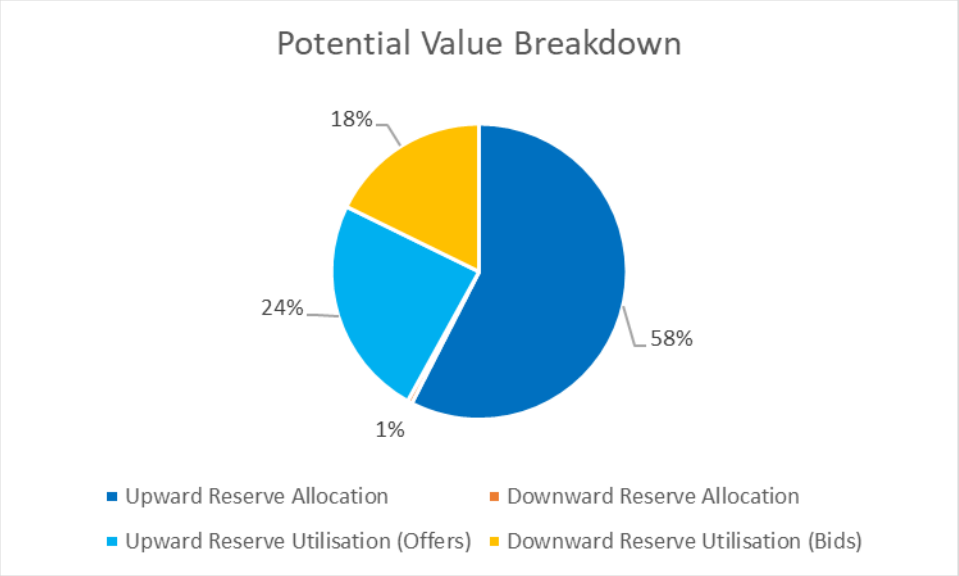
3. Effective prices of trial providers calculated for balancing energy. This included the up-front commitment cost and the utilisation cost.

4. Bids and Offers energy imbalance stacks were created of the actions taken in the BM. This removed system actions, actions taken for the creation of reserve, bids whose prices were more attractive than the effective prices of trial providers, and offers whose prices were more attractive than the effective price of trial providers.

5. Average price of energy imbalance bid stacks was calculated

6. Average price of energy imbalance offer stacks was calculated

For each half hour this provides the effective volumes, price and cost of the trial provider and the alternatives for each of the four value areas. This was used to create the potential savings from each half hour for the four value areas. ESO judgement was used to assign each half-hour period to an area of value. The potential value by category is shown below.



Assumptions made in calculating monetary benefit

We have determined this potential value assuming robust capability was in place to assess, nominate and instruct the trial market participants. During trial conditions, our experience has shown that prior to full implementation of enduring solutions there is additional capability required within the ESO's control room, in our procurement process, and in market development activities.

Potential value has been calculated by looking at the alternative actions taken in the Balancing Mechanism and assuming that the ESO has well developed, fit for purpose processes and systems in place to be able to achieve this potential value consistently for all assets including storage.

It should be noted that the potential value is based on the assessment methodology set out above. A mechanism for assessing the true cost of any future service would need to be developed as part of any enduring solution.

How benefit is realised in the consumer bill

Operating storage assets in a different way has the potential to increase the level of utilisation, which provides a natural incentive for these assets to compete with other assets who provide reserve, potentially resulting in cost efficiencies for the end consumer. The future impact is a greater pool of flexibility in the BM which will deliver increased operational resilience and support the wider ambitions of operating carbon free by 2025.

The cost savings associated with this work will be realised in the consumer bill as lower BSUoS charges for future consumers.

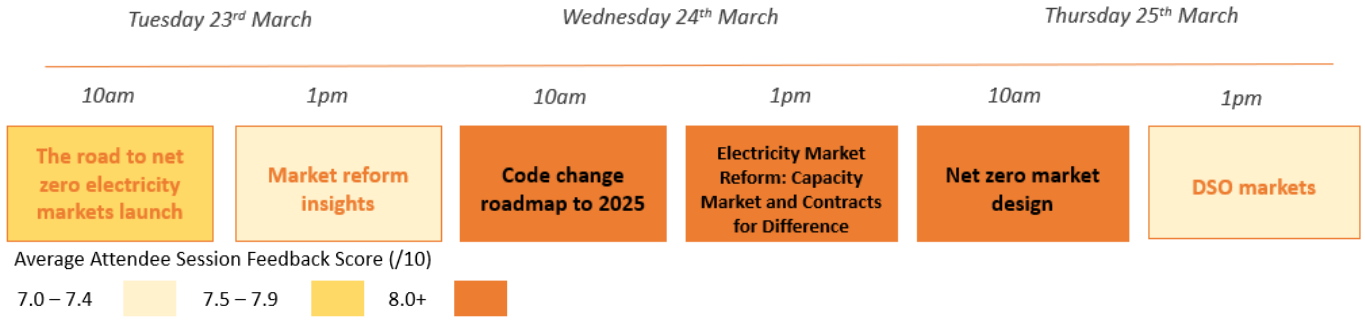
Non-monetary benefits	**Improved safety and reliability and improved quality of service** The main purpose of this trial was to gain experience which can be factored into future reserve reforms, which we will co-create with the industry. We have found that running such a trial is a great way to test the value proposition for consumers prior to mobilising and informing future code developments and provides the opportunity to learn by doing to inform future systems developments and inform future trials. The Reserve from Storage trial has provided valuable learning points, which will be factored into any future rollout of the service, as well as into wider market reform. An example of this learning is that an enduring solution should: • Be accessible to all technically capable assets • Work within or alongside existing market frameworks, e.g. stackable • Be fully compliant with Clean Energy Package • Be easy to understand and transparent • Be appropriately included in the cashout price calculation • Deliver robust capability and auditable processes
Assumption made in calculating non-monetary benefit.	The reserve from BM storage trial was set up to expedite learning, and therefore carried out using the existing BM frameworks. It is important that we consider the learning from the trial in the design stages of reserve reform, and any implementation of enduring solutions is consistent with reserve reform proposals. In adopting the learning by doing approach by the running the trials, a great amount of experience was gained. To facilitate the trial, additional processes were temporarily introduced in the ESO's control room, and although manageable with four participants, additional capability would be necessary to facilitate industry-wide participation. It is important to ensure that enduring solutions have robust capability in place to facilitate the full the end to end process: including submitting data to the ESO's control room, receiving instructions, and participating in the Settlements process.

B.2 Stakeholder views

- In response to stakeholder feedback, we "joined the dots" between different market reforms with our ESO markets roadmap to 2025 and multi-day stakeholder event, "the road to net zero electricity markets".
- Following the soft launch of Dynamic Containment in October 2020, we have evolved this product in response to stakeholder feedback, introducing features such as the ability to stack revenue streams
- We're working closely with the industry on reactive reform, and collaborated with UKPN to deliver the Power Potential technical trials
- We have accelerated reserve reform in response to industry feedback, co-creating new products with our stakeholders
- We worked closely with industry stakeholders to develop and implement solutions to the operability challenges caused by low demands resulting from the COVID-19 lockdown
- We have improved stakeholder satisfaction with code administration, as shown by our recent Code Administrator survey

ESO markets roadmap to 2025 and multi-day stakeholder event

Following feedback received from the Performance Panel at the mid-year stage regarding a joined up view and plan for the Role 2 area, the Markets team ran a series of interactive, online events in March 2021. There were six sessions in total which concentrated on a different aspect of electricity market change as the industry progresses to a zero carbon grid. We provided an overview of how planned market changes come together for 2025 and beyond. The sessions were a combination of sharing ESO work on the evolution of electricity markets, and interactive discussions where attendees were able to take part in focussed sessions with subject matter experts on key areas. We had ~1500 attendees across all six events and each event had well over 100 attendees. There were many thought-provoking questions and ideas for us to take away.



We held a post-event survey which showed very positive feedback, with an average score of 7.89 out of 10 for all sessions. Attendees told us:

'*These were very complex topics to get through within a week … this was a very good event to join the dots between markets.'*

'Senior leaders able to answer questions, even the difficult ones!'

'Good range of speakers and collaboration with stakeholders.

'Well organised and presented.'

Product Roadmaps for Response and Reserve implementation

Implement the first new frequency response product

On 1 October 2020, we soft launched the Dynamic Containment (DC) product with new sub-second, post-fault response capability following an extensive consultation with industry. The soft launch sees the ESO running daily tenders for DC seven days a week, moving the frequency response market closer to real-time, which is a significant development in market reform activities.

As part of the continued development of DC through the soft launch workstreams we sought to unlock stacking within the Balancing Mechanism (BM) as providers told us the ability to 'stack' their revenues and provide other services would be hugely beneficial. We recognised the additional value that adding the ability to stack in the BM would offer and we anticipated this additional flexibility would increase competition in more markets. We published a document that outlined our plans to introduce this development and in January 2021 we went live with BM stacking alongside DC.

Alongside this we further engaged with industry to make early developments to the DC service via a consultation which closed in January. The proposed changes we made as part of the consultation incorporated feedback we had received from both a post-launch survey and one-to-one sessions with providers. Responses to the consultation were received from 9 providers covering a range of areas. They were generally supportive of the overall approach that we had proposed for the first wave of developments to the service, including:

- Moving the penalty to apply daily rather than weekly so participants are still incentivised to deliver if they fail a test early in the week.
- The separation of availability determination for high-frequency and low-frequency services in both operational and performance reporting.
- Amending the market window to open at D-1 15:00 in response to feedback about the commercial and resourcing pressures faced by providers.
- Allowing parties to adjust their MW volumes on a daily basis in addition to adjusting their price and withdrawing their availability

Overall stakeholders have told us they feel engaged and support the launch of DC and its continued development. Feedback from the post-launch survey and one-to-ones included the following feedback about the ESO:

- Positive engagement – continual communication and engagement with ESO team, webinars prior to the service going live were very informative
- Support – interaction with the Performance Monitoring team was really useful
- Documentation – clear explanations provided, clear links to glossary, comprehensive coverage of all service requirements
- Relaxation of rules (Real-time metering, testing, Grid Supply Point, metering) – this was good to allow parties to participate from the launch
- Day ahead procurement – allows more flexibility and rapid changes from technical outputs

Provider: '*In my opinion the DC team has done/is doing an excellent job with the introduction of this new product and should be congratulated. You appear to be making light work of a very complicated task. It is clear that the product is required, and this soft launch is clearly the best way of making the transition - at times you've had to defend your approach, but I think you did that well.*'

As part of the one-to-ones we sought feedback on the areas where stakeholders wanted to see improvement to the DC service and our approach to product development. The following points are examples of where we received improvement feedback and what we have done about it:

- Clarity on the Service Delivery and Service Parameters: We have since expanded the Guidance Document wording around the service parameters to provide a narrative explanation to supplement the formulae in the service terms. We have also updated various Service Parameters terms and their descriptions.
- Alignment between Testing Guidelines and other documents - We updated all documents to ensure they were aligned, for example we have since removed the 49.9Hz and 50.1Hz step tests (formerly 1.5 and 1.6) as we noted the live frequency Test 4 better assesses that delivery in this frequency range is as expected.

As part of Markets week, we have published the Frequency Response Reform podcast[36] outlining the next steps for Dynamic Containment.

Consult on future frequency response products

During the Markets week stakeholder events, one of the sessions was 'Market reform insights.' As part of the Response Reform breakout session, we shared the high-level delivery plan for Dynamic Moderation (DM) and Dynamic Regulation (DR), which demonstrates our plan for months of engagement on the system requirements and product designs. We shared our plans to follow a similar launch plan to DC, taking a soft launch approach to enable sprint delivery and future developments to the services. During the breakout session, we asked participants how we could improve the soft launch approach for DM and DR. We know from the provider one-to-ones that the soft launch approach was well-received due to the learn-by-doing approach. The following feedback will shape the improvements we will make to our soft launch approach for DM and DR:

'Soft launch for DC was good; but more time between detail and auction start (to allow testing/qualification) would be beneficial.'

'Creating working groups including industry stakeholders and providers so we design together the service. Trials inviting industry providers will help to design better the service.'

'As soon as possible, give indication of response time, duration time. Hold detailed workshops rather than just presenting views (both are useful!) Give early view on volumes.'

'Set out any criteria which will be relaxed and firm durations of how long this will last. Allow enough time for participants to be ready for soft launch.

'Early communication ahead of time of requirements and detail on the product.'

'More forward visibility of market requirement from DM and DR would be very useful, even if just preliminary estimates.'

'Allow existing parties to provide DM or DR - current plan by ESO prevents this so hinders the market (and cost consumers more).'

'Consult on the product design with more time before soft launch, so that reforms can be made more easily in response to industry feedback. And don't copy across some of the DC assumptions around locationality and baselining, as these are questions that are subject to ongoing development. Thanks!'

Report on auction trial

We published the Q3 evaluation report[37] on the Auction Trial in September 2020, which shared our learnings to date, and feedback from auction trial participants. Feedback on the trial has been positive and participants are supportive of the EPEX Spot platform.

Generator: '*Congrats on a trial well run, we have thoroughly enjoyed being part of it.'*

Generator: '*Definitely we have seen big improvements in the market coordination for frequency response auction trial.'*

During Markets week, we held a session on the auction trial and bringing procurement closer to real-time. During this session, we shared our learnings from the innovation project so far and explained how these learnings will help us move more closer to real-time procurement in the future; importantly, we know that more granular procurement increases participation because it gives response providers more flexibility and industry has told us the auction platform provides a positive user experience. We were asked at the session whether we could consider using the platform for response procurement; we recently announced[38] that from this summer we will be using the EPEX

[36] https://players.brightcove.net/867903724001/default_default/index.html?videoId=6240917811001&muted&autoplay&loop

[37] https://www.nationalgrideso.com/balancing-services/frequency-response-services/frequency-auction-trial

[38] https://subscribers.nationalgrid.co.uk/t/d-98C9F086CABEBF442540EF23F30FEDED

auction platform on an interim basis to procure Dynamic Containment (DC). DC will be procured at day ahead in EFA blocks and via a pay-as-clear auction, which are the key characteristics in the weekly auction trial.

Market design and implementation plan for reformed reserve products

The Reserve Reform project aims to deliver a standardised suite of upward and downward reserve product(s) that work holistically with new frequency response products, and that can be procured at day ahead through an auction held on the Single Market Platform from March 2022. We are co-creating this product with industry and hosted a workshop on 9 December 2020 to communicate the need for reserve, and the ESO's drivers when designing a product suite and market. We also wanted to understand the industry's needs and drivers, share ideas to facilitate co-creation of a new reserve product suite and identify common themes and areas for further investigation. The workshop was well attended, with around 100 parties getting involved in brainstorming ideas virtually. Feedback from attendees was very positive, and we built on this engagement for our consultation in March.

Provider: *'Just wanted to say I think the reserve reform workshop worked really well. The content of the slides worked great for providing context, needs, current thoughts and prompts for discussion, and the Mural board is fab.'*

Provider: '*I have been impressed by the way NGESO is doing this reform. As you know – I don't often say that!'*

Short-Term Operating Reserve (STOR) consultation

In January the consultation for the proposed updates to Short-Term Operating Reserve (STOR) day ahead procurement closed. This consultation ran in parallel with the Dynamic Containment (DC) consultation. We have previously engaged with industry to share the key requirements for moving STOR to day ahead. We have also held webinars and provided various other updates through the last few months, including providing a FAQ document. We held sessions with parties actively delivering DC to gather early learning and development areas. In addition to this we have been meeting with investors, potential providers and parties. In December 2020 we published our Soft Launch Development Plan which outlined the intention to align the DC consultation with the STOR work. Responses were received from nine Providers covering a range of areas and were generally supportive of the overall approach.

Provider: '*We welcome that the Reserve reform work has commenced, and that NG ESO is clearly committed to its co-creation principles.'*

Provider*: 'In general the participation guidance is clear and unambiguous. The document clearly articulates the service and how providers can participate in day ahead STOR.'*

Provider: *'We feel that day-ahead procurement of Reserve is appropriate and compliant with EBGL. It should enable the value of Reserve to be driven by real scarcity events (rather than simply declared on three arbitrary dates in the year) meaning for greater competition which ultimately is beneficial to the end consumer.'*

Short-Term Operating Reserve (STOR) Auction Platform

All respondents agree/strongly agree that the 'STOR Auction Platform is easy to use'. The STOR Auction Platform has simplified the bidding process for 50% of users. No users believe that the process has become more complicated as a result of the change. The training content has received an average rating of 4.5/5 stars, with all users gaining confidence in using the platform having completed the training (up to a confidence rating of at least 9/10).

Supplier: '*Firstly, many congratulations on the mock auction. Every part from training materials, reminders, data portal and email comms is excellent. You've to be congratulated on all of this. Even my SalesForce new username worked first time!'*

Generator: '*It looks like the mock auction went smoothly. The Salesforce platform was intuitive and easy to work with.'*

Support development and implementation of Pan-European replacement reserve standard products

We continue to work with industry through the GB Trans European Replacement Reserve Exchange (TERRE) Implementation Group to consider the next steps on TERRE Implementation.

Conclusions from the group are:

- Market participants have a strong preference to not carry out any further work in this area, because of the revised priorities now on the industry and with no potential for Replacement Reserve (RR) market likely in the short term, and they have no basis for investment cases.
- There is a strong desire for a single route of entry in the Balancing Mechanism, and the opportunity to stack services. This feeds into reserve reform activities already in progress.
- Cost Benefit Analysis (CBA) on a GB-only Replacement Reserve (RR) product could have benefits to inform the future technical agreements with the EU in the longer term. This would help with wider participation across the border in future. TERRE was wholly focused on the channel region coupling for GB, such as the interface with RTE.

We have since discussed the group recommendations with Ofgem and agreed for a CBA to be conducted by an independent third party. The CBA will be used to inform the frequency reform work being undertaken by NGESO in addition to future technical agreements with the EU. We are keeping industry up to date via our website[39] including links to minutes and slides from the Implementation Group's meetings held between November 2020 and February 2021. The next meeting is expected to be held in May 2021.

Product Roadmap for Reactive implementation

Publish our strategy for the future of reactive power

We have been undertaking a six-step approach, set out below, to review our reactive power need and the findings from existing reactive power projects to explore potential solutions.

We shared this approach and the initial output with regards to the problem analysis and the latest findings from existing relevant projects in an industry webinar last December. We also held sessions with some providers who have actively participated in the previous reactive power procurement, to understand issues and blockers from their perspectives. We held the second webinar at the end of March to introduce our next plan, which is to explore a market-based solution. We have explained the key objectives, four focused areas of analysis, and the engagement approach, aimed to set up a clear expectation and co-create the solution with industry together. Both webinars were well attended, and positive feedback was received.

Provider: *'A useful update on thinking and challenges'*

Provider: *'The webinar was very useful, hope to have registration and slides soon. Thank you!'*

Provider: '*Happy to work very closely with National Grid to shape future procurement'*

We have also launched a market survey mainly to help us understand the capability and interests from the existing and future providers, in order to analyse the potential market size.

Power Potential trial with UKPN

Power Potential completed the commercial market trials on 28 March 2021. The trials began on 6 January 2021 and by working in partnership with UK Power Networks and with the industry in a trial environment we have been able to identify a number of learning points. We are aware of the flexibility market DNOs are working on and are ensuring there is no conflict with the reactive power market in the later stage. On 4 May 2021 we submitted our report on the conclusions and key findings from Power Potential.

[39] https://www.nationalgrideso.com/industry-information/balancing-services/reserve-services/replacement-reserve-rr?overview

Delivery of the Power Responsive initiative

Power Responsive continue to engage with and support a number of innovation projects, all seeking to unlock demand flexibility from various sources of funding mechanisms and with a range of different stakeholders that form project teams.

In March 2021, prior to publishing the Power Responsive Annual Report on 1 April 2021, we recorded a succinct 23-minute vid-cast[40] to industry. It highlighted recent policy, regulatory and industry-led initiatives supporting or impacting demand side flexibility, as well as focusing on market metrics in 2020 and looking ahead at the coming 12 months. We have also held a steering group in October 2020[41] where discussions focussed on 'Unlocking Small Customer Flexibility'. We held another steering group in January 2021[42] where we focussed on code modifications that address the specific actions from the Energy Emergency Executive Committee (E3C) and Ofgem final reports into the power outage of 9 August 2019, as well as the development of a new Reserve Product via the Reserve Reform Project which is underway.

Improving the way we facilitate code change

The 2020 ESO Code Administrator survey results show a step-change in our performance as a Code Administrator over the past year with a 25 percentage point increase in satisfaction compared to that of 2019. We have published an executive summary[43] which highlights the key findings which we have also presented to our Code Panels. We are pleased that our overall satisfaction score has significantly increased, at the same time as delivering a high volume of Workgroup meetings and improvements. Following the 2019 survey, we used the feedback, as well as our own data, to put together an internal improvement plan and create deliverables that would directly address key industry issues, but also to challenge ourselves to think of additional benefits to stakeholders.

Stakeholder feedback received in the anonymous 2020 Code Administrator survey:

'With the codes I have been involved in, they (ESO) dealt with them really well and efficiently.'

'The individual I dealt with put a lot of effort in guiding us through the process we need to comply with.'

Customer focussed communications

Throughout the last year, the ESO Code Administrator has made a step change in updating its communications, its role as critical friend at pre-modification stage and streamlining the information about code change on the website. We listened to feedback received in the previous CACoP survey, as well as ongoing feedback from our stakeholders, to ensure that every change that we've made has been useful for industry.

In the past year we have launched easier to read and more standardised emails to industry. We ensure we use Plain English and use a subscription tool so that recipients can tailor their preferences. We published our first ever Code Administrator Annual report that helped stakeholders understand our performance and improvement areas in more detail and to offer greater transparency.

Improving our communications in these ways has ensured that we are helping industry to navigate the often complex nature of code change.

Anonymous feedback received in our 2020 Code Administrator survey:

'They (ESO) have made a big effort to make the information they provide us in an understandable format'

'Far more communications by email so it gives industry awareness of what is happening. We are better informed in a timely manner.'

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[40] https://players.brightcove.net/867903724001/default_default/index.html?videoId=6245702702001

[41] http://powerresponsive.com/wp-content/uploads/2020/10/Power-Responsive-Steering-Group-Summary-1st-October-2020.pdf

[42] http://powerresponsive.com/wp-content/uploads/2021/01/Power-Responsive-Steering-Group-Summary-21st-January-2021-1.pdf

[43] https://www.nationalgrideso.com/document/187391/download

Incorporation of all 14 Code Administrator Code of Practice (CACoP) Principles

Two modifications were raised in March 2020 to facilitate the 14th CACoP principle; sandboxing. Due to congestion from high priority modifications, they were given a low priority. The modifications will proceed in line with the Panel's decision on where they sit in terms of a priority against other modifications. We anticipated that this would not be progressed with any urgency. We reflect back on the year and note that we have made a number of improvements to better facilitate modifications as mentioned in this chapter, but our future work will focus on how we can continue to provide a quality service while dealing with a greater volume and more complex change.

Onboarding process for new industry parties

The ESO Code Administrator pledged to provide more support to new entrants to industry who might not have been familiar with the code change process. We hosted two onboarding webinars[44] with around one hundred attendees. We received excellent satisfaction scores for both events (8.5 and 9.1 out of 10) as well as some great feedback:

Consumer representative: '*Some of my colleagues do a lot of codes work whereas it is not a central feature of my particular work. So I really valued the overview and learning from the webinar. And wanted to say thanks very much. Great session.'*

We published all questions and answers as a useful tool for attendees following both sessions. We will provide more webinars in future for new industry parties as we recognise that by continuing to improve the onboarding process, we are removing barriers to entry and increasing competition.

Improving industry confidence in ESO Code Governance

In the 2019 CACoP survey, stakeholders told us that they lacked confidence in the ESO Code Administrator, specifically that the documentation that forms the basis of code governance was not accurate and often difficult to interpret.

The team completely overhauled all of its documentation. It consulted with industry throughout the process, ensuring that all the changes would actually benefit stakeholders. The result is more concise reports with executive summaries that help all readers understand the nature of each modification at a high level. The important technical detail is still there, but now the documents are accessible for all levels of understanding. We feel this is a major success from the past year, and feedback reassures us that these changes have helped our stakeholders gain confidence in our service:

'Good background info on mods that allows those not familiar with the topic to understand it in a concise and efficient way.'

'They've made the key element of the change proposals and assessments much shorter, and much more concise documents with a lot of details.'

'Better laid out and better templates. Clearer to understand what is going on.'

Facilitate electricity network charging reform through Charging Futures

Charging Futures facilitates engagement with current and future users of the Great Britain electricity system, considering current issues across both transmission and distribution arrangements to give more effective reforms, providing an efficiently operating system for the benefit of the end consumer.

The ESO Code Administrator has delivered a programme of Charging Futures Forums as lead secretariat, with the events hosted by Ofgem. When the COVID-19 pandemic happened, the events moved from being held physically to a virtual platform. Our stakeholders have received the new way of hosting these events well, with an average satisfaction score of 9.05 for our role as secretariat.

[44] https://www.nationalgrideso.com/industry-information/codes-homepage/code-changes-beginners-guide

We will take the learning from moving to hosting the events virtually and ensure that we offer what stakeholders get the most value and interaction from. We will continue to offer all the relevant Charging Futures materials as we have done this year, via webinars, podcasts, emails, summary notes and the Charging Futures website.

Transform the customer experience for network charging

Publications and guidance of the impact of charging reform to our customers

The final Transmission Use of System (TNUoS) tariffs for 2021-22 were published at the end of January 2021 with the impact of the Targeted Charging Review (TCR) outlined in the report. We have published guidance on CMP281: Balancing Use of System (BSUoS) charges for storage. Following on from the publication of our tariffs, we hosted a successful Transmission Charging Forum in February where we looked to provide further clarity on the significant regulatory changes, such as TCR for TNUoS and BSUoS charges. A total of 270 industry colleagues attended the virtual forum across four days. We sent out a survey and received very positive results, with an average score of 8.2 out of 10. We have since published a webinar recording on Connection charging, BSUoS, TNUoS tariff setting and billing on our website.

Improve the digital customer experience for TNUoS, BSUoS and Connection Charging Data; including improvements to existing NGESO billing system to improve user experience

With the implementation of the new ESO data portal for the wider ESO, key data and information related to BSUoS, TNUoS and Connection charging have been reworked and improvements to accessibility and functionality have been made. With these changes, industry and interested parties now have the ability to create direct connections to published TNUoS tariff data through the data portal API function, allowing for real-time data updates.

Establish a 'cross party' approach to onboarding, mapping out whole industry requirements

Having engaged and discussed with Elexon, it was agreed that the first step is to develop a customer onboarding package for ESO charging. Customer feedback has been sought on onboarding guidance through the 2021 Transmission Charging Forum. The initial onboarding pack has been drafted and is due for customer testing by the end of May 2021.

Transform industry frameworks to enable decentralised, decarbonised and digitised energy markets

Supporting the Access Significant Code review (SCR)

We have been engaging with stakeholders through the Transmission Charging Methodologies Forum (TCMF) regarding the Generation Residual modifications (CMP317 & CMP327) needed, as well as providing an update on the Demand Residual modification (CMP332). We have engaged regularly with SHET about the Access Significant Code Review (SCR) and have covered what the transmission options could mean in practice.

Lead code modifications

We invited views for our annual review of changes to the five C16 licence condition statements in an initial consultation issued on 17 November. This follows an industry forum webinar on 10 November and is prior to the required formal consultation. There was a lot of productive discussion around the proposed changes and wider feedback from attendees on a number of points in relation to the C16 statements. These views and proposals were consolidated into an early consultation which ran from 16 November to 7 December 2020, this consultation allowed wider industry to offer their early views and support or challenge views made by other stakeholders or NGESO. We received the following feedback:

Generator: '*Just wanted to say – I love a short and to the point consultation – thanks!'*

Generator*: 'Thank you very much for taking time to respond to all our initial feedback in a great level of detail. We really appreciate it.'*

We proposed the following areas of focus for review this year and ran a number of consultations for existing products such as Short Term Operating Reserve and Fast Reserve; new products such as Dynamic Containment; consideration of further products including Reserve Reform and a downward flexibility product similar to Optional Downward Flexibility Management (ODFM); and a review of the reports and how they could be improved in the future.

A formal consultation was run in January 2021 with the revised statements, was approved by Ofgem, and went live on 1 April 2021.

We received positive feedback in the Ofgem decision letter[45] in regard to our increased transparency of product procurement.

Optional Downward Flexibility Management (ODFM)

During spring 2020 we had introduced the Optional Downward Flexibility Management (ODFM) service to ensure that the system remained operable during periods of low demand. This was introduced rapidly following the first COVID-19 lockdown, as our analysis showed that significant demand suppression would be expected during the summer period. Having introduced this product so quickly, we acknowledged that it was imperfect, but would factor learnings and stakeholder feedback into future reforms.

Towards the end of summer 2020, it seemed that the COVID-19 situation was improving, with lockdown restrictions easing and demand levels returning to normal. As such, we did not anticipate the ODFM product being required during 2021. We therefore focussed our finite resources on the activities which we believed would add most consumer value, and those where stakeholders were asking us to accelerate, such as Dynamic Containment, and reforms for Reactive Power and Reserve.

During winter 2020-21, the COVID-19 situation appeared to be worsening, with lockdown restrictions being re-introduced across the UK. Although we still didn't envisage using ODFM during 2021, we couldn't rule out a credible scenario where it would be used, and took the prudent decision to retain it as an insurance policy. As we did not anticipate the service being used, we had not originally intended to make any modifications to it, due to the resource constraints outlined above. We sought to give Ofgem and market participants as much notice as possible of our plans to re-introduce ODFM.

During spring 2021, we subsequently recognised that there was an opportunity to improve the ODFM service such that it fed into the cash-out process. Noting the strong stakeholder feedback we had received previously, we issued a further consultation on an updated C16 statement, to reflect these changes.

Although during this process we sought to respond to stakeholder feedback and prioritise those activities which delivered the most consumer benefit, we recognise that our messaging during the year had led to some confusion, and the timing of the March C16 consultation allowed limited time for discussion. We will factor these learnings into our future reserve reform activities.

Balancing Services Charges Task Force

The work undertaken by the Task Force enables the industry to address and remove unfavourable market distortions. This in turn will result in improved competition which will reduce costs to the end consumer. We led and provided coordination and administrative support for the Task Force, as well as writing the final report and chairing the Task Force itself. We also provided analysis on the two deliverables and associated subject matter. The Task Force consulted on its interim findings in July 2020 and published its final report for consideration by Ofgem in Autumn 2020. The Task Force submitted its final report to Ofgem on 30 September 2020. Ofgem have published their BSUoS taskforce response, and as a result we are working with industry and have raised code modifications to develop the arrangements in this space as part of our BSUoS Reform programme.

[45] https://www.ofgem.gov.uk/publications-and-updates/decision-not-use-our-power-direction-veto-eso-c16-statement-changes

B.3 Plan delivery

B.3.1 Highlights

- We delivered the new Dynamic Containment (DC) product and introduced day-ahead procurement ahead of schedule. We are continually developing it in response to stakeholder feedback, for example adding the capability to stack services with the Balancing Mechanism. We also published the frequency response auction trial report.
- We clearly set out our plans via the ESO Markets Roadmap to 2025 and held a multi-day stakeholder event
- We have progressed reforms for both Reactive Power and Reserve, working closely with stakeholders. Highlights have included workshops for Reserve and Reactive reform in December, the Power Potential commercial and technical trials, and developing a new Day Ahead Short Term Operating Reserve (STOR) market which is compliant with the Clean Energy Package. On 31 March, we achieved a key milestone by procuring STOR on a daily basis, bringing balancing markets closer to real-time. Over 200 STOR units with a volume of 6.5GW pre-qualified to participate in the daily auction process, with 28 separate companies amounting to c.3GW taking part in the opening auction. Our Markets Roadmap provides an overview of these reforms and how they will continue to be implemented in the future.
- We progressed urgent activities to manage the effects of COVID-19, including developing the new Optional Downward Flexibility Management (ODFM) service which was used in summer 2020, and ensuring that it remains part of our toolkit for 2021. We also progressed urgent code modifications to defer charges and clarify the policy for emergency disconnection of embedded generation.
- We provided strong thought leadership on significant charging reforms, including the Balancing Services Use of System (BSUoS) Task Force, Targeted Charging Review (TCR), Access Significant Code Review (SCR), and BSUoS reform. We have also used our technical understanding of the transmission system and charging methodologies to provide qualitative and quantitative policy inputs on issues such as industrial strategy and the impact on different categories of demand users in transmission charging.
- We have acted on previous feedback to improve stakeholder satisfaction with code administration, and our 2020 survey showed a step change in overall satisfaction of 25 percentage points compared to 2019.

This section reports our performance against the deliverable descriptions and dates set out in the Forward Plan Addendum[46]. The Forward Plan Addendum set out our revised view (as of July 2020) of what we would deliver during 2020-21. During the period of regulatory flexibility, we shared with Ofgem a number of our deliverables where there were known impacts of COVID-19; these are clearly identified in the Addendum. However, we note that the impact of COVID-19 has been felt across many areas of the ESO's work.

We have defined the status of our deliverables as follows:

- Complete: the activity has been fully completed
- Complete for 2020-21: the activities planned for this year have been completed, but the deliverable will carry on into future years
- Ongoing: the activity is still in progress
- Deprioritised: the activity will not be delivered, we explain the reasons for this in the commentary.

For deliverables which continue into future years, we provide a reference to the relevant part of the RIIO-2 Delivery Schedule.

[46] https://www.nationalgrideso.com/document/173131/download

B.3.2 Deliverables

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Product Roadmaps for Response and Reserve implementation			
Implement the first new frequency response product	Date is being revised[47]	Complete	We launched Dynamic Containment (DC) on 1 October 2020 after months of industry engagement, and introduced daily procurement, which is a significant development in our market reform activities under Role 2 within the ESO Forward Plan. Our initial intention of trialling day ahead procurement in the Response and Reserve Roadmap was for early summer 2021, which brings us ahead of schedule in our market reform. Further developments to DC (e.g. procuring high frequency) will be delivered under response reform as communicated in the Markets Roadmap to 2025 document published in March during Markets Week.
Consult on future frequency response products	Date is being revised	Complete	The delivery dates for Dynamic Moderation (DM) & Dynamic Regulation (DR) were amended to accommodate changes to the Forward Plan in 2020. We intend to develop the new response services in 2021 and launch them by March 2022. We have communicated a delivery plan in the Markets Roadmap to 2025 document, which was published in March, this contains milestones for new product development. We hosted a response reform webinar in April where we discussed DC procurement and development, DM and DR development, the weekly auction trial and key milestones in the delivery plan.
Report on auction trial	Q2-Q3 2020-21	Complete	Complete with changed format: we have published the status update, implemented separate procurement of Low Frequency (LF) and High Frequency (HF) as part of Dynamic Containment (DC), and have begun day-ahead procurement as part of DC. In Q3 2020-21 we hosted 1:1s with auction trial participants to seek feedback on the trial. Using that feedback, and analysis of the trial to date, we published a report reviewing progress and learnings from the auction trial. In addition, we launched multiple user functionality, published a user guide for active participants, shared a unit ID mapping table for industry to have visibility of units taking part in the trial and the monthly FFR tender. In response to stakeholder feedback we also published a document explaining merit orders. We have removed the separation of LF/HF from the trial and instead implemented it in the delivery of DC. DC LF was delivered in October 2020 and plans are in place to deliver DC HF in autumn 2021. We previously committed to planning for and trialling day ahead procurement and running residual auctions under the auction trial. DC took on day ahead procurement, and we no longer see benefit in the residual auction, which was supported in the independent review of the trial, which we published in September. The feedback from providers, learnings from the trial to date, coupled with our experience of day ahead procurement of DC will shape the development of the enduring auction platform. For more information please listen to the auction platform podcast recorded in March 2021 for Markets Week.
Market design and implementation plan for reformed reserve products	Date is being revised	Complete	The reserve product reform consultation was published on 4 March 2021, with responses requested by 2 April 2021. We are now engaging with industry groups such as ADE, Energy UK and the FGG.

[47] 'Date is being revised' is due to the target dates being uncertain at time of publishing the Forward Plan Addendum

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Support development and implementation of Pan-European replacement reserve standard products	Q1-Q4 2020-21	Ongoing	Completed: After leaving the European Union we now have a Trade and Cooperation Agreement (TCA) with our EU partners. BEIS have written two letters to NGESO. Unfortunately, in the area of balancing, these do not add further detail to what we have in the TCA. As a result, after consultation with Ofgem and the wider industry, we have put TERRE on hold, and we have withdrawn our Grid Code and BSC mods on MARI. We have also informed the central European projects that we are changing our status on TERRE and MARI from Member to Observer. Ongoing: On TERRE we have committed, via the TERRE Implementation Group, to a cost-benefit analysis looking at a GB only standalone version.
Product Roadmap for Reactive implementation			
Publish our strategy for the future of reactive power	Q3 2020-21 - Q2 2021-22	Complete for 2020-21 (see RIIO-2 Delivery Schedule D4.6.2)	We have introduced the 6-step approach that is being used to review and develop 'Future of Reactive Power', the first round of industry engagement was completed, which included meetings with some individual stakeholders and a webinar in December 2020, to share what the reactive power issues are and the current observations/learnings from existing projects (Pathfinder, Power Potential, network boundary transfer etc). The second Industry webinar was held on 31 March, introducing the plan and scope of work, and our intention to start designing and analysing the reactive power market next. A Market survey was launched on 2 April 2021 to help us understand the potential size of the market and the general interest from industry.
Power Potential trial with UKPN	Q3-Q4 2020-21	Complete	All Power Potential trials, Technical and Markets have now been completed with the latter closing out on 28 March 2021. The project team is currently compiling the learning from the project within a number of SRDC (Successful Delivery Reward Criteria) reports focusing on Cost Benefit Analysis, Technical and Commercial Trial Results, and DSO Risk / Reward. These will be submitted to Ofgem through April and May in advance of a project closure report and a final stakeholder meeting (RMAP).
Review learning from Power Potential	Q3-Q4 2020-21	Complete	As part of the project closure processes the project team shared key learnings[48] from Power Potential with key inter-related projects. These include both the RDP programme, that is working directly with DSO / DNOs, and the "Future of Reactive" project that is considering the development of wider reactive power and voltage control markets.
Power Responsive			
Deliver innovation projects to unlock demand flexibility	Q2 2020-21	Complete	The Residential Response Network Innovation Allowance (NIA) Project has now concluded, as has the United Utilities project Enhancing Flexibility from Wastewater Catchment Areas.
Improving the way we facilitate code change			
Incorporation of all 14 Code Administrator Code of Practice (CACoP) Principles	Ongoing	De-prioritised	Two modifications were raised in March 2020 to facilitate the 14th CACoP principle; sandboxing. Due to congestion from high priority modifications, they were given a low priority. The modifications will proceed in line with Panel's decision on where they sit in terms of a priority against other modifications. We anticipate that this will not be progressed with any urgency at this stage. We therefore do not have any control over the speed in which it progresses.

[48] https://www.nationalgrideso.com/document/191146/download

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Customer focussed communications	Q1 2020-21	Complete	An email subscription tool has now been implemented alongside easy to read emails. The first Code Administrator Annual report has also been published on our website in direct response to stakeholder feedback asking us for more transparency.
Onboarding process for new industry parties	Q2–Q3 2020-21	Complete	The ESO Code Administration team has now created a comprehensive onboarding page on the ESO website. This was created in direct response to feedback that told us that new industry parties often found it hard to navigate the complexities of the code change process. We have provided simple, easy to read information and clearly signposted where stakeholders can find more information. In addition to this, we wanted to give new parties additional help. We have also conducted two successful onboarding webinars and will look to continue to offer more support to new parties across the next year.
Improving industry confidence in ESO Code Governance	Q1-Q4 2020-21	Complete	The ESO Code Administration team has taken on feedback from industry that told us it needed more confidence in us. Since then, we have made our critical friend process more robust. We have undertaken many other improvement activities to help us better facilitate the code change process to be more transparent. Most recently, we created a new process for Panel to prioritise modifications. We feel examples like this where we can provide the right tools and guidance, truly demonstrate one of the ways we are improving industry confidence.
Facilitate electricity network charging reform through Charging Futures			
Facilitate electricity network charging reform through Charging Futures 1. Targeted Charging Review (TCR) 2. Access and Forward Looking Charges Significant Code Review (SCR) 3. Reform of Balancing Services Charges	Q1-Q4 2020-21	Complete	We continue to offer a programme of accessible events for parties to learn and contribute to electricity charging reform that our stakeholders have come to expect. Despite COVID-19 we hosted our second virtual forum via webinars in July and the second Balancing Services Charges Task Force[49] published its final report in September 2020. Most recently, we hosted two Charging Futures webinars that received high stakeholder satisfaction scores. Average secretariat score of 9.05 and average event score of 8.4. The speed of delivery is dependent on Ofgem's decisions so point 2 and 3 will continue to be discussed in Charging Future Forums in 2021.
Transform the customer experience for network charging			
Publications and guidance of the impact of charging reform to our customers	Q3-Q4 2020-21	Complete	There were a number of uncertainties underlying the charging regime, such as RIIO-2 parameter resets and Targeted Charging Review (TCR) implementation. The TNUoS five-year view (21-22 to 25-26) was published on 31 August 2020, which has implemented the TCR changes. To help the industry understand the potential impact from some of the uncertainties, we have also provided sensitivity analyses to help provide a range of outcomes and views on tariffs. The Final Tariffs for 2021-22 were published at the end of January 2021 and the impact of TCR on the 2021-22 tariffs have been outlined in the report. We have published guidance on CMP281 (BSUoS charges for storage), TNUoS modelling for 3-ended HVDC circuits, and the TNUoS onshore locational security factor. We hosted a successful charging forum where we provided some clarity on the significant regulatory changes such as TCR for TNUoS and BSUoS charges.

[49] http://www.chargingfutures.com/media/1477/second-balancing-services-charges-task-force-final-report.pdf

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			Going forward, guidance documents will be published on the TNUoS generation residual (TGR) and Transmission Demand Residual (TDR) following the related CMA appeal and Ofgem's further decision.
Introduce new 'new entrant' e-learning on charging	Q1-Q4 2020-21	Complete	We delivered the following milestones as set out in the Forward Plan Addendum: • Q1: Publish an updated webinar for connection charges • Q2: Publish an updated webinar for BSUoS charges • Q3: Develop workshops on the topics selected by the customers as part of the Charging Forum event • Q4: Publish an updated webinar for TNUoS charges with a focus on new charging methodologies introduced by TCR. Q1: We provided industry with a first look of the confirmed/potential impacts of the TCR. In addition to this we have also provided insight into the generation re-zoning which forms part of CUSC modification proposal (CMP324/325). In conjunction with the 2021-22 Forecast TNUoS Tariffs report, we produced a pre-recorded webinar providing further insight into upcoming changes. The recorded webinars for connection charges were rescheduled for Q4. Q2: After the publication of the TNUoS five year view, we hosted a webinar in September 2020 to go through the report and analysis with a focus on the new charging methodologies. Recorded webinars for BSUoS were rescheduled for Q4: this covered the TCR BSUoS changes taking effect in April 2021. Q4: Following the successful Transmission Charging Forum, we have published recorded webinars on connection charging, BSUoS, TNUoS tariff setting and billing on our website.
Improve the digital customer experience for TNUoS, BSUoS and Connection Charging Data; including improvements to existing NGESO billing system to improve user experience	Q1-Q4 2020-21	Ongoing (see RIIO-2 Delivery Schedule D6.3)	Completed: With the implementation of the new ESO data portal for the wider ESO, key data and information related to BSUoS, TNUoS and Connection charging have been reworked and improvements to accessibility/ functionality have been made. With these changes, industry and interested parties now have the ability to create direct connections to published TNUoS tariff data through the data portal API function, allowing for real-time data updates. We delivered the following milestones as set out in the Forward Plan Addendum: • Q1: We completed the review of the current systems, data requirements and the information we currently provide externally, taking into account the TCR decisions. • Q2-Q3: A scope and plan was outlined, we looked to develop the required changes throughout, by revisiting our scope and seeking feedback to ensure delivery is fit for purpose and meets expectations, both internally and externally. Due to COVID-19, the priorities have been to assist the industry via two support schemes - TNUoS scheme and BSUoS scheme (CMP345/350). As such, we have experienced delays in the optioneering work. To ensure the timely delivery of the regulatory changes, it was decided to implement the TCR changes in the existing Charging and Billing System. Ongoing: We will be looking to enter the implementation phase. The optioneering work has been completed and the sanction paper is due to be submitted for internal approval.
Establish a 'cross party' approach to onboarding, mapping out whole industry requirements:	Q1-Q4 2020-21	Ongoing (see RIIO-2 Delivery Schedule D6.3)	Completed: The key milestones we set out in the Forward Plan Addendum were: • Q1: Agree the approach and scope for the joint-up onboarding guidance with ELEXON • Q2: Engage with customers, seeking their feedback and suggestions on the onboarding process.

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			• Q3: Begin drafting the guidance documents. • Q4: Finalise and publish the guidance, incorporating the finalised new TNUoS and BSUoS charging methodologies. Having engaged and discussed with Elexon, there were several issues highlighted such as who is responsible for the accuracy of the pack and how we can keep the information updated given the amount of frequent changes. It was therefore agreed that the first step is to develop a customer onboarding package from an ESO charging perspective. The Q2 and Q3 milestones were delayed due to lockdown and challenges on industry party resource. However, customer feedback was sought on onboarding guidance through the 2021 Transmission Charging Forum. Ongoing: The initial onboarding pack has been drafted for suppliers (the largest customer category) and is due for new supplier testing by the end of May. The onboarding pack for other customer types will be completed by September 2021. In the pack we signpost the information customers may want to find from Elexon or Ofgem.
Transform industry frameworks to enable decentralised, decarbonised and digitised energy markets			
Implement Targeted Charging Review (TCR) decision in conjunction with DNOs.	Q1-Q4 2020-21	Complete	The key milestones as set out in the Forward Plan Addendum for delivering the Targeted Charging Review (TCR) were: • Q1: Working groups complete development of modifications and submit to Ofgem • Q1: ESO to produce preliminary cut of bands • Q1: CUSC and DCUSA modifications approved by Ofgem • Q2: Designated party set final bands • Q4: TNUoS go-live There were three different sets of TCR modifications: BSUoS, Transmission Demand Residual (TDR) and Transmission Generation Residual (TGR). For BSUoS, we have completed all of the milestones. For TDR, we have completed the development of modifications and submitted them to Ofgem. We have also raised subsequent follow on modifications as requested by Ofgem. We are awaiting a decision from Ofgem to progress the subsequent milestones for transmission band setting. For TGR, we had completed all milestones. The ESO has now prepared follow on modifications as outlined in Ofgem's decision letters. Due to feedback received via TCMF, CMP368/369 modifications were raised in April 2021 following the outcome of the CMA appeal on CMP317/327
Supporting the Access Significant Code Review (SCR)	Q3 2020-21 and ongoing	Complete for 2020-21 (see RIIO-2 Delivery Schedule D6.1)	We have provided Ofgem with all of the necessary modelling and information for their cost benefit analysis to be undertaken. We will continue to support the Access Subgroup through the creation of papers on focus areas for Ofgem, once work on the Access SCR resumes.
Lead code modifications	Q3-Q4 2020-21	Ongoing (see RIIO-2 Delivery Schedule D6.1)	Completed: The codes team have progressed all code modifications relating to the Targeted Charging Review (TCR) and Significant Code Review (SCR). Changes relating to BSUoS charges and TNUoS generation charges as a result of the TCR, have also been approved, although we await Ofgem's decisions on the remaining demand changes. The zoning modification has recently been approved by Ofgem. Ofgem have published their BSUoS taskforce response and as a result we will

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			work with industry to raise changes to develop the arrangements in this space. Ongoing: In terms of other code changes, due to the TCR and other industry congestion, these have moved into RIIO-2 and will be concluded within 2021-22.
Balancing Services Charges Task Force	Q2 2020-21	Complete	The BSUoS taskforce has now concluded and the report published and sent to Ofgem. The taskforce's conclusions support removing BSUoS charges from generators to be paid 100% by final demand and recommend that the charge is fixed in advance by the ESO to remove risk premia from consumer bills. Ofgem have now published their response and we are working closely with them and industry on the next steps. We have raised the required modifications to CUSC as part of this work.
Capacity Market Modelling - Cross-border participation in capacity markets	Q1-Q4 2020-21	Complete	ENTSO-E have a mandate to develop the methodology under Regulation (EU) 2019/943 as part of the Clean Energy Package, which will help facilitate direct participation of cross-border capacity in the capacity market. ACER published their decision on the cross-border participation in capacity markets on 22 December.[50] We have now reviewed the details of this methodology. We believe that the changes we made to our modelling in 2020 mean we are already consistent with the ENTSO-E methodology, for example the definition of a stress period, modelling European countries in line with their reliability standards (stress periods are defined in the Capacity Market rules as periods when GB experiences loss of load). We also note the positive feedback from BEIS' Panel of Technical Experts in their 2020 PTE Report on the changes we made in 2020.[51] As such, we do not envisage any significant modelling changes are needed to facilitate direct participation of cross-border in the GB capacity market, whenever a decision is taken to implement it.
Capacity Market (CM) Modelling – facilitating broader participation in the CM to provide security of supply at best value for consumers.	Q1-Q4 2020-21	Complete	ESO have been supporting a DCUSA Change Proposal referred to as DCP350 to create a register of embedded assets. This was approved by DCUSA in May 2020 and by the Authority on 1 July 2020. The first version of the data was published in July 2020. We intended to use this data to improve our modelling of embedded generation for the capacity market, which may lead to a change in how we determine de-rating factors. We assessed the data in the Electricity Capacity Registers in conjunction with metred hourly output data that we had already acquired from Electralink. This assessment was discussed and scrutinised by BEIS, Ofgem and BEIS Panel of Technical Experts within the capacity market modelling process. The outcome of the assessment concluded that the data quality was not good enough to be able to develop an alternative, robust de-rating factor method. We are continuing to work closely with the DNOs to improve data quality and we are intending to publish the analysis to-date in Q1 2021-22.
Delivery of the Power Responsive initiative			
Support coordination of Distributed Energy	Q1-Q4 2020-21	Complete	We worded with Everoze to deliver the Annual Report for 2020[52], which was published on 1 April 2021. We are also continuing to work with Piclo and Electron local market trials. At the Steering Group in January we

[50] https://wp.acer.europa.eu/Official_documents/Acts_of_the_Agency/Individual%20decisions/ACER%20Decision%2036-2020%20on%20cross-border%20participation_XBP%20CM.pdf

[51] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/900062/panel-technical-experts-report-on-2020-electricity-capacity-report.pdf

[52] http://powerresponsive.com/wp-content/uploads/2021/03/Power-Responsive-Annual-Report-2020.pdf

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Resource (DER) engagement on flexibility developments			brought experts from Market Change Delivery and Grid Code teams to discuss their work on reforming reserve products and delivering code changes on emergency disconnection.
Power Responsive Stakeholder Engagement	Q1- Q4 2020-21	Complete	We have progressed with virtual events such as the Major Energy Users' Council (MEUC) webinar session on 14 October 2020, and the Energyst Event in November.

B.4 Outturn performance metrics and justifications

Metric/ Performance Indicator	Performance	Status
2A. Reform of Balancing Services Markets	Percentage of total spend procured through open and competitive markets:	
	Frequency response 85%	●
	Reserve 39%	●
	Reactive 0%	●
	Black start 0%	●
	Constraints 15%	●
2B. Code Admin Stakeholder Satisfaction	The average score for 2020-21 is 8.8	●
2C. Charging Futures	The average score for 2020-21 is 8.4.	●
2D. Year ahead forecast vs outturn annual BSUoS	The year ahead BSUoS forecast was £3.52/MWh, and the outturn was £4.77/MWh, giving an APE of 26%	●
2E. Month ahead forecast vs outturn monthly BSUoS	6 months of Absolute Percentage Error (APE) greater than 20%; 2 months between 10% and 20%; 4 months below 10%	●

Table 9: Summary of metrics and performance indicators for Role 2

● **Exceeding expectations**

● **Meeting expectations**

● **Below expectations**

2A Reform of Balancing Services Markets

2020-21 Performance

This metric encourages us to provide a high quality service to our stakeholders as well as visibility, transparency and engagement. The reform of balancing services markets should increase competition and lower prices.

Performance is measured using metrics such as total spend and total volume procured. Where possible, we will look to include average market price paid. The measures will be by service area rather than individual market. The data for each measure is split into two categories: competitively procured or competitive bilateral.

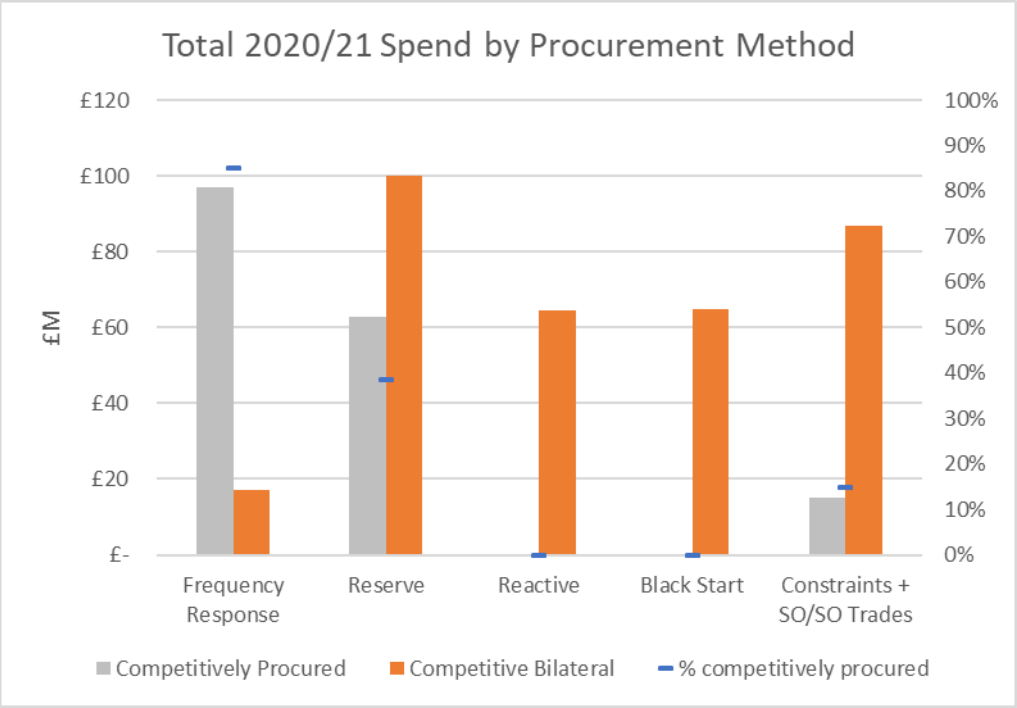


Figure 5: Cumulative spend on services per procurement category in £millions

Service	2019-20 %	Target % for 2020-21	Actual % for 2020-21
Frequency Response	81%	85%	85%
Reserve	43%	55%	39%
Reactive	0%	5%	0%
Black start	0%	10%	0%
Constraints	0%	10%	15%

Table 10: Percentage of total spend procured through open and competitive market

Supporting information

Frequency response – Meeting Expectations for the year.
Over the year we have seen several changes to the frequency response markets which have affected the amount spent. Over the summer the amount spent in the mandatory, weekly auction and Firm Frequency Response (FFR) markets remained relatively constant. The lower figure of 69% for market procurement of frequency response in Q1 was due to the extremely low demand conditions experienced during April, which drove a large spend on commercial frequency response from pumped hydro to ensure system security whilst the new Optional Downward Flexibility Management (ODFM) service was introduced.

In the second half of the year we removed the unit and volume caps in the auction trial and launched the first of our new suite of frequency response products (Dynamic Containment, DC). Both of these developments have resulted in increased spend in competitive markets. The introduction of DC also resulted in a higher clearing price for dynamic response in the auction trial, as some participants moved into the new market.

Average clearing price £/MW/h (weekly auction trial):

	Q1	Q2	Q3	Q4
Dynamic	6.29	5.84	8.76	8.63
Static	5.30	4.10	4.12	4.05

Average clearing price £/MW/h (Dynamic Containment):

Q3	Q4
17.0	17.0

Reserve – Below Expectations for the year.
We spent £9m more on competitive bilateral contracts in Q1 2020-21 compared to Q1 2019-20 as a result of the impact of the COVID-19 pandemic, as well as the suspension of Short Term Operating Reserve (STOR) and Fast Reserve procurement in January. This trend continued into Q2 as we continued to manage periods of exceptionally low demand over the summer.

In the second half of the year we saw a small increase in spend on competitive markets, but otherwise a similar pattern to the previous year.

Average market prices: Whilst the STOR and Fast Reserve markets are suspended, there are no average market prices available. For optional Fast Reserve instructed within day, average utilisation price is:

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
£/MWh	84	57	51	48	48	64	67	72	84	108	90	86

Reactive – Below Expectations for the year.
We ran the first round of industry engagement on the future of reactive power in December 2020 to capture feedback to further analyse the gaps and co-create the solution with industry.

Black start – Below Expectations for the year.
Despite awarding contracts through open and competitive tenders for the South West and Midlands in 2020, the spend associated with them will not appear until 2022 and therefore does not appear in this metric. We did not sign any new bilateral contracts in 2020, and are intending to continue developing the market approach further. We plan to launch a further competitive event in Q2 2021-22 for services in the South-East region.

Constraints – Meeting Expectations for the year.
In the first half of the year, the Mersey Short Term Pathfinder tender drove a small increase in competitively tendered spend, however the overwhelming majority of the competitively tendered spend was on the temporary ODFM service. This increase in competitively tendered spend was offset somewhat by spend on the competitive bilateral contract negotiated with Sizewell to manage low demand conditions over the summer.

In the second half of the year, the expiration of the Sizewell contract reduced the competitive bilateral spend to nearly zero, with the competitively procured spend continuing as a result of the Mersey Short Term Pathfinder tender, which ran until 1 April 2021.

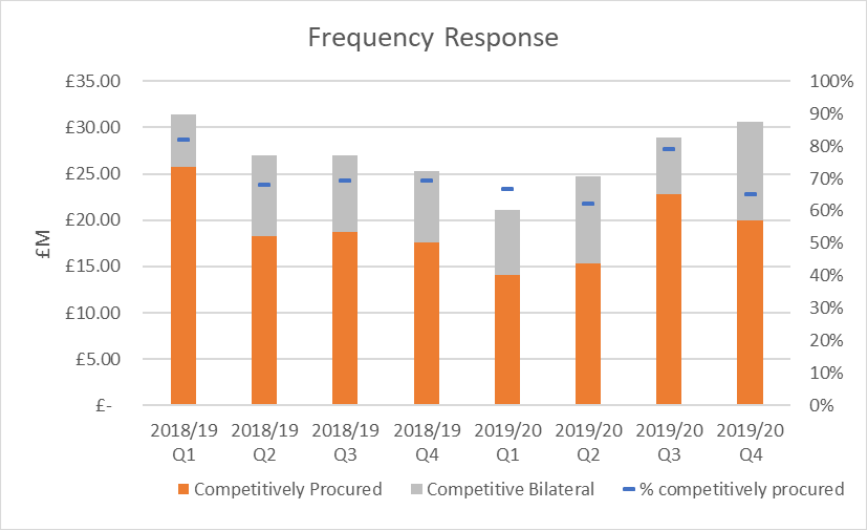
Performance benchmarks

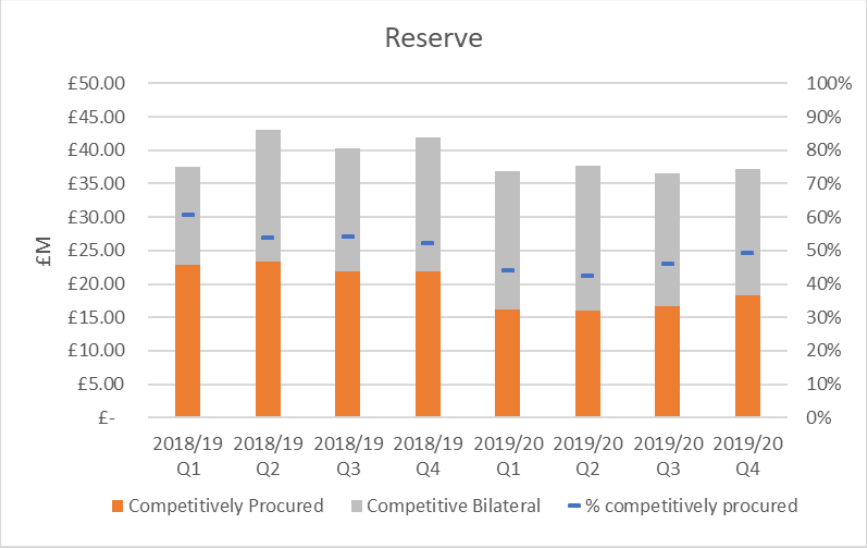
Each performance benchmark is specified as a range.

	Exceeding expectations	Meeting expectations	Below expectations
Frequency response	95% or above	Above 75% and less than 95%	75% or less
Reserve	60% or above	Above 50% and less than 60%	50% or less
Reactive	15% or above	Above 0% and less than 15%	0%
Black start	20% or above	Above 0% and less than 20%	0%
Constraints	20% or above	Above 0% and less than 20%	0%

Historical data

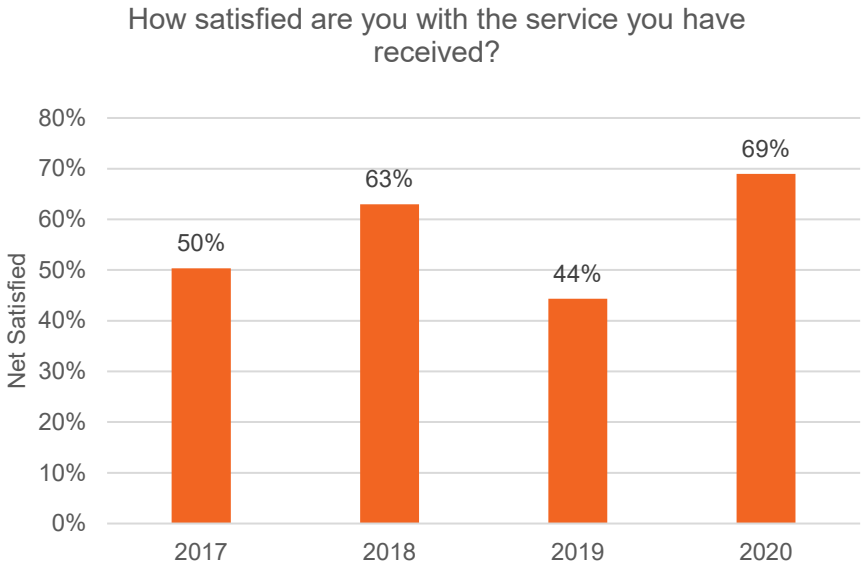
The following figures show the metric calculated using historical information. This is provided as context for the current metric. Only frequency response and reserve are included, as the other services have no regular competitive marketplaces.





2B Code Admin Stakeholder Satisfaction

2020-21 ESO Code Administrator Stakeholder Survey Performance



Supporting information

In 2020, there was no cross code annual satisfaction survey. This was due to the fact that the COVID-19 Pandemic had just impacted at the time that the survey would have usually been conducted.

Towards the end of 2020, working from home had become more of a normality and we were keen to understand how the significant improvements that the ESO Code Administrator had made, had impacted our stakeholders. It felt appropriate to conduct a similar survey to ensure our stakeholders felt the benefit and also to make sure any future improvements would be justified with feedback.

For the purposes of this section, we have illustrated the greatly improved satisfaction score below. We have also included our workgroup satisfaction scores to further evidence how we are exceeding stakeholders' expectations.

You can see a summary of the results of the survey here[53].

ESO Code Administrator Workgroup Satisfaction Scores

Workgroup meetings are conducted throughout the governance process. When a workgroup meeting is concluded for the final time, we ask attendees to complete a survey that asks them for feedback on the experience. For 2020-21 baseline stakeholder satisfaction score is 7.34. Thus, the exceeding expectation benchmark, which is 5% higher than the baseline score, is 7.71.

Workgroup	Month surveyed	Average rating
CMP324/325	June	9.33
CMP334	June	8.00
CMP337/338	June	9.50
CMP345	June	9.00
GC0131	June	7.00

[53] https://www.nationalgrideso.com/document/187391/download

CMP317/327/339	July	8.67
CMP350	August	8.00
CMP335/336	September	10.00
CMP343/340	September	10.00
GC0147	December	9.00
CMP357	January	8.33
2020-21 Average rating		**8.80**
2019-20 Average rating		**7.34**

Table 11: Workgroup Satisfaction Performance

Supporting information

In 2020, Ofgem did not conduct a cross code survey. We took the decision in late 2020 when working from home had become a normality, to conduct our own ESO Code Administrator survey. We felt this was important as we had conducted a significant programme of change and improvements. We are pleased to report that stakeholder satisfaction has increased by 25% since the 2019 survey. We want to ensure that this sentiment continues and are committed to making the code change process as simple and transparent as possible for our stakeholders.

We are pleased that the 2020-2021 average rating is 8.80 which, if there had been a CACoP survey, would have exceeded expectations. We will take the learning from the scores and ensure that our stakeholders continue to benefit from the way in which workgroups are administered.

Performance benchmarks

- **Exceeding expectations:**
  - CACoP – Performance above 5% of the average stakeholder satisfaction score across all code administrators for the 2020 CACoP survey, across all our three codes.
  - ESO led stakeholder surveys – increased performance by at least 5% above our baseline score.
- **Meeting expectations:**
  - CACoP - Performance (within +/-5%) of the average stakeholder satisfaction score across all code administrators for the 2020 CACoP survey, across all three of our codes.
  - ESO led stakeholder surveys – Maintain performance within 5% of our baseline score. Our baseline performance is based on average survey scores taken for the 2019-20 period. These results and baseline score are set out in the benchmark calculations section of the Forward Plan Addendum.
- **Below expectations:**
  - CACoP – Performance below 5% of the average stakeholder satisfaction score across all code administrators for the 2020 CACoP survey, across all our three codes.
  - ESO led stakeholder surveys – performance below our baseline score by at least 5%.

2C Charging Futures

2020-21 Performance

Charging Futures supports network users by giving them opportunities to learn about the changes, and to contribute to how future arrangements work. Surveys are conducted following Charging Futures Forums and webinars with their attendees.

The baseline score for 2020-21 is the average feedback score received throughout the performance year 2019-20, not including survey results for webinars where the main content is not led by National Grid ESO.

The 2020-21 baseline stakeholder satisfaction score is 7.8. Thus, the exceeding expectation benchmark is 8.19, which is 5% higher than the baseline score.

Charging Futures Forum scores 2020-2021

Event	Month	Secretariat Score
Balancing Services Task Force Webinar 1	July	8.3
Charging Futures Forum, morning session	July	7.9
Charging Futures Forum, afternoon session	July	8.3
Balancing Services Task Force Webinar 2	August	8.9
Charging Futures Forum, morning session	December	8.1
Charging Futures Forum, afternoon session	December	8.9
2020-21 Average rating		**8.4**
2019-20 Average rating		**7.8**

Table 12: Charging Futures Forum scores 2020-2021

Supporting information

The latest Charging Futures Forum in December 2020 received a score of 8.4. There was no Forum between April to July, which was not unusual as the frequency prior to the pandemic, would usually be quarterly, or dependent on when Ofgem feel it is appropriate to update industry.

We are pleased with these scores and will ensure all feedback will be used for other meetings where we hope to meet stakeholders' expectations. We are pleased to report that overall, the secretariat score is classified as "exceeding expectations".

Performance benchmarks

- **Exceeding expectations:** Average scores from surveys undertaken throughout the year are more than 5% higher than the baseline score.
- **Meeting expectations:** Average scores from surveys undertaken throughout the year are within the range of +/-5% of the baseline score.
- **Below expectations:** Engagement scores achieved throughout the year fall more than 5% below the baseline score.

2D Year ahead forecast vs outturn annual BSUoS

Supporting information

Our year ahead BSUoS forecast was £3.52/MWh, but outturn BSUoS for the year was £4.77/MWh giving an APE of 26% which was below expectations. This forecast was produced in early March 2020 prior to COVID-19 restrictions being imposed.

Forecasting BSUoS for 2020-21 was particularly challenging as balancing costs rose sharply for the year and demands fell as a result of the various restrictions imposed due to the global COVID-19 pandemic. Constraint costs have been high throughout the year due to the challenges of operating a low demand system, whilst tight margins across the winter months have led to increased prices and high costs of securing operating reserve. Across the year BSUoS volume was 7% lower than 2019-20 and coupled with the increased cost this led to a 39% increase in BSUoS from 2019-20.

Performance benchmarks

- **Exceeding expectations:** Absolute Percentage Error 10% or below
- **Meeting expectations:** Absolute Percentage Error between 10% and 20%
- **Below expectations:** Absolute Percentage Error 20% or above

2E Month ahead forecast vs outturn monthly BSUoS

BSUoS forecasts are important to our stakeholders, although we note that our ability to forecast BSUoS is impacted by factors outside of our control. BSUoS costs are factored into the wholesale price of energy charged by generators, and therefore a forecast is vital for those parties when working out where to price their generation.

Due to the volatility in the comparison of our month ahead forecast with the outturn, we report the percentage variance as there can be large swings in accuracy. This metric does not just look explicitly at the volatility, but at the number of occurrences outside of a 10% and 20% band.

2020-21 Performance

Month	Actual	Month-ahead Forecast	APE	APE>20%	APE<10%
April-20	4.78	3.69	0.23	1	0
May-20	6.24	3.87	0.38	1	0
June-20	5.18	7.18	0.39	1	0
July-20	4.79	5.56	0.16	0	0
Aug-20	4.19	5.61	0.34	1	0
Sept-20	4.75	5.16	0.09	0	1
Oct-20	4.27	4.24	0.01	0	1
Nov-20	5.60	3.50	0.38	1	0
Dec-20	4.17	3.97	0.05	0	1
Jan-21	3.67	3.78	0.03	0	1
Feb-21	5.10	4.33	0.15	0	0
Mar-21	5.18	3.89	0.25	1	0

Table 13: Month ahead forecast vs. outturn BSUoS (£/MWh) Performance

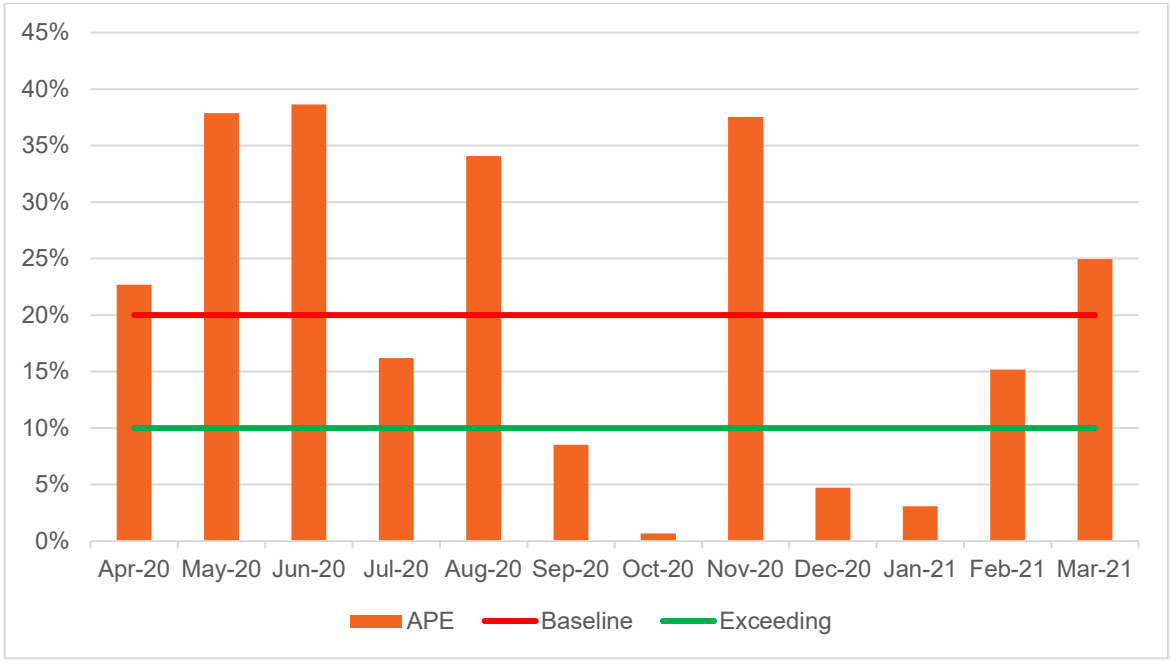


Figure 6: Monthly BSUoS forecasting performance

Supporting information

BSUoS forecasting has been very challenging through the year with the impact of COVID-19 causing massive disruption to the energy market. There were six months with absolute percentage errors above 20%, which brought our performance below expectations.

Our forecasting performance was below the baseline for April, May and June. The April 2020 forecast was produced in mid-March before the national lockdown was imposed, and as such the impact on both balancing costs and volumes was unknown. As the scale of the operational challenge became clearer and new products were introduced to the market to deal with record low demand levels, we worked hard to produce additional BSUoS forecasts to try to reflect this. In April 2020 we produced an additional set of forecasts later in the month to give a revised view of BSUoS, in May 2020 we produced two forecasts to show the costs with and without the new products being introduced, and from June to September 2020 we produced forecasts based on three different demand scenarios. As we have gained more information on the impact of COVID-19 on both costs and demand, our forecasts have improved.

As we moved towards winter and associated higher demand levels, we saw less reduction from pre-COVID expectations, and less volatility in the BSUoS outturn, which enabled us to achieve a much lower Average Percentage Error (APE). Our BSUoS forecasting performance turned to green in September with a predictable increase across most categories offset by a reduction in constraint costs as the Sizewell contract and Optional Downward Flexibility Management (ODFM) services finished. However, the outturn BSUoS for November was significantly higher than forecast which was driven by both increased balancing costs and decreased demand. Balancing Costs were driven by constraint costs. These were largely incurred managing the B7 boundary with a capacity reduction of over 2GW coupled with high wind which outturned 19% higher than November 2019. Demand outturned lower than forecast due to the November lockdown.

Our forecasting performance for December and January was exceeding the baseline due to a predictable reduction in constraint costs with the network more intact and less congestion on the system. However, the reduction in constraint costs was partially offset by an increase in the cost of operating reserve as tight margins drove prices up. Demand in January was also higher than December, despite the lockdown in January; this was due to the usual holiday demand suppression for Christmas which generally leads to lower demands in December than other winter months. In February, operating reserve costs remained high, as they have been across the winter driven by tight margins. Constraint costs rose significantly following the loss of the Western Link HVDC mid-month, resulting in a higher than forecast volume of actions required to manage congestion on the Anglo-Scottish boundary. Demand was slightly above forecast and was close to levels experienced last year despite the continuing lockdown conditions. Balancing costs remained high in March due to high constraint and reserve costs. The Western Link HVDC remained unavailable for the early part of the month, but constraint costs were lower than February due to lower wind. This was offset by an increase in energy costs, primarily Operating Reserve, driven by high costs due to tight margins. Demand was also lower than forecast resulting in higher outturn BSUoS.

Our latest view of BSUoS can be found on our website[54].

Performance benchmarks

- **Exceeding expectations:** Less than 5 out of 12 monthly forecasts are above 20% Absolute Percentage Error, and 5 or more forecasts less than 10% Absolute Percentage Error
- **Meeting expectations:** Less than 5 out of 12 monthly forecasts are above 20% Absolute Percentage Error
- **Below expectations:** 5 or more out of 12 monthly forecasts above 20% Absolute Percentage Error

[54] https://data.nationalgrideso.com/balancing/bsuos-monthly-forecast

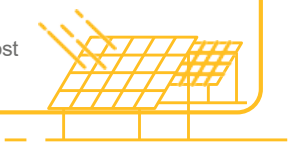
Role 3

System insight, planning
and network development

Role 3: System insight, planning and network development

Evidence of consumer benefits

- We delayed the Pennines pathfinder tender by 4 months, allowing us to optimise the regions and re-evaluate the required reactive power volume, and allowing the Transmission Owner (TO) time to conduct site-specific studies so that the information could be provided to industry at the start of the tender
- Our Northern England and Scotland Operability Study (NESOS) work assessing the impact of significant generation closures led to a number of recommendations, one of which has the potential to save consumers £11.7m-£32.4m per year
- We have built on the Future Energy Scenarios with our Bridging the Gap and Costing work, identifying only a 7% cost difference across the different scenarios, and signposting short term actions to help the UK reach its net zero target



Stakeholder views

We work closely with our stakeholders and have listened to their views. A few examples are:

- We set out clear timelines for our Pathfinder projects, and demonstrated how they interact with market developments
- We have worked closely with DNOs on the RDPs and as part of the ENA, including on the Open Networks project
- We promoted the Loss of Mains programme, and worked with Ofgem to engage those stakeholders who are more difficult to reach
- We have engaged extensively on Early Competition, working closely with the ESO Networks Stakeholder Group
- New interactive ETYS publication in response to stakeholder feedback was well received and attracted an increased number of views
- We engaged with over 220 individual stakeholders, from over 100 organisations, when producing our Bridging the Gap report

Plan delivery

- Several Pathfinder milestones: invited expressions of interest for Constraint Management and Stability Phase 2 Pathfinders, launched tender for Pennines voltage pathfinder. Lessons learned are regularly captured and fed into future Pathfinders.
- We set out a 5-point plan for managing constraints
- Network Options Assessment opened to interested persons, one year ahead of the requirement to do so
- Progressed the Regional Development Programmes, working closely with DNOs
- Connection applications throughout the second half of the year continued at a high level and by the end of 2020-21 the ESO recorded a 22% increase in the level of customer applications on 2019-20 levels.

Performance metrics and indicators

Metric/ Performance Indicator	Performance	Status
3a Right first time connection offers (metric)	The overall percentage of Right First Time connections offers this year is 96%	●
3b NOA consumer value (metric)	We are exceeding expectations for the consumer benefit of ESO options, with an average value of 5.04% taken across the FES scenarios. We are below expectations for the second part of the metric which compares the number of ESO options to the total number of options in the optimal paths, we calculated this to be 5%	● ●
3c Customer connections-customer satisfaction (performance indicator)	The satisfaction surveys were paused in the first half of this year due to the impact of COVID-19. In the second half of 2020-21 the score has been 7 out of 10	●
3d Whole system unlocking cross boundary solutions (performance indicator)	532.3MW of Distributed Energy Resource (DER) within WPD network and 401.2MW within UKPN network accepted for 2020-21	N/A
3e Future balancing costs saved by operability solutions (performance indicator)	We successfully released commercial service contracts under Stability Pathfinder phase 1 and the Mersey Voltage Pathfinder over 2020-21. Overall, we expect to save £29.4m in future balancing costs.	N/A
3f Capacity saved through operability solutions (performance indicator)	We have successfully delivered the N-3 capability with UKPN and are now working to complete this project with WPD and SSEN. As the volumes of DER applying to connect are now beginning to increase, we are stepping up RDP developments and are undertaking commercial design workshops with DNOs on the south coast, in addition to completing the high-level requirements for GEMS with SPT.	N/A

● Exceeding expectations ●Meeting expectations ●Below expectations

C.1 Evidence of consumer benefits

We present three case studies for role 3, to showcase some key areas where we have delivered significant consumer benefit. It would not be practicable to approximate the consumer benefit of all of the deliverables in role 3, although we would expect each of these deliverables to deliver benefits to today's consumers, future consumers, or both. We have included the following case studies for role 3:

- NOA Pennine Pathfinder requirements review
- Northern England and Scotland Operability Study (NESOS)
- Building on our Future Energy Scenarios (FES)

We have used the following areas of consumer benefit, as defined by Ofgem:

- Improved safety and reliability
- Reduced environmental damage
- Lower bills than would otherwise be the case
- Improved quality of service
- Benefits for society as a whole

C.1.1 Case Study: NOA Pennine Pathfinder: reviewing our requirements

Activity

The NOA Pennine high voltage Pathfinder first appeared in the 2019-21 Forward Plan with a commitment to run a Request For Information (RFI) in Q1 2019-20. Its aim is to deliver consumer benefit by instigating a competitive approach to delivering solutions to meet reactive power requirements, maintain compliance for voltage limits across the network, and avoid the despatch of fossil fuelled generation.

However, in early 2019-20 we were notified that Fiddlers Ferry power station would close by April 2020. The consequential impact assessment identified a network compliance impact in the Mersey region. As the Pennine requirement was not expected until 2024, we took the conscious decision to reprioritise workload to meet the more immediate Mersey need, comfortable that time frames would allow us to initiate the Pennine Pathfinder slightly later and still meet our compliance needs.

Initially, we had indicated that following Mersey Contract Award in May 2020 we would begin the Pennines Pathfinder in November 2020.

The Mersey Pathfinder, however, yielded us a considerable amount of useful experience in what worked well and not so well in running a Pathfinder project. As such, we took the opportunity to pause slightly and incorporate those lessons learned into the Pennines approach which is a larger, more complex region with a larger reactive power requirement.

In November 2020, we communicated[1] to industry that we needed to delay the Pennine pathfinder for two main reasons and committed to providing an update in January 2021. The two main benefits we identified in doing this were:

- A need to optimise the region(s) and re-evaluate the required reactive power volume
- Allowing NGET time to conduct site specific studies so that the information could be provided to industry at start of the tender – a lesson learnt from Mersey

We updated industry in January 2021 that the Pennine tender would launch by April 2021. During that time, we were able to make some significant improvements.

Reducing the reactive power requirement:

We were able to significantly reduce the reactive power requirement which we would need to procure to ensure compliance across the Pennine region. The Pennines Pathfinder was initially evaluated using a manually intensive method that had been suitable for considering the much smaller and self-contained Mersey area for the previous Pathfinder.

However, when expanded to the Pennines, the level of interactivity between requirements in sub-regions of the broader area meant that, without optimisation, the final requirement would be evaluated as being greater than the true need, by being the sum of each individual sub-region.

Recognising this, we developed tools to automate analysis, allowing much greater study volumes to be carried out at speed. This was able to capture and account for interactivity in our specification of the requirements, which gave the twin benefits of reducing the necessary volume to be procured from 1800MVAr to 700MVAr and allowing us to provide clarity to industry participants by presenting a refined and simpler tender without overt levels of interactivity across different sub-regions.

Providing greater technical information:

Working in collaboration with NGET, we were able to provide greater technical information to applicants at the start of the process relating to site suitability, effectiveness and the state of existing infrastructure. This in turn allowed participants to be better informed, reduce uncertainty in their commercial decisions and so make more effective tender bidding strategies, all of which should lead to more efficient tender outcomes.

Our high voltage Pathfinder process is included within our NOA methodology to ensure economical and efficient options for high voltage are available when required. This ESO-led process is designed to identify high voltage issues in the transmission system and quantify the requirements. We then seek to procure the overall economic and efficient options through a competitive tender.

	The Pathfinder operates in parallel with the annual NOA cycle. While the annual NOA focuses on bulk power transfer and associated high loading, the high voltage Pathfinder assesses periods of light system loading and minimum demand. Ultimately, we want to find innovative new ways to operate the electricity system of today and tomorrow and keep costs down for consumers, the Pathfinder approach allows us to widen participation and opens up new ways for the industry to help us meet system needs.
Role	3. System insight, planning and network development
ESO Ambitions	• An electricity system that can operate carbon free • Competition everywhere • The ESO is a trusted partner
Forward Plan Deliverables	• Pennine Voltage Pathfinder: Project recommendations
Is the consumer benefit mainly this year or in future years?	The consumer benefit delivered by the Pathfinder will be realised over the 10-year contractual period between April 2024 and March 2034.
Calculation of monetary benefit to consumers	The benefit to consumers will be calculated by comparing the cost of the successful tender solution(s) to the costs to the consumer from the ESO recommending that the Transmission Owner build their proposed options.
Assumptions made in calculating monetary benefit	The assumptions pertaining to utilisation and previous contract costs are deemed confidential but would be shared directly with Ofgem on request. The residual value of any asset beyond the 10-year contract period is not included. Also, the costs of running the tender such as ESO staff costs and TO/DNO feasibility costs are not included.
How benefit is realised in the consumer bill	The Pathfinder project expects to deliver BSUoS benefits by meeting reactive power requirements through long-term contracts and new providers, paying less than the obligatory reactive power service utilisation fees, and reducing the need to procure active power (MW) to access reactive power capability.
Non-monetary benefits	**Improved safety and reliability:** the Pennines Pathfinder will ensure security of supply as it will ensure that the Security and Quality of Supply Standards can be met in the Pennine region in future years. **Reduced environmental damage:** using the Pathfinders to meet voltage requirements will avoid the need to dispatch synchronous fossil-fuel generation for system operability reasons **Improved quality of service:** implementing lessons learnt from the Mersey Pathfinder has simplified the tender process making the process more accessible to tender participants. **Benefits for society as a whole**: simplifying the tender process will encourage new types of providers to tender in, increasing competition.
Assumptions made in calculating non-monetary benefit.	We have assumed that the simplified tender will be more accessible to participants, and that the Pathfinder process will result in avoiding despatch of fossil fuelled generation to deliver a reactive power service.

C.1.2 Case Study: Northern England and Scotland Operability Study (NESOS 2020)

Activity

Recent market intelligence has indicated a rapidly-changing generation background in Northern Great Britain by the winter of 2024-25 driven by accelerating government ambition. Several power stations could reach the end of their asset lives earlier than originally expected. We recognised that this was an issue which would benefit from a focussed piece of assessment work to consider conditions expected in winter 2024-25, summer 2025 and beyond. We therefore worked closely with all three Transmission Owners (TOs) to set up the Northern England and Scotland Operability Study (NESOS) 2020 project to assess any operational impacts from the changing generation background. Two scenarios were considered to conduct sufficient sensitivity studies.

The NESOS project started in November 2020 and ran until the end of the 2020-21 financial year.

Due to the pace of change and new information, we needed to work outside of the normal assessment processes and to focus on specific aspects of network operation. Compared to the ESO's normal assessment of future operability via the Future Energy Scenarios (FES), Electricity Ten Year Statement (ETYS) and Network Options Assessment (NOA) processes, the NESOS 2020 project has the following features which makes it more suitable for addressing this particular challenge:

- It focusses on identifying operational impacts and challenges from earlier closures of power stations in the Northern England & Scotland area, rather than looking at the whole GB network.
- It focusses on the earliest expected period when particular power stations could be closed, which is the winter of 2024-25 and summer of 2025. It tests network capabilities and looks for bottlenecks which would impact on system operation and network development in the northern GB area.
- It conducts a comprehensive package of studies and detailed power system analysis relating to circuit loading, system access, high or low voltages, stability and other operational considerations. The inputs were designed to test the limits of system operation in the northern area.
- It is based on more onerous but credible network assumptions, including demand and generation profiles, and future outage patterns.
- It consists of a joint working group combining expertise in network planning and operation from the TOs and ESO. The project has also worked closely with the Joint Planning Committee Operational Assessment (JPCOA) group to coordinate better outage plans in the 2024-25 period.

The objective of the NESOS 2020 work was to achieve a shared view on the challenges faced, which may then form the basis of new actions and future work. NESOS 2020 consisted of two workstreams:

- power system analysis to examine a range of security and operability issues for winter 2024-25 and summer 2025
- system access planning to review outage plans for the 2023-25 period, assessing the potential impact of large generation closures on the deliverability of significant network projects.

We carried out power system studies, using a modified version of the ETYS model, to assess the impact of the power station closures on security of supply (sufficient generation to meet winter and summer peak demand), voltage (whether voltages can be maintained within limits using existing resources and operational measures), and transient stability (the ability of the system to withstand disturbances).

The TOs' RIIO-T2 plans are dependent on transmission outages which will allow network improvement projects to take place. We have worked with the TOs to review plans across the transmission areas and considered whether the planned outages are feasible in the absence of certain power stations. This analysis has led to the selection of transmission outage patterns which were used in the power system studies. It has also led to recommendations for outage plans to be changed to ensure that the system could be operated securely and economically in all scenarios.

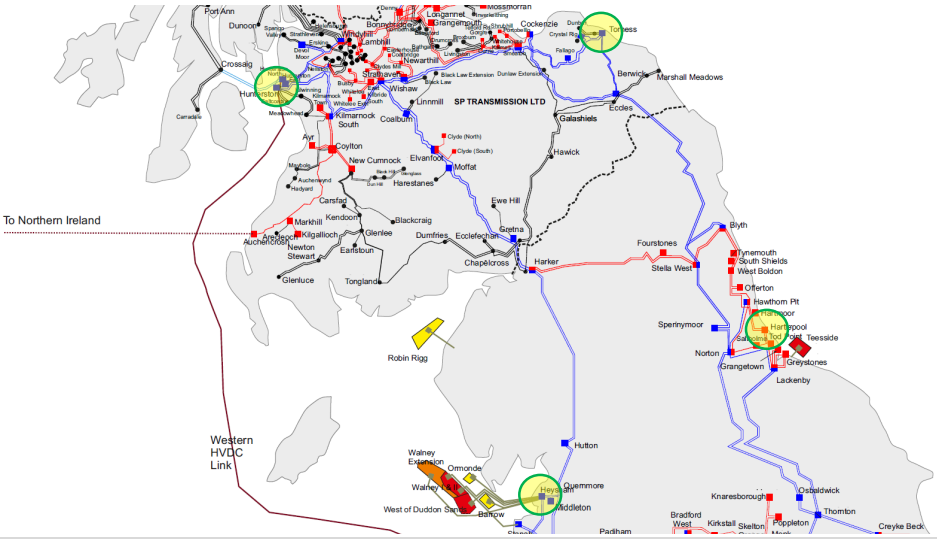
Overall, NESOS analysis demonstrated that Scotland and the North of England can be operated securely, and the network, upon the implementation of the highlighted further work or equivalent options in other projects, will be capable of managing the operational impacts from the changes in

generation background described above. Some of the conclusions and recommendations/from the project are set out below:

- Reactive power reinforcements may be needed in the Harker/Hutton/Heysham area and in the Windyhill/Devol Moor area. Analysis will continue in collaboration with the relevant TOs to fully define the requirements and propose the most economical and efficient solution.
- Some of the existing or proposed network reinforcement schemes in the National Grid Electricity Transmission (NGET) and Scottish Power Transmission (SPT) networks could be brought forward. This would avoid the need to re-dispatch large volumes of generation under very low wind conditions, leading to cost savings for the end consumer.
- The Western HVDC link (WHVDC), Caithness-Moray-Shetland HVDC link (CMS Link) and North Sea Link (NSL) were shown to have a critical role in supporting security of supply and voltage management. To ensure that the WHVDC and CMS links can operate properly, the reinforcements for short-circuit level, inertia and dynamic voltage control would need to be in place and delivered on time via the Stability Pathfinder (phase 2) or any other cost-effective solutions. The maintenance work for three HVDC links would also need to be effectively coordinated with other outage(s).
- Another option to prevent operability issues from occurring is to re-schedule some of the outages planned for future years, to avoid certain combinations.

The latest supply background information will be fed into in the next FES, ETYS and NOA process. In the meantime, we established a collaborative working group to carry out in-depth analysis to see what possible impact from the above background change.

This piece of work, which is additional to the usual FES, ETYS and NOA processes, is an example of the ESO acting quickly to make use of the latest information, and collaborating with key transmission and generation stakeholders to ensure an optimal outcome for consumers.



Role	3. System insight, planning and network development
ESO Ambitions	• The ESO is a trusted partner
Forward Plan Deliverables	• N/A
Is the consumer benefit mainly this year or in future years?	The consumer benefit of NESOS 2020 will mainly be realised in future years. Its main benefit relates to security of supply, which is consistently the top concern of consumers when surveyed. The outcomes of the NESOS project will ensure that the transmission system can be operated securely and economically if power stations close in the mid 2020s. In comparison to the FES, ETYS and NOA processes, NESOS provides the opportunity to zoom in on a particular region and additional sets of scenarios. All three TOs, as well as the ESO, study the same region with a full consideration of those additional sets of conditions, to ensure we can plan and operate this part of the network securely and efficiently.

Stakeholders in government, as well as the power station owners, have also valued our proactive approach to addressing the potential security of supply issue; this has also helped them to shape their energy policy.

Calculation of monetary benefit to consumers

NESOS has provided a more detailed technical assessment of specific network conditions than could be normally attained through NOA. The limits of credible system security were tested which is beyond the typical year-round conditions studied in NOA but also important to ensure secure future system operation.

Timely identification of system issues has meant that commercial as well as asset-based solutions can be considered.

One of the savings identified from the NESOS results would reduce balancing costs by around £11.7m-£32.4m per year.

This is calculated as follows:

- The NESOS studies have identified that, in a particular scenario, the likely generation and demand patterns would mean that there are significant flows from East to West of the NGET network, which would cause circuits to be overloaded. This would be a pre-fault overload, meaning that even without a fault occurring the circuits would not have sufficient capacity to transport power to where it is needed.
- The NESOS recommendations would avoid this situation by NGET and SPT bringing forward scheme work to take place earlier than 2024.
- If this scheme work is not brought forward, ESO would have to re-dispatch generation to avoid this pre-fault overload, reducing the output of generation (bidding off) in the East and increasing the output of generation (offering/buying on) in the West. Our analysis shows that this would need to take place when the load factor for wind farms in North of England and Scotland is lower than 10%: this is the case for approximately 12% of the time - equivalent to 1037 hours per year (derived as a 20-year average).

Low Case (Western Link S=>N)	Generation re-dispatch (MW)	Hours (Peak period)	Price £/MWh	Cost (£) =MW x Hours x Price
Bid off at East side	900	173	0	£0
Buy on at West side	900	173	75	£11,677,500
		Low case Grand total:		£11,677,500

High Case (Western Link 0MW)	Generation re-dispatch (MW)	Hours (Peak period)	Price £/MWh	Cost (£) =MW x Hours x Price
Bid off at East side	2500	173	0	£0
Buy on at West side	2500	173	75	£32,437,500
		High case Grand total:		£32,437,500

- Costs are calculated by the formula: **costs = MWs x Hours (peak periods) x Prices**
- The indicative bid price is £0/MWh, and the offer price is £75/MWh, based on a typical gas-fired power station.
- Hours derived from the averaged 1037 hours per year: 173 hours for peak periods.
- In the **Low Case**, the Western Link has a south to north flow (into Scotland) to supply demand, then roughly 900MW generation needs to be re-dispatched from East to West during peak periods; in the **High Case**, Western Link has 0MW thus 2500MW generation needs to be re-dispatched during peak periods.

This analysis refers to just one of the NESOS recommendations: each of the recommendations is expected to lead to a significant consumer benefit. Other examples, for which we have not estimated a benefit, are:

- The need for reactive power reinforcements has been identified sooner, giving the opportunity for schemes which will resolve these issues (such as installing shunt reactors) to be brought forward. This will benefit consumers by avoiding unnecessary spend on reactive power services. During 2020-21, the ESO spent £64.3m on reactive power services in GB.
    - The NESOS recommendations identified possible scenarios where fault levels would be too low for the Western HVDC Link to be able to operate. Recent experience has

	demonstrated that high constraint costs can be incurred if the Western HVDC is out of service, particularly when wind generation output is high in Scotland. Acting on the NESOS recommendations means that synchronous compensation investments can be fed into the ongoing Stability Pathfinder (Phase 2), to explore the most economic and effective option to ensure that the Western HVDC link can remain in service.
Assumptions made in calculating monetary benefit	The calculation above assumes: • The cost of the NGET/SPT scheme work is similar regardless of when it takes place • Wind farms above the B8 boundary have a load factor of less than 10%, approximately 12% of the time (this is based on historical data from the past 20 years) • We have assumed that the cost of re-dispatching generation is as per the figures above.
How benefit is realised in the consumer bill	The fundamental purpose of the NESOS work is to ensure security of supply in future years. However, our pro-active approach gives the opportunity for a range of options to be considered, optimising between spending on infrastructure (TNUoS) and commercial solutions (BSUoS).
Non−monetary benefits	**Improved safety and reliability:** this analysis ensures that the network can be operated safely, and in compliance with the SQSS, following power station closures. The joint review of outage plans will ensure that outages can proceed to allow TO investment plans to go ahead: ensuring that maintenance and reinforcement work is carried out as required, and ensuring that the networks remain safe and reliable. **Improved quality of service:** we have worked closely with key stakeholders, setting up an interactive technical assessment process to bring expertise from TOs and ESO together and work on joint solutions to the emerging issues. This also includes close collaboration on outage plans, ensuring that TO works can go ahead as required. The NESOS project has improved engineering collaboration between ESO and all TOs, and established an effective process for all parties to sharing knowledge and expertise, and to study issues together that might affect all three TOs' networks.
Assumptions made in calculating non-monetary benefit.	The NESOS 2020 work is based on the assumption that the supply background in the North of England and Scotland will get more challenging in the coming years. This is different from the assumptions made in the most recent FES, ETYS and NOA documents (at the time of writing), although updated assumptions will be used in future analysis.

C.1.3 Case Study: Building on the Future Energy Scenarios (FES)

Activity	FES: Bridging the Gap to Net Zero and 2020 Future Energy Scenarios: Costing the Energy Sector both build on our Future Energy Scenarios (FES) 2020[55] work which was published in July 2020. The FES: Bridging the Gap to Net Zero programme's role is to take the FES key messages each year and investigate more closely what needs to be done in the short term, to reach the UK's 2050 net zero target. We do this in close collaboration with our stakeholders, so that the subject matter, structure of the project and final report are all informed and shaped by our stakeholders' feedback and input. While the main output from this programme is a report which is not part of our Future Energy Scenarios (FES) analysis, it is about finding areas of consensus about the action industry needs to take and making policy recommendations. The Bridging the Gap final report[56] was published in March 2021, this year we looked at how the energy system needs to evolve to manage unpredictable demand. We held a series of events starting in the autumn to discuss how peaks and troughs could impact the system and consider the levers, enablers and mechanisms that can help us manage the 2030 system effectively. (Please see our Stakeholder Evidence section for more detail). 2020 Future Energy Scenarios: Costing The Energy Sector was carried out in response to feedback from stakeholders. The aim of the costing project was to cost the FES 2020 scenarios for the energy sector, providing a comparison across the four scenarios. Our costing work supports the key messages from our FES 2020 report showing that the key messages in July not only were technologically sound but are also economically sound. The overall cost is broadly similar across the scenarios, and costs are kept lower when consumers are engaged, energy efficiency is pursued, and we have negative emissions in the energy sector. To undergo this project, the ESO worked with Afry who provided costs for each of the different elements. The report and data workbook were published in December[57]. The model created by Afry for the costing work will be able to be repeated for subsequent revisions of the FES. Some of the costs included in the model will help the analysis for FES 2021.
Role	3. System insight, planning and network development
ESO Ambitions	• An electricity system that can operate carbon free • A whole system strategy that supports net zero by 2050 • The ESO is a trusted partner
Forward Plan Deliverables	Insights documents: • Future Energy Scenarios (FES) • FES: Bridging the Gap to net zero
Is the consumer benefit mainly this year or in future years?	The consumer benefit will mainly be realised in future years as we move towards a net zero system by 2025 and zero carbon emissions by 2050. Our FES costing work demonstrates it won't cost significantly more money to get to net zero. Consumer benefit from Bridging the Gap can be derived from industry collaboration through stakeholder events and workshops to address some of the challenges of decarbonisation and agreement about the actions required and their timings.
Calculation of monetary benefit to consumers	The monetary savings to consumers could be delivered through highlighting where there are savings to be made. In 'Leading the Way' we saw savings when consumers are engaged, energy efficiency is pursued, and we have negative emissions in the energy sector. By highlighting this, it gives the industry some more guidance on where overall energy sector costs can be saved and we would expect that to filter down to the consumer. The final Net Present Value (NPV) cost for each of the scenarios are: • Leading the Way: £2,821bn • Steady Progression: £2,927bn

[55] https://www.nationalgrideso.com/document/173821/download

[56] https://www.nationalgrideso.com/document/187761/download

[57] https://www.nationalgrideso.com/future-energy/future-energy-scenarios

- System Transformation: £3,019bn
- Consumer Transformation: £3,020bn

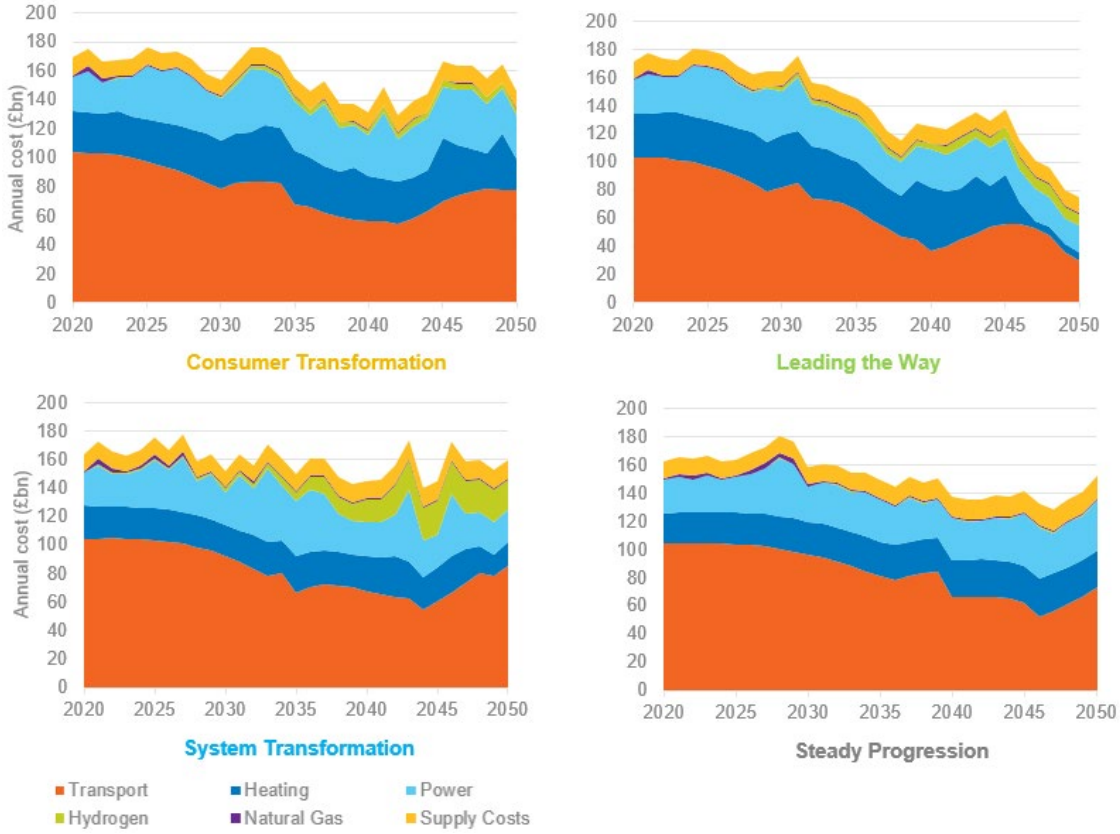


Figure: Year-on-year costs by sector and scenario

These Net Present Value (NPV) figures do not represent the overall cost of net zero, but rather the total capital, operating and fuel costs within the energy sector until 2050.

There is only a 7% difference across the scenarios which is considered small when compared to the margin of error in producing the costs. This shows that the policy choices between our scenarios don't vary the outturn cost significantly however does allow for areas of savings to be highlighted.

Assumptions made in calculating monetary benefit

- FES 2020 said that reaching net zero carbon emissions by 2050 is achievable but requires immediate action across all key technologies and policy areas, and full engagement across society and end consumers.
- Leading the Way is the scenario with the lowest total cost and has many different elements to it that drive the cost down across the board while achieving net zero before 2050. The largest of these elements are transport, residential heating and negative carbon emissions. Lower costs are partly due to investment in decarbonisation being brought forward in this scenario. We therefore see lower costs and return on investment in this scenario while decarbonisation costs are still ongoing in the other scenarios.

How benefit is realised in the consumer bill

Consumer benefit will be realised by having an energy system that achieves net zero emissions by 2050. This can only be done by the industry having a strong platform to discuss the changes needed to be able to achieve this. FES and the documents that build upon this provide this platform, sharing data to be able to have an open and objective discussion. An example of a document that uses the FES is the NOA which uses scenario plans to evaluate the least regret solutions to develop protecting consumers from over investment whilst meeting future system needs. This will allow for the development of an efficient net zero energy system that will ultimately filter down to consumer bills.

Non−monetary benefits	**Benefits to society**: ultimately lowering costs and reducing carbon emissions. **Improve quality of service**: providing all our costs allows for others to challenge this analysis and also create their own forecasts. **Reduced environmental damage:** moving towards a net zero scenario by increasing awareness and leading the debate.
Assumptions made in calculating non-monetary benefit.	We assume that stakeholders will act in a timely manner on the Bridging the Gap recommendations. By highlighting the minimal cost differential between the FES scenarios, this drives industry action towards net zero.

C.2 Stakeholder views

- We set out clear timelines for our Pathfinder projects, and used the ESO Markets Roadmap to 2025 to demonstrate how Pathfinders interact with market developments
- We have worked closely with DNOs on the Regional Development Programmes and as part of the Energy Networks Association, including on the Open Networks project
- We have run a promotion campaign for the Loss of Mains programme, and worked with Ofgem to engage those stakeholders who are more difficult to reach
- We have engaged extensively on Early Competition, working closely with the ESO Networks Stakeholder Group which has 15 representatives from impacted stakeholder groups
- We took a new interactive approach to the Electricity Ten Year Statement (ETYS) publication in response to stakeholder feedback: this resulted in positive feedback and an increased number of views
- Our Bridging the Gap report was developed by stakeholders, for stakeholders. We engaged with over 220 individual stakeholders, from over 100 organisations.

Whole system operability

Lead the Accelerated Loss of Mains Change Programme (ALoMCP)

Loss of Mains protection is there to make sure generators connected to distribution networks shut down safely when needed. The programme is making good progress in tackling the embedded generation capacity at Loss of Mains risk, with 61% of the total generation capacity within the original scope engaged in the ALoMCP programme or having confirmed to the programme that they have achieved compliance.

In order to maintain progress and address increases in programme scope, that programme has enhanced its communications and engagement activity focussing on two stakeholder groups: firstly the large and therefore high value sites which it is practical to engage with directly and secondly, the smaller and generally harder to reach sites that need guidance and assistance in order to participate in the programme as required.

DNOs have now directly contacted over 12,000 sites, and following multiple contacts in many instances, approximately 7,000 sites have now applied to the programme or confirmed their existing compliance outside of the programme. Although the priority has been to encourage larger sites to engage, over 70% of the sites that DNOs have contacted have registered capacity below 1 MW.

Broader engagement has made use of existing channels of communication, particularly through energy suppliers who have an active relationship with distribution connected generators. A supplier forum has been established to share experience and good practice in engagement activity, to discuss programme insight and provide access to a toolkit of programme engagement materials. A webinar was hosted by Energy UK, with a presentation by the ESO and DNOs, introducing the supplier forum.

Ofgem have also been able to assist in reaching harder to engage stakeholders, recognising the influence Ofgem's authoritative voice could play in increasing participation. ESO provided programme eligibility criteria to enable Ofgem to filter generator records to identify sites most likely to be eligible to participate in ALoMCP. This resulted in two activities being delivered:

- Ofgem sent ALoMCP programme information, provided by ESO, directly to the owners of 2,700 generation sites within the Renewables Obligation
- Ofgem then wrote to suppliers asking them to share ALoMCP programme information with their FIT-registered customers

Communications experts have also been engaged to develop and implement an integrated campaign to highlight the need for action. The campaign:

- Utilises two key milestone dates as focal points to raise awareness (11 May 2021 – twelve months left to apply to the ALoMCP for funding to make the required changes and also 1 September 2021 – twelve months remaining before the compliance deadline).
- Will improve access to and navigation through online information[58] containing the application portal and guidance information to help less knowledgeable generators establish what action is required.

ESO has supported DNOs in utilising regional and sectoral channels to engage harder to reach generators through active participation in the programme's stakeholder workstream. This has included ESO presenting programme information to DNO customer forums.

The costs of programme delivery are significantly lower than the cost of managing Loss of Mains risk through other system actions that ESO takes. Programme cost and savings headlines are:

- The cost of managing Loss of Mains risk was £200m in 2019-20 and £345m in 2020-21.
- Programme costs: £25.6m of costs have been committed to date, comprising £23.3m allocated to approved applications from embedded generators and £2.3m of incurred programme delivery costs.

Programme savings: we expect to reduce balancing services costs by over £20m per year from 2021-22 onwards directly because of the changes made to vector shift based protection by the programme. Changes to RoCoF based protection so far have a potential value of a further £18m per year which is likely to be delivered and subsequently grow from 2022 onwards. The scale of risk reduction delivered through the programme and also the development of the Frequency Risk and Control Report (FRCR) and Dynamic Containment service will deliver more indirect cost savings and it means that ESO will be able to manage losses through frequency control rather than limiting RoCoF.

Whilst generator feedback indicates that compliance is the primary driver for participation in the programme, the provision of a payment towards the cost of the LoM protection changes, provides additional benefits by encouraging sites to register their details on the programme portal. This enables Licensees to gather more up to date and accurate details of Loss of Mains protection settings, which directly influences ESO actions and costs in managing LoM risks on the electricity system. The Programme is currently developing functionality to add to the application portal which will make it easier sites to register their compliance outside of the programme, enabling Licensees to acquire more up to date details of LoM protection settings without the need for programme payments.

We are also engaging with the Distribution Code Review Panel (DCRP) to provide clarity on the approach to be taken to enforce compliance. Within the programme, communication activity is pivoting increasingly to an emphasis on the September 2022 compliance deadline, rather than the availability of payments towards the cost of the required changes.

Addressing actions raised in the E3C regarding 9 August 2019 power disruption

One of the main actions that resulted from the investigation into the 9 August Power Disruption was to assess and modify the Security and Quality of Supply Standards (SQSS) modification specifically to review the National Electricity Transmission System (NETS) SQSS Criteria for Frequency Control. This was progressed through a workgroup and approved by Ofgem before Christmas 2020 addressing an action from the Energy Emergencies Executive Committee (E3C) and Ofgem final reports into the power outage of 9 August 2019.

The Frequency Risk and Control Methodology was published for consultation with industry from 21 December 2020 to 13 January 2021. An industry webinar was hosted on 6 January with over 50 attendees. Seven responses to the Methodology consultation were received, and the feedback was summarised into themes which the ESO addressed in the final version of the Methodology.

In March we issued a consultation[59] on the first edition of the Frequency Risk and Control Report (FRCR) that sets out the results of an assessment of the operational frequency risks on the electricity system and confirms which risks will and will not be secured operationally by the system operator. An industry webinar was hosted on 8 March with over 100 attendees. Responses were requested by 12 March on whether the FRCR represents appropriate development in determining the way that we will balance cost and risk in maintaining security of supply while operating the system, as well as on specific proposals. Six responses were received with broad support for all four

[58] https://www.ena-eng.org/ALoMCP/

[59] https://www.nationalgrideso.com/industry-information/codes/security-and-quality-supply-standards-old/modifications/gsr027-review

recommendations. Following a recommendation from the SQSS Panel, the first version of the FRCR was submitted to Ofgem for approval on 1 April 2021, to align with the licence changes which are anticipated to bring the new version of the SQSS into effect.

Constraints 5-point plan

In March 2021, we held a webinar to launch our 5-point plan for constraints. The five points discussed were:

- Clearer forecasts on BSUoS costs. We recognise that a new approach which provides greater transparency and insight in our cost forecasts could be of even greater value to industry. We're building a new team to develop our constraint cost forecasts, and we're aiming to move away from a central forecast to providing a range of constraint costs.
- Procuring intertripping capability competitively. This is being done through a tender being run in Scotland to reinstate existing commercial intertrip contracts in Scotland if economical, and additionally build new capability through our Constraint Management Pathfinder.
- Working with regional networks on a whole-system approach. Through the Regional Development Programmes (RDPs), we're already collaborating closely with DNOs to develop future regional constraint markets and solutions.
- The commercial model for storage in a heavily constrained network. We're looking to carry out a future system analysis to help us identify potential commercial models for a storage service that would help us manage constraints and bring best value to the consumer.
- Enhancing existing Network Capacity. Through our Network Options Assessment (NOA) we'll continue to support and highlight the benefits of new technology and network initiatives which could bolster the grid, deliver better value to consumers, and progress the clean energy transition.

Feedback we received included:

Industry participant: *'It's good to see that the ESO is taking a holistic approach and considering different options to tackle network congestion.'*

Industry participant*: 'Actions need to be taken quickly to prevent network congestion and we would like to work with you (ESO) to help solve this.'*

Industry participant*: 'I would be interested to see how storage could be part of solving the network constraint problem and be more involved with the ESO.'*

Following this we have created project plans for each of the five points and are incorporating attendee questions into the solutions we are developing. These plans will be shared with industry for further comment and input.

NOA Pathfinder projects

The NOA Pathfinders are the route to enabling non-TO participation in the NOA process, through a fair and transparent tender process. We have improved our website, creating a dedicated webpage for each Pathfinder project. Feedback we have received via our webpage surveys has been positive. We have factored the learnings from the various Pathfinder projects into the latest Network Options Assessment (NOA) methodology, and into subsequent Pathfinder work.

Stability Pathfinder

For Stability Pathfinder Phase 1 delivery against the stability contracts has been progressing, with one provider live and several more expected to become live in 2021. The learnings from Phase 1 of the Stability Pathfinder fed into the Request For Information (RFI)[60] for phase 2. In December 2020 we published an update to the FAQs[61] for the Stability Pathfinder Phase 2, along with our responses following the publication of the Expression of Interest (EOI)[62]

[60] https://www.nationalgrideso.com/document/185176/download

[61] https://www.nationalgrideso.com/document/178406/download

[62] https://www.nationalgrideso.com/document/187371/download

on 30 September 2020. The EOI was seeking short circuit level and inertia services up to 2030. We ran a series of webinars in October and November to cover these topics:

- EOI overview
- Technical requirements and feasibility study
- Draft assessment methodology
- Draft contract terms

We responded to over 200 queries from these webinars. The window for sending submissions to this EOI to participate in the later stages of Phase 2 closed in January and the outcome was communicated to all participants in February.

Since the EOI closure:

- We have received and responded to over 250 queries mainly from 29 providers who have participated and passed the EOI stage.
- We have held a webinar on the second draft of the service contract terms on 29 March which was attended by around 30 people.

Due to the volume of EOI solutions (over 1500), we are reviewing the timelines and we have been giving frequent updates to all participants. We have also been in regular conversations with SPT and SHET to streamline the connections review process to be able to shape the overall timeline.

As part of Markets week in March 2021, we held a dedicated session on Pathfinders seeking feedback on industry views.

The positives were:

- Encouraging new approaches/technologies to participate
- Our engagement with industry on the development of the Pathfinders through the documentation, webinars, newsletters and website.
- Our ambition and activities to meet the zero carbon ambition

Some constructive feedback was:

- Greater transparency/information needed on our tender assessment
- Push to accelerate the deployment of these services

Mersey voltage Pathfinders

We published the Mersey Voltage Pathfinder Tender results[63] and the Lessons Learnt report[64] in December 2020. The Lessons Learnt document was shared and discussed with the Energy Networks Association (ENA) Open Networks group, and the learning has been factored into the upcoming Pennines Voltage Pathfinder. Lessons learned were we should be engaging earlier with TO(s) and DNO(s), increasing timescales for technical assessments, simplifying requirements and levelling the playing field. The experience will feed into the future Pathfinder tenders, influencing, for example, what will be accepted in the future.

Pennine Pathfinder

Defining the requirement for the region and how to procure it was proving to be complex. We knew from the Mersey Pathfinder stakeholder engagement that we needed to be clear on our requirement and provide stakeholders with enough information to adequately propose suitable solutions. We also needed to address questions about TO participation. Therefore, the Pathfinder was delayed giving us more time to refine the requirements for this complex region, which has a high level of interactivity across sub-regions. On 26 March we announced a 10-year tender for Reactive Power services in the Pennine region. Starting 1 April 2024, it is to be part of a continued approach to procuring reactive power to determine whether a third party can deliver a more cost-effective solution compared to the network asset alternative. This tender is open to potential providers embedded within the Distribution network as

[63] https://www.nationalgrideso.com/document/182746/download

[64] https://www.nationalgrideso.com/document/182751/download

well as at Transmission level, including those that are not yet connected. This year we have been addressing feedback and been able to simplify and reduce levels of interactivity across the Pennine and North of England region such that we can tender for two distinct sub-regions. This simplifies what we will provide to the market and what we will ask of providers. We have been working with NGET to identify site-specific information and we have completed an Initial Site Feasibility report reviewing sites within the Pennine and North England region. Within the report, NGET reviews individual sites, highlights if there are spare bay(s) and provides indicative costs and timelines. Although this report provides a snapshot in time of the status at the different sites, this has been a key lesson learned from our previous Mersey Tender and has been developed as part of our commitment to provide more information upfront to tender participants.

We also have an agreed scope of works document with the DNOs accounting for lessons learned from the Mersey Pathfinder. We will continue to work with the DNOs to assess sites that fall into the identified regions as part of the tender.

Constraint Management Pathfinder

Following our announcement on the decision to tender at the end of Q2 2020-21, on 22 December we published[65] information about the post fault generation turn down/ demand turn up service. We included an overview of the service, requirements and a timeline to provide more information on the service we intend to procure to provide more information to interested providers. The first phase launched in March 2021, we are engaging with industry and exploring new short and long term solutions for intertripping services that could contribute to managing constraints more effectively in the future. An Expressions of Interest (EOI)[66] was sent out to industry in March 2021, it invites potential participants to express an interest in participating in the Constraint Management Pathfinder (CMP) by completing an EOI. This Pathfinder is looking for options to help reduce network congestion costs between the Anglo-Scottish boundary between October 2022 – September 2023.

Early Competition

We launched our Phase 3 consultation on 4 December 2020, which was open until 15 February 2021. This consolidated the output of feedback gathered from phases 1 and 2 of the project and further explores both the technical and commercial aspects of an early competition model. This final consultation also set out the suggested roles and responsibilities of parties and an indication of potential timescales for implementation. Our final submission to Ofgem in April 2021 will use feedback from our phase 3 consultation to further refine the end-to-end early competition model.

When our Phase 2 consultation closed in August 2020, we had good engagement from stakeholders, but were disappointed that we received only 7 formal responses. To understand why, we surveyed stakeholders to better understand what they did and didn't like to ensure we changed our approach with Phase 3. In December when we published our Phase 3 consultation, we hosted a launch webinar where we took stakeholders through our proposals and gave an opportunity to ask any clarification questions. We also hosted six Q&A sessions, this built on the approach we took to phase 2, but addressing stakeholder feedback we hosted multiple sessions which covered specific chapters. This ensured stakeholders didn't have to read the full document before being able to engage and contribute to the session. We increased the number of formal responses to our Phase 3 consultation to 12.

One of Ofgem's requirements when asking us to undertake this piece of work was to form a stakeholder group similar to that created for RIIO-2. The ESO Networks Stakeholder Group (ENSG) role is to challenge our stakeholder engagement and ensure we have reflected feedback from all stakeholder groups. The group had their first meeting in August 2020 and are made up of 15 representatives of sectors (members are representing their sector rather than the organisation they are employed by) who could potentially be impacted by the introduction of early competition. Throughout the project they have challenged our stakeholder approach – leading to a 10-week consultation window for Phase 3, increased from six weeks. They have also held deep dives into our more contentious policy areas, such as the role of the TO, to ensure that we had engaged appropriately and that the stakeholder feedback and rationale for our recommendations was clear. Responding to ENSG feedback we hosted an additional webinar in March 2021 on a TO counterfactual approach and will include any additional feedback from this in our final Early Competition Plan. This is an area where we have heard different views from TOs, potential market entrants and citizen

[65] https://www.nationalgrideso.com/document/183531/download

[66] https://www.nationalgrideso.com/document/187931/download

representation bodies. Throughout our plan on areas where we have received differing stakeholder views, we have made recommendations which we believe to be in the interest of consumers and as such our final recommendations may not align with any stakeholder preferences. Through our consultation surveys, we received the following feedback:

Industry participant: '*Proactive consultations, openness to issues that you hadn't thought of (which is not normal if you had been using a survey format).'*

Prospective competitor: '*Financial aspects of the proposal could have been presented and explored more effectively. It would be much helpful if the ESO could confirm in liaison with Ofgem consistency and alignment of this process with other relevant proposals on this matter consulted on with the Industry, for example RIIO-2.'*

NOA: Enhanced communication

We published our Network Options Assessment (NOA) to share our recommendations in January 2021 for which reinforcement projects on the National Electricity Transmission System (NETS) should receive investment to help us deliver and operate a zero-carbon electricity network. We took this opportunity to launch our new redesigned NOA webpage[67]. The ambition was to increase the accessibility of our results where the readers would be able to navigate to our site and find all the key messages of this year's NOA. That way they would be able to view the results at a quick glance and then be able to download the full report to find out more details behind the recommendations. Furthermore, this gave us the opportunity to get further insights into our engagement post publication and understand if readers were finding the relevant information they were looking for. Through the creation of these webpages we are now able to continue in our goal of enhancing the NOA and its digital content. Through our new webpages and other engagements, we were able to reach 65% more new readers than last year's webpages and also increased the traffic to our webpages by over 25%.

The key statistics mentioned above were also due to the various engagements that were done throughout the year.

- "Network Planning for net zero" webinar held on 11 February where we had over 130 participants. This was an industry-wide event where we took stakeholders through the planning process, including how the Future Energy Scenarios (FES), Electricity Ten Year Statement (ETYS) and NOA worked together to meet our net zero ambition.
- Our Network Development monthly newsletter includes updates on ETYS, NOA, NOA Pathfinders and also Early Competition Plan updates. This newsletter is followed by over 1400 readers.

Going forward we will continue to engage with the industry and ensure that our campaign strategy continues to increase the number of stakeholders we reach.

Additionally, for the first time this year's NOA considered the economic benefits of offshore integration within its analysis and the team is continuing to work with the Offshore Coordination Project and engage with industry to gather feedback on the NOA's offshore wider work results. Through our 5-point plan to manage constraints on the system, we'll continue to support and highlight the benefits of new technology and network initiatives.

Network Options Assessment (NOA) third party options

The Interested Persons' process was introduced last year, and we are about to consult on a refined process based on our lessons learnt and feedback gained from our stakeholders. We proactively engaged with Ofgem earlier this year to discuss how the process could be improved upon in a way that reinforces its intended purpose - increasing the diversity of options considered within the NOA. Feedback from Ofgem on our proposed changes to the process was positive and we will now consult with the wider industry as part of our annual NOA methodology consultation. We plan to include a more detailed summary of this year's Interested Persons' process in the NOA methodology consultation scheduled for May, which will include the timescales for 2021. We have engaged with Interested Persons on how we present our view of future wider system needs in Part A of the System Requirement Forms (SRF). SRF Part A provides early visibility of network boundary requirements ahead of Electricity Ten Year Statement publication, so reinforcement options can be developed by the licensed parties. We are investigating how and when we could present this information more broadly for Interested Persons.

[67] https://www.nationalgrideso.com/research-publications/network-options-assessment-noa/methodology

Electricity Ten Year Statement (ETYS)

In November 2020 we published our Electricity Ten Year Statement (ETYS). This is an annual publication in which we share our latest assessment of the future requirements of Great Britain's electricity transmission system. Feedback from stakeholders said they would like more interactivity throughout the document and the maps, with more detailed data, and more renewables content. Therefore, this year we took a new approach to the ETYS and have published the analysis in a series of interactive webpages. We saw an increase in views on the ETYS webpages by 244% compared to last year. 79% of the people using the pages told us they were happy with them and we've seen a 267% increase in new users coming to the website for the ETYS content. Almost 50% of the website mini surveys suggest that users understand the content a lot better.

Industry participant: *'Really interesting content and very well presented.'*

Regional Development Programmes (RDPs)

Our Regional Development Programmes (RDPs) look across the whole-system landscape and work with Distribution Network Operators (DNOs) and Transmission Owners (TOs) to identify key areas of development – including reducing constraints. Through the RDPs we're collaborating closely with DNOs to develop future regional constraint markets and solutions, with projects to unlock more capacity for smaller, regionally-connected (and often renewable) power sources in more heavily-congested parts of the network.

Whilst many of our RDPs are multi-year projects, in 2020-21 we delivered our first RDP functionality with the completion of the N-3 intertripping RDP project with UKPN and NGET. The project went live in the ESO control room in November 2020 and is facilitating the connection of DER on the south coast. Similar works have also progressed with WPD and SSE-N, and are planned to be completed in 2021-22.

In the Generation Export Management Scheme (GEMS) project we are working with SPEN to develop a non-build operational solution to facilitate the connection of new generation in the south west of Scotland. In 2020-21 we have collaboratively developed the high-level technical requirements for the project.

We have worked with UKPN and WPD to scope commercial arrangements for co-ordinated constraint management services (referred to as MW dispatch) through a series of bilateral workshops. To ensure consistent approaches between these projects and GEMS we have created a joint RDP forum to share learnings. This will also ensure consistent development with the work of the ENA Open Networks project.

Whole System thought leadership

Support BEIS and industry in developing a strategy for clean heat

We published a Clean Heat thought piece[68] in November 2020. In it we explore a range of outcomes for the future of heat, with the differences driven by the speed of decarbonisation and the level of societal change. We look at external factors that could affect clean heat pathways and how the ESO needs to collaborate with other system operators. We held a webinar in December 2020 to discuss and engage with industry, 40 people attended and provided useful feedback that we are now feeding into the heat assumptions in this year's Future Energy Scenarios (FES).

Regional Distribution Future Electricity Scenarios (DFES)

We have had our first exchange of building block data (ESO to DNO and DNO to ESO) based on the same scenario framework across all organisations. We are in the process of reviewing the success of this and will continue to develop the process via group collaboration with the Energy Networks Association (ENA) Open Networks project.

ENA Open Networks project

Stakeholders felt that, although the ESO's engagement in Open Networks events had improved, there was room for improvement outside of the Open Networks meetings. Stakeholders requested commitment and engagement from ESO subject matter experts as the ESO develops its own plans and deliverables, so that DNOs can benefit from ESO expertise.

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[68] https://www.nationalgrideso.com/document/180471/download

We have been addressing this feedback and made several steps forward:

- We have been holding regular bilateral meetings with each DNO involved in RDPs. Since the start of 2021 we have also been hosting a monthly joint forum where RDP developments are being discussed with all DNOs to ensure alignment.
- We developed a DSO strategy which was published[69] in April 2021. This was introduced at a dedicated webinar in Markets week in March 2021.
- We have begun to initiate business planning meetings with DNOs to ensure the development of aligned business plans. This will continue through 2021-22.
- We have been attending Ofgem ED2 working groups to provide both subject matter insights and also insights for development of appropriate metrics for DSO.

The ESO also became an official member of the Energy Networks Association (ENA) in March. Through working collaboratively with network owners and operators and adopting a whole system view of the challenges that lie ahead, we can accelerate progress towards both a zero carbon electricity grid and the UK's net zero goal.

Network value assessment tools

Voltage needs identification tools/ processes

We have received positive feedback from our work with ENTSO-E in this year's Ten Year Development Plan (TYNDP). Significant improvement in the tools and process allowed us to submit all of the required data, and we exceeded their expectations by carrying out CO2 analysis for Great Britain for the first time.

Interconnector: *'Compared to T18 it is really better, better communication, results seem more realistic, results provided one time.'*

Enhanced customer experience

Connection applications throughout the second half of the year continued at a high level and by the end of 2020-21 the ESO recorded a 22% increase in the level of customer applications on 2019-20 levels. We have continued to engage with our customers throughout the COVID-19 pandemic to ensure connection applications are processed and customers receive the required outputs. The feedback we have received is:

Generator: '*Bi-weekly meetings are particularly helpful for us to resolve complex problems timely and efficient manner. Our contract manager has kept time for bi-weekly meeting and diligently attend every action, which has significantly supported the delivery of renewable projects in Scotland.'*

Generator: '*The offer documents, especially for third party works, require a better commentary to understand what works are needed and how they impact on the connection delivery timescale.'*

We have refreshed the Connections website[70] and added customer journey information, FAQs, and an Acronym Glossary. There are also interactive customer packs regarding the pre-application process, securities, and interactivity guidance. Over 1000 people have since visited the site and the documents have been downloaded ~200 times.

Insights documents

Operability Strategy Report

[69] https://www.nationalgrideso.com/document/190271/download

[70] https://www.nationalgrideso.com/your-connections-journey

We shared our Operability Strategy Report (OSR)[71] with industry on 23 December 2020. It explains the operability challenges we face in maintaining the electricity system. On 11 January 2021 we published a blog[72] highlighting the report and our insight into a zero carbon electricity system.

Provider: '*I thoroughly enjoyed reading it this morning and thought it was excellent – a real step up from previous ones (which I also thought were good!).'*

Industry participant: '*It is a great doc, and answers loads of questions that we had. Not least about the illusive MW Dispatch project'*

Following the publication of the OSR, we have begun capturing some lessons learnt in readiness for the next report later this year. We work closely with our stakeholders to ensure our approach is appropriate for systems, markets, policy, technology and innovation as we develop and deliver solutions to tackle the challenges ahead.

Future Energy Scenarios (FES)

We have committed to costing the scenarios in response to feedback from stakeholders. The 2020 Future Energy Scenarios (FES) were published in July 2020 and in November 2020 we held a webinar to share our findings from our FES 2020 costing report. The aim of the costing project was to cost the FES 2020 scenarios for the energy sector, providing a comparison across the four scenarios. Our costing work supports the key messages from our FES 2020 report showing that the key messages in July not only were technologically sound but are also economically sound. We have also published a data workbook alongside this report with full detail of the data behind it, in order to be fully transparent. During the launch there was feedback which indicated that it was good to see these results. The data workbook has been well received. People were also surprised that the 'Leading the Way' scenario was the cheapest. As the launch was virtual, this allowed flexibility to attend and watch on catch-up.

FES: Bridging the Gap

This year's Bridging the Gap's area of focus was the challenges to system operation with the increasing levels of renewable electricity generation, required by decarbonisation. With our stakeholders, we identified the different kinds of peaks and troughs we might see regularly on the electricity system between now and 2030. This was presented at a webinar attended by over 130 people, followed by presentations by external speakers, who gave their thoughts on how markets, technology and data and digitalisation can help manage these challenges.
Working with these speakers, we then set up workstreams, made up of stakeholder volunteers, to take a more detailed look at each of the three topics. Whilst the timeframe was short, we were able to draw on a range of expertise and insight to identify areas of consensus and to develop recommendations and next steps. Our interim findings were presented at a series of external webinars, where we canvassed the audience for their views, which fed into our final report[73]. This was published in March 2021 and contains next steps and recommendations for the ESO and for wider industry respectively. It is presented as an industry view about how to make progress towards being able to operate a net zero electricity system along the timescales outlined in FES.

In summary, we worked with stakeholders in the following ways:

- A core stakeholder group to advise on design and content (~15 people)
- Webinar in October presenting the subject and asking for input (+130 attendees)
- Three working groups over the course of November (20 external volunteers)
- Presentations by the three working groups of their findings (~50 attendees at each)
- Final report launch with over 80 attendees
- In total, over 220 individual stakeholders, from over 100 organisations.

Industry participant: '*It makes a powerful case for market reform to stimulate flexibility. An interesting co-creation exercise, which sensibly picks and mixes different elements of the FES scenarios.'*

Industry participant: '*Would be good to get more specific and actionable about what will happen, when, how and driving this forward with whom.'*

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[71] https://www.nationalgrideso.com/document/183556/download

[72] https://www.nationalgrideso.com/news/operability-strategy-report-our-insight-zero-carbon-electricity-system?utm_source=linked_in&utm_medium=social&utm_campaign=balancing_the_grid&utm_content=article

[73] https://www.nationalgrideso.com/document/187761/download

We have included a 'key actions' section in the Bridging the Gap 2021 report, as well as recommendations that contain specific reference to actions taken forward by the ESO and industry.

Through additional feedback we identified that we needed to circulate pre-read material for the event to ensure that all stakeholders had sight of it, and to be clear on the purpose of the event via communication with stakeholders from the beginning (i.e. social media, distribution lists, event advertising).

C.3 Plan delivery

C.3.1 Highlights

- We have made good progress on the Loss of Mains programme, with over 16 GW of distributed generation now engaged in the programme, and we are now on track to deliver savings this summer - more than 12 months before the programme's compliance deadline in August 2022.
- We have reached key milestones for our Pathfinder projects: we invited expressions of interest for the Constraint Management and Stability Phase 2 Pathfinders, and launched a tender for the Pennines voltage Pathfinder. Lessons learned are regularly captured and fed into future Pathfinders.
- We set out a 5-point plan for tackling constraints, including developing intertripping capability through our Constraint Management Pathfinder, and working with regional networks on a whole system approach
- We opened up the Network Options Assessment process to Interested Persons, one year ahead of the requirement to do so
- We progressed the Regional Development Programmes, working closely with DNOs
- Connection applications throughout the second half of the year continued at a high level and by the end of 2020-21 the ESO recorded a 22% increase in the level of customer applications on 2019-20 levels.

This section reports our performance against the deliverable descriptions and dates set out in the Forward Plan Addendum[74]. The Forward Plan Addendum set out our revised view (as of July 2020) of what we would deliver during 2020-21. During the period of regulatory flexibility, we shared with Ofgem a number of our deliverables where there were known impacts of COVID-19; these are clearly identified in the Addendum. However, we note that the impact of COVID-19 has been felt across many areas of the ESO's work.

We have defined the status of our deliverables as follows:

- Complete: the activity has been fully completed
- Complete for 2020-21: the activities planned for this year have been completed, but the deliverable will carry on into future years
- Ongoing: the activity is still in progress
- Deprioritised: the activity will not be delivered, we explain the reasons for this in the commentary.

For deliverables which continue into future years, we provide a reference to the relevant part of the RIIO-2 Delivery Schedule.

C.3.2 Deliverables

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
Whole system operability			
Lead the of Loss of Mains Protection setting programme	Q2 2020-21 and ongoing	Complete for 2020-21 (see RIIO-2 Delivery Schedule D15.3.2)	Over 12.9GW of generation at 6,709 sites have now applied to the programme, with changes already made at sites with a combined capacity of over 9.2GW. The addition of generators contacted and known to have achieved compliance takes the total engaged to 16.3GW, or 61% of total generation capacity within scope. The programme is on track to address risks associated with Vector Shift (VS) protection in line with expectations and our forecast expenditure on Vector Shift Risks for 2021-22 is now zero. The benefits associated with Rate of Change

[74] https://www.nationalgrideso.com/document/173131/download

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			Frequency (RoCoF) risk reduction are expected to be seen progressively over 2021 and we have taken action to bring this forward as much as possible, with enhanced payment arrangements in place, increased engagement and enhanced risk assessment. Programme priorities have been agreed for the next 18 months and efforts continue to bring more distributed generators into the programme. Applications rates picked up as a result of increased engagement activity with 1.7GW of applications approved in Window 6 compared to 1GW in the previous window.
Address actions raised in the E3C report into the GB Power Disruption Event of 9 August 2019	Q1 2020-21	Complete	We progressed and completed NGESO actions identified by the Ofgem and E3C reports following the power outage of 9 August 2019, including completing an internal audit, conducting a review of the current Limited Operational Notification (LON) and Grid Code derogation processes, and implementing the improvements identified by these reviews. As agreed we have raised Grid Code modification GC0141 which is now under industry process, and SQSS modification GSR027 on frequency standards which has been approved by the Authority and is now awaiting final approval from Ofgem for implementation of the new SQSS requirements.
Implement approach for efficient reactive power flows between networks	Q4 2020-21	De-prioritised	Conclusion of this work was indirectly impacted by changes in working arrangements brought about by COVID-19 related restrictions and was de-prioritised relative to other deliverables where workload had ramped up. Our analysis has indicated that it is unlikely that a generic conclusion on an optimal exchange of reactive power can be drawn, and therefore we are focusing instead on market-based solutions using cost-benefit analysis, such as the ongoing voltage Pathfinder projects and wider reactive power market reforms to explore a better way of managing future voltage issues. This year, we focussed instead on refining the Pennine reactive power requirements, where there was an opportunity to benefit consumers, as outlined in our role 3 case study. Future work on the choice of reactive power solutions will concentrate on wider reactive power market reforms.
Defining roles and responsibility for voltage management across the transmission-distribution interface.	Q3 2020-21	Ongoing (see RIIO-2 Delivery Schedule D15.3.1)	This deliverable was being progressed alongside the development of the approach for efficient reactive power flows between networks. Conclusion of this work was indirectly impacted by changes in working arrangements brought about by COVID-19 related restrictions and was de-prioritised relative to other deliverables where workload had ramped up. Any necessary planning process changes relating to voltage management across the transmission-distribution interface will be taken forward by extension of the business as usual process.
NOA Pathfinder projects			
Stability Pathfinder	Q2 2021-22	Ongoing (see RIIO-2 Delivery Schedule D8.1)	Completed: We launched the Stability Pathfinder Phase 2 RFI on 17 June 2020. We held an RFI webinar on 25 June 2020. Webinar recording and FAQ document is available on our website. We published RFI summary feedback and next steps on 19 August 2020 which included a timeline for Phase 2 tender process. Expression of Interest was published on 30 September 2020 seeking short circuit level and inertia services up to 2030. We have run a series of webinars in October & November. Milestones for phase 2 of the Stability Pathfinder are as follows: • Q2 Invitation for Expressions of Interest which was published in September • Q3 Publish draft commercial terms which was published in October • Q4 Commence technical feasibility studies published in March 2021 following EOI outcome

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			• Q4 Publish final commercial terms (will be published end of May 2021) The NOA methodology was updated in July 2020, in line with our licence obligation which incorporated any lessons learnt from Phase 1 which was completed in January 2020. Ongoing: We will publish a further update to the NOA methodology next year, incorporating learnings from the Stability Pathfinder phase 2.
Mersey Voltage pathfinder: Project recommendations	Q1 2020-21	Complete	On 22 May 2020 the ESO awarded 9-year contracts for static voltage support in the Mersey region to PeakGen (200 MVAr Reactor) and Zenobe (40 MVAr of reactive capability from battery storage). These contracts are worth a total of £8.67m and are due to commence from April 2022. This Pathfinder is the first time that we have directly compared market solutions to a TO network asset build approach for a long-term transmission level requirement. An update to the tender results and lessons learnt report was published on 11 December 2020. We have also confirmed the contracts signed to address the short-term Mersey voltage needs on 19 March 2021. This confirmed that the contract strategy was informed by the results of EOI that highlighted that other parties were unable to meet the technical requirements or timescales.
Pennines Voltage pathfinder	Q2-Q4 2020-21	Complete	An update on the Pennine tender was published on our website on 29 January 2021. We published an invitation to tender on 26 March 2021. The tender is expected to last up to 40 weeks with an outcome no later than January 2022 for contract start in 2024. Over the last two months we have been able to simplify and reduce levels of interactivity across the Pennine and North of England region such that we can tender for two distinct sub-regions. We are tendering for a minimum of 700MVAr across the 2 regions, and the tender is open to both new and existing connections at transmission and distribution levels, including aggregators. We have been working with the transmission owner (TO) NGET to identify site-specific information; this is available to industry on request. We have also defined and agreed the scope of studies with the DNOs who will assess any solutions that fall within their areas as part of the tender.
Constraint Management Pathfinder	Q1-Q2 2020-21	Complete	We delivered on our target we set in the Forward Plan of providing a response to the market of a tender for an intertrip service. From then, we provided the market more information on the service on the service design, how participants will be able to take part and a timeline of the overall process. The Constraint Management Pathfinder has now progressed to running an Expression of Interest (EOI) as per the timeline and is inviting already connected generation to participate in the service we announced further details in December 2020. During the six-week window we are hoping for generation connected to the Scottish transmission network to enter a feasibility assessment to be pre-qualified and entered into a commercial tender. Successful tenders will be able to deliver the service from as early as 1 October 2022 onwards. The ESO is also working with the TO to build intertrip channels to connect the providers so effectively, the generator would declare an interest and the ESO would work with the TO to facilitate the rest. This is the first time the ESO will be running a commercial tender to procure intertrip volume.
Early Competition			
Early Competition plan setting out implementation for models.	Q1-Q4 2020-21	Completed (in April 2021)	Throughout the year we have been working closely with stakeholders to develop a model for early competition. We have had to adapt our approach to engagement due to the COVID-19 pandemic, moving to virtual workshops rather than face to face. We have developed our

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			proposals iteratively using two formal consultations to seek views in addition to targeted workshops. We have also established robust governance for the project including setting up our ESO Networks Stakeholder Group (ENSG) to provide challenge on our approach to stakeholder engagement and how we have taken the feedback received on board in developing our proposals. There are also areas where we have had constructive feedback and have responded to this by extending our second consultation window to 10 weeks (first one being 6 weeks) and held an additional workshop with industry stakeholders on the approach of a TO counterfactual in March. We submitted our final plan to Ofgem at the end of April. This includes some modifications to our proposals following responses to our Phase 3 consultation. This was accompanied by a report from the ENSG on our stakeholder engagement. Feedback from the ENSG has been positive on our engagement approach and our willingness to take on board and act on feedback. We will also be holding a webinar on our final plan for stakeholders in May.
NOA: Enhanced communication			
Improve accessibility of Electricity Ten Year Statement (ETYS) and Network Options Assessment (NOA) publications	Ongoing	Complete for 2020-21 (see RIIO-2 Delivery Schedule D7.2)	As a result of feedback we have received, this year we intend to make it clearer how the content for both of these publications applies to our stakeholders. We are also intending to reach new stakeholders and make the publications accessible and relevant to them by trying to answer the "so what?" question. We have published ETYS online and have replaced the single document with an interactive web version. Our stakeholders can provide feedback directly to us via the website which means we can seek to respond quickly. We can also learn from what interests our stakeholders using this approach and provide them with more relevant information in future publications.
Regional Development Programmes (RDPs)			
Development of commercial arrangements for Transmission Constraint Management (TCM) service from DER	Q2-Q4 2020-21	Complete	Initial design workshops, held with both UKPN and WPD, have been successful in defining the project phases and overall scope. These workshops have also focused in on the core elements of the commercial arrangement that will now be further informed by stakeholder feedback. Learning from these workshops will continue to be disseminated through our monthly Joint DNO Forum. We have now also published our updated RDP Fact Sheet on the NGESO website, which has been endorsed by all GB DNOs and the ENA. In addition, the '2025 - Road to Net Zero' publication contains information on our delivery plan for both the DER TCM projects with respective DNOs. IT development of TCM services in UKPN and WPD areas has now commenced and is progressing as planned to delivery in 2022-23: see RIIO-2 Delivery Schedule D15.5.1 and D15.5.2.
Co-ordinated DER inter-tripping functionality for transmission fault management. Including completion of work with WPD and UKPN	Q2-Q4 2020-21	Ongoing (see RIIO-2 Delivery Schedule D15.11.1)	Completed: Co-ordinated DER intertripping functionality is now in service in the UKPN south coast area. Ongoing: Due to the volume of remaining NGET transmission outages required to complete the N-3 work with WPD and SSEN, we have not been able to deliver this capability during the 2020-21 financial year. We explored alternative methods of delivery with NGET earlier in the year, however, due to the additional complexities of an incremental delivery, it was unlikely to deliver any benefits over the original approach. NGESO is now focussing on progressing the elements of delivery that can proceed with both SSEN and WPD, in lieu of the completion of the outstanding transmission outages. We are aiming to begin exchanging data via the ICCP links in July 2021, with completion of the remaining

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			outages by November 2021 and full end-to-end commissioning by January 2022.
Develop the Generation Export Management Scheme (GEMS) in South West Scotland to manage transmission constraints	Q2-Q4 2020-21	Ongoing (see RIIO-2 Delivery Schedule D15.11.2)	Completed: NGESO has completed significant design work over the course of the last year to ensure the required documentation is ready for the procurement of the GEMS technical solution with SPT. In addition, good progress has been made across all GB DNOs to ensure a consistent approach is derived for the commercial contract structure for DER, in line with the ongoing RDP Design Workshops and the latest ENA Open Networks work in this area. The majority of the work to integrate the SPD ANM into business-as-usual processes has been completed. Ongoing: GEMS development work will continue as planned through to commissioning in 2022-23, There are some areas of the Active Network Management (ANM) integration that require finalisation. This is not currently delaying the deployment of the ANM solution across SPD's network although we are striving to resolve these areas during April.
Whole System thought leadership			
Support BEIS and industry in developing a strategy for clean heat.	Q1-Q4 2020-21 and ongoing	Complete for 2020-21 (see RIIO-2 Delivery Schedule D13.4)	We met with BEIS at least quarterly throughout the year. We continue to discuss whole energy system matters with the system operation teams in National Grid Gas Transmission (GSO) in the context of our ongoing stakeholder engagement on energy policy. No formal project was taken forward in 2020-21 as our teams are focused on understanding the longer-term direction of the ESO in the context of the Ofgem review of system operation and the Energy White Paper. We published a thought piece about the implications for system operation of clean heat pathways on 16 November 2020 and held a webinar on 8 December 2020 to get industry feedback on the thought piece.
Active engagement in the development of DSO and co-ordinated flexibility markets including cross-sector considerations	Q3 2020-21	Complete	The ESO has been actively involved in all ENA Open Networks workstreams and at the Steering Group meeting. We have led the project's Whole Energy System workstream and the associated whole system CBA deliverable. We have also led on the procurement processes deliverable in the project's flexibility workstream. We have been involved in the development of the DSO framework for RIIO-ED2 and have begun to engage with DNOs to ensure our activities align with their proposed works. We have also engaged with broader DSO policy developments such as responding to Ofgem's call for evidence on the visibility of distributed generation connected to the GB distribution networks.
Network value assessment tools			
Voltage needs identification tools/ processes.	Q4 2020-21 and ongoing	Complete	Developed Historical Data Mining Tool and completed initial view on potential next priority regions for high voltage assessment. Initial outcome of voltage needs identification process was published at the end of June 2020. Additional tools developed: • Power Uncertainty Year-round Analyzer (POUYA) - A tool to do year-round probabilistic assessment of the GB network to cope with the increasing uncertainties arising from renewables. • An additional module in Python for POUYA to assess year-round losses and CO2 calculation for Ten Year Development Plan (TYNDP) projects. • Voltage optimization - Python based tool to assess future reactive power requirements.

Deliverable	Target delivery date (from Forward Plan Addendum)	Status	Commentary
			• Voltage pathfinder option testing - A DIgSILENT Programming Language (DPL) script to test high number of voltage solution options combinations and flag any compliance issues • Stability Pathfinder option testing - A DPL script to calculate the fault infeed for different options and topologies submitted to the Stability Pathfinder • Voltage screening tool - allows us to visualise the recent frequency of use of voltage control equipment and cost of actions taken to resolve voltage issues on the system in operational timescales.
Enhanced customer experience			
Continue to work with Customers and Network Owners to understand the requirements and scope of a system wide single platform to provide online account management and connection application functionality	Ongoing, due to be completed in 2022	Ongoing (see RIIO-2 Delivery Schedule D14.1.1)	Discussions with Customers and Stakeholders regarding scope of Portal completed in January 2020. We did intend to engage on further discussions to identify functionality, but the TOs have accelerated their portals and have now physically launched them. From the products the TOs have launched, and the work we did with industry last year, we now know what is required from the ESO portal. Work on the ESO portal has now commenced with project planning and scoping activities being progressed.
Insights documents			
Operability Strategy Report	Q3 2020-21	Complete	The frequency of this report has changed to annual (rather than every 6 months) to align with our other publications. The report was published in December 2020.
FES: Bridging the gap to net zero	Q3-Q4 2020-21	Complete	Starting in September 2020, we engaged with a wide range of external stakeholders about how markets, technology and data and digitalisation can help the energy industry manage the challenges of increasing numbers of peaks and troughs due to greater decarbonisation. We held four webinars and ran three working groups, which resulted in a set of key recommendations and actions for the ESO, industry and policy makers. The final report was launched on 4 March to an external audience via a webinar. It was also published on our website.
Summer Outlook	Q1 2020-21	Complete	Published April 2020: https://www.nationalgrideso.com/document/167541/download
Winter Outlook	Q3 2020-21	Complete	Published October 2020: https://www.nationalgrideso.com/document/178126/download
Winter Review and consultation	Q1 2020-21	Complete	Published 24 June 2020: https://www.nationalgrideso.com/document/171986/download
Future Energy Scenarios (FES)	Q2-Q3 2020-21	Complete	Report published July 2020. https://www.nationalgrideso.com/document/173821/download The Launch conference for stakeholders was shifted to a virtual event online. This year we designed the FES report to be digital first, reducing our environmental footprint and making the overall length of the document 25% shorter, whilst including broader analysis and new sections on whole system flexibility not previously covered by FES.

C.4 Outturn performance metrics and justifications

Metric/ Performance Indicator	Performance	Status
3A. Right first-time connection offers	The overall percentage of Right First Time connections offers this year is 96%.	●
3B. NOA consumer value	We are exceeding expectations for the consumer benefit of ESO options, with an average value of 5.04% taken across the FES scenarios. We are below expectations for the second part of the metric which compares the number of ESO options to the total number of options in the optimal paths, we calculated this to be 5%.	● ●
3C. Customer connections- customer satisfaction	The satisfaction surveys were paused in the first half of this year due to the impact of COVID-19. In the second half of 2020-21 the score has been 7 out of 10.	●
3D. Whole system unlocking cross boundary solutions	532.3MW of Distributed Energy Resource (DER) within WPD network and 401.2MW within UKPN network accepted for 2020-21.	N/A
3E. Future balancing costs saved by operability solutions	Over 2020-21 we successfully released commercial service contracts under Stability Pathfinder phase 1, the Mersey Voltage Pathfinder, and the Loss of Mains programme. Overall, we expect to save £29.4m in future balancing costs.	N/A
3F. Capacity saved through operability solutions	We have successfully delivered the N-3 capability with UKPN and are now working to complete this project with WPD and SSEN. As the volumes of DER applying to connect are now beginning to increase, we are stepping up RDP developments and are undertaking commercial design workshops with DNOs on the south coast, in addition to completing the high-level requirements for GEMS with SPT.	N/A

Table 14: Summary of metrics and performance indicators for Role 3

● **Exceeding expectations**

● **Meeting expectations**

● **Below expectations**

3A Right First Time connection offers

2020-21 Performance

This metric measures whether the ESO aspects of connection offers were correct the first time they were sent out to customers.

Connections Offers	Results
Year to date number of connections offers signed	354
Year to date ESO related reoffers	13
Year to date percentage of Right First Time connections offers determined from ESO related reoffers	96%

Table 15: Connections re-offers data

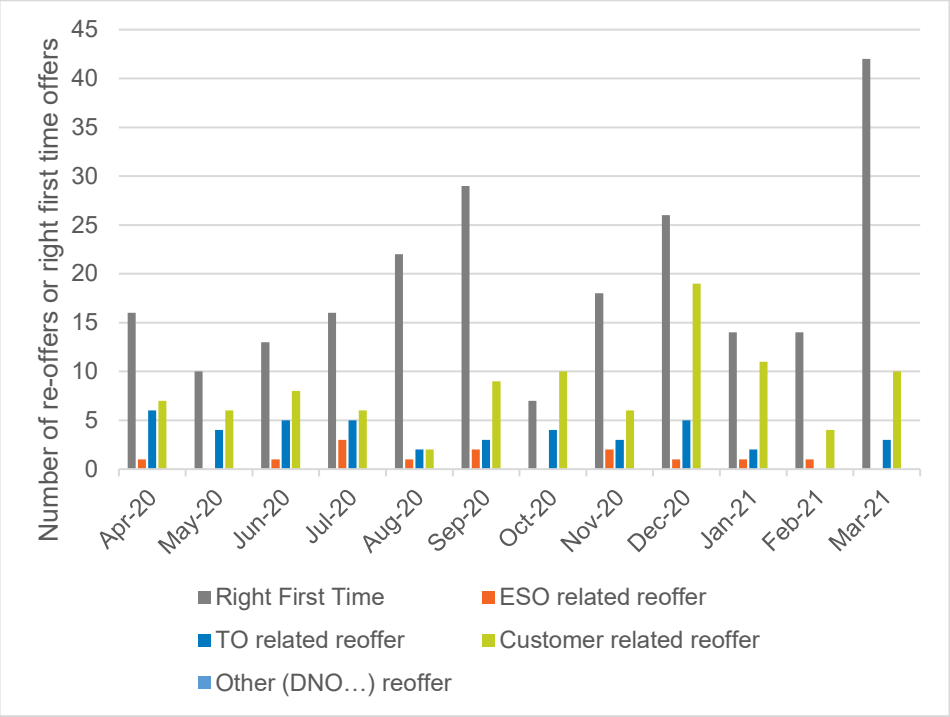

Figure 7: Connections offers monthly performance

Supporting information

Right First Time has been meeting expectations for the entire 2020-21 year with ESO re-offers totalling 13, and 95% to 96% right first time across the year. Customer applications into the ESO Connections team have increased 22% on 2019-20 levels and despite COVID-19 working arrangements this target has continued to be met. We continue to review the reasons for re-offers and share any learning across the teams.

Performance benchmarks

- **Exceeding expectations:** 100% of connection offers Right First Time (excluding those where the error was not due to the ESO)
- **Meeting expectations:** 95-99.9% of connection offers Right First Time (excluding those where the error was not due to the ESO)
- **Below expectations:** Less than 95% of connection offers Right First Time (excluding those where the error was not due to the ESO)

3B NOA consumer value

2020-21 Performance

Supporting information

We are exceeding expectations for the consumer benefit of ESO options, with an average value of 5.04% taken across the FES scenarios. We are below expectations for the second part of the metric which compares the number of ESO options to the total number of options in the optimal paths, we calculated this to be 5%. More detail can be found below.

Currently the Network Options Assessment (NOA) uses single year least-worst regret (LWR) to determine the investment strategy for the next year for TOs and/or relevant parties. Single year LWR evaluates and compares the economic regret of delivering each critical option against the economic regret of delaying it by one year. In economic analysis, the regret of an investment strategy is the benefit difference between that strategy and the best strategy for that scenario. The recommendations we make for each option, or combination of options, are based on minimising the levels of regret across all scenarios, which is in the best interest of consumers.

To calculate the overall consumer benefit, we would need to decide a counterfactual value to compare to. Conventionally, it would be either to build all the options provided or not to build anything. However, neither scenario is feasible. Therefore, we use the concept of 'anti-regrets'. This means that the recommendations made on critical options, in each of the optimal paths, using LWR, are reversed. The 'anti regret' is the single year regret of doing the opposite of what NOA recommended and serves as a benchmark for comparing the 'best' and 'worst' investment strategies possible. We perform this analysis by calculating the single year regret, in each of the FES scenarios, by changing:

- Options that received a 'Proceed' recommendation to 'Delay'
- Options that received a 'Delay' recommendation to 'Proceed'

Delaying an option that was recommended to 'Proceed' results in additional constraint costs in some scenarios. Whereas proceeding an option that was recommended to 'Delay' results in inefficient first year spend since the reinforcement is delivered earlier than it is required. The difference in economic benefit between the NOA recommendations and the strategy of doing the opposite of the recommendation (anti-regret) is the quantifiable measure of consumer benefit.

Last year, at the time of reporting the consumer benefit for NOA 2019-20 was based on FES 2019, we used the latest market intelligence and views from the wider industry at the time, and understood that three out of the four FES 2020 scenarios that were being developed would meet the 2050 net zero targets. However, at the time, the FES 2019 Two Degrees scenario was the only one that most accurately represented this updated view and was therefore the most appropriate scenario for reporting the consumer benefit. This year, now that three out of the four FES 2020 scenarios meet the net zero target, i.e. Leading the Way, Consumer Transformation and System Transformation, a range of consumer benefit values can be calculated. Therefore, we have taken the approach of using the average of the three scenarios that meet the net zero targets. This aligns with our other metrics that we report on and is consistent with last year's reporting.

In order to calculate the consumer benefit generated from ESO options, we compare the consumer benefit, specifically of ESO options, as a percentage of the overall consumer benefit of the NOA, where:

- Consumer benefit of NOA = (Anti regret of ALL critical options-Regret of NOA recommendations)
- Consumer benefit of ESO Options = (Anti regret of critical ESO options-Regret of NOA recommendations)
- Consumer benefit of ESO Options % = (Consumer benefit of ESO Options) (Consumer benefit of NOA) ×100

Using the above formula, we calculate the consumer benefit of ESO options for each scenario, and take the average across the three aforementioned scenarios, to get a value 5.04%. This value exceeds the baseline target of 4%. It should be noted that the value of 2 ESO collaborative options (with codes KWHW and MBRE) are not included in this value since they are optimal but not critical options and hence, not subject to regret analysis. This year, the benefit of both the asset-based and ESO options has increased significantly, as a result of much higher forecast power flows over the next 20 years in the three net zero FES 2020 scenarios. Further, we also see increased consumer benefit from the ESO proposed options which play a key role in relieving constraints ahead of the delivery of larger asset-based options with longer lead times.

For the second part of the metric which compares the number of ESO options to the total number of options in the optimal paths, we calculated this to be 5%, tracking below the baseline target. This was calculated based on six

ESO exclusive or collaborative options being optimal this year, these options have the following NOA codes: CS05, CS06, CS07, CS08, MBRE & KWHW. This year the TOs submitted an additional 24 options into the NOA process and as a result the total number of options in the optimal paths increased by 22 to a total of 113 options. This led to a significant reduction in the percentage of options in the optimal path made up by ESO options. We have previously reported that the ESO cannot control the number of options which are submitted by the TOs. This feedback has since been incorporated in the new RIIO2 metrics where the focus is on narrative based on the value the ESO has created through the inclusion of alternative options.

Consumer benefit from SWW and LOTI

During this financial year, we have progressed with the several existing strategic wider works (SWW). Two SWW projects have been completed: Shetland Islands and Orkney Islands, with a total consumer value of £254 million. For the East Coast of Scotland and North England SWW, the analysis is still ongoing and the result is expected to be included in next year's report.

In addition, we have also progressed a number of projects through the new Large Onshore Transmission Investments (LOTI) process. This includes: Yorkshire Green, SEA Link, Isle of Skye and Dumfries & Galloway, however this analysis is still ongoing and therefore we do not have a consumer benefit value to report at this stage.

Consumer benefit from Connections and Infrastructure Options Note (CION) assessments

In the last year, we have conducted two new CION assessments. They are Awel y Mor and Atlantic Super Connection. The total consumer benefit from these assessments is approximately £931 million. Three other CION assessments are still ongoing and therefore we cannot report a consumer benefit value for them at this stage. These inflight projects include: West of Orkney wind farm, Seagreen Phase 3 and Xlink.

Consumer benefit from ad-hoc CBA

In the past year, we conducted a total of three ad-hoc CBAs, in line with our baseline target of three. These included:

- Abernethy for SHET, where we calculated the savings from non-build solutions compared to asset-based reinforcement
- Drax-Thornton reconductoring for NGET, the benefit is obtained from comparing the cost of reconductoring versus like-for-like cable replacement.
- Isle of Skye, where the benefit of using dynamic line rating technology was assessed against a non-build recommendation.

By carrying out these assessments the ESO aims to make the recommendation that is in the best interest of consumers. We estimate that the recommendations across these projects have the potential to save consumers £37.8 million.

Overall consumer benefit 2020-21 Summary

The consumer values for all the activities through the last financial year are listed below

ESO Workstream	Consumer Benefit
SWWs	£254m
CIONs	£931m
Ad Hoc CBAs	£38m
Total	£1,241m

Consumer benefit value created across year 2020-21

Performance benchmarks

- **Exceeding expectations:** The % of ESO exclusive and ESO collaborative options is >12% of the total number of options in the optimal path or the value is >4% of the overall consumer benefit.

- **Meeting expectations:** The % of ESO exclusive and ESO collaborative options is between 10% and 12% of the total number of options in the optimal paths or the value is between 3% and 4% of the overall consumer benefit.

- **Below expectations:** The % of ESO exclusive and ESO collaborative options is below 10% of the total number of options or the value is below 3% of the overall consumer value

3C Customer Connections- Customer Satisfaction

2020-21 Performance

Supporting information

2020-21 has seen a limited number of responses for Customer Satisfaction, despite a 22% increase in customer applications. This is partially due to the hold on surveys through the initial part of the year due to the COVID-19 pandemic. Of the responses the Connections team have received, the score across the year has been 7 out of 10, therefore we are below expectations. Comments have pointed towards improvement areas regarding timely response to customer queries, more information on complex processes e.g. securities and more co-ordination between the ESO and TOs. The Connections team are actively addressing these feedback points and have already made significant changes to the website giving more information on the process and associated methodologies as well as holding working together workshops with the TOs. The unprecedented volume of applications seen over 2020-21 has created challenges not only within the ESO but has also impacted processes and provision of information from the TO companies. Additional new initiatives such as Pathfinders and new connection types coming forward has compounded these issues.

The questions asked in the survey were:

- In your current role how long have you been engaging with the ESO?
- How frequently are you usually in contact with the ESO?
- How would you classify your business?
- Which teams do you regularly deal with in the ESO? (for this score the team selected was Connections)
- Overall on a scale of 1 to 10, where 1 is very dissatisfied and 10 is very satisfied, taking all aspects of the service you have received into account, how satisfied are you with the ESO?
    - 1-8; “What could ESO have done for you to score a 9 or above?
    - 9-10; “What did the ESO do well?
- From previous customer and stakeholder feedback, the ESO has identified areas of focus in the experience it provides. Please can you highlight how you feel the ESO is performing currently?
- How strongly do you agree with the following? Please rate on a scale of 1 -10, where 10 = strongly agree and 1 = strongly disagree
    - The ESO delivers on its commitments in a timely manner
    - The ESO provide credible expertise
    - The ESO is transparent
    - The ESO cares about me and the impact they have on my business
- Is there anything we haven't covered that you would like to feedback to the ESO?
- Do you believe that action will be taken from feedback provided?

Performance benchmarks

- **Exceeding expectations:** Score out of 10 of 8.2 or more
- **Meeting expectations:** Score out of 10 between 7.8 and 8.2
- **Below expectations:** Score out of 10 of 7.8 or below

3D Whole System, Unlocking Cross Boundary Solutions

2020-21 Performance

This Performance Indicator is an assessment of the effectiveness of our whole system actions, measured in terms of their outputs. This indicator measures the changes to contracted Distributed Energy Resources (DER) in each of the Regional Development Programmes (RDP) regions, as a result of the UKPN/ESO collaboration in the South East Coast region and the WPD/ESO collaboration in the South West region.

2020-21 Performance (UKPN)

Grid Supply Point (GSP)	MW	Commentary on DER technology types
Bolney	96.9	No new DER in Q1. Multiple new acceptances of 76.9MW for a mixture of Battery storage, Solar and Waste in Q2. 20MW of Solar in Q3. No new DER in Q4.
Canterbury	-423	No new DER in Q1. 5MW moved to Sellindge in Q2. No new DER in Q3. 418MW moved to Richborough in Q4
Ninfield	124.3	5MW of battery storage in Q1. Multiple new acceptances of 119.3MW for a mixture of Battery storage and Solar in Q2. No new DER in Q3 and Q4
Sellindge	-3	16MW of Gas accepted in Q1. 5MW of DER terminated in Q2. No new DER in Q3. 24MW moved to Richborough in Q4
Richborough	606	442MW moved from Sellindge and Canterbury and 164MW of new Battery and Storage added in Q4
Total	**401.2**	

Table 16: Change to contracted MW capacity of UKPN DER connections

2020-21 Q1-Q4 Performance (WPD)

Grid Supply Point (GSP)	MW	Commentary on DER technology types
Abham	16	No new DER in Q1 and Q2. 16MW of PV accepted in Q3. No new DER in Q4
Alverdiscott	114	59MW acceptances of Solar were received throughout Q1 to Q3. 55MW added in Q4 of PV and Battery technology
Axminster	49.9	No new DER in Q1 and Q2.

		49.9MW Thermal plant (gas) accepted in Q3. No new DER in Q4
Bridgwater	92	130 MW acceptances and 45MW terminations of mixed technology DER were received in Q1 and Q2. No new DER in Q3. 7MW of Mixed technology accepted in Q4
Exeter	44.5	38MW of PV accepted in Q1. No new DER in Q2 and Q3. 6.5MW of Mixed technology accepted in Q4
Indian Queens	127.2	Q1 saw the termination of 30MW of PV. No new DER in Q2. 11MW Wind, 8MW Battery, 40MW of PV and 58.2MW of mixed PV/Battery sites accepted in Q3. 40MW of battery accepted in Q4.
Landulph	53.3	29MW of Mixed technology accepted in Q1. 6MW of Solar accepted in Q2. No new DER in Q3. 16.3MW of PV and a 2MW extension to an existing thermal site in Q4.
Taunton	35.4	No new DER in Q1 and Q2. 20MW of Battery accepted in Q3. 15.4MW of battery accepted in Q4.
Total	**532.3**	

Table 17: Change to contracted MW capacity of WPD DER connections

Supporting information

We have provided opportunities for increased embedded generation volumes by creating capacity that allows the DNOs to contract with their customers.

UKPN

In the first half of the year, DER had been added at certain GSPs in the South East, however these have not been large volumes. There were several applications received from UKPN for three of the four GSPs seeking additional capacity. In Q4 we saw a rise in DER capacity at the relevant GSPs and Richborough was added to the Regional Development Programme (RDP) approach. There has been a change in moving some DER from Canterbury and Sellindge to Richborough, with additional DER added to Richborough. There has been no additional DER at Bolney or Ninfield.

WPD

The first half of the 2020-21 period saw the impact of COVID, with the level of accepted DER slowing and existing inflight schemes becoming static due to uncertainty and delays in construction and procurement timescales. Q3 and Q4 saw improvements, but there has been a general slowdown of numbers of new applications in the South West. WPD are actively working with NGESO to utilise new technologies and approaches such as Active Network Management (ANM) and RDP products to provide increased capacity on the Distribution Network in that region, and in parallel develop longer term reinforcement solutions.

3E Future balancing costs saved by operability solutions

2020-21 Performance

This is a Performance Indicator to demonstrate the consumer benefit of implementing new operability tools such as Stability, Frequency, Constraint Management Services and Loss of Mains.

Operability Solution projects	Annualised cost saving through RIIO 2
Counterfactual Spend (£m)	99.9
Contract cost for Stability Pathfinder phase 1 (£m)	54.7
Savings due to Stability Pathfinder phase 1 (£m)	8.7
Contract cost for Mersey Voltage Pathfinder (£m)	1.0
Savings due to Mersey Voltage Pathfinder (£m)	12.6
Contract cost for Loss of Mains programme (£m)	14.1
Savings due to Loss of Mains programme (£m)	8.1
Total savings (£m)	**29.4**

Table 18: Future balancing costs saved by operability solutions

Supporting information

We successfully released commercial service contracts under Stability Pathfinder phase 1 and the Mersey Voltage Pathfinder, and as a result, we expect future balancing costs savings in the next few years. The saving was estimated based on the counterfactual spend forecast if no new operability solution was brought in, we then annualise the figure through the contract length based on the assumption that all contracts will be delivered on their contractual dates. However, if there is any delay to those dates, we may need to update those annual figures.

In our 2019-20 Forward Plan publication in March 2020, we included a balancing cost saving forecast from the Loss of Mains protection change programme. COVID-19 has impacted the programme's delivery assurance process in the first quarter. Activity has resumed with new safe working practices, so far over 12.9GW of generation at 6,709 sites have now applied to the programme, with changes already made at sites with a combined capacity of over 9.2GW. The addition of generators contacted and known to have achieved compliance takes the total engaged to 16.3GW, or 61% of total generation capacity within scope. These changes have already impacted on Balancing Costs.

For the above three projects (Stability Pathfinder, Voltage Pathfinder, Loss of Mains), the counterfactual spend is the forecast cost of balancing the system based on the forecast of future system conditions such as those contained within the Future Energy Scenarios (FES) and other relevant market intelligence information, if no new commercial solution were implemented. After introducing the new commercial solutions through an open market tender, that counterfactual spend would disappear, but there would be additional contract costs relating to the payment for the service providers who deliver those new commercial solutions, so the savings are calculated as the difference between the counterfactual spend and the contract cost.

3F Capacity saved through operability solutions

2020-21 Performance

The Regional Development Programmes (RDPs) are taking a whole system view of the required transmission network capacity. As such, we monitor the progress of both transmission and distribution connections to ensure the RDP is delivered and capacity released when needed. Changes in the total Forecast Connected Distributed Energy Resources (DER) Capacity will be monitored and reported through this indicator to ensure current RDPs are being progressed in line with the system need. This indicator will also report on new RDP areas where work has been progressed throughout each quarter to provide new whole system solutions.

The required network capacity needs to be sufficient to cover a range of credible system backgrounds accounting for the operations of both transmission and distribution connected parties. In some areas of the network, where there are multiple transmission connected parties, there may be a much higher capacity required than just that needed to manage DER volumes.

The RDPs are delivering a number of new systems, process improvements and enhanced data exchange activities which will enable improved visibility, controllability and coordination of smaller DER. In addition, the GEMS project will not only enable better management of DER in south west Scotland, it will provide enhanced capabilities relating to the instruction of larger, transmission-connected plant. In lieu of traditional transmission build solutions, these enhancements will expand NGESO's toolbox in terms of how the available capacity on the transmission network is managed. The development of a variety of routes to market, which allow smaller DER to participate in NGESO congestion management services, will increase the available resources to manage more locational congestion on the transmission network, whilst also ensuring economic and efficient whole system coordination with each of the DNOs.

Overall supporting information

Extensive study work was carried out for each RDP area, which covered a variety of forecast scenarios, generation backgrounds along with proposing various solutions to solve predicted transmission and distribution issues. As part of this study work, a base network was modelled which has been used to define the baseline transmission capacity across each year. As each solution was implemented and tested through the study scenarios, this gave an indicative MW value of additional capacity that could be offered, so long as the appropriate operability solutions are in place to suitably control the additional capacity, should alternative network conditions outturn in comparison to those that were assessed. As the RDPs are delivering operability solutions (e.g. control systems and market-based solutions), these do not often have a defined MW capability however, the numbers provided give an indication in relation to volumes that are most economic to manage in this way.

WPD N-3 Intertripping

Year	2020-21	2021-22	2022-23
Forecast Connected DER Capacity (MW)*	1800	1950	2350
Baseline Transmission Capacity (MW)**	1700	2300	2300
Additional Capacity Released (MW)	N/A	600	N/A

*This figure is based on 100% connection of Forecast DER Connected Capacity, with no load factors applied.

**Network Capacity if no RDP solution in place.

Supporting information

Over the course of the last year, the forecast connected DER capacity has remained largely consistent, with slight shifts in the actual connection dates of certain individual DER units, as shown in the revised numbers in the table.

The delivery of the additional transmission capacity has also been shifted into the next delivery year as a result of the outage delays that we have previously reported. It should be noted that due to the current suite of tools available to the ESO we do not envisage any operational issues as a result of the delay in overall delivery of the N-3 capability.

UKPN N-3 Intertripping

Year	2020-21	2021-22	2022-23
Forecast Connected DER Capacity (MW)*	1900	2000	2100
Baseline Transmission Capacity (MW)**	1700	2300	2300
Additional Capacity released (MW)	600	N/A	N/A

*This figure is based on 100% connection of Forecast DER Connected Capacity, with no load factors applied.

** Network Capacity if no RDP solution in place.

Supporting information

The forecast connected capacity of DER across UKPN's area has slowly trended upwards across the course of the last 12 months, as new applications have been received.

The N-3 functionality has now been fully delivered between NGESO, NGET and UKPN which will allow more efficient operational management of the increased connections in the south east area of the transmission network. The ESO is now investigating further system improvements that could be realised as a result of this new functionality and lessons learnt from the project are being fed into delivery with WPD and SSEN.

WPD MW Dispatch

Year	2020-21	2021-22	2022-23
Forecast Connected DER Capacity (MW) *	1800	1950	2350
Baseline Transmission Capacity (MW)**	2600	2600	2600
Additional Capacity released (MW)***	N/A	N/A	1300

*This figure is based on 100% connection of Forecast DER Connected Capacity, with no load factors applied.

** Network Capacity if no RDP solution in place.

***Based on delivery of IT infrastructure by Q4 2022-23.

Supporting information

Changes in the overall generation background have remained largely consistent across the last year, with the MW Dispatch project still on track to deliver the additional transmission network capacity in line with when the forecasted DER is likely to connect.

UKPN MW Dispatch

Year	2020-21	2021-22	2022-23
Forecast Connected DER Capacity (MW) *	1900	2000	2100
Baseline Transmission Capacity (MW)**	5100	5100	5100
Additional Capacity released (MW)	N/A	N/A	1350

*This figure is based on 100% connection of Forecast DER Connected Capacity, with no load factors applied.

** Network Capacity if no RDP solution in place (this capacity is also shared by transmission-connected parties and is required to accommodate flows on the interconnectors).

***Based on delivery of IT infrastructure by Q4 2022-23.

Supporting information

The forecast connected capacity of DER across UKPN's area has slowly trended upwards across the course of the last 12 months, as new applications have been received. However, the MW dispatch project is still on track to deliver the additional transmission network capacity in line with when the forecasted DER is likely to connect.

SPT – Generation Export Management Scheme (GEMS)

Year	2020-21	2021-22	2022-23
Transmission & Distribution Forecast Connected Capacity (MW)*	1800	2000	2250
Baseline Transmission Capacity (MW)**	1800	1800	1800
Additional Capacity released (MW)	N/A	N/A	500

*This figure is based on 100% connection of Forecast Connected Capacity on to the transmission and distribution networks, with no load factors applied.

** Pre-GEMS deployment. Baseline Transmission Capacity accounts for diversity in generation output.

Supporting information

There have been no significant changes to the forecast connected capacity during the course of the last 12 months however, it is anticipated that there will be new interest in this area over the coming months.

The GEMS project is on track to deliver an enhanced operational solution in this area of the network in late 2022 in line with projected system needs.

Cost data

In our 2020-21 Forward Plan, we set out our planned costs for 2020-21, as well as forecast outturn costs for 2019-20 and outturn costs for 2018-19. Value for Money does not form part of the incentive scheme for 2020-21, but here we provide an update of our outturn costs for 2019-20, as well as a forecast of our outturn costs for 2020-21.

The numbers are in 18-19 prices and rounded to the nearest million. They represent business Opex costs before regulatory adjustments, and exclude Capex and Business Support costs. Each role has a proportion of directors' costs overlaid to represent the true cost of each role. Other costs consist of Business Change, Innovation, Assurance, Regulation, Stakeholder & Customer and Early Competition. Offshore Co-ordination is included within Role 3.

It is important to note that the Regulatory Reporting Pack (RRP) remains the formal cost report for the ESO. The outturn costs for 2019-20 are taken from the 2019-20 RRP published in July 2020. The outturn costs for 2020-21 are only a forecast at this stage, and are subject to change: the final numbers will be formally reported in the 2020-21 RRP which will be submitted to Ofgem in July 2021.

18/19 prices	Outturn costs for 2018-19 (£m)	Outturn costs for 2019-20 (£m)	Outturn costs for 2020-21 (£m)
Role 1	26	31	32
Role 2	12	10	10
Role 3	15	14	14
Other costs	8	6	8