# Facilitating the transition to a flexible, low carbon energy system

## The Electricity System Operator RIIO-2 Business Plan 2021-23

9 December 2019

nationalgridESO

# Contents

# How to use this document

**Our Business Plan is divided into three main parts:**

**Part 1 (page 3)**

**Outlines our business background, the context for our plan including our ten-year vision, the assumptions underpinning our proposals, and how stakeholders have helped develop them.**

**Part 2 (page 32)**

**Sets out our planned outputs against the three Roles we play and the Themes that lie beneath these. In each Theme chapter, you will find information about the benefits, costs and net present value of our proposed new activities, as well as stakeholder views on our proposals. We have also included, in each of the Theme chapters, our five-year strategy and delivery roadmaps for the proposed activities.**

**Part 3 (page 126)**

**Provides more detail on the parts of our business that underpin everything we deliver, including our IT strategy, our approach to innovation, the cross-cutting teams and shared services that support us to deliver value for consumers and how we will invest in people and capability.**

**To help explain our thinking clearly, for each of the activities listed in Part 2, we have segmented our information under the following headings:**

- Costs
- Ongoing activities and enhancements
- Transformational activities
- Investment roadmap
- Stakeholder views
- Cost-benefit analysis
- Proposed performance metrics

Throughout the Business Plan you will see reference numbers e.g. A1, A1.1 and D1.1.1. These references are to help link our proposed activities, sub-activities and deliverables. A full list can be found in the activity architecture tables in Annex 1, section 2.

Supporting this Business Plan is additional information which you can review alongside the various sections.

**These include:**

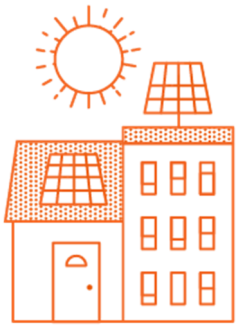
- **Annex 1** - **Supporting information,** which includes summary investment tables, activity architecture tables, more information on our performance in RIIO-1, benchmarking, metrics, and assumptions underpinning our Business Plan. It also includes larger delivery roadmaps that are easier to read.
- **Annex 2 - Cost-benefit analysis (CBA) report,** which outlines more on how we calculated the net present values and determined which proposals to take forward. This report includes our cost summary tables, which you can review as you read through the various chapters.
- **Annex 3 - Stakeholder report,** which highlights the feedback we have received through our extensive stakeholder engagement and how we have used it to develop our plan.
- **Annex 4 - Technology investment report,** which supplements chapter 10 – technology underpinning our plan. It sets out the IT investment references and includes benchmarking information.
- **Annex 5 - Finance report,** which covers the supplementary information on the ESO's financeability, pensions, revenue and other costs.
- **Annex 6 – How our plan meets Ofgem's and the Challenge Group's requirements,** which includes the feedback received by the Challenge Group and how we have responded to it in our suite of documents.
- **Annex 7 – Metrics and measuring performance,** which provides more detail on our metrics proposals.
- **Annex 8 – Shared services,** which sets out how the ESO's share of National Grid group costs has been calculated.
- **Annex 9 – Business IT security report** (confidential), which outlines the investments essential for IT security.
- **Annex 10 – Glossary,** which has definitions of the terms used within this Business Plan submission.

**Other things to note are that:**

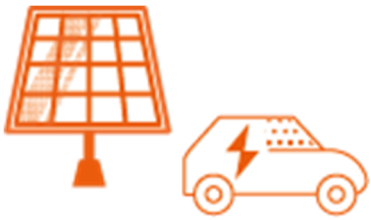
- The benefits and costs in this document are all in 2018/19 prices.
- We have calculated the benefits presented using Ofgem's net present value (NPV) model. More detail is in Annex 2.
- The costs and full time equivalent (FTE) employee numbers presented in this plan have been rounded to the nearest hundred thousand and nearest whole FTE.
- The RIIO-1 costs presented in this document are calculated as follows:
  - Opex and FTE numbers are the average for the ESO since legal separation (years 2019/20 and 2020/21), which reflects the current ESO business structure.
  - Capex numbers are the average over the eight years of RIIO-1. As capex programmes tend to span many financial years, this gives a more typical spend profile.
  - The costs presented in this document represent our proposed spending.

# Facilitating the transition to a net zero energy system…

May 2019: Great Britain had its first fortnight without using electricity from coal since the 1880s.**Over 3,500 coal free hours this year.**

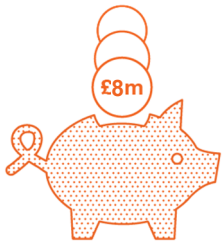


Peak solar generation record. **9.55 GW power generated from solar.**



Embedded generation: **in 2012 the industry predicted 12% in 2020, levels hit 27% in 2017.**


**60% increase in active Balancing Mechanism Units** in the system and a **42% increase in balancing service providers** since the beginning of RIIO-1.




**£8 million annual efficiency savings** in RIIO-2.

**2025** when we will be able to operate a carbon free electricity system.

# …while providing value for consumers

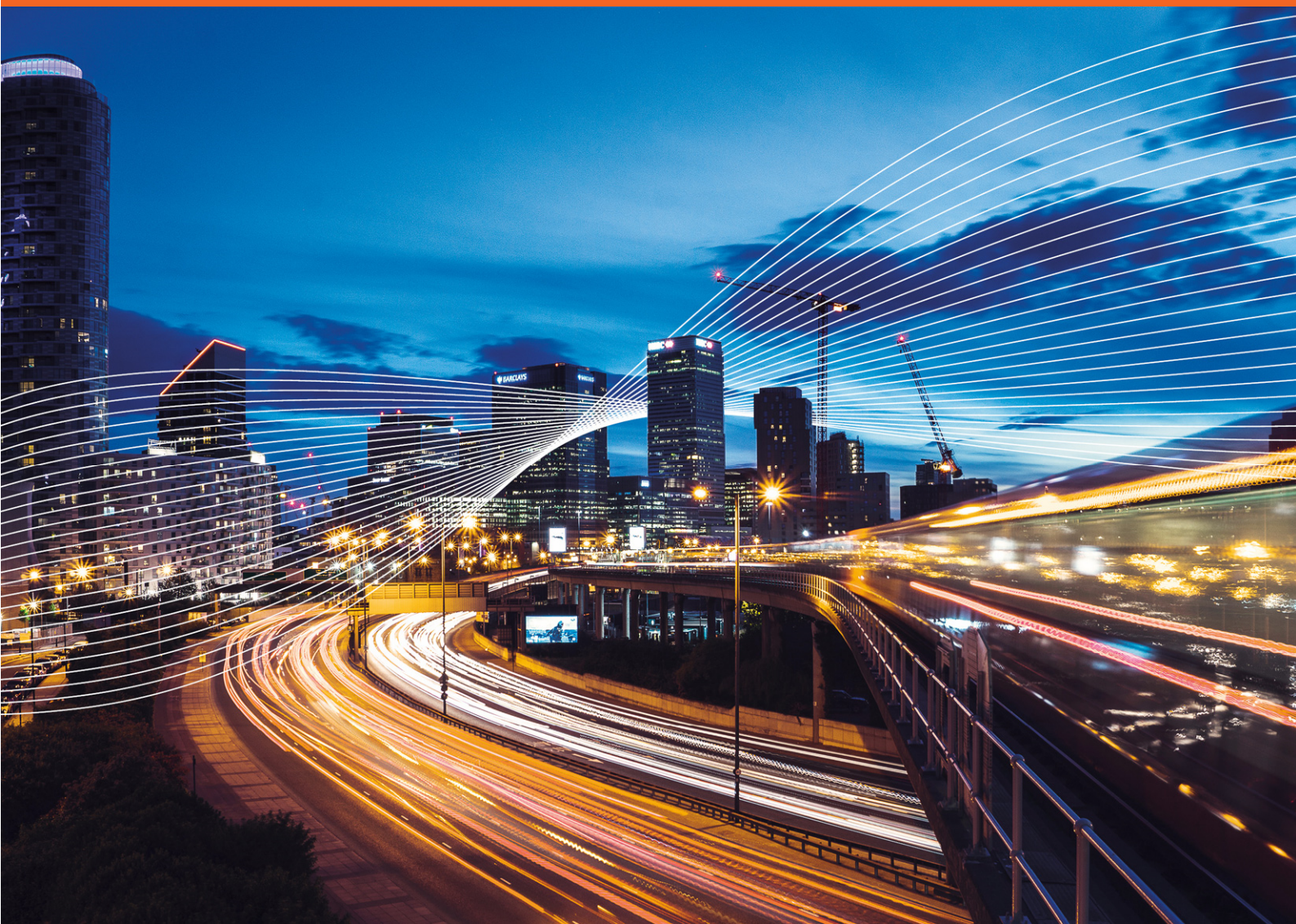
**£2 billion net present value of consumer benefits** to be delivered in RIIO-2.


**£257 million** annual cost of the ESO.


**Consumer bills around £3 lower.**

# Part 1
# Context





# 1. Introduction and context

Energy is the lifeblood of our economy and society. As the Electricity System Operator (ESO) for Great Britain, we hold a unique position at the heart of the nation's energy system. Our actions influence investment decisions and markets worth billions of pounds and our role is critical for the transformation of the energy system. In RIIO-2 we will deliver around £2 billion net present value of consumer benefits.

**Our mission, as System Operator, is to enable the transformation to a sustainable energy system and ensure delivery of reliable affordable energy for all consumers.**

Success in 2025 looks like:

1. an electricity system that can operate carbon free
2. a strategy for clean heat, and progress against that plan
3. competition everywhere
4. the System Operator is a trusted partner.

For our full ESO RIIO-2 ambition, please see our website[1].

Delivery of our mission will not cost consumers more. Our actions in RIIO-2 will lower average annual consumer bills by around £3 than they otherwise would have been.

**An effective ESO can play a crucial and positive role in ensuring that the UK has the ultra-low carbon, affordable, reliable and efficient power system it needs in the near future.**
**Wider Interest Group**

The energy landscape has undergone a revolution – and change will continue at an even greater pace. The ESO sits at the heart of a complex, multi-directional system of electricity flows, where small-scale renewables, storage and demand-side participation make operating the system more challenging than ever before. We are already rising to this challenge and will continue to do so throughout the RIIO-2 period and beyond. Our vision to 2030 sets out how we must change, including developing new capability and culture within our business. Supported by a new, bespoke regulatory model, we will facilitate the transition to a zero-carbon power system, helping to achieve the UK's recent commitment to net zero emissions by 2050. Alongside this, we will continue to deliver energy safely and reliably and provide value for consumers in everything we do.

Our RIIO-2 Business Plan identifies, in detail, the necessary investments in the ESO to transform our business and achieve these goals over the next two years. Each chapter in Part 2 includes our five-year strategy. Our ten-year vision is set out in section 1.2.

## 1.1. Business plan Roles and Themes

This Business Plan is structured under the three roles of the ESO, as set out in Ofgem's decision document on the ESO's financial methodology and roles framework[2] published on 25 October 2019.

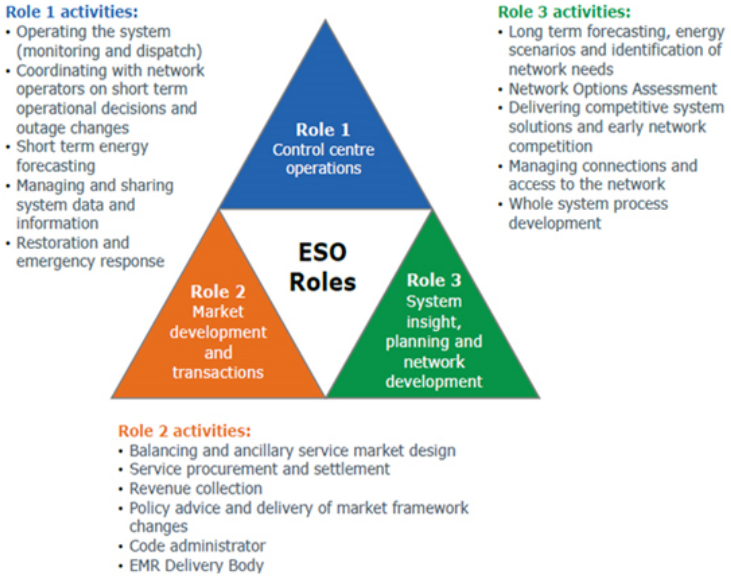



*Figure 1: ESO Roles*

[1] https://www.nationalgrideso.com/about-us/business-planning-riio/future-planning-2021-onwards

[2] https://www.ofgem.gov.uk/publications-and-updates/riio-2-financial-methodology-and-roles-framework-electricity-system-operator

In *Our RIIO-2 Ambition*[3] and our draft July and October Business Plans, we set out our proposals under four Themes, which map to the Roles as shown below:

| | |
|---|---|
| Role 1<br>Theme 1 | **Control centre operations:** reliable, secure system operation, to deliver electricity when consumers need it. |
| Role 2<br>Theme 2 | **Market development and transactions:** transforming participation in smart and sustainable markets. |
| Role 3<br>Theme 3 and Theme 4 | **System insight, planning and network development:** unlocking consumer value through competition and driving towards a sustainable, whole energy future. |
| Roles 1, 2, and 3<br>Cross-cutting teams | **A number of teams support our activities across all three roles.** These are innovation, customer and stakeholder, regulation, assurance, and business change |

To help stakeholders understand the evolution of our RIIO-2 Business Plans, we have continued to reference the Themes in this document, highlighting in each chapter which Role they fall under.

We recognise that to deliver the ambitious outputs that stakeholders want, the ESO will need to change significantly. Our capabilities and culture must evolve. We describe towards the end of the Business Plan how we will transform in these areas as we become an organisation at the cutting-edge of technology - trusted by the industry, consumers and society to facilitate the energy transition.

## 1.2. Our vision for the ESO in 2030

Climate change is the challenge of a generation. Delivering an electricity system that contributes to the UK meeting its net zero commitments by 2050 is central to our mission and we will act as a key enabler for change. In 2030 the UK will have made significant progress towards achieving that commitment. We will plan and operate an optimised and intelligent electricity system that welcomes all participants who want to use it. We will provide a transparent and efficient market-driven environment where everyone can contribute and participate in the new energy ecosystem.

After over a decade of driving the transformation of the electricity system, our stakeholders trust us to lead the fundamental change across industry that is required to decarbonise Great Britain's energy use. This means driving innovation and harnessing emerging technologies to deliver a flexible electricity system that meets the challenge of decarbonisation head on.

Our investment plans are designed to ensure that we facilitate the transition to a low carbon energy system, so that investments made by ourselves and others can start to deliver benefits as early as possible.

Below we set out a vision for the ESO in 2030 under each Theme:

### Role 1, Theme 1: Reliable, secure system operation to deliver electricity when consumers need it

We will keep the lights on and get energy to people when they need it, maintaining today's reliability levels in a rapidly decarbonising and decentralising world. We will ensure our control centres are resilient, flexible and agile, with the ability to keep pace with the changing energy landscape. We will confidently and regularly operate periods of zero carbon electricity with high levels of renewable output and dynamic demand. The number of market participants will have increased significantly, as a result of growth in distributed energy resources, electric vehicles and energy storage. We will have invested and adapted ahead of need, to continue to operate securely and reliably through extensive automation, greater use of artificial intelligence and enhanced training and simulation, to deal with the vast amount of data needed to run the electricity system. There will be alignment with distribution system operation (DSO) to enable seamless planning and operational coordination to realise the benefits for consumers of a decarbonised energy system.

### Role 2, Theme 2: Transforming participation in smart and sustainable markets

We continue to drive to deliver efficient outcomes for consumers and are always conscious that everything we do has an impact on consumer energy bills. A key focus will be enabling whole system flexibility through the markets we operate. Our balancing markets will be decarbonised and distributed, to help achieve the UK's commitment to net zero emissions by 2050. We will maximise consumer benefit by facilitating competitive markets and managing system costs, attracting high volumes of flexible energy, such as demand-side response and storage.

The diversity of participants in our markets is growing, and where there are hundreds of participants today, there could be thousands engaging in our markets in 2030. These markets must work for everyone – new players and current stakeholders alike – and we will take a leading role in the design of efficient energy markets that do exactly this. To achieve this our balancing products, markets, processes and IT infrastructure will have transformed, to be easily understood and accessed by service providers and fully integrated with other flexibility markets.

We will have transformed access to the Capacity Market to deliver security of supply with a plant mix that supports the UK's 2050 carbon target at an appropriate cost to consumers. A whole system approach to codes and the application of digital technologies will make

[3] https://www.nationalgrideso.com/document/141256/download

codes more accessible. And the code and charging arrangements will facilitate the rapid change required to achieve the low-carbon energy system.

### Role 3, Theme 3: Unlocking consumer value through competition

We seek the best whole electricity system solutions, working collaboratively with Transmission Owners (TOs) and Distribution Network Operators (DNOs) across transmission and distribution to deliver electricity to Great Britain's homes and businesses as efficiently as possible. We will have transformed our approach to identifying and meeting new network requirements to consider the increased complexity arising from greater levels of clustered variable renewable generation. All network development will have gone through a consistent, coordinated cost-benefit analysis, and where of sufficient value to consumers, a competition has taken place to determine the most appropriate solution and provider to meet network needs.

We will have technical standards that are appropriate for the decarbonised energy system we are planning and operating.

### Role 3, Theme 4: Driving towards a sustainable whole energy future

We will use our unique position in the industry to help Great Britain meet net zero through driving debate and collaborative action across the energy sector. This means stepping up and playing a crucial part in the transition to net zero – using our insights to identify and accelerate no regrets strategies that deliver consumer value over the long term. By taking a whole energy system view we will facilitate the transition to clean heat by helping prepare the energy networks and optimising between them. In doing so, we can drive the transition to a low-carbon energy system in a way that maximises benefits to consumers.

We will work closely with DNOs and TOs to deliver a more efficient, whole electricity system. This will include streamlined processes for connections and accessing the electricity networks. We will also have a mature capability to model and understand interactions between different network needs and simulate optimal operability solutions across the whole year. This will allow us to identify and manage the operability challenges of transitioning to a net zero economy and develop the capability to understand and resolve this through Themes 1,2 and 3.

### Open data unlocking zero carbon system operation and markets

Our data will be presumed open and it will be automated, and machine-readable. We will have people and systems with the capability to unlock value from the growing quantity and complexity of data and data tools. We will also champion open data sharing across the energy industry, thereby lowering consumer bills and delivering benefits to society as a whole.

## 1.3. A Business Plan developed in partnership with stakeholders

In April 2019, we published *Towards 2030: a system operator for GB's energy future*[4] which set out our longer-term vision of the future of energy. Alongside this, we published *Our RIIO-2 Ambition*[5] – our view of the outputs and activities we proposed to deliver in the crucial RIIO-2 period, as part of our journey to 2030. This was based on almost two years of extensive business and stakeholder engagement that we carried out both through our usual engagement channels and via RIIO-2 specific engagement. Stakeholders were universally supportive of the level of ambition set out in the document and that we are committed to delivering it.

We published draft Business Plans in July and October. These provided the next level of detail on the new, transformational activities and set out how they benefit consumers. This Business Plan sets out our final proposals and how they have been developed and refined with stakeholders.

For more information on how stakeholder feedback has informed our plan, please see chapter 2 and Annex 3 – Stakeholder report.

[4] https://www.nationalgrideso.com/document/141141/download

[5] https://www.nationalgrideso.com/about-us/business-planning-riio/future-planning-2021-onwards

# Key Outputs

### In RIIO-2 we will collaborate with stakeholders to deliver:

- new Control Centre architecture and systems to operate a zero carbon network by 2025
- new area monitoring and control systems, to ensure power system stability in a low carbon world
- new market and auction platforms to promote competition and enable participants as small as 1 MW to participate
- a digital engagement platform to provide a single point of contact for all ESO data and services, enabling a step change in data use and sharing across the industry
- new competitive processes, so that asset and non-asset solutions can compete to meet future transmission network needs
- a streamlined network connection process across the whole electricity system.

### We will also continue to:

- operate the electricity system so there is a minute-by-minute balance of supply and demand of electricity, managing balancing and constraints to minimise costs to consumers
- manage existing balancing service markets, develop future markets and make improvements to facilitate greater transparency, participation and competition
- manage industry revenue flows through playing a leading role in setting charging methodologies, and collecting charges for use of the transmission network and balancing services
- continue our electricity market reform (EMR) delivery body role
- manage connection applications for the transmission network, and acting as the contractual counterparty for these connections
- plan for the future of the electricity system, including network planning and the *Network Options Assessment* process, as well as how this interacts with the whole energy system
- publish a variety of insights and data, including our annual *Future Energy Scenarios*
- deliver IT system changes required by our customers, and those mandated by Great Britain and European Union regulations.


**Consumer bills around £3 lower**


**Net present value of benefits to consumers: £2 billion**

## 1.4. Maximising benefits for consumers through new transformational activities

Our Business Plan includes a set of ambitious new outputs. We estimate that these will generate **net present value benefits[6] of around[7] £2 billion for consumers over the five-year RIIO-2 period**.

Some of the major components of these benefits are:

- Investment in our control centre architecture and systems, so we can operate a zero carbon system by 2025. Direct benefits come from reduced emissions and lower consumer bills through better access to lower-cost interconnection and reduced balancing costs – delivering consumers a **net present value benefit of £210 million.**
- Working more closely across transmission and distribution networks to take a whole system view of zero carbon operability. This will reduce consumer bills through avoided network costs and constraint cost savings – delivering consumers a **net present value benefit of £466 million.**
- Transforming network planning by introducing competition between network and commercial solutions. This will promote innovation in 'non-build' solutions and reduce bills through avoided asset investment and lower constraint costs – delivering consumers a **net present value benefit of £663 million.**

Our actions mean that industry costs are lower than would otherwise be the case through lower balancing costs, avoided network investment, and industry efficiencies. This also creates savings that will be passed to consumers through lower bills. **In RIIO-2 the ESO will deliver a net annual saving to consumers of around £3 per bill**[8].


*Figure 2: Types of benefit we deliver*

For more detail on the types of benefits see Annex 2 – CBA report. Section 2.3.1, below, outlines how these align to consumer and stakeholder priorities.

### 1.4.1. How we have calculated benefits

For our transformational activities, where appropriate, we have undertaken a Cost-Benefit Analysis (CBA) to determine the value of each activity for consumers. We based our approach on Ofgem guidance,[9] supplementing our quantitative analysis with:

- ESO commercial/technical justification; and
- stakeholder feedback.

We started with a long list of options developed by experts within the business, and then ruled some out for technical reasons, such as IT capability, or commercial reasons, such as risk appetite. This refined list was then tested though our enhanced stakeholder engagement process as described in chapter 2, to create a short list. These remaining options were then subject to a CBA. With a combination of this analysis and stakeholder views we arrived at the proposals in this Business Plan. For detail on the options considered and why they were not taken forward see the Other options considered section across the Theme chapters. Details of the full CBA process are in Annex 2 – CBA report.

There are dependencies between our transformational activities, where one activity's benefits cannot be fully realised without other activities being undertaken. We have only considered the direct benefits of an activity

[6] in this document we refer to the net present value or NPV of an activity or group of activities, calculated over the five-year RIIO-2 period. When referring to the quantified benefits themselves, we refer to the as gross benefits. When summing benefits thought this document care should be taken that they are the same type and note rounding may mean values do not match precisely. See the CBA report for more details on how we have calculated NPV.
[7] This is a central estimate. Our analysis suggested that accounting for market, delivery and third-party uncertainty the NPV could be between £1.2 and £3.1 billion. Additional risk and financing costs from fixing Balancing Use of System (BSUoS) charges would also be needed to be taken into account in the ESO's overall financing requirements.
[8] This saving is as a result of our new and transformational proposals only, which will save around £4.70 on each bill. The cost of the ESO in RIIO-2 is around £1.80. The ESO's core ongoing role also delivers consumer savings that have not been quantified, so the £3 is likely to be an underestimate
[9] https://www.ofgem.gov.uk/publications-and-updates/riio-2-final-data-templates-and-associated-instructions-and-guidance

which reduces the chance of double counting benefits. Figure 3 illustrates these relationships.

The financial benefit figure we have estimated for consumers is likely to significantly understate the total benefits that the ESO will drive. This is because it only includes the direct benefits that are able to be quantified and does not consider wider environmental improvements or the wider benefits of our core role – providing a safe and reliable supply of electricity to underpin an economy worth over £2 trillion.

We have undertaken sensitivity analysis for our CBA, considering market, delivery and third-party uncertainty. For capex investments we have detailed the cost uncertainties in Annex 4 – Technology investment report. For the benefits uncertainty and the impact of these on the CBA, see Annex 2 - CBA report.

The performance metrics we propose in this plan will help to assess the extent to which benefits are being realised. Around 60 per cent of benefits will be directly tracked by the metrics. Where our proposed metrics do not track benefit realisation directly, we track the drivers of benefits. Overall, over 80 per cent of benefits or benefit drivers will be tracked through the metrics[10]. Further details are in Annex 2 – CBA report.

Our proposed metrics are in each of the Theme chapters, supported by Annex 7 – Metrics and measuring performance. We propose to review these metric proposals and targets when we are closer to the start of the RIIO-2 licence period so we can ensure they are appropriate and stretching, taking into account the incentive scheme, draft and final determinations, and most recent performance.

## 1.4.2. Monitoring benefits

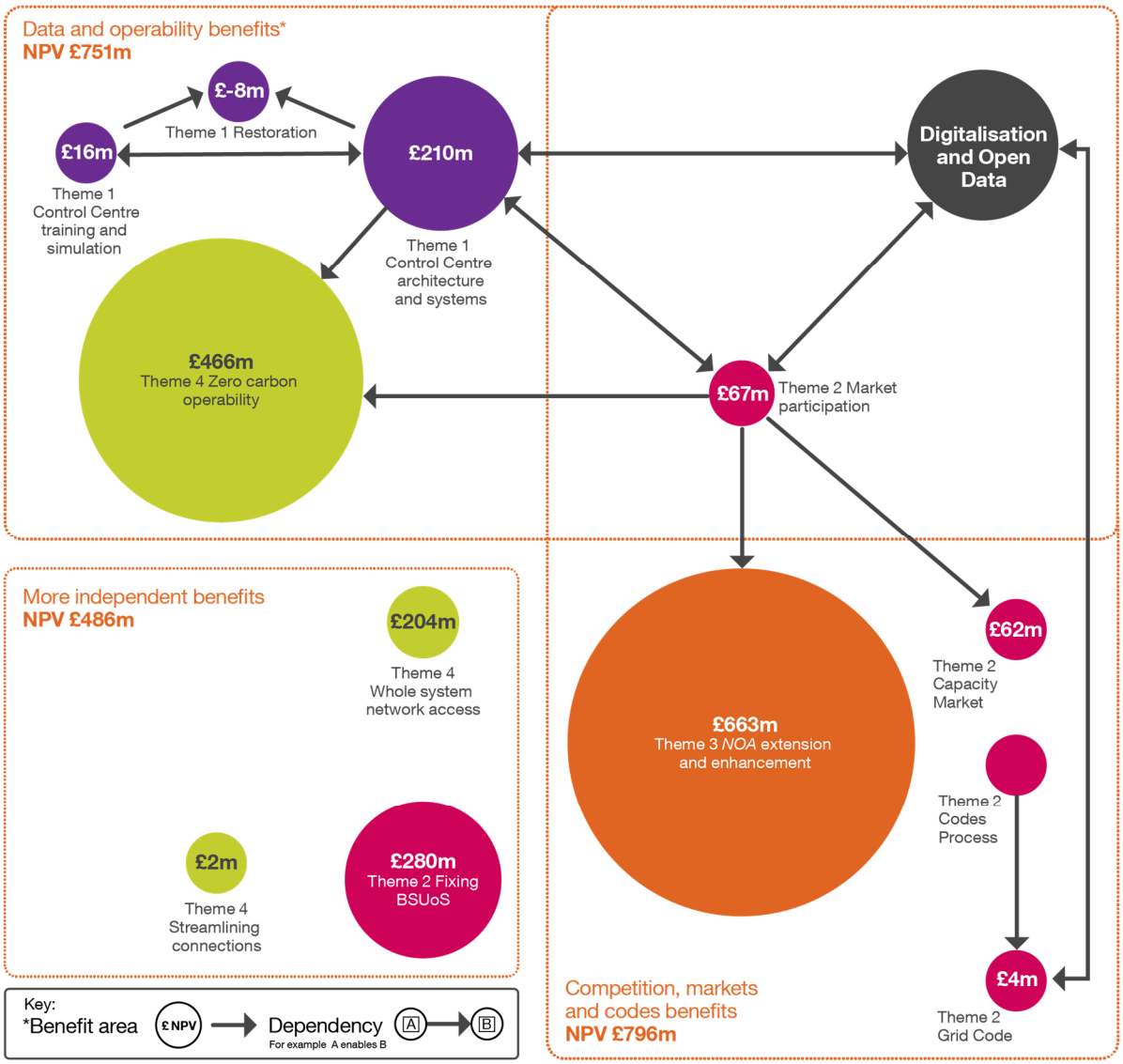



*Figure 3: Benefits dependency map. (NPV = net present value.)*

[10] This excludes benefits from activity A6.6 'Look at partially or fully fixing BSUoS'. We intend to report on the consumer benefits from this activity as part of a regular report on the benefits of code modifications. More detail is in Annex 7- Metrics and Measuring Performance.

## 1.5. A flexible Business Plan for a changing energy landscape

Since the start of the RIIO-1 price control we have seen unprecedented change in the energy system:

- In May 2019, Great Britain had its first fortnight without using electricity from coal since the 1880s, with over 3,500 coal-free hours so far this year.
- A new peak solar power generation record was set on 14 May 2019 with 9.55 gigawatt (GW) of power generated from solar.
- In our 2011 *Future Energy Scenarios* (FES), we anticipated that in 2019 we would have around 1 GW of solar power capacity in GB; we now have over 12 GW.
- In 2012 industry predicted 12 per cent embedded generation in 2020; levels hit 27 per cent in 2017.
- There has been an increase of 60 per cent in active Balancing Mechanism Units in the system and a 42 per cent increase in ancillary service providers.

### 1.5.1. The future is already here

The 'three Ds' of the energy transition – decentralisation, decarbonisation and digitalisation – are well known features of the energy landscape today and will become increasingly so over the coming years. Looking ahead we see an energy system where:

- **renewable and low carbon technology** dominates how we generate electricity, the way we travel and how we heat our homes.
- this technology is more **decentralised,** with significant distributed and local generation, supported by energy storage and demand-side solutions.
- consumers **produce, store and sell energy** in response to market signals, based on cost and carbon-intensity, through peer-to-peer trading, smart homes, and participation in our balancing service markets.
- **advanced data and analytics** change the way market participants interact with us and each other, enabling them to make informed choices.

The ESO of 2025 will be an organisation that operates the system using new technologies. These will harness the power of **automation, artificial intelligence and machine learning** to efficiently manage the complex energy system of the future. We will **lead changes to markets** so new sources of flexibility, including innovative providers and disruptive technologies, can participate in the low carbon energy mix of the future. We will pave the way in **sharing data** across the industry, which will influence better decision-making and increased transparency. It will be essential for us to work across **transmission and distribution boundaries**, collaborating with network and market companies to solve local and national balancing challenges together. Our RIIO-2 Business Plan describes how we will meet these challenges to become the ESO of 2025 that the energy transition needs.

### 1.5.2. Flexing our plan to support different pathways

The ESO will publish two-year Business Plans in the context of a five-year strategy

Recognising the changing energy landscape, during the RIIO-2 period the ESO will publish two-year Business Plans in the context of a five-year strategy for each of the four delivery Themes. This will allow us to update our plan and proposed investment based on the latest view of the energy landscape, the needs of stakeholders and the pathways to our 2050 net zero target.

Our plan also provides flexibility for other parties. Some of the investments in our plan are designed to remove barriers to these 2050 pathways for other participants in the energy system. For example, stakeholders have welcomed our commitment to be able to operate a zero carbon electricity system by 2025. This will make sure that system operability is not a constraint on the deployment of low carbon generation.

Sections 3.2-3.4 give more information about how we will manage uncertainty in our plan, the future energy scenarios, and our view of the energy system out to 2030.

## 1.6. The ESO business

We operate the National Electricity Transmission System for Great Britain. We balance supply and demand in real time, making sure consumers have safe and reliable energy at their fingertips at a cost they are willing to pay[11].

The ESO plays a unique role within the energy system. Although we are relatively small in terms of internal costs, we influence industry costs that are many times higher.

We do not have a large asset base, with an expected regulatory asset value (RAV) of around £220 million at 31 March 2021. This results in a very small balance sheet compared with the more than £4 billion revenues we transact in our industry revenue management collection role.

While we are an asset-light business, we run IT systems that enable core energy industry activities, such as real-time system operation by our Control Centre, and maintain IT infrastructure necessary to enable the

[11] Including the Estimating Electricity and Gas Transmission Consumers' Willingness to Pay for Changes in Service during RIIO-2 report.

energy transition. Our IT systems have an asset life of five to ten years. We invest heavily in people and have a directly employed workforce of around 650, many of whom have specialist skills.

The ESO became a legally separate entity within the National Grid group on 1 April 2019. Separating the ESO business from National Grid Electricity Transmission (NGET) allows for increased independence and transparency in our decision-making.

**Board assurance of our Business Plan**

The ESO has its own Board of Directors[12], including three independent non-executive directors. It has overseen the development of our RIIO-2 Business Plan and assured our plan for accuracy, ambition, efficiency and financeability. The Board assurance statement can be found on our website alongside this plan.

**We understand the ESO's duty to meet the current and future needs of the energy industry and its wider stakeholders, and its role in the achievement of net zero emissions by 2050, along with the continued provision of a reliable energy supply at an efficient cost to consumers.**
**ESO Board**

### 1.6.1. International Cooperation

We are an active member of the European Network for Transmission System Operators for Electricity (ENTSO-E). Through ENTSO-E we collaborate with other European TSOs on the development of coordinated approaches to network planning, system operation and markets, supporting the development and entry into force of key European legislation to deliver these aims. Our collaboration in this regard has supported the successful ongoing implementation of legislation under the Third Energy Package[13] and we are currently supporting work to implement the new Clean Energy Package[14].

We lead and support Great Britain's industry on the implementation of this European legislation through the Joint European Stakeholder Group with the support of our key stakeholders. We play a leading role in formulating and raising modifications to our codes and frameworks, to support a well-functioning European electricity market. An example of this work is the conclusion of the modifications necessary to support Project TERRE (a European project to implement a new cross-border reserve product) and associated wider access to the Balancing Mechanism for smaller parties, which is now in its implementation phase.

We are an active member of Coreso (Coordination of Electricity System Operators), a regional security centre for electricity that brings together European TSOs to promote the efficient and safe management of the European electricity system. Coreso contributes to the coordinated security of the European electricity system, the integration of large-scale renewable energy generation and the development of the European electricity market.

We are participants in GO15. GO15 comprises the world's 19 largest power grid operators, who collectively represent more than 70 per cent of the world's electricity demand. GO15 was created in 2004 following several blackouts across the world to investigate fundamental issues of common interest to its members and to develop joint action plans addressing improvement of power system security.

We are an active participant in the European Transmission System Operators (TSO) HR Forum, which enables us to share and leverage best practice ideas. The forum includes HR Executive Directors at 12 major European TSOs where, as an example, we work together to propose joint projects for staff in all business lines aimed at building and reinforcing "Human Networks". These include inter-TSO workshops, an Executive Management Development Programme run by a top European Business School, regular meetings between HR Directors and HR experts to benchmark operations, and more recently an Erasmus TSO programme to enable young professionals to spend time in another TSO working in similar roles.

### 1.6.2. How we will be regulated in RIIO-2

RIIO-2 is an opportunity to design a bespoke regulatory framework for the legally separate ESO, so that we can deliver this ambitious plan.

In Section 1.1 we set out the three Roles that form the basis of our regulatory framework, and the proposals in this Business Plan.

In RIIO-2, the ESO will have:

- A two-year business planning cycle, within the five-year RIIO-2 period. This requires us to set out a long-term vision to 2030 or beyond. We have also produced a medium-term strategy over five years and detailed our costs, activities, deliverables and performance metrics in this Business Plan, which will be reproduced every two years.
- A regulatory asset value (RAV)-based, slow money approach for capex, and a fast money approach for

[12] https://www.nationalgrideso.com/about-us/meet-ngeso-board
[13] https://ec.europa.eu/energy/en/topics/markets-and-consumers/market-legislation/third-energy-package
[14] https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/clean-energy-all-europeans

opex.[15] All efficient costs will be passed through to consumers.

- No sharing factor, and a cost disallowance approach aligned to the other RIIO companies.
- Potential for additional remuneration to recognise otherwise unremunerated risk.
- Continuation of an *ex post*, evaluative incentive scheme.[16]

The regulatory framework is key to facilitating delivery of the ambitious plan and significant consumer benefits outlined in this document, with the potential to deliver an ambitious, proactive and agile ESO.

Ofgem has provided financial working assumptions for the key framework parameters for the ESO in RIIO-2. Our assessment of these assumptions is that they discourage the ESO from being ambitious or taking risks, and potentially encourage risk-averse behaviours. While incentives could offer an upside, an *ex post* evaluative scheme is unpredictable and insufficient alone to encourage the behaviours desired by stakeholders.

Amendments to these key parameters would implement a framework that is financeable and appropriate for the roles and activities the ESO undertakes. We have prepared this Business Plan on the assumption that the ESO will have a sustainable funding model that ensures the financeability of the ESO as a standalone business. More information is in chapter 9 – Financing our plan.

## 1.6.3. Investment in the ESO in RIIO-2

Our proposed investment[17] in the ESO in RIIO-2, including our core, ongoing outputs, is an average of £257 million per year. This incorporates efficiencies worth £8 million per year. Please see chapter 3 – Assumptions underpinning our plan for more information on the efficiencies we have incorporated in our plan. The ESO's annual average spending in RIIO-2 includes £60 million of proposed new investment as well as continued delivery, and enhancements to, the processes and systems we use to carry out our core role. The increase on our RIIO-1 annual average spending of £182 million[18] per year is mainly due to this £60 million new proposed investment. Other cost increases have been offset by efficiency gains, so the rest of the net increase reflects increased investment in our core IT services, including additional investment in digital and cyber security measures.

We have set out our proposed spending for a five-year period, reflecting the longer-term nature of many of the transformational outputs we propose. Our cost-benefit analysis and data tables also look at a five-year period, as required by Ofgem. The proposed spending set out for the first two years of this period should be read as part of this longer-term investment proposal. The spending for 2023/24 and beyond will be updated when we publish our next two-year Business Plan.

The cost of our role in RIIO-2 is around £1.80[19] on a consumer's annual energy bill, however our proposed new and transformational outputs will save consumers around £4.70 per year, resulting in a net reduction of around £3 from the level it would have been without the ESO's actions. The ESO's core ongoing role also delivers consumer savings that have not been quantified, so the £3 is likely to be an underestimate.


*Figure 4: ESO average annual investment, staff numbers (full time equivalent (FTE)) and benefits in RIIO-2*

### 1.6.3.1. Investments shared across the National Grid group

Of our proposed £257 million average annual investment in RIIO-2, £179 million will be spent on services that are shared across the National Grid group, including £159 million on IT. £78 million represents our spending on ESO-specific IT investments, with a further £33 million being invested in shared IT infrastructure and cyber security and £48 million on IT running costs. £20 million will be invested in shared business support functions. For more details on IT please see chapter 10, and for shared business support functions see chapter 12. Annex 8 – Shared Services outlines how these shared costs have been allocated to the ESO.

**Investment**

The ESO's Business Plan spending will be reported on a two-year cycle. In this Business Plan we focus on the first two years of RIIO-2 but have also set out

[15] Slow money is where costs are added to the RAV, and therefore revenues are recovered over time from both current and future consumers. Fast money allows companies to recover a percentage of total expenditure within a one-year period. For example, 15% fast money would allow companies to recover 15% of total expenditure within year, with the rest being capitalised in the RAV (slow money).

[16] Further details are still being consulted on by Ofgem.

[17] Excluding items not classified as totex, for regulatory accounting purposes. The average of £257m is for 2021/22 and 2022/23. In line with Ofgem's requirements, this Business Plan focuses on the first two years of RIIO-2.

[18] This number has been updated since the £180 million in our October Business Plan, based on the 2018/19 regulatory reporting pack forecast for the last two years of RIIO-1

[19] First two years of RIIO-2, 2018-19 prices.

# 2. A plan informed by our stakeholders

our view of what spending will be over the full five-year period.

## 2.1. The importance of stakeholder views

As we embark on this unprecedented opportunity to develop a new regulatory framework and Business Plan for the ESO, we need the insight and support of our customers and stakeholders so we can make sure that we focus on the right areas. It is critical that we produce a plan that reflects stakeholders' needs and maximises benefits for consumers and society as a whole. This document has been produced in collaboration with stakeholders, with proposals constantly tested and refined.

**Our engagement objective**

We are committed to working with our customers and stakeholders to help shape the future of the energy market and understand how best the ESO can deliver value for our customers and consumers. Through enhanced stakeholder engagement we will be able to create a plan that reflects their needs.

In this chapter, we set out what we have learnt from our engagement and how we have structured our stakeholder engagement programme. The ESO continuously engages stakeholders and our RIIO-2 specific engagement is a natural extension of this. Details about how stakeholders' views have shaped our proposals can be found in the Theme chapters and are described in more detail by Theme and by topic in the supporting Annex 3 - Stakeholder report.

We have also embraced an enhanced engagement approach through the introduction of our ESO RIIO-2 Stakeholder Group (ERSG). Comprising members from across the industry, its role was to scrutinise the production of our plan and how effective we have been at engaging stakeholders. The group will submit a report to Ofgem that sets out their views on our engagement activity and the development of our Business Plan, which will be published on our website by 23 December 2019[20].

### 2.1.1. Engagement key themes

Feedback from stakeholders has encouraged, supported, challenged and guided us towards the ambitious Business Plan presented here. Similarly, the broad knowledge and experience of ERSG has created an environment of robust challenge and strong support to elevate the level of ambition in our plan. This builds on our current role and capabilities to reflect the evolving role we can play as system operator in the future.

**ERSG supports our stakeholder engagement to develop the Business Plan.**

"The quality of information provided on feedback from customers and stakeholders and how this has been reacted to is high. Members are impressed with ESO reactivity to feedback, and feel that this has resulted in a much improved Business Plan."

We have received a lot of support for the level of ambition we have put forward in our Business Plan. ERSG in particular has been positive about it and this has also been supported by a range of stakeholders beyond the group.

**Strongly welcome the ESO's efforts to put forward an ambitious plan that sets clear goals and reflects stakeholder feedback.**
**Trade association**

The main points we have learnt through our stakeholder engagement are that we need to:

- be ambitious and proactive - creating benefits for consumers and delivering a high-quality service in all that we do
- set ourselves up strongly to deliver against the plan, including establishing the culture needed to deliver the proposals through all levels of the organisation
- adopt a principle of open data to help facilitate transparent and efficient markets

[20] https://www.nationalgrideso.com/about-us/business-planning-riio/ESO-RIIO-2-Stakeholder-Group

- transform our engagement approach to involve stakeholders throughout RIIO-2 in the development and execution of our major deliverables
- be mindful of how our proposals are dependent on wider industry change initiatives
- work closely with Transmission Owners (TOs) and Ditribution Network Operatoes (DNOs) to ensure a joined-up experience for market participants and connection customers across transmission and distribution
- make sure our funding model drives us to be ambitious and enables us to respond flexibly to new challenges as they arise, with strong incentives to provide benefits for consumers over and above our day-to-day role
- be transparent on our shared services costs and how they have been calculated.

As a result of stakeholder feedback, we have developed our Business Plan to:

- provide clarity on the intention of our ambition on operating a carbon free electricity system and which activities contribute to its delivery
- better understand consumer views on the future energy system and show how our plan aligns to their priorities
- talk more holistically about our ongoing activities, enhancements to them during the RIIO-2 period and transformational activities to help readers understand our Business Plan
- refine and expand the cost-benefit analysis and how we explain both the costs and benefits in the Business Plan
- include investment roadmaps to achieve our ambitions, including setting out those actions that will be taken forward during the remainder of the RIIO-1 period
- take an agile, modular approach to developing our new balancing and control capabilities, including building them offline
- clarify how we will work with universities to secure an increased pool of appropriate resources
- make participation in our markets easier through establishing a single integrated platform for both balancing service markets and the Capacity Market
- remove our proposal to take on responsibility for the Capacity Market rules
- clarify our proposed role in relation to leading the debate in Theme 4
- adopt a principle of open data – committing to sharing our data (in machine readable format) while making sure we are protecting data confidentiality and security
- transform engagement in delivering all our IT capabilities through fully involving stakeholders in their development through a design authority
- understand how our people, capability and culture need to change and identify what we are going to do to manage this transition.

Stakeholder feedback has also helped us to develop a funding model proposal that will enable the ESO to be a financeable, sustainable company that is forward-looking, ambitious and agile.

We set out more detailed changes throughout the Business Plan and the feedback that has informed this in our Annex 3 - Stakeholder report

## 2.2. Our stakeholder engagement strategy

Our stakeholder engagement strategy takes a dynamic approach. It includes continuous feedback, which enables us to develop and refine our thinking into the prioritised activities that feature in our Business Plan. We are inclusive in our engagement approach and work with a broad range of stakeholders of different sizes and across a number of sectors. We have evolved our engagement strategy to an ‘always on’ approach that adopts a permanent invitation to engage.

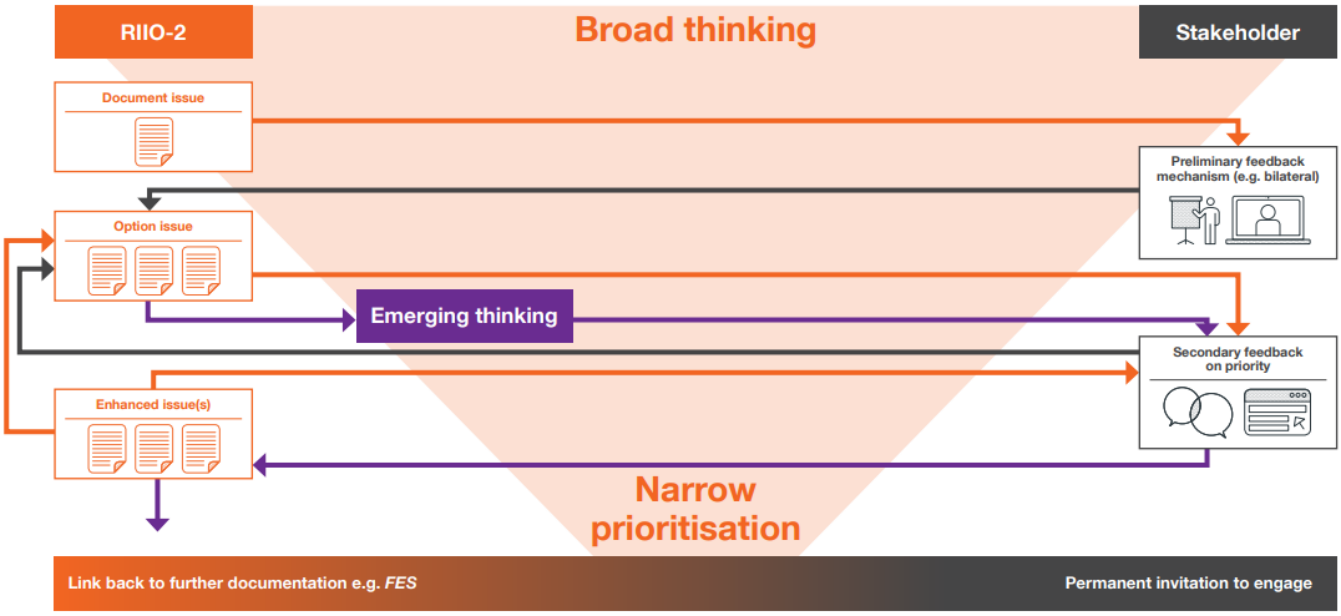



*Figure 5: RIIO-2 stakeholder engagement strategy*

We seek to use the principles of the AA1000 Stakeholder Engagement Standard in our engagement approach to establish a benchmark. It means that we plan, prepare, implement and improve engagement activity, so we maximise the value of our engagement and are respectful of stakeholders' time. We are not accredited to the standard, so have not assessed our performance against it. Instead, we commissioned an independent review of our stakeholder engagement approach in the first half of 2019 to make sure we are taking a best practice approach in developing our Business Plan. The review was positive, based on stakeholder feedback and a comparison with best practice organisations. Some enhancements to evolve our approach were recommended, many of which we have taken forward as we have developed our Business Plan.

## 2.3. Dynamic engagement through the Business Plan process

We have taken an approach of continuous story creation, which falls into three broad areas – broad thinking, developing our proposals, and testing our proposals. These are described in more detail below and are reflected in the structure of our Annex 3 – Stakeholder report.

**[ESO] RIIO-2 is leading the pack in terms of proactive engagement. Process isn't finished but so far, so good.**
**Generator / supplier**

### 2.3.1. Broad thinking

We first started the RIIO-2 process by looking to really understand what stakeholders wanted from the ESO and also what consumers' priorities were for the future energy system. These have changed throughout the process based on feedback received, although they remain the fundamental cornerstone of our plan.

To create our Consumer and Stakeholder priorities in figure 6 we commissioned an independent research study, reaching stakeholders, Members of Parliament and 2,000 members of the public. We also brought together the outputs of our day-to-day engagement activities from across the ESO and created additional activities as part of a coordinated programme of engagement for RIIO-2 to test and refine the priorities. This included regular direct conversations, and an online stakeholder webinar with 88 attendees from 68 organisations. We further refined the priorities based on feedback from ERSG. You can find out more about how they were created on our website[21].

Our Consumer and Stakeholder priorities are used throughout the Business Plan to assess how our activities will deliver value. In our proposal chapters (chapters 4-8) we have highlighted which Consumer and Stakeholder priorities are supported by our activities.

[21]https://www.nationalgrideso.com/about-us/business-planning-riio/have-your-say-our-future-plan


*Figure 6: Our Consumer and Stakeholder priorities*

Our Consumer priorities align to the types of benefits we will deliver, see section 1.4 above:

- We want an affordable energy bill is aligned to Lower bills than otherwise the case
- We want a decarbonised energy system, fit for the future is aligned to Reduced environmental damage
- We want energy to be available when we need it is aligned to Improved safety and reliability
- We want a safe and secure energy system is also aligned too Improved safety and reliability

For benefits type Improved quality of service, this is better aligned to our stakeholder priorities as consumers do not have direct interaction with the ESO. For Benefits for society as a whole, this includes broader economic and health benefits for consumers.

Throughout this Business Plan we refer to both consumer priorities and types of benefits. The above alignment allows us to read-across these two category types.

### 2.3.2. Developing our proposals

In developing the proposals in the Business Plan, we built on the priorities of consumers and stakeholders, focusing on key areas of the business we could transform. We understood we needed to be clear about what we wanted to do as a business and our role within the energy transformation. A key piece of feedback we receieved was to be more ambitious. In September 2018 we held a workshop covering RIIO-2 and *Forward Plan* timescales to set this direction. Further development of this through our internal strategic work led us to publish *Our RIIO-2 Ambition* in April 2019 with examples of transformational activities.

We consulted on our high-level proposals through this document, inviting written views. We also used a variety of engagement channels to maximise the range of stakeholders we reached and had effective conversations with. The channels included stakeholder workshops with roundtables, direct engagement, webinars and email bulletins. The stakeholder consensus was that the document provided a good level of ambition but they wanted to understand further detail for each of the transformational activities.

**Whenever there are changes they listen – they will set up a meeting quickly, they are easy to engage. Set-up is perfect.**
**Consumer interest organisation**

### 2.3.3. Testing our proposals

In July 2019 we published our first draft Business Plan. This provided further detail and costs of proposed transformational activities, investments and the people and capability we will need to run the ESO required to make this change. We ran workshops at the Electricity National Control Centre in July and August 2019 to talk through aspects of the Business Plan and understand stakeholder views. We updated our draft Business Plan in October 2019 to address the feedback we received.

Stakeholders were largely supportive of our proposals in the October draft Business Plan. In order to refine our proposals ahead of this final submission to Ofgem, our engagement since its publication has focused on:

- testing and further developing our performance metrics with stakeholders;
- understanding their views on our more detailed costs and benefits;
- engaging further with TOs (bilaterally and as a group) on our respective RIIO-2 proposals and with DNOs on aspects of our proposals on which we would like to work more closely; and
- engaging on the plan as a whole.

We have also tested our metrics through trade association events, a webinar and bilateral meetings. A summary of the feedback we received at the October workshop on each topic and how we have responded is included in Annex 3 – Stakeholder report.

Alongside this we have engaged stakeholders from across the energy industry on the regulatory framework for the ESO, so we can better understand their views on Ofgem's decisions and consultations on our funding model. This has allowed us to develop a funding model

proposal that will deliver the ambitious, proactive and agile ESO that stakeholders want us to be.

**ESO is giving a good level of access to people and events. It's all positive in terms of ability to contact and engage.**
**Distribution Network Operator**

### 2.3.4. Our engagement activity

Engaging with a representative group of stakeholders gives us confidence we have created our Business Plan proposals with an appropriate breadth of stakeholder views. We mapped our stakeholders according to their interest in our Themes and activities, and the level of impact that changes to our role may have on their businesses. We used this approach to plan the most effective engagement channels for individual stakeholders across a range of sectors.

We have aimed to be accessible in our engagement and, where possible, use and build upon the existing engagement opportunities that we have in place. These include our customer connections seminars, charging forums, *FES* workshops and electricity operational forums. This approach ensured we made the most of a broad range of opportunities to engage. Additionally, collaboration with other bodies gives us access to wider and more specialist views in a way that is more efficient for the ESO and our stakeholders. We also created further channels to make sure we reach a broad range of stakeholders for each Theme and over-arching topics such as whole electricity system.

**All the transmission companies are going through the price control so prompts [in emails] are useful and an importance level indicator would be useful too.**
**Network company**

| | | |
|---|---|---|
| **Face to face engagement, including:**<br>• Bilateral meetings<br>• Workshops<br>• Webinars | **To date we have held:**<br>• Around 135 bilateral meetings<br>• 10 Workshops<br>• 11 Webinars | **Which has resulted in engagement with:**<br>• Over 900 individuals from<br>• Around 350 organisations |
| **ESO RIIO-2 Stakeholder Group** | **To date we have held:**<br>• 8 meetings<br>• 1 workshop<br>• 1 Control Centre visit<br>• 1 IT webinar | **This has involved:**<br>• 19 of our key stakeholders |
| **Published communications, including:**<br>• Bi-Monthly bulletins<br>• Website<br>• Thought pieces<br>• Podcast | **To date we have published:**<br>• 8 bulletins<br>• 4 stakeholder reports<br>• 3 thought pieces<br>• 1 podcast | **These have reached:**<br>• Average of 900 individuals through our bulletins<br>• 213 plays of the podcast |

*Figure 7: Summary of our RIIO-2 engagements*

Network companies are amongst our key stakeholders. We have sought to engage them specifically and regularly, both bilaterally and as a group. With TOs, we have discussed our respective proposals to determine where our plans may overlap and interact such that we can work collaboratively to move forward and deliver collective value for customers and consumers. We have engaged with DNOs through the Energy Networks Association (ENA), our own engagement events and have had an open invitation to engage bilaterally on how our proposals could interact with their future role and activities and how we can work more closely together.

We continue to be actively engaged with the ENA in the lead up to RIIO-2 and beyond, most significantly through the Open Networks project where we chair two of the five work streams. We will also be involved in developing the programme of work for this project in 2020. We remain committed to collaborating with stakeholders, including network companies, to develop and implement whole system solutions to the challenges faced by the industry. We will build upon the discussions that we have had through our RIIO-2 Business Plan development to ensure co-ordination with DNOs as they develop their own RIIO-ED2 plans.

The ENA intends to develop a distribution system operation (DSO) implementation plan detailing the key milestones and the transition to DSO during the first half of 2020. We will ensure that our relevant Business Plan activities and milestones are fed into this process and that a whole system view is taken in the transition to DSO.

Figure 7 sets out a summary of how we have engaged over and above our existing engagement channels.

#### 2.3.4.1. Stakeholder engagement numbers by segment

We have met more than 900 individuals from around 350 organisations through some 1,500 interactions[22]. Generators, service providers and suppliers were the groups most commonly represented. However, our engagement reached a broad range of stakeholders, including those beyond the current industry participants. The 'other' category in figure 8 includes non-domestic consumers, construction companies, automotive companies and charities. In the figure 8 below, many stakeholders have been assumed to be representing more than one stakeholder segment. For example, one person may be classed as both a generator and a supplier, which will appear to inflate the numbers for these groups.


*Figure 8: Stakeholders we have engaged in development of the Business Plan by sector*

[22] The number of interactions is higher than the number of stakeholders engaged with as we interacted with some stakeholders more than once.

#### 2.3.4.2. Accessible ESO RIIO-2 engagement

This range of engagement channels and our 'always on' approach to engagement have resulted in stakeholders telling us that they find the ESO RIIO-2 programme to be very accessible and feel well engaged and consulted. All of the stakeholders we asked find it easy or very easy to engage with the ESO and 93 per cent were satisfied or very satisfied with the process.

Stakeholders also gave us some useful pointers on how we can improve our engagement. The Business Plan, and Annex 2 - CBA report and Annex 3 - Stakeholder report address earlier requests to see more detail on costs and benefits, and also allow us to play back the range of views we've received and how we've responded to them. As our Business Plan process progressed, we refined and further improved our engagement. For example, in response to stakeholder feedback we have engaged as much as possible through trade associations. We also investigated improvements to make the RIIO-2 parts of our website more accessible.

## 2.4. Enhanced stakeholder engagement

The RIIO-2 enhanced engagement approach involved the establishment of an independent stakeholder group to provide challenge on and input to our Business Plan proposals. In addition, Ofgem formed a RIIO-2 Challenge Group to independently assess Business Plan proposals across sectors and to provide challenge on Ofgem's regulatory approach.

### 2.4.1. Our independent Stakeholder Group

The role of our stakeholder group was to challenge and test our approach to developing our proposals, and the way that we engaged with stakeholders to reach our views.

We wanted to make sure the members of ERSG were representative of our role in industry and reflective of the wider industry across Great Britain. Therefore, members included customers and service providers, key stakeholders and wider public interest organisations. The challenge provided by the group has been invaluable in developing our Business Plan, pushing us to go further in our ambition, be more coherent about our approach to stakeholder engagement and change how IT is developed in the company. They also provided comment and challenge to both us and Ofgem on our regulatory framework.

We recognised the critical role that the independent Chair of the group would play, so we followed a rigorous scoping and shortlisting process of possible candidates. Charlotte Morgan, a partner in the Global Energy and Infrastructure Group at Linklaters, was appointed independent Chair of our stakeholder group in July 2018.

You can find more information about our group and their discussions so far on our website[23] and in Annex 3 - Stakeholder report. In line with the request from the Challenge Group, throughout the Business Plan we have set out in call out boxes where ERSG does or does not support our proposals.

**I believe the ERSG has such an important role to play in delivering the RIIO-2 framework and, ultimately, driving value for end consumers.**
**Charlotte Morgan, ERSG Chair**[24]

We hope to continue with an evolved version of the ESO RIIO-2 Stakeholder Group beyond development of this RIIO-2 Business Plan. We are currently exploring the potential remit with the Chair and members.

### 2.4.2. Ofgem RIIO-2 Challenge Group

Ofgem's RIIO-2 Challenge Group provides another welcome level of scrutiny and challenge to make sure we deliver a robust plan that will provide benefits for consumers. We have met the Challenge Group four times over the development of our Business Plan and twice further as part of the consistent view of the future group. We have found their feedback very valuable in helping improve the quality of our plan. Their feedback has encouraged us to be clearer on our costs, benchmarking and how we're ensuring an efficient plan. They have also pushed for transparency of shared services costs, sought confidence in our ability to deliver the proposed IT investment, and sought more clarity on our deliverables, benefits, risks, metrics and how we are going to work with others to deliver our plan. We hope you will see enhancements to address these points in this final version of our Business Plan.

You can find more information about these groups, our engagement with them and how we have responded to their feedback in Annex 3 - Stakeholder report.

**ESO is very committed to ERSG, which is to their credit. It's a diverse group which is good, and it's well constructed.**
**ERSG member**

[23] https://www.nationalgrideso.com/about-us/business-plans/future-planning-2021-onwards/have-your-say-on-our-future-plans/eso-riio2-stakeholder-group

[24] https://www.nationalgrideso.com/news/eso-prepares-first-legally-separate-price-control

## 2.5. Understanding consumer views

Understanding consumer views has been important to the development of our Business Plan. As our engagement programme has progressed, we have further improved our approach to incorporating consumers' views. We have strengthened our understanding of their needs by undertaking additional research and engaging with a broader sector of stakeholders such as a community energy organisation and a local authority. This is alongside our direct engagement with consumer representative groups of domestic and non-domestic consumers and including such organisations on our ERSG. In our review of consumer research, we have learned the following.

The group was presented with four goals the energy transition may address. They found that all four were important and "one did not necessarily emerge as an overriding priority". The four goals were:

- ensuring energy is affordable for all households;
- increasing the use of low carbon energy sources;
- reducing overall energy use in the UK; and
- ensuring a reliable energy supply is continuously available.

These four goals very closely align with our consumer priorities and also with four of the six long-term outcomes identified by Sustainability First as part of their New Pin[27] research findings as shown in figure 9. This verifies that our thoughts are robust when understanding what consumers expect in the future of energy and our plan is developed with this in mind.

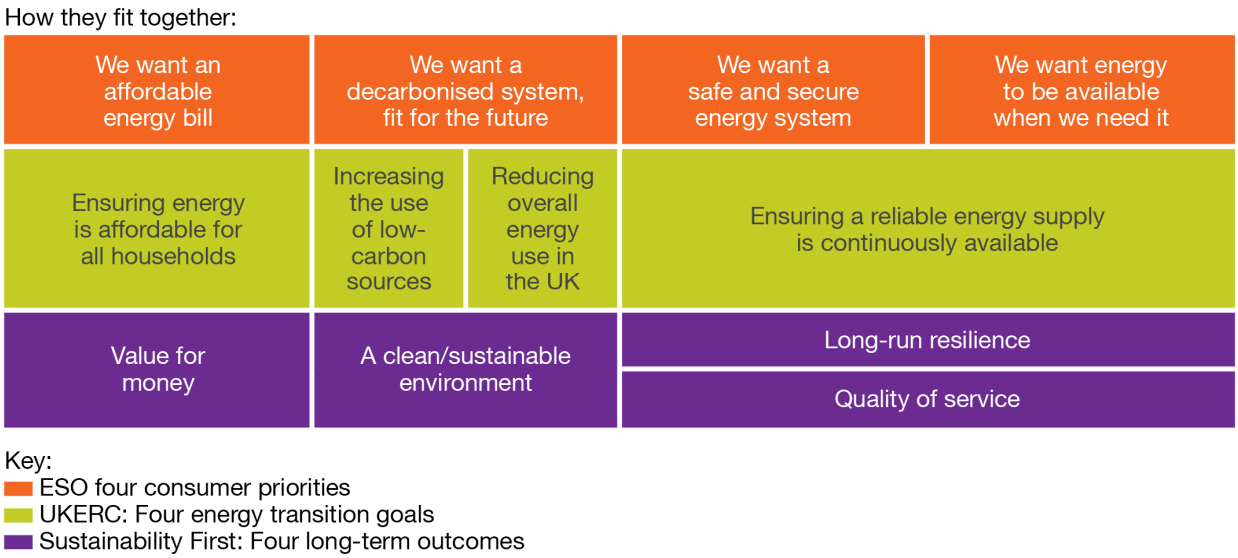



*Figure 9: How the different consumer priorities fit together*

The UKERC Synthesis Report[25] found that the British public wants and expects change in how energy is supplied, used and governed. They are positive about the need for energy system change and do not prioritise demand over supply or vice versa. The report also found that affordability is more important than the lowest cost possible in terms of energy system change. The cost related to a number of factors, such as long-term stability versus fluctuation in cost, existing market structures, getting a 'fair deal' and trust in energy companies.

A second report by UKERC 'Paying for energy transitions[26]' surveyed 3,150 consumers, followed by five focus groups across the UK. The study found that generally the public are willing to pay towards the transition to a low carbon, reliable and affordable energy system but believe this is alongside both government and energy companies making a more significant investment.

We do know, despite these findings, that a significant proportion of people already struggle to pay their energy and water bills. The New Pin research found in 2015 ten per cent of households in England, 30 per cent in Wales and 39 per cent in Scotland were estimated to be in fuel poverty. In March 2019, as detailed by the BEIS Attitude tracker[28], 30 per cent of a population surveyed across the UK was worried about paying their energy bills.

The report also found the public was most likely to be concerned about steep rises in energy prices in the future (75 per cent), the UK not investing fast enough in alternative sources of energy (69 per cent), and the UK becoming too dependent on energy from other countries (65 per cent). Finally, 84 per cent support the use of renewable energy.

For non-domestic consumers, we identified through direct engagement and reading relevant reports:

- New routes to market should be developed for community energy schemes. System operators

[25] http://www.ukerc.ac.uk/publications/energy-2050-synthesis-report.html
[26] http://www.ukerc.ac.uk/publications/paying-for-energy-transitions.html
[27] https://www.sustainabilityfirst.org.uk/new-pin/new-pin-pubs-sub
[28] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/800429/BEIS_Public_Attitudes_Tracker_-_Wave_29_-_key_findings.pdf

should include community energy projects in their flexibility and capacity procurement strategies.

- Community energy groups should be invited and supported to participate in local trials for flexibility, demand management, peer-peer trading and other specific services to the grid, like network cost avoidance.
- Data from heat maps and grid data is intimidating for communities to use, stakeholders wondered if itis possible to make data more accessible and easier to navigate.
- Local authorities and community energy groups were supportive of our ambition to operate a carbon free system as many of their members and customers were concerned about climate change and wanted to see more renewable energy available.
- Stakeholders welcomed our proposals to remove barriers from entry to markets and their ability to aggregate their projects up to 1 MW.
- Providing further insight to policy development and our data analysis was welcomed, with *FES* being mentioned as a useful document they used to enable their business strategy and when engaging with the Department for Business, Energy and Industrial Strategy (BEIS).

### 2.5.1. Consumers' willingness to pay

Through our independent survey of consumers, we got a very clear message that reliability and resilience are the highest priority for consumers, both now and in the future. We have drawn on other publicly available information to help us understand further consumers' willingness to pay for their different priorities[29]. The willingness to pay study commissioned by the four Great Britain electricity and gas transmission owners confirmed the relative priorities of the other consumer studies as well as placing some values around the priorities. In terms of reducing the risk of power cuts, the analysis suggests that consumers are willing to pay more to reduce the length of an interruption to power supply by one hour and to reduce by a day the duration of a prolonged interruption causing widespread disruption.

UKERC's Paying for energy transitions looked at public views on paying for the energy change; and previous UKERC research showed that the assumption people only care about the cheapest possible option was not necessarily correct. The work shows "public understandings of the acceptability of a sustainable system change are affected by a range of personal and social values over and above the cost appearing on their bills."

### 2.5.2. How are we minimising cost to consumer bills?

The average Great Britain consumer's annual electricity bill is £612 based on Ofgem's analysis in August 2019. We estimate that the average UK household will be paying £1.80 on average for the ESO's internal activities during the first two years of RIIO-2 (2018/19 prices). This equates to around 0.3 per cent of the total electricity bill and less than 0.2 per cent of the dual fuel bill. Although this is an increase in what consumers currently pay for the ESO, it is in line with their priorities and what they expect from a future energy system. Our plans in RIIO-2 will generate around £2 billion net present value of consumer benefits over the next five years, reducing annual consumer bills by around £3, compared to what they would otherwise have been. In each of the Theme chapters we detail how benefits are realised through our transformational activities. Full details can be found in Annex 2 - CBA report.

### 2.5.3. How has this influenced our plan?

Within this Business Plan, we have highlighted which Consumer and Stakeholder priorities have been taken into consideration in the development of our proposals where relevant. Most of our transformational activities provide end consumer benefits and are the main factor of our cost-benefit analysis process.

## 2.6. Let's keep talking

Stakeholder input and feedback has been incredibly important in helping us to develop our Business Plan to this point. Engagement will continue to be important after submission of this plan as we move onto agreeing and then implementing the activities and changes the ESO will take forward in the RIIO-2 period. This will include:

1. **Open hearings** – understanding stakeholders' views on areas of disagreement or contention that are being discussed at Ofgem's open hearings.
2. **Scoping of new activities** – to prepare delivery of many of the new activities at the beginning of the RIIO-2 period we will need to scope them further, with the help of stakeholders. In addition, some of our proposals, such as the design authority will be implemented before the RIIO-2 period.

We will also work collaboratively with stakeholders to deliver our plans, particularly where delivery of the benefits of our activities depend on other parties taking actions alongside the ESO.

Please get in contact via box.eso.RIIO2@nationalgrideso.com if you would like to speak to us, feedback on anything in the document or be involved in the further development of the proposals.

[29]Including the *Estimating Electricity and Gas Transmission Consumers' Willingness to Pay for Changes in Service during RIIO2* report https://www.nationalgridet.com/document/131211/download and UKERC's *Paying for energy transitions* report http://www.ukerc.ac.uk/publications/paying-for-energy-transitions.html

# 3. Assumptions underpinning our plan

## 3.1. Efficiency

We are committed to making sure we run our business at an efficient cost to consumers. In RIIO-2 our proposed investments will facilitate the transition to a low carbon energy system while lowering annual consumer bills by around £3. Our proposed investment represents around £1.80 on an annual consumer bill. This equates to around 0.3 per cent of the total electricity bill and less than 0.2 per cent of the dual fuel bill.

In developing this Business Plan, an important component of our efficiency considerations is satisfying ourselves and stakeholders that our planned investments will deliver consumer value, and that our choice of solution and delivery approach is efficient. Part 2 of this document, together with Annex 2 – CBA report and Annex 4 – Technology investment report, provide detailed explanation and justification for these aspects.

Ongoing cost control and management of risk will also contribute to plan efficiency. Our regulatory framework for RIIO-2 is intended to promote efficiency through:

- *ex ante* Business Plan scrutiny and strong stakeholder input at all stages of plan development, ensuring that our proposals are robust and will deliver the outputs that stakeholder want
- a two-year budget cycle. This will give us the opportunity to incorporate any further efficiency opportunities gained in the first two years of RIIO-1 into our Business Plan for the period starting in 2023/24
- pass-through funding, which will enable any reductions in spending, compared with Business Plan forecasts, to be fully passed on to consumers
- our incentive scheme, which should recognise and reward efficiencies in delivering Business Plan outputs, or indeed where further outputs or benefits have been delivered for no extra cost.

For more information on our regulatory framework, please see chapter 9 – Financing our plan.

In this section, we focus on unit cost efficiency. We explain how we have challenged every element of our proposed RIIO-2 spending to ensure they are efficient and will remain so over the period. This includes CBA, cross-industry and international benchmarking, and quantifying efficiencies made in RIIO-1 that will continue to deliver benefits in RIIO-2.

### 3.1.1. What does efficiency look like for the ESO?

Efficiency is measured through the quantity of input resources (people, time, materials) needed to achieve an outcome. The relative efficiency of similar companies can be assessed by looking at the ratio of outputs to inputs for each company being assessed. A company is at the efficiency frontier when it is using optimal levels of input resources to achieve a defined outcome.

Output quality is also a component of efficiency. Much of the assessment of our performance against our plan will be on quality measures, for example improvements in forecasting performance, or stakeholder feedback on the outputs we have delivered. For more information see Annex 7 – Metrics and measuring performance.

### 3.1.2. Whole company benchmarking

We conducted a high-level international benchmarking exercise to examine the ESO's overall costs compared to other system operators. We looked at costs in relation to:

- Population served – accounting for population differences, the results are presented in per capita units.
- Network service – adjusting for the kilometres of networks the organisation oversees.

We identified a short list of comparator organisations and extracted cost information from financial reports to generate high-level cost benchmarks. We excluded some ESO-specific costs to improve comparability. We then applied various adjustments to ensure consistent comparisons between geographies and different years. Finally, we adjusted and normalised the metrics to benchmark against ESO cost information.

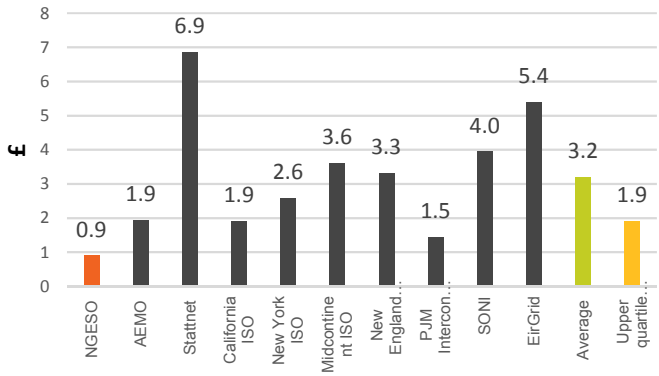



*Figure 10: High-level benchmarking – direct operating costs per capita (£ 2018 prices)*

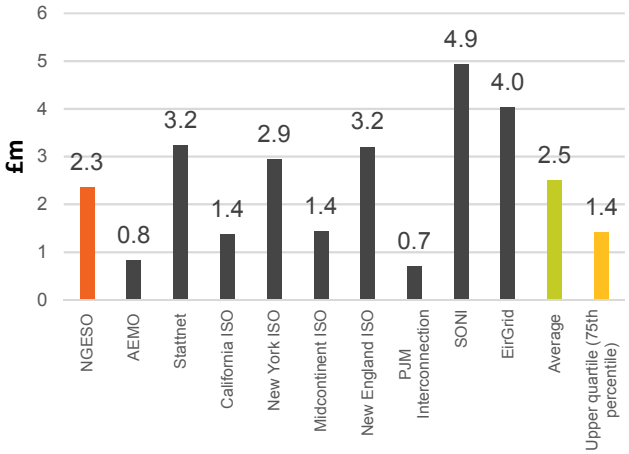



*Figure 11: High-level benchmarking – direct operating costs per 1000 km of network (£ million, 2018 prices)*

The initial results show the ESO's costs are below the average against both measures.

We also conducted some high-level benchmarking of cost trends, using historical adjusted (but not normalised) cost trends versus the comparator companies. The costs are expressed in 2018 prices, using the retail price index (RPI).

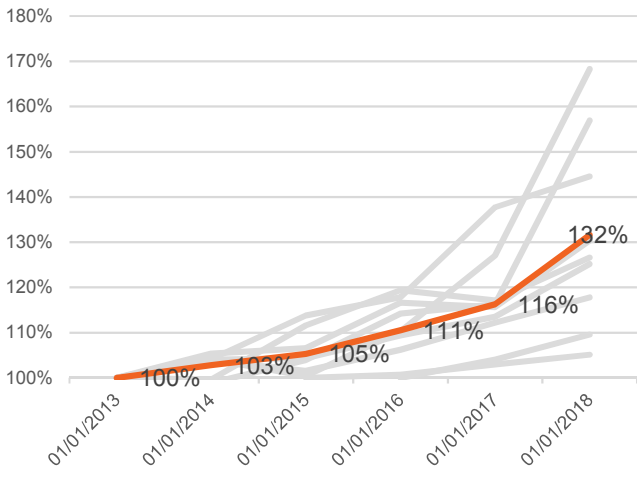



*Figure 12: Historic real costs index (RPI inflation adjusted)*[30]

The bold line on the graph shows average increasing real costs through the period 2015 to 2018, with the grey lines showing individual organisations.

Reviews of the commentary in the accounts and financial statements of the companies we surveyed suggest the main reason for the rise is that organisations are seeing a transformation in the energy market – and an associated increase in complexity in managing the electricity systems.

The challenges are also recognised by other system operators. For example, the Australian energy market operator AEMO[31], in its final budget and fees report, notes "the changing energy environment is resulting in additional resources and investment being needed to manage: increased complexities of managing the grid day by day".

The AEMO also states that "labour increase includes increases in resources along with a provision for ongoing resources to manage the increasing complexity of our work. Consulting costs are higher in 2018/19and include specialist advice and support relating to modernising our markets and managing the complexities of the grid".[32]

Please see Annex 1- Supporting information for more details of the methodology and assumptions behind this benchmarking.

### 3.1.3. Activity benchmarking and incorporation of RIIO-1 efficiencies

Organisation-level benchmarking cannot provide a perfect assessment of cost efficiency. The direct comparability of costs and factors driving those costs is often limited.

We have conducted international and cross-sector benchmarking to ensure that our proposed spending is efficient.

As well as the high-level review of our overall costs in relation to other system operators, we have conducted a more detailed challenge of our proposed £257 million annual costs and activities.

We have broken them down into different categories depending on the most appropriate way to challenge these costs for efficiency. This allows us to identify costs that lend themselves more easily to benchmarking because equivalent activities and functions exist in other companies or sectors.

We have also identified areas where the efficiency improvements we made in RIIO-1 have reduced our proposed spending in RIIO-2. Through our benchmarking and the efficiencies that we have embedded from RIIO-1, we believe that this Business Plan represents an efficient level of costs.

The categories are:

1. **Ongoing activities delivered more efficiently**.
   a. **£71 million direct operating costs for ongoing activities.** These are subject to £7 million embedded efficiency savings in our proposed costs for the ongoing services we have delivered in RIIO-1 and will continue to deliver in RIIO-2.

[30] Note: the analysis presented above does not control for any normalisation factors such as the varying levels of complexity across various networks.

[31] AEMO Electricity Final Budget and Fees 2018/19, https://www.aemo.com.au/-/media/Files/Electricity/NEM/Participant_Information/Fees/2018/Final-AEMO-Electricity-Final-Budget-and-Fees-2018-19.pdf page 2

[32] AEMO Electricity Final Budget and Fees 2018/19, page 6

These reflect the efficiency gains from process streamlining, automation and offshoring that we invested in over RIIO-1 (see case study). Where activity costs have gone up, we have set out the external drivers that have led to this increase. In RIIO-2 we commit to a further **one per cent efficiency stretch target** on these costs to ensure we remain at the efficiency frontier. More details about the frontier are below.

b. **£20 million shared service costs.** These have been benchmarked for efficiency using cross-sector data. This benchmarking showed that our forecast costs for RIIO-2 are equivalent to the most efficient companies, after adjusting for costs of being a regulated network and the additional security measures we take to protect our operations from threat. These costs include £4 million 'catch up' efficiency, where we have made adjustments to our forecast costs based on benchmarking results. For more details please see chapter 12. In RIIO-2 we commit to a further **one per cent efficiency stretch target** on these costs to ensure we remain at the efficiency frontier.

c. **£106 million ongoing IT costs** to run and grow our core services and ensure appropriate levels of cyber security. These were subject to a detailed, cross-sector benchmarking study by Gartner. We conducted a further review of these costs with our Application Development and Maintenance Partners. As a result, we are confident that our proposed IT costs are efficient. For more details please see chapter 10.

**2. Efficient levels of new and transformational investment**.

a. **£60 million proposed investment in new and transformational outputs** has been subject to cost-benefit analysis to assess the consumer benefit case for this investment, and which options should be taken forward. All proposed new capital expenditure has been benchmarked for efficiency by Gartner and our Application Development partners, as above.

We have also benchmarked the staff costs that underpin most of our operational costs, to show they are efficient. Our aim is to be at the market median position in relation to our comparator group. The last review, conducted in 2018, showed that total cash remuneration is in line with median pay for a comparator of 130 entities in the utilities, oil and gas, and chemical sectors, with an average comparison ratio of 101 per cent. For more information, see chapter 14.

**All of the proposed investment in this Business Plan have been benchmarked and/or subject to efficiency savings and an efficiency stretch target.**

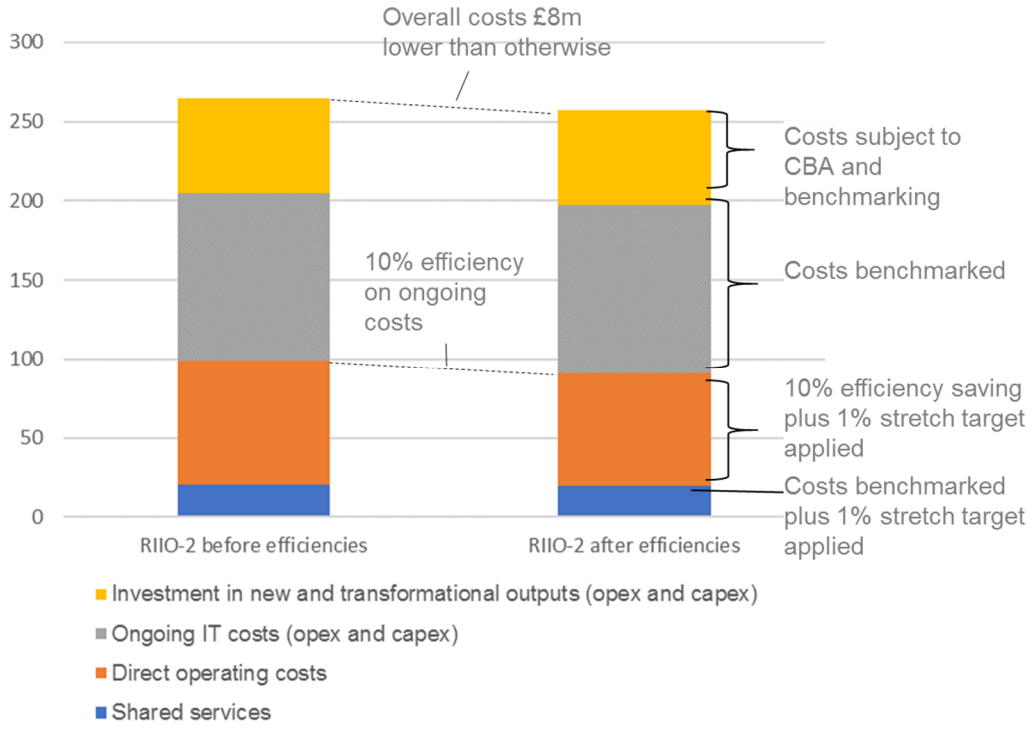



*Figure 13: Average annual proposed investment, before and after efficiencies*

## Case study: system modelling and customer data transformation

In RIIO-1 we explored efficiency through assessing the benefits of outsourcing processes the ESO undertakes to create electricity system models to an offshore supplier.

We identified two key processes in data collection, manipulation and technical analysis that could be undertaken by a specialist offshore team. These were then moved offshore.

The benefits that can be achieved through this approach include cost savings, or an uplift in capacity, capability and effectiveness, depending on the needs of the process. The modelled cost savings from this approach are reflected in our proposed costs for RIIO-2.

We have also identified improvements in effectiveness. These include automating the validation of Transmission Owner (TO) data submissions, reducing the turn-around time from days to minutes, enabling quicker problem resolution and increased confidence in the quality of the output. As a result, the onshore team is able to focus on higher-value, transformational activities. These benefits are embedded in our proposals for RIIO-2 and will help to improve the capability of our business to deliver the ambitious outputs that stakeholders want.

### 3.1.4. Frontier shift and efficiency stretch target

Frontier shift happens where the unit costs of an efficient company change over time – the frontier of possible outputs from a given set of inputs changes. If a company has become more efficient, the frontier will move outwards showing that more outputs can be produced for the same level of inputs.

Through our benchmarking, catch-up efficiency, and the efficiencies we have embedded from RIIO-1, we believe that the total costs in this Business Plan are efficient. To ensure we remain at the frontier throughout RIIO-2, we are investing in innovation and process improvement to achieve a step change in our ability to deliver value for consumers.

- Building on our system modelling and customer data transformation project (see case study), we are increasing capability via offshoring, enabling us to access larger pools of engineering services capability through a supply-chain contract with Accenture.
- To achieve the ambitious outputs in our Business Plan we will use this approach to deliver more robust process control and monitoring of supplier performance for the processes that are offshored. This will contribute to improved reliability of our system and a more agile response to changing demand. As this partnership matures Accenture will be incentivised to challenge our thinking on how we deliver services and provide us with access to market-leading digital solutions at scale. This will deliver more value and performance enhancements.
- We have invested in innovation projects that will enhance performance and may have potential to reduce operating costs. Many of the benefits from our innovation activity are positive for the wider industry or consumers in the form of reduced balancing costs, rather than reductions in the ESO's internal costs. For example, our RIIO-1 Samuel Inertia Element project, which aimed to reduce balancing costs associated with inaccuracies in estimating inertia, will deliver £6 to 10 million of savings for consumers per year.[33] Where innovation has contributed to the proposals in this plan, we provide details in Part 2.
- Our one per cent efficiency stretch target compares well with the EU Capital (K), Labour (L), Energy (E), Materials (M) and Services (S) (EU KLEMS) productivity data[34] for the UK. This data shows that industries in a broadly comparable range of sectors[35] from 1999 to 2016 delivered an average of 0.87 per cent productivity growth over the period. We have applied this stretch target to our ongoing and shared services operational costs as these are more likely to consist of repeatable, known processes that can benefit from more efficient ways of working.

[33] Please see chapter 13 for more details, and https://www.smarternetworks.org/project/NIA_NGET0052

[34] http://www.euklems.net/. This database has been used previously in other regulatory reviews and it includes data for a number of industry sectors including electricity, gas and water supply.

[35] Manufacturing, machinery & equipment, electricity gas & water supply, construction, chemicals, transportation & storage, maintenance of motor vehicles and professional, scientific, technical administrative and support service activities.

## 3.2. How we will manage uncertainty

As the energy landscape is constantly evolving, we need a robust process to manage changes and update our activities as appropriate. Our regulatory framework has been designed to enable this in two ways:

- Our Business Plan focuses on our activities for the first two years of RIIO-2, in the context of the five-year strategy and ten-year vision. In subsequent two-year cycles, we will review the energy landscape as we update our proposed costs and activities.
- Pass-through funding for our costs gives us the flexibility to adjust our spending within two-year Business Plan cycles, as we respond to changes in the energy landscape and/or stakeholder needs.

We therefore do not have formal uncertainty mechanisms as part of our regulatory framework. However, the ESO may use reopeners for cyber and physical security investments, in line with the other RIIO-regulated companies.

In addition to the above, we consider uncertainty in our plan as follows:

- The *Future Energy Scenarios (FES) 2019*[36] give a range of views of how the electricity system might evolve over the coming ten years. The ranges we have considered are set out in Section 3.4 The industry environment to 2030.
- The energy landscape assumptions, which underpin our plan, can be found in Annex 1 – Supporting information. These also show, at a high-level, how the activity, timeline, cost and benefit could potentially change if the assumption is not realised.
- The delivery confidence section, below, highlights the main risks to delivery of the whole Business Plan and their mitigations.
- We have included risks and mitigations for the specific activities in Annex 2 - CBA report.
- Our CBA includes market, delivery and third-party sensitivities to give a range of potential benefits. The CBA will be updated with each two-year forecast of costs and activities.

Annex 2 - CBA report also explains where we have explicitly or implicitly used a range of *FES* scenarios. For example, in forecasts of constraint costs.

## 3.3. Scenarios

The energy landscape in 2030 will be significantly different to today. The scale and pace of this transition is accelerating, notwithstanding that policy, technology and society are challenging to predict.

While a single, 'best view' of the energy landscape is unlikely to be accurate – and could lead to over or under-investment – scenarios present a way of understanding and managing this uncertainty by outlining credible future energy landscapes. Good scenarios should consider the whole energy system, be developed with stakeholders, use robust evidence and modelling, and be flexible enough to be used across the industry.

Our ESO Business Plan is based on *FES 2019*, which meets these criteria through its large and collaborative stakeholder development process, and by providing a view across fuels, networks and sectors. It is also used widely by the ESO and stakeholders for a range of purposes.

We have used the scenarios in *FES 2019*:

- to inform our understanding of the changing energy landscape that we need to address in developing our proposals; identifying the key drivers of change over the RIIO-2 period and testing these with stakeholders
- to develop a ten-year vision of the key impacts that change will have on the energy system and how we are preparing to manage them
- to provide data for use in the cost-benefit analysis – for example, on carbon intensity when calculating the benefit of our activities in reducing environmental damage.

Given the broad range and timeframe of the *FES,* we worked with stakeholders to determine what they felt the key drivers of change would be for the industry and the ESO over the RIIO-2 period. In section 3.4.2. we detail what each of these key drivers mean for the energy landscape and for the ESO.

**Key drivers of change**

- Decarbonisation of electricity supply
- Decentralisation
- Digitalisation and 'big data'
- Policy and governance
- Electric vehicles (EVs) and the decarbonisation of transport
- Storage
- Consumer behaviour
- Decarbonisation of heat
- Demand-side response

*Figure 14: list of stakeholders' key drivers of change*

[36] http://fes.nationalgrid.com/fes-document/

### 3.3.1. ENA common view

In September 2018, Ofgem's RIIO-2 Challenge Group requested a consistent view of the future across the RIIO-regulated companies. In response, all of these businesses, including the ESO, came together at a new Scenarios and Forecasting Working Group, coordinated by the Energy Networks Association (ENA). The group has produced a report, with an annex of detailed assumptions, which addresses this request from Ofgem. An independent review accompanies the report[37]. The main element of the work is a set of consistent assumptions across the RIIO-regulated companies, for use in their Business Plans. This report was further updated in September 2019. We refer to this work as the ENA common view[38].

To further ensure consistency across RIIO-2 Business Plans, Ofgem issued guidance to the other RIIO-regulated companies[39]. It stated that they should:

"Design their baseline revenues around parameters which are no greater than the lowest point of the ranges provided in the ENA Scenario and Forecasting Working Group report and ensure that their plans can flex."

While this guidance was not specifically for the ESO, we believe that consistency across networks and fuels for business planning purposes is essential to fully understand impacts on the whole energy system. As such, we will consider the view from *FES 2019* that is best aligned to the lowest ENA common view range. We have highlighted any areas where this is not possible. This assumption will then be used throughout the Business Plan, including in our CBA.

The details of this are in section 3.4.1, where we have highlighted, for each technology, the assumption we have used throughout the Business Plan. This assumption will be from one of the *FES 2019* scenarios.

We have also flexed the scenarios used that support our ambitions, in particular around carbon free system operation.

## 3.4. The industry environment to 2030

The *FES* describes four potential futures to 2050, set out on a framework of speed of decarbonisation and level of decentralisation. No one pathway is expected to dominate, but the scenarios are designed to capture a credible range of outcomes that will have an impact on the energy system.

All scenarios:

- are Great Britain wide. The scenarios include regional variations in how the energy landscape could change, where evidence is available
- take a whole system view. They explore a future where different parts of the energy market work together in new ways to maximise efficiency and value for consumers
- include a mix of technologies but show different levels of adoption
- model progress from today to 2050.

Two of the scenarios, Two Degrees and Community Renewables, meet an 80 per cent reduction in carbon dioxide ($CO_2$) emissions target by 2050 and two, Consumer Evolution and Steady Progression, fail to meet that target. The UK government has since tightened the 2050 target to net zero carbon emissions. It is likely that new policy and support will be put in place to achieve this aim.

[37] http://www.energynetworks.org/assets/files/Cross%20sector%20common%20view%20RIIO%20challenge%20group%20fin%20-%20ESO%20review.pptx
[38] http://www.energynetworks.org/assets/files/ENA%20Common%20RIIO2%20Scenario%20report%20-%20March%202019%20FINAL.pdf
[39] https://www.ofgem.gov.uk/system/files/docs/2019/06/riio-2_business_plans_guidance_june_2019_-_published.pdf see section 3.4

### 3.4.1. Key changes and uncertainties to 2030

Over the coming ten years there will be a significant change in the types of demand and generation across the energy system. Using the key drivers of change and *FES 19,* we determine what impacts are likely from the changing energy landscape and have directly informed our proposals to meet the challenges highlighted in the section below. These figures are also referred to throughout the Business Plan and Annex 2 – CBA report.

| Technology | Change to 2030 from *FES 2019* | ENA common view | Business plan assumption | Uncertainty factors |
|---|---|---|---|---|
| **Driver: decarbonisation** | | | | |
| Interconnectors | Large increase from 4 GW today to between 12 GW and 20 GW | 15 GW to 16.5 GW by 2030 | Community Renewables<br>16GW in 2030[40] | Large range reflecting project risk, but minimum backed by Ofgem's cap and floor regime and projects under construction. |
| Gas generation | Scenarios range from 37 GW today to between 23 GW and 43 GW | 20 GW to 33 GW by 2030 | Two Degrees<br>31 GW in 2030[41] | Economic pressure suggests a reduction is most likely as other sources of supply, such as wind and interconnectors, take market share. |
| Coal generation | All coal plants closed by 2025 | n/a | All coal plants closed by 2025 | Limited uncertainty, given known closures and Government policy. |
| Offshore wind | Large increase from 9 GW today to between 21 GW and 34 GW | 25 GW to 29GW by 2030 | Steady Progression<br>24 GW in 2030 | High growth expected due to sector deal of 30 GW by 2030 and falling costs as seen in the September 2019 Contract for Difference (CfD) results of <£40/MWh. Costs have fallen significantly from £120/MWh for round 1 projects. |
| Solar | Scenarios range from 12 GW today to between 16 GW and 30 GW | 20 GW to 24GW by 2030 | Consumer Evolution<br>19 GW in 2030 | Following the rapid growth two to three years ago, we expect the slow down to continue following the removal of subsidies, with growth returning in the later 2020s |
| Carbon intensity of electricity ($gCO_2$/kWh) | Large decrease from 248 $gCO_2$/KWh to between 112.7 $gCO_2$/KWh and 24.9 $gCO_2$/KWh | n/a | Steady Progression<br>92 $gCO_2$/KWh in 2030 | High uncertainty dependent on delivery of the low carbon generation set out above. |
| **Driver: decentralisation** | | | | |
| Distributed generation – installed capacity | Large increase from 31 GW today to between 38 GW and 69 GW | n/a | Two Degrees<br>48 GW in 2030 | Charging reviews are likely to reduce growth in the shorter term, but growth is still expected in the longer-term due to falling costs of distribution-connected solar, onshore wind and gas peaking plant displacing transmission-connected Combined Cycle Gas Turbine (CCGT). |

[40] Although greater than the lowest point of the ENA range, given the updated *FES 2019* we believe these are the best fit for our Business Plan

[41] Although greater than the lowest point of the ENA range, given the updated *FES 2019* we believe these are the best fit for our Business Plan

| Technology | Change to 2030 from *FES 2019* | ENA common view | Business plan assumption | Uncertainty factors |
|---|---|---|---|---|
| **Driver: decarbonisation of heat** | | | | |
| Electric heat pumps | Increase from 160k today to between 360k and 4.75 million installations | 1.2 to 2.4 million by 2030 | Consumer Evolution<br>520k in 2030 | Highly dependent on Government policy. |
| **Driver: demand-side response** | | | | |
| Industrial and Commercial Demand Side Response (DSR) | Increase from 1 GW today to between 1.4 and 4.5 GW | 2 GW to 2.7 GW by 2030 | Consumer Evolution<br>2 GW in 2030 | We expect this to be linked to the level of decentralisation and renewable markets. |
| **Driver: digitalisation and 'big data'** | | | | |
| n/a | n/a | n/a | Assumed high levels of digitalisation and use of "big data" across the economy | Dependent on technology levels and consumer acceptance. |
| **Driver: policy and governance** | | | | |
| n/a | n/a | n/a | Current net zero policy, but for other polices no specific view<br>Current governance framework is assumed to continue | Currently policy is high uncertain. |
| **Driver: consumer behaviour** | | | | |
| n/a | n/a | n/a | Current consumer trends towards energy efficiency and technology continue | Consumer behaviour is highly uncertain, in particular around new technology and attitudes towards energy policy. |

*Figure 15: Key changes and uncertainties to 2030*

### 3.4.2. What does this mean for the ESO?

These changing supply and demand patterns have different characteristics to the electricity system of the past. They combine to increase the operational, market and planning challenges as the energy system evolves. We are experiencing a paradigm shift from planning and operating a network to meet the requirements at peak demand times to peak demand being just one of a set of challenging periods that the system needs to be designed and operated for. Our Business Plan sets us up to ensure we can continue to manage these challenges safely, securely and efficiently for consumers over the coming decade. For example:

- Increases in the decarbonisation and decentralisation of generation will mean more data for our control centres to analyse and visualise and more market participants to dispatch. Our proposals in Theme 1 will ensure we have the balancing and control tools to do this.
- There will be a large amount of new transmission network capacity required to transport electricity from where it is produced on the periphery of the network to where it is needed in the centre of the country. We will also need access to higher levels of flexible generation that can change its output very quickly to accommodate changes in outputs or demand elsewhere. These challenges are addressed by our proposals in Themes 2 and 3.
- We will be required to work closely with DSOs to manage more local constraints on the network, as a result of clustering of generation sources and more active distribution networks. Theme 3 will help manage this challenge.
- There will be increasingly changeable market dynamics due to local energy and peer to peer trading, interconnection with other markets that we will need to take account of in managing the balancing market and the output from the wholesale market. Our proposals in Themes 1, 2 and 3 will help manage these challenges.
- There will be more challenging network outage management as seasonal patterns and smart networks will remove the quiet summer window where maintenance has traditionally taken place. Our proposals in Theme 4 help manage this challenge.
- We will require more tools to manage supply losses on a system with lower inertia. Our proposals in Theme 4 help manage this challenge.
- To effectively and efficiently restore they system we will need new services from different providers – and greater resilience – as we rely less on existing providers. Our proposals in Theme 1 help manage this challenge.

## 3.5. Delivery confidence

Through the development of our Business Plan for RIIO-2 we have identified a set of key risks to its successful delivery. Within the plan, we have addressed our approach to managing and mitigating these risks. The risks identified are at a high level to cover delivery of the whole Business Plan. Specific delivery risks are identified in Annex 2 - CBA report.

We recognise the complexity and volume of change that we are proposing to deliver in our Business Plan and we want to ensure that we deliver a high quality and coordinated output that is owned and led by the ESO. We will bring together the elements required to deliver a sustainable programme of change covering IT, process, people and culture and organisational design. Following stakeholder feedback we have refined our proposals to ensure the most effective method of delivery.

In line with the ambition our stakeholders have for us, our RIIO-2 proposals represent a step up on RIIO-1 levels of spending. In the last two years of RIIO-1, we are prioritising activities within the envelope of our RIIO-1 allowances to prepare the business to deliver our increased level of ambition and investment in RIIO-2. We would be open to discussions with Ofgem about the extent to which the RIIO-1 regulatory framework and incentive scheme could enable us to go further.

### 3.5.1. Ability to source the right level of capability to deliver our Business Plan

Our Business Plan is ambitious and with that ambition we require both an increased number of people in the business and a more diverse, specialist range of capabilities.

Our employee numbers increase between RIIO-1 and RIIO-2 to enable the delivery of our ambitions and will require a recruitment drive. We will create a compelling value proposition to attract the best talent available, focusing on creating an inclusive and diverse workforce with fair and benchmarked pay and reward. We will source talent through a blended mix of ‘growing our own’, recruiting specialists and hiring contractors so we have the right capability mix during RIIO-2. This includes consideration of the specialist IT delivery capability we will need. Chapter 14 – People, culture and capability describes this in more detail.

### 3.5.2. Investing in our IT portfolio

We need to invest in our IT systems to achieve our ambitions and deliver what stakeholders want from us. Several key IT systems will reach the end of their usable life during RIIO-2. The investment required to meet our ambitions and the value of our IT investment has grown from RIIO-1.

This investment is significant. To make sure we can increase the IT portfolio effectively, we will take a modular approach to our IT solutions, deploying modules incrementally throughout RIIO-2. This will ensure that solutions are fit for purpose and flexible to energy industry needs.

We will also use a range of delivery models to remain cost efficient. We will create an internal delivery body, led by a business programme director, to augment the key skills across the ESO, IT and those of our framework partners and vendors.

To achieve the right outcomes at the right time, we are introducing the design authority at the heart of ESO business. For more information, please see chapter 4.

We are also working with the support of our major IT partners and using external sector case studies to plan a successful delivery strategy. We are adopting lessons learnt from other business that have transformed, including Transport for London and Red Bull Racing.

More detail on our delivery approach for RIIO-2 can be found in chapter 10 – Technology underpinning our plan and Annex 4 – Technology investment report.

### 3.5.3. How we finance the increased size and scope of our future ESO business

We are continuing to review the delivery of our plan following Ofgem’s August and October funding model decisions and confirmation of financial working assumptions for the ESO. To finance the growth in investment in this Business Plan, we will need to rely more heavily on support from equity investors. Our current view is that the financial assumptions provided by Ofgem do not provide an adequate equity investor proposition, and if additional equity cannot be attracted there is likely to be a deteriorating trend in financeability, with potential consequences for delivery of the Business Plan objectives. We will update our analysis when the RIIO-2 draft determinations are published in summer 2020.

### 3.5.4. Ensuring our activities deliver the ambitions that stakeholders have for us

We have approached the development of our Business Plan from both a top-down and bottom-up perspective. Throughout 2018 we engaged extensively to understand the priorities of our stakeholders, customers and consumers. In early 2019 we used those priorities to shape our ambitions for 2030 that set out our strategic direction. This was published in April. Working with our leaders and teams across the ESO, we then mapped out our requirements to be delivered during RIIO-2 period and built a robust set of proposals. We then tested and refined these proposals with our external stakeholders through formal events and bilateral meetings, so our proposals are fit for purpose and aligned to the future needs of the energy industry.

### 3.5.5. Aligning with industry and collaboration

We have acted on the feedback from our stakeholders, refining and improving our proposals. Where we have made proposals that also require the active participation of wider industry for delivery, we have held specific stakeholder engagement events to provide clarity on our

proposals, to seek input to their development and to understand the level of stakeholder support for our proposals. The new design authority will provide greater transparency for stakeholders on our IT delivery programme and provide a forum for cross-industry discussions on interdependencies, as well as increasing our accountability for delivery. We have set out in Annex 3 - Stakeholder report how we have approached co-creation, the feedback that we have received and how that has influenced our Business Plan.

### 3.5.6. Identifying our future IT requirements and scoping the right solutions

We have built our IT proposals based upon our mission and the ambitions that stakeholders have for us, the changes and trends that we have observed in the energy industry, and how fit for the future our current architecture is. These factors plus additional external drivers and technology availability have led us to identify and propose the suite of IT solutions in our Business Plan. Where possible we have identified a range of options and tested our proposals with both industry stakeholders and external IT delivery providers.

# Part 2
# Our proposals

4. **Role 1, Theme 1.** Ensure reliable, secure system operation to deliver electricity when consumers need it

5. **Role 2, Theme 2.** Transforming participation in smart and sustainable markets

6. **Role 3, Theme 3.** Unlocking consumer value through competition

7. **Role 3, Theme 4.** Driving towards a sustainable, whole energy future

8. Digitalisation and open data unlocking zero carbon system operation and markets

# Role 1, Theme 1
# Control Centre operations

Ensure reliable, secure system operation to deliver electricity when customers need it

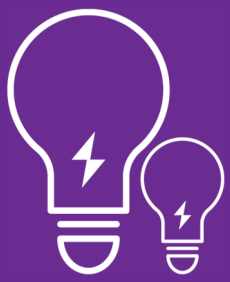
## Consumer priorities

- We want an affordable energy bill
- We want energy to be available when we need it
- We want a decarbonised energy system, fit for the future
- We want a safe and secure energy system

## Stakeholder priorities

- I want efficient whole energy system operation
- I want you to enable the smart, flexible and low carbon energy system of the future
- I want you to be open, engaging and easy to work with
- I want you to be adaptable and innovative
- I want to provide more balancing and ancillary services

## The ESO RIIO-2 Stakeholder Group supports Theme 1



## What this Theme covers

What we need to do to be able to operate a carbon free system in 2025 and beyond while continuing to ensure a safe and reliable supply of electricity that underpins the UK economy.

## What we propose to do

Developing new control centre balancing and network control capabilities in an agile and modular fashion informed by digital twin technology and a stakeholder design authority. In parallel, we will ensure we have the right training, simulation and restoration procedures for operating a carbon free system.

## What our Stakeholders have told us

Stakeholders welcomed our ambition but wanted to know the detailed steps we will take to achieve it. They want us to deliver new system capability in an agile, transparent manner with cross industry representation on our design authority. There is appetite from stakeholders to be on the group.

## What are the key benefits?

New balancing and control tools will enable the ESO to unlock the benefits of new markets and technologies in providing flexibility services, minimising bills for consumers. It will ensure system safety and reliability by ensuring we have the right tools to handle an increasingly complex operating environment.

# 4. Role 1, Theme 1: Control Centre operations. Ensure reliable, secure system operation to deliver electricity when consumers need it

## Theme 1 delivers £218 million net present value of consumer benefits[42] and lowers consumer bills by £0.42 a year[43]. Investment[44] for this Theme (2 year): £133.3 million.

### 4.1. Five-year strategy

We aim to be able to operate a carbon free system in 2025 and beyond. Our five-year strategy focuses on what we need to do to deliver this goal, while continuing to ensure a safe and reliable supply of electricity that underpins the UK economy, worth over £2.3 trillion[45].

**Net zero by 2050:**

We will enable the UK to transition to net zero emissions by:

- building the tools and systems we need to operate a carbon free system
- training our control centre engineers to operate a carbon free system
- ensuring we can restore a carbon free system, should the need ever arise.

This is a foundation of enabling the UK to achieve net zero emissions by 2050, as well as unlocking the significant economic and environmental benefits that a decarbonised economy brings[46]. This strategy will also mean the costs of operating the system all year round is lower than would otherwise have been the case.

The changes in the energy landscape over RIIO-1 have increased the operational challenges our control centre faces every day. As well as the changing generation mix highlighted earlier in the document, we have also dealt with new operability challenges such as the impact of decreasing system inertia and reduced levels of synchronous generation.

Operating the system will become even more complex over the RIIO-2 period. Significant investment is required to manage a system with more variable generation from a range of new low carbon technologies and services, demonstrated by a reduction in carbon intensity from 248g$CO_2$/kWh to under 100g $CO_2$/kWh by 2030. Much of it will be connected at the distribution level, where it is less visible to us; installed capacity will go up from 31 GW today up to around 48 GW by 2030.

Our control centre engineers will need to make more decisions in an increasingly unpredictable environment. Meanwhile, society will be increasingly reliant on electricity, with heat, transport, lighting, communication and medical systems all needing a reliable supply and have changing expectations of system restoration.

#### 4.1.1. Costs and benefits

Our proposals in Theme 1 are the foundation for all our other proposals. Many of the benefits articulated in the other Role/Theme chapters can only be realised if we significantly upgrade our control centre systems and environment. Our regulatory framework needs to support this additional level of investment through:

- Encouraging the delivery of outputs and consumer benefits through a clear, targeted incentive scheme with *ex ante* clarity on how performance will be assessed.
- Supporting an innovative, agile programme of IT transformation where the ESO is empowered to take investment decisions that will deliver consumer benefits. This includes being able to change and optimise the programme of investment, if this is in the

[42] Consumer benefits are the net present value (NPV) of Theme 1's transformational activities over the RIIO-2 period. When referring to the quantified benefits themselves, we refer to the as gross benefits. When summing benefits throughout this document care should be taken they are the same type and it should be noted that rounding may mean values do not match precisely. See Annex 2 - CBA report for more details on how we have calculated NPV.
Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £46 million and £438 million.

[43] Relatively, on average over the RIIO-2 period

[44] The ESO will generate a net saving for consumers in RIIO-2. The proposed investment in this chapter will help to deliver this net saving

[45] World Bank: https://data.worldbank.org/country/united-kingdom. Based on exchange rates as of 22 August 2019.

[46] Committee on Climate Change: Net-zero – the UK's contribution to stopping global warming https://www.theccc.org.uk/wp-content/uploads/2019/05/Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

best interests of consumers, without undue fear of disallowance.

- Ensuring the ESO can raise appropriate levels of equity and debt finance to fund this investment.

To meet these challenges and realise our ambition, transformation is needed. Supported by stakeholders, our five-year strategy involves:

- transforming our Control Centre architecture and systems (A147), developing enhanced balancing capability (A1.2) and transforming network control (A1.3). We will do this in an agile and modular way by reengineering our control centre architecture (A1.4).
- upgrading our Control Centre training and simulation capabilities (A2), by enhancing training material (A2.2), upgrading our training simulation and technology (A2.3) and through updated workforce and change management tools (A2.4).
- evolving our restoration procedures (A3) to ensure they meet the expectations of consumers in a highly electrified world, by ensuring we are compliant with the new restoration standard (A3.2), building on our Distributed Energy NIC project[48] (A3.3).

As a result of our proposals, market participants will have increased confidence and transparency of our decision-making and will be able to provide services to us regardless of their size or connection type. We will be able to operate the system carbon free, in a safe and reliable way, minimising bills for consumers.

The graph below shows our proposed capex, opex and employee full time equivalent (FTE) numbers. The proposed investment is profiled in line with the capabilities we will be developing and delivering in a modular fashion, and thus is largest towards the middle of the RIIO-2 period. Details on how we have incorporated efficiency assumptions and benchmarked these costs are in Part 3.

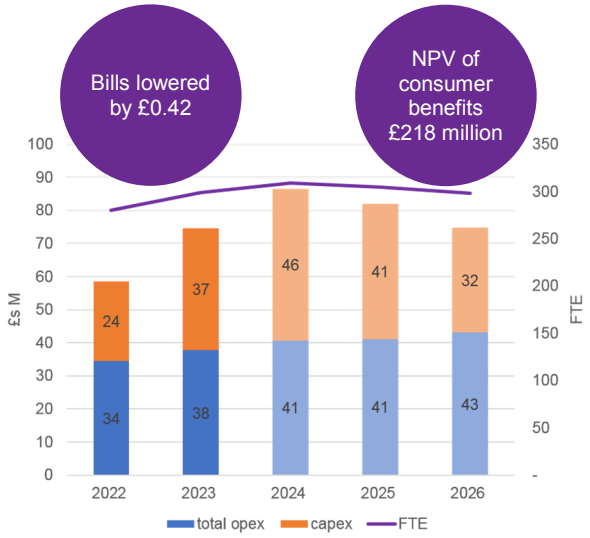



*Figure 16: Theme 1 costs, FTEs and benefits*

The main consumer benefits under this Theme are:

- £145 million of gross benefits from a five per cent improvement in managing constraints and a two per cent improvement in managing response and reserve through a combination of improved situational awareness tools and improved training capabilities
- £109 million gross benefit from unlocking three per cent of flexibility arising from reduced system operation costs, resulting in lower consumer bills than would have otherwise been the case[49]
- £51 million gross benefit from our Control Centre architecture and systems investments and resulting reduced carbon intensity (impact of the difference between our Steady Progression scenario and Two Degrees scenario)
- £12 million from unlocking two per cent of estimated gross benefits by upgrading our tools to better handle greater levels of interconnection[50]
- £5 million in efficiencies realised through updating our shift patterns and working arrangements in our control centres.

For more details, see Annex 2 - CBA report.

We will focus on our Consumer priorities:

- An affordable energy bill:
  - unlocking the benefits of increased participation and competition in balancing and ancillary markets, delivered in Theme 2, by being able to monitor, schedule and dispatch a greater number of market participants

[47] These are the activity codes introduced earlier in this document. These unique identifiers help to link the activities, sub-activities and deliverables.
[48] *Black Start from distributed energy resources (DER)* is a project we are undertaking in conjunction with SP Energy Networks and TNEI, and is funded through the Network Innovation Competition. The project aims to demonstrate a world first – coordinating a number of DER to provide a safe and effective restoration service. More details are available at: https://www.ofgem.gov.uk/system/files/docs/2018/11/redacted_electricity_nic_submission_2018_esoen01_v03.pdf
[49] Proprietary analysis based on the Committee on Climate Change: Roadmap for Flexibility Services to 2030 report https://www.theccc.org.uk/wp-content/uploads/2017/06/Roadmap-for-flexibility-services-to-2030-Poyry-and-Imperial-College-London.pdf.
For more details, please refer to the Annex 2 – CBA report
[50] Proprietary analysis based on a Poyry report for Ofgem - Near-term interconnector cost-benefit analysis: independent report (Cap & Floor window 2) https://www.ofgem.gov.uk/system/files/docs/2018/01/near-term_interconnector_cost_and_benefit_analysis_-_independent_report_.pdf

  - improving our real time balancing and control tools, meaning we will better understand the operational situation and run the system more efficiently.
- Energy to be available when needed:
  - developing a better understanding of the operational limits of the system
  - quicker restoration, in line with the expected new Great Britain restoration standard, will follow from implementing our restoration decision-making tool.
- A decarbonised energy system, fit for the future through:
  - being able to schedule and dispatch the new low carbon technologies and services of the future
  - Control Centre engineers being able to better operate the decarbonised and decentralised energy system of the future, through enhanced training and simulation
  - wider restoration service diversity resulting in less need to maintain readiness (warmth) of thermal plants.
- A safe and secure energy system, through:
  - better trained Control Centre engineers, leading to improved operational decision-making from enhanced training and simulators
  - a level playing field with new parties able to participate in restoration, leading to more diversity in restoration providers, giving the ESO more options for system restoration
  - growing a resilient workforce, promoting Science, Technology, Education and Maths (STEM) and developing talent across the whole electricity system, by partnering with universities and industry.

**We commend the ESO on their zero carbon ambition**
**House of Commons Science and Technology Committee**

### 4.1.2. Stakeholder feedback on our zero carbon ambition

Stakeholders were universally supportive of our 2025 carbon free ambition although many asked us to clarify the exact intention. We agree that this feedback is reasonable, given that when we launched the ambition we did not explicitly given a definition of zero carbon operation in terms of technology or timescale.

Our ambition is to be able to run a carbon free system if that is what the market provides. We will continue to remain technology-neutral and operate the system in an economical and efficient way, consistent with our licence conditions, but we must prepare for a net zero future. The definition and scope of our ambition will remain flexible to changes in generation technology and government policy.

Stakeholders have commented that this could be very challenging and that we shouldn't underplay system issues such as voltage and inertia management. Some stakeholders, particularly service providers, said they would like to see a roadmap to 2025, outlining the milestones and deliverables needed to meet this ambition. Service providers said that this was important to ensure they could adapt their own systems and interfaces efficiently in response to our new systems as required. This document, including the investment roadmap shown later in this section, provides stakeholders with more detail on the individual capabilities needed.

Some stakeholders reflected that, while they were supportive of our 2025 zero carbon system operation target, we should not hold ourselves to it if it turns out to be too expensive. A consumer interest organisation thought it was better for consumers in the long term to let the target slip rather than bake in some very expensive sub-optimal solutions. They suggested we should think about short and long-term consumer benefit and remain agile around our plan as we move closer to 2025. We agree - this something we will remain live to as we deliver over the RIIO-2 period. and and is reflected in our modular approach to the development of new control centre systems.

## 4.2. A1 Control Centre architecture and systems

Our Control Centre operates the power system to deliver a safe and reliable electricity supply. We will continue to ensure we can do this in a manner consistent with our licence obligations, through the activities proposed in this section.

### 4.2.1. Costs

| Control Centre architecture and systems | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 22.1 | 23.2 | 34.6 | 37.0 | 30.5 | 23.0 |
| Opex (£m) | 16.7 | 26.3 | 28.5 | 30.0 | 28.9 | 29.8 |
| FTE[51] | 179 | 198 | 209 | 215 | 212 | 208 |

[51] Opex and FTE numbers are the average for the ESO since legal separation (years 2020 & 2021), which reflects the current ESO business structure. Capex figures are the average over the eight years of RIIO-1.

### Highlights

We propose to design, develop and implement new Control Centre tools and systems in conjunction with stakeholders. This will enable us to manage more low carbon market participants, minimise consumer bills and ensure continued safe and reliable system operation

We will make improvements to our ongoing forecasting activities and the structuring and optimisation of the services we use to manage the system. This will ensure we have the appropriate plans in place to manage current and future operability challenges. This will include building on the success of our Network Innovation Allowance (NIA) project[52] with Sheffield Solar (part of the University of Sheffield). We will invest to ensure we continue to receive solar photovoltaic (PV) generation data to incorporate into our demand forecasts; this expenditure is currently NIA-funded and will expire in March 2021.

Complementing changes to existing processes will be the deployment of artificial intelligence (AI) and machine learning to assess large volumes of data in new ways.

| Commercial Operations & Strategy | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex (£m) | 4.0 | 5.4 | 5.3 | 5.2 | 5.2 | 5.1 |
| FTE | 48 | 51 | 51 | 51 | 51 | 51 |

### Highlights

We propose to perform extra analysis in developing operability plans, support more regional development programmes (RDPs) and undertake more trading activities. These will help ensure we deliver an operable system in an economical way.

## 4.2.2. A1.1 Ongoing activities and enhancements in RIIO-2

Our ongoing activities in this area cover the control centre and supporting teams. Further details are available in our *Future of the ENCC report*[53]. These teams will continue to:

- balance Great Britain's demand for energy with supply from generators around the clock (D1.1.1)
- maintain security of supply in real-time, and the ability to restart the system in the event of a partial or total loss of power (D1.1.2)
- maintain the integrity of the transmission network, while managing the economical operation of the system (D1.1.3)
- support our European operations, including with the European Network of Transmission System Operators for Electricity (ENTSO-E) and Coreso, the coordination body for security of supply in Europe (D1.1.4)
- perform ongoing maintenance and incremental upgrades to our legacy balancing and situational awareness tools (D1.1.5)
- assess future operability challenges, communicate these through our *Operability Strategy Report* and ensure the Control Centre has appropriate management plans, whilst also managing them ahead of real-time (D1.1.6)
- produce and publish detailed forecasts, including for national demand and wind generation, provide data and insight to inform Control Centre decision making and performance review and integrate relevant IT projects into business as usual (D1.1.7).
- provide trading solutions to deliver a safe, secure and economical strategy into the Control Centre (D1.1.8).

Further enhancements to our ongoing activities during RIIO-2 include:

- maintaining our legacy balancing and situational awareness tools while we develop new ones (IT investment references 170 Frequency visibility, 210 Balancing Asset Health and 240 ENCC Asset Health)
- improve our systems and processes to handle greater levels of interconnection (IT investment reference 120 Interconnectors)
- enhancing our published forecasts using detailed statistical and machine learning (IT investment reference 260 Forecasting enhancements)
- evolving our operability strategy work to ensure the system remains operable
- responding to stakeholder feedback by providing Transmission Owners (TOs) with enhanced models to help them plan their outages more effectively.

Most of our investment and FTEs increase is from our transformational activities. Here we demonstrate that the costs of our ongoing activities are efficient.

Our Control Centre currently comprises 129 FTEs. This will increase slightly to 133 FTEs to support an increased volume of Control Centre instructions, from around 200 per hour today to around double this at the end of the RIIO-2 period (D1.1.1 to D1.1.5).

Our ongoing Control Centre process review will enable us to operate the system more efficiently while the

[52] ENA Smarter Networks Portal – Solar PV Monitoring Phase 3 https://www.smarternetworks.org/project/NIA_NGSO0008

[53] National Grid Electricity System Operator: Future of the Electricity National Control Centre https://www.nationalgrideso.com/document/149711/download

transformational activities are delivered in a modular way over RIIO-2. (D1.1.1 to D1.1.5)

Our control support teams will need to make changes to systems resulting from European legislation including the Clean Energy Package, Project TERRE, Project MARI and other regulatory changes. Our ongoing teams will manage these on current FTE profiles by realising efficiencies from current processes (D1.1.1 to D1.1.5).

**[The Operability Strategy Report] is a very useful overview. There is a lot of work being taken forward here, which chimes with the need to commoditise flexibility services.**
**Cornwall Energy**

The Commercial Operations and Strategy team headcount will increase by three FTEs, from 48 to 51, over the RIIO-2 period.

Two FTEs are needed to manage the greater levels of modelling and analysis to go into producing the *Operability Strategy Report* as the energy landscape becomes more complex. This modest increase demonstrates an efficiency against a backdrop of greater workload (D1.1.6).

One extra FTE will be supporting six regional development programmes (RDPs)[54] per year, compared with the two in total there has been so far, and a potential 100 per cent increase in interconnector trading volumes as interconnector capacity increases from 4 GW today to around 16 GW by 2030 (D1.1.6 and D1.1.8).

The Energy Forecasting team headcount will remain flat by implementing advanced machine learning tools and automation so we can deliver an increased number of forecasts to the market during the current *Forward Plan 2019-21* timescales and into RIIO-2. This will include four additional wind forecasts and an extra day-ahead demand update. This will also mitigate the increased challenge of forecasting from growing embedded generation. This is an area in which we currently have limited visibility and we expect distributed generation capacity to increase by around 50 per cent by 2030 (D1.1.7)

The cost of Coreso membership has increased by around £1.5 million per year on RIIO-1 average levels. (D1.1.4)

### 4.2.3. Transformational activities

**The net present value of our Control Centre architecture and systems proposals are estimated at £210 million and deliver £1.99 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2023/24 onwards.**

Our Control Centre architecture and systems play a critical role in enabling us to keep the network secure and balance the system.

We need to make significant improvements to our Control Centre tools and IT systems to be able to realise our ambition, unlock the benefits mentioned in other Themes and meet the expectations of industry.

**System operators and networks must make significant improvements to the informational and operational technology, digital and communications infrastructure.**
**BEIS and Ofgem open letter to the ENA[55]**

Ongoing maintenance and incremental improvements alone will not achieve this, even if we were to significantly increase the number of Control Centre engineers to unsustainable levels.

There is a need to invest now, because our existing tools are coming to the end of their life. To achieve our ambition and prepare for a net zero future, we believe we should invest in tools that can operate a zero carbon system. This approach is supported by our stakeholders and cost-benefit analysis.

Within this Business Plan we have separated out the Control Centre architecture and systems into three key areas: enhanced balancing capabilities (A1.2), transforming network control (A1.3), and control centre architecture (A1.4). More detail on the specific IT investments can be found in Annex 4 - Technology investment report.

#### Evolution of FTE

Most of the increases in FTEs are from our transformational activities. An increase is needed due to the volume of work required to transform our digital capabilities, while maintaining current system security and efficient balancing costs.

The enhanced balancing capability (A1.2) and Control Centre architecture (A1.4) activities need 11 FTEs in 2021/22 and 15 in 2022/23, with the profile tailored throughout the remaining RIIO-2 period to the new tools being developed in a modular way.

[54] For more information on RDPs, please see chapter 7

[55] BEIS and Ofgem: Open Letter to the ENA Open Networks project https://www.ofgem.gov.uk/system/files/docs/2019/07/ofgem-beis_joint_open_letter_to_the_ena_open_networks_project.pdf

A new leadership position will be created to oversee the ESO transformation at a senior level. This will allow existing senior management to concentrate on delivering the consumer benefits outlined in the other Theme chapters. During the first two years of RIIO-2, the additional FTEs will be needed for two main activities:

- implementing the design authority, including recruiting, inducting and working with external stakeholders, scoping requirements and considering development and procurement methods
- designing and delivering new capabilities, including providing expertise from a technology, operational and academic perspective into the new market balancing algorithms our systems will use.

Transforming network control (A1.3) will need 4 FTEs in 2021/22 and 11 FTEs in 2022/23, with the profile tailored to the delivery of new systems in the remainder of RIIO-2. The additional FTE are needed to develop our new situational awareness and visualisation tools, whilst continuing to offer the same levels of Control Centre support that they currently do. Some of this resource will be internal, seconding people onto the delivery of new systems, where they can use their existing knowledge to drive a clearly defined project scope while reducing the number of extra FTEs that must be sourced. At the end of RIIO-2, these FTEs would return to their teams.

We have considered industry standards and our historical performance to set an efficient level of FTEs in proportion to proposed investment. As outlined in chapter 14 – people, culture and capability, a focus on sourcing high-quality talent, with skills in data science and advanced analytics, will help ensure the capex FTE profile remains efficient.

### Evolution of capex

Our transformational Control Centre architecture and systems proposals include a significant capex investment of £124 million over the RIIO-2 period. This spend is necessary because we cannot continue with our existing tools to reach our 2025 carbon free ambition. This is because they were not designed to handle a decentralised system with potentially thousands of market participants. The main components of this capex investment are:

- the new enhanced balancing capability tool (IT investment reference 180 Enhanced balancing capability) - £41 million over RIIO-2 (D1.2.1)
- the new network control tool (IT investment reference 110 Network Control) - £27 million over RIIO-2 (D1.3.1)
- the data and analytics platform (IT investment reference 220 Data and analytics platform) - £20 million over RIIO-2 (D1.4.1).

Due to the time it takes to develop new balancing and control systems, it is necessary that work starts as soon as possible, hence our proposed capex investment of £45 million in the first two-years of RIIO-2. The main components of this cost are preparatory design and development work of £18 million for the enhanced balancing capability tools (D1.2.1), £8 million for the new report control tool (D1.3.1) and £9 million for the new data and analytics platform (D1.4.1).

The capex profile over the remainder of RIIO-2 is profiled with the delivery of new systems. We propose to spend £12 million in 2023/24 on the enhanced balancing tool with delivery at the end of that year, and £12.4 million over 2024/25 and 2025/26 on the network control tool ready for delivery in 2024/25, with further development the following year. Investment in the data platform will reduce over the period, with additional investment required for adding new components in a modular fashion.

The transformational capex spend has been benchmarked by a range of external providers, including Gartner, Hackett and our application development and maintenance partners (ADAM), to ensure it is efficient. More detail is in chapter 10 – Technology underpinning our ambition.

#### 4.2.3.1. A1.2 Enhanced balancing capability

Our core balancing systems allow generation and demand to be balanced in real time by scheduling and dispatching market participants in a cost-effective way. Significant investment will be needed to deal with greater decentralisation of providers and to accommodate closer-to-real-time GB and European markets.

We will:

- Refresh and enhance our core balancing capabilities in a modular way during the RIIO-2 period. This will involve modifying and upgrading our scheduling and dispatch systems, building on the strategic design work that will be completed during RIIO-1. During the first two years of RIIO-2 our work will focus on building and testing these new capabilities ahead of planned go-live in 2023/24. (D1.2.1 and IT investment references 180 Enhanced balancing capability and 480 Ancillary services dispatch).
- Deliver inertia modelling capabilities, building on the inertia monitoring and forecasting work outlined in the *2019-21 Forward Plan*. This will be delivered in 2021/22 and will link with our enhanced balancing capabilities in 2023/24. We will develop other tools during RIIO-2 to address emerging technology and system management issues, as highlighted in future *Operability Strategy Reports*. (D1.2.2 and IT investment reference 130 Emergent technology and system management).
- Expand the use of greater automation, machine learning and use of artificial intelligence to handle increases in the amount of incoming data and the number of expected actions. We will consider how ringfenced innovation funding could support this (D1.2.3 and IT investment reference 450 Future innovation productionisation).

The benefit of enhanced balancing capability is that it will ensure we can schedule and dispatch a far greater number of market participants at once than we can today, using automation. As shown by figure 18 we are having to re-dispatch an increasing proportion of the market; up to 55 per cent in some half-hourly settlement periods. Increased automation will also mean that market participants will have greater confidence in our decision-making.

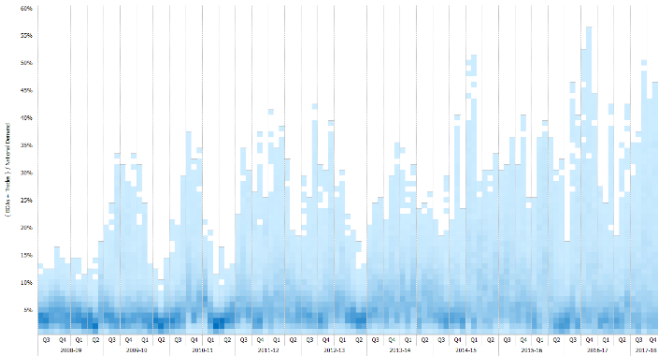


*Figure 17: Increasing ESO redispatch actions (Control Centre and trading activity) as a proportion of national demand*

#### 4.2.3.2. A1.3 Transform network control

To operate the electricity system economically and efficiently, our Control Centre engineers need a high degree of situational awareness. This is the ability to monitor and understand the status of the network and evolving operational limits.

Our Control Centre engineers currently manage around 1 billion data points per day, and we expect this number to increase. The better we understand the real-time 'operational envelope'[56] the more efficiently balancing costs can be managed without increasing system security risks.

We will:

- Replace our current real-time situational awareness tool, the Integrated Energy Management System (IEMS). The new network control tool will go live in 2024/25. During the first two years of RIIO-2, we will focus on defining the requirements of the new tool, working with network parties through the design authority and commencing the build of some modules for the tool. It will build on two of our recent innovation projects: Project RecorDER[57] and Project SIM[58]. (D1.3.1 and IT investment reference 110 Network control).
- Develop new online and offline modelling capabilities, including whole electricity system simulation and modelling aided by machine learning and probabilistic analysis. This enhanced look-ahead capability will allow us to predict transmission problems in a more volatile operating environment. We will also understand more clearly the impact of distribution network capability, so that we can make better decisions. Our work in the first two years of RIIO-2 will mainly be preparatory, ahead of development and testing in subsequent years (D1.3.2 IT investment reference 150 Operational awareness and decision support).
- Enhance our Control Centre video walls and operator consoles to ensure we can visualise the real-time state of the network. Upgrades are needed given the increased data coming into the Control Centre that our engineers must be able to understand and analyse to make optimal decisions. Our work will start in 2022/23 focusing on project set-up, with delivery in later years (D1.3.3 and IT investment reference 140 ENCC operator console).
- Increase our operational liaison with DNOs and offshore transmission owners, allowing us to implement in real-time the enhanced whole electricity system coordination proposed under Theme 4 (D1.3.4).

The benefit of transforming our network control capability is that we will be able to manage and visualise the expected significant increase in the volume of data coming into the Control Centre. We use this information to better understand the operating envelope, allowing us to run a more efficient system safely and at lower cost to consumers.

#### 4.2.3.3. A1.4 Control Centre architecture

We must make changes to our control centre systems in smarter and quicker ways than we have previously. We will use digital twin technology, a sandbox environment and shadow control room to test and inform the development of our new balancing and control capabilities. We will also host them on a central data platform.

[56] The operational envelope refers to the tolerance we need to allow for to handle system events. The better we can analyse incoming data, the clearer the operating envelope is to us, meaning we can more efficiently and economically operate the system by, for example, holding appropriate levels of reserve. A poor understanding of the operational envelope could lead to us being unnecessarily risk averse.

[57] Energy Networks Association Smarter Networks Portal: RecorDER https://www.smarternetworks.org/project/nia_ngso0018/

[58] Energy Networks Association Smarter Networks Portal: SIM – Samuel Inertia Element https://www.smarternetworks.org/project/NIA_NGET0192

### D1.4.1 Data and analytics platform

To develop the new capabilities in an agile and modular way, the first step will be to create a data and analytics platform. (IT investment reference 220 Data and analytics platform).

The new balancing and control systems, as described in activities A2 and A3, will then connect to this platform (see figure 21), meaning it will receive live operational data, making it available to all systems that require it and log any system actions.

The data held on the system will be available to all external parties through the data portal. We will begin work on the data platform towards the end of RIIO-1, with delivery in 2022/23, and integrate our new tools when they are ready.

The benefits of this approach are three-fold, as demonstrated in figure 18. Please note that the names of the tools are indicative.

- It creates a new communications architecture that allows new systems to be integrated seamlessly in a 'plug-and-play' or 'app-like' way. This allows our plan, and future system upgrades, to flex as needed to meet the challenges of facilitating the transition to net-zero.
- The data platform will act as a single version of the truth for all data, providing accessibility and transparency for stakeholders.
- It provides a consolidated graphical user interface for our Control Centre engineers, allowing them to better visualise and analyse the operational data.

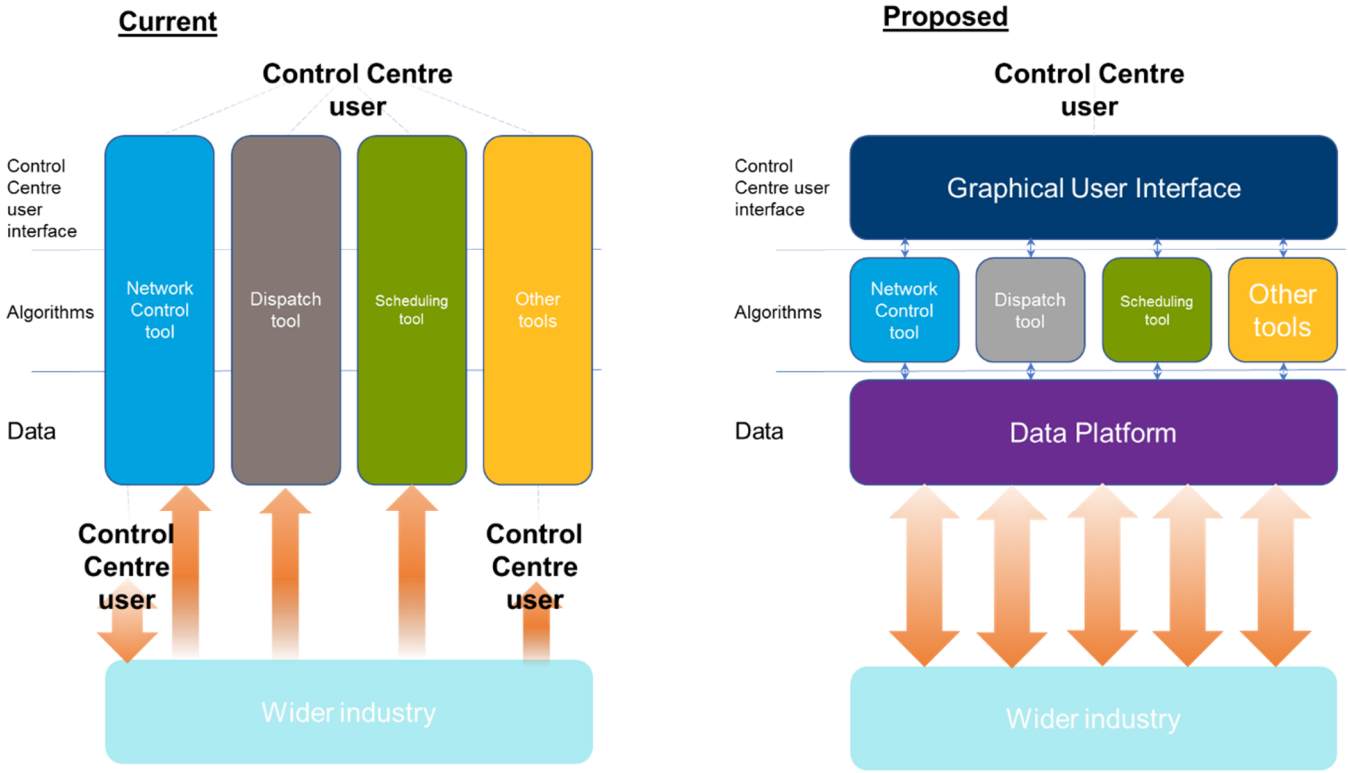



*Figure 18: Comparison of current and proposed Control Centre*

### Digital twin technology, sandbox and shadow control room

Digital twin technology will replicate our digital control room systems using real-time data. This approach is in line with the recommendations of the National Infrastructure Commission (NIC)[59] and the Energy Data Taskforce[60] on the use of digital twin concepts to manage infrastructure more effectively. Digital twin technology will mean we can run simulation and hypothesis testing to inform and enhance the way we develop our new balancing and control tools which will then be built offline in an agile and modular way. A sandbox environment with live data feeds will allow us

[59] National Infrastructure Commission: Data for the Public Good https://www.nic.org.uk/wp-content/uploads/Data-for-the-Public-Good-NIC-Report.pdf

[60] Energy Data Taskforce: A strategy for a Modern Digitalised Energy System https://es.catapult.org.uk/news/energy-data-taskforce-report/

to test these tools with a small group of market participants.

In parallel, we will use a shadow control room to assess how these capabilities work in a 'real-life' control centre environment. This will include visualisation, end-to-end processes, team dynamics and human reaction times. This opportunity will be extremely important as the control centre needs to manage and understand increasing volumes of interrelated data.

We do not envisage creating a separate shadow control room team, but instead will explore how an existing space could be used to create a shadow control room environment.

Digital twin technology and a shadow control room will be developed in parallel to our capabilities and will evolve as these new capabilities are delivered.

As demonstrated in figure 19 and figure 20, the benefits of this approach are:

- It allows for extensive 'real-world' development and testing using live data feeds and the ability to run multiple complex scenarios to refine the new tools. At present, we can only test new systems using limited snapshot data.
- Enabling training to take place on new systems, using live data in a safe offline environment before go-live. Presently, offline training can only use snapshot data and live training is done via shadowing.
- The ability to test impacts and benefits of the changes in a Control Centre environment, through a shadow control room.

More information on our use of digital twin technology, including further engagement, can be found in our digitalisation strategy.

### Digital twin technology

Digital twin technology is offline replicas of our digital Control Centre IT estate with live data feeds that we can use to simulate both markets and the operation of the Great Britain transmission system. It can be used as a testing and/or pre-production environment to validate the benefits and impacts of changes to the market and physical network. It will use AI to run multiple, complex scenarios in a real-time training and simulation environment.

### Shadow control room

A shadow control room is a physical space that mirrors the Control Centre environment. It allows us to test current and future processes with our new balancing and control capability in a 'real-life' environment with live data feeds.

### Sandbox

A sandbox is an environment with live data feeds that we can use to test new tools with just a pre-agreed subset of the market. The market subset will vary depending on the changes being tested.

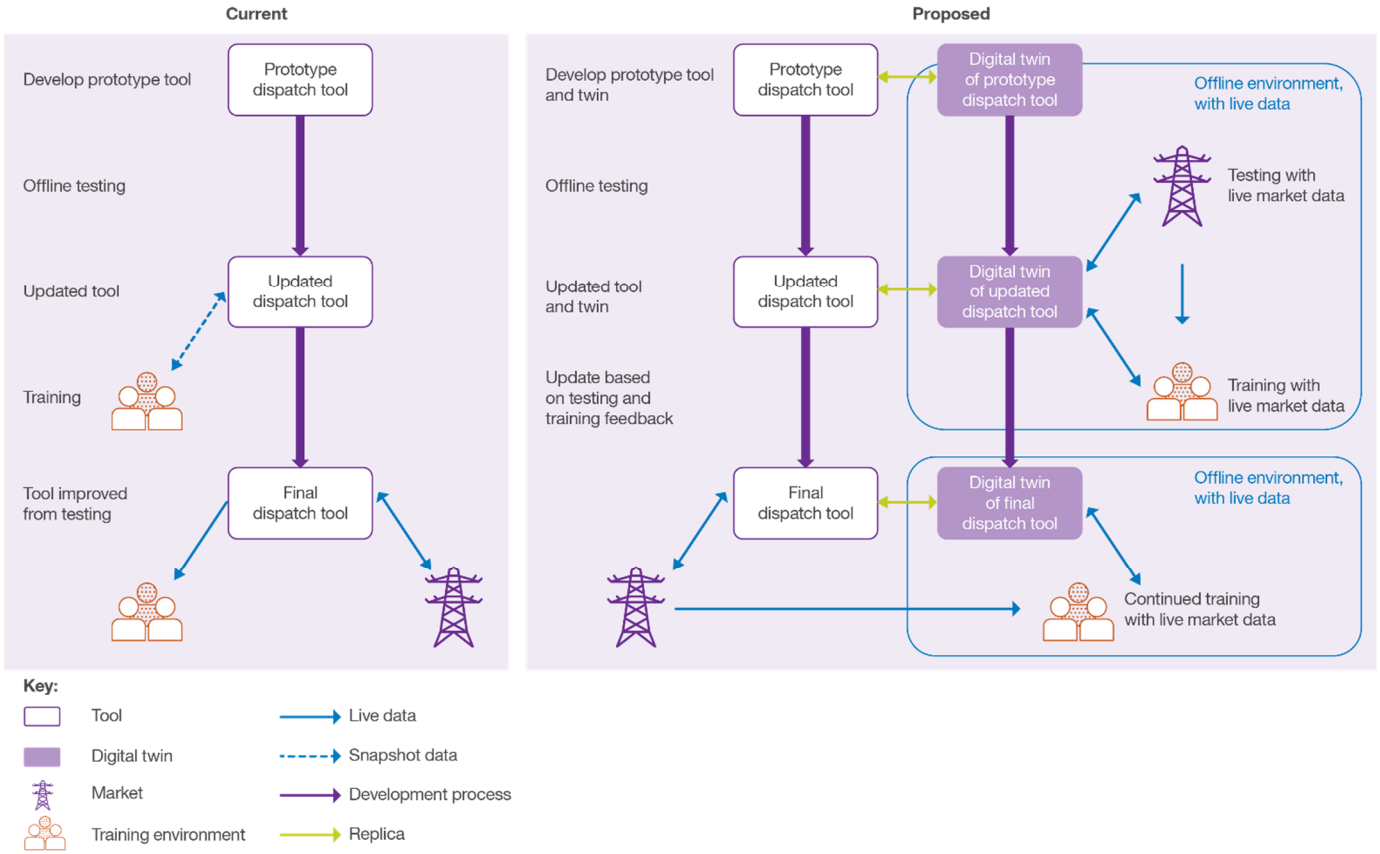



*Figure 19: How digital twin technology will be used in the development of new Control Centre systems*

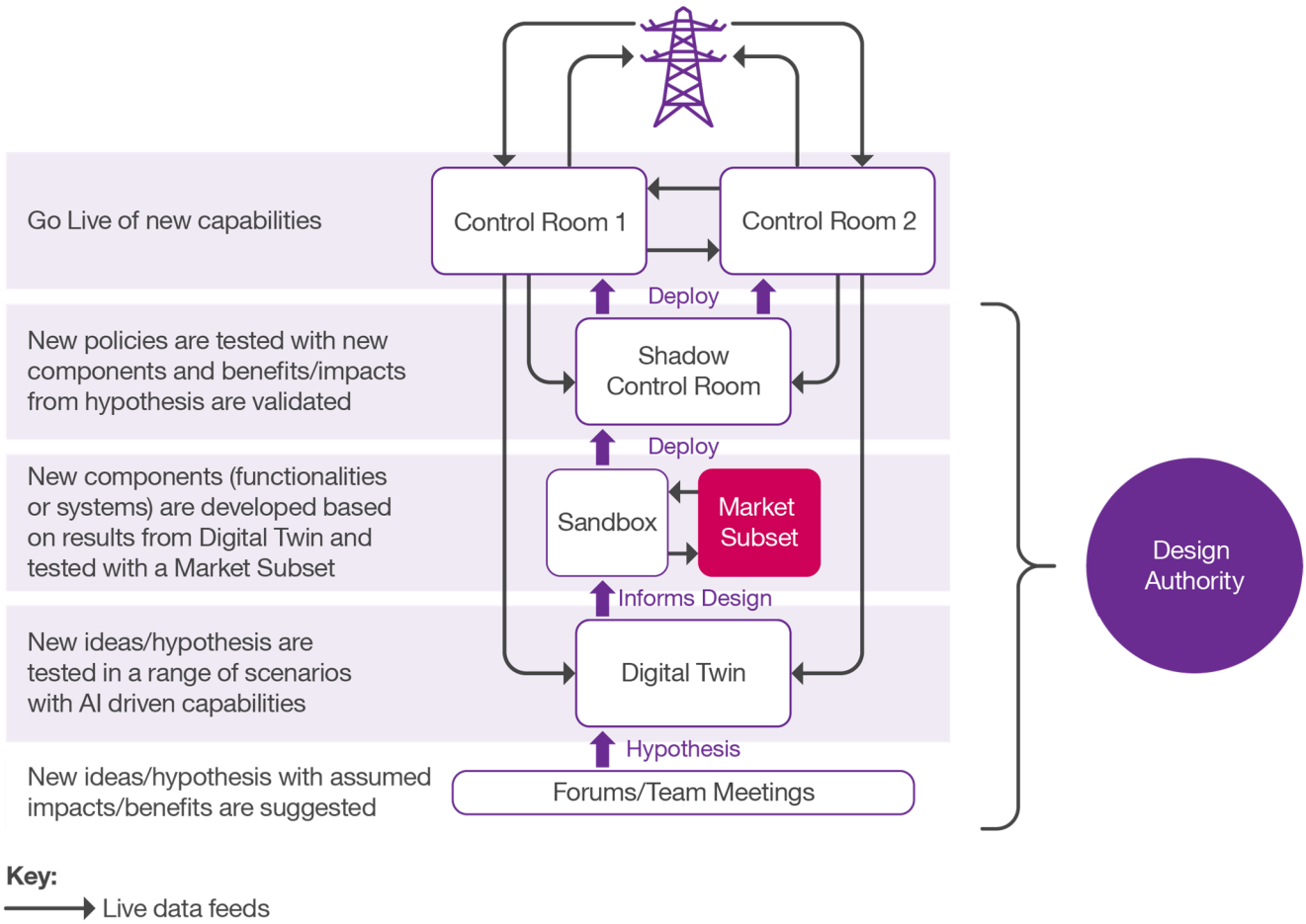



*Figure 20: Development process for Control Centre capabilities*

### D1.4.2 Design authority

We will continue to collaborate with our stakeholders to ensure the success of future developments. To develop the new systems, we will work with industry under a cross-sector design authority for ESO transformation. This will give stakeholders a say in the design of new systems, ensuring they reflect future market needs, delivering a step change in levels of transparency and accountability.

The design authority will be dual-layered: a strategic design authority to inform the overall direction and a delivery design authority that will provide input into the design, development and testing phases of our solution development.

We expect to open the design authority to external stakeholders in 2020/21 and some have already expressed their interest in being involved. As stakeholders have suggested, we need to consider the required skills and experience of the members at each layer. It will meet regularly throughout the RIIO-2 period. We envisage the design authority could involve the ESO, network and market participants, technology companies and academics. The group will be advisory, with the ESO retaining decision-making responsibility which is something that stakeholders from various sectors agreed with.

### Interactions between Theme 1 and Theme 2

Our proposals in Theme 2 will procure the flexibility services we need to be able to operate a carbon-free system. Given the increased number of participants, and associated increase in volumes of data, new tools are needed to ensure we can monitor, schedule and dispatch these participants.

The single day-ahead response and reserve market will go-live at the end of 2022/23. We expect this to incrementally increase the number of market participants. Our new balancing tool will be delivered in 2023/24 and the new network control tool in 2024/25, ready to handle the increase. There will be upgrades to the current legacy systems in the interim to ensure continued level of service.

**The development of markets and systems are two sides of the same coin.**
**IT service provider**

## 4.2.4. Investment roadmap

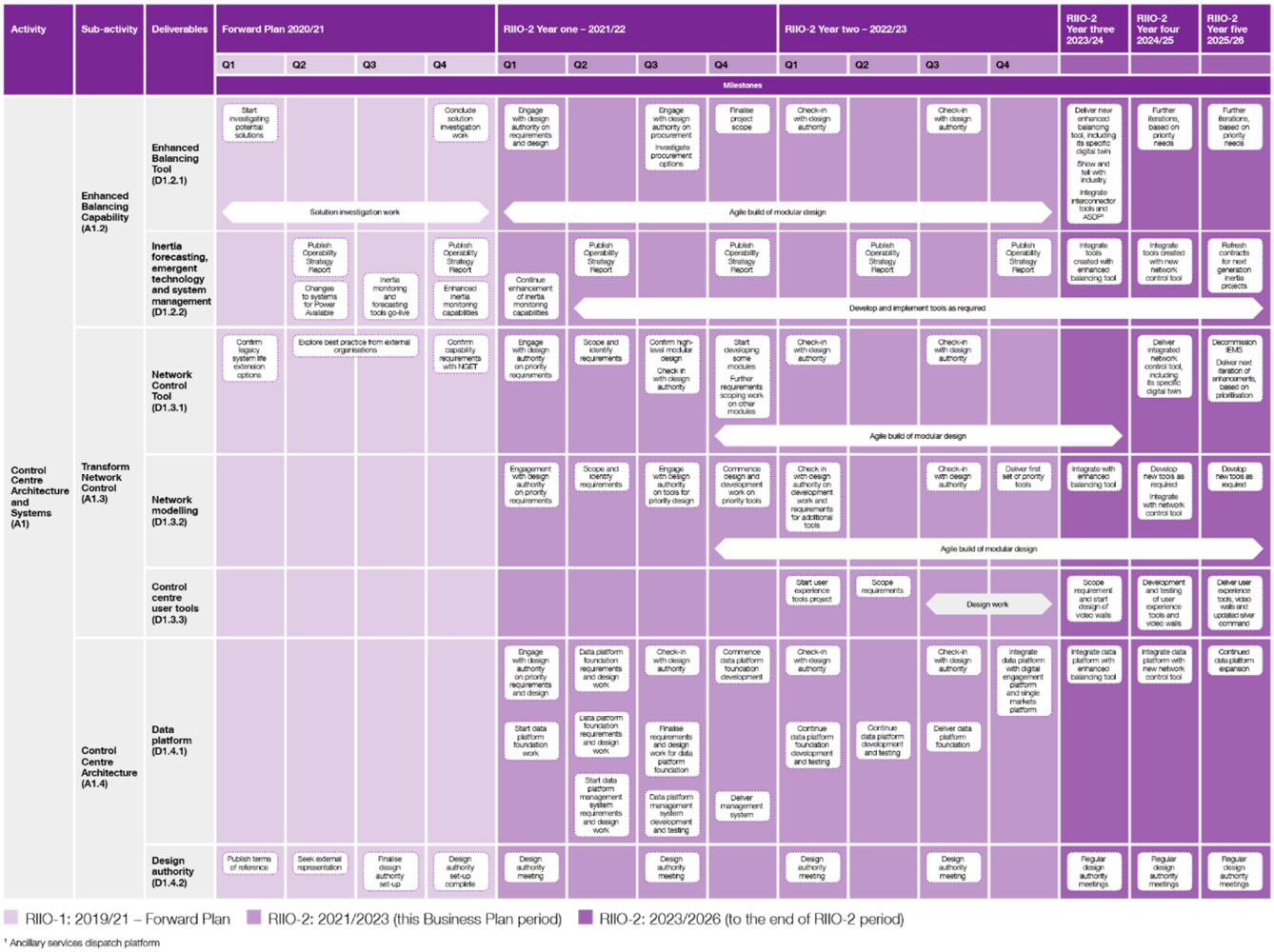



*Figure 21: Investment roadmap*

## 4.2.5. Confidence we can deliver

The ESO is in transition. Following the recent legal separation, we are moving away from being an asset business to becoming a technology company operating in an environment that changes in real-time. We will need to change our organisation, operations and culture along the way, and we understand that managing a transition of this scale is difficult.

We will create an internal delivery body, led by a business programme director, to augment the key skills across the ESO, IT and those of our framework partners and vendors. To ensure the programme delivers the right outcomes at the right time, we are introducing the design authority at the heart of our business.

We are currently working with the support of our major IT partners and using external sector case studies to plan a successful delivery strategy and embed the lessons learnt from other businesses that have completed transformations, including Transport for London[61] and Red Bull Racing[62].

We understand that this Business Plan does not represent a full project scope for the replacement of control centre architecture and systems. The scoping process can typically take over 18 months; we started an initial process in quarter 3 of 2019/20 and expect it to complete it at the end of the year. For this process to be agile, modular and market-led, it would not be appropriate to conduct a full project scope now. Instead, we will work with the design authority to investigate potential solutions. Subsequent Business Plans will be used to address changes in scope, cost and timing. The creation of the internal delivery body, along with the design authority, will allow us to manage this process.

We will be held to account on our performance by the design authority and through reporting on the metrics (see section 4.2.9).

We discuss risks and mitigations to our proposals in Annex 2 – CBA report, section 2.1.6.

[61] tfl.gov.uk/
[62] redbullracing.redbull.com/

## 4.2.6. Stakeholder views

### Rationale and approach to delivering new control capability

We asked stakeholders if they agreed with our rationale to update control centre architecture and systems at the Operational Forum, at our IS Change Forum and at our RIIO-2 engagement events.

Parties such as generators, networks and trade associations welcomed our proposals and agreed that they need to be upgraded to be fit for the future. We also heard, particularly from generators and service providers, that we need to learn from our experience of previous projects (for example the Electricity Balancing System (EBS)) to take a more agile, modular approach to new capability development.

Stakeholders thought that this approach would help to mitigate costly delays, maintain transparency and keep their own costs down. Some service providers said that the approach we took in developing the Platform for Ancillary Services (PAS), which is similar to our proposals for RIIO-2, worked well.

We agree with this feedback, and this has been reflected both in how we will develop new capabilities (using a modular approach) and by developing a new architecture (as outlined in figure 20) that will make subsequent upgrades easier.

We heard from some smaller service providers that a key requirement is transparency around the algorithms and back-end decision-making for any new system development. We agree that transparency is important and aim to address this using the design authority approach.

It was also recommended that we benchmark our proposals against other system operators and comparable sectors. As mentioned in the section above, we have worked with our IT partners and learned lessons from comparable external organisations. Stakeholders from renewable generation companies stressed the future challenges of managing a low-inertia system. As a result, they supported our proposals to introduce enhanced network monitoring such as inertia monitoring. This will help to improve our visibility of the system and therefore control.

**Your proposals for a digital twin, design authority and sandbox are enormously ambitious**

**Trade Association body, RIIO-2 engagement meeting**

The ERSG commented that it may be challenging to deliver new systems that are suited to as many stakeholders as possible given the number of participants and preferences. We understand this and consider that the remit and scope of the design authority will help to tackle this challenge by providing key input into the design, development and testing of our proposed solutions.

The ERSG also enquired about the cost impact on users of integrating our new capabilities with their systems. There may be a cost to some legacy generators to update their systems and the design authority approach should help to provide transparency around the timing and scope of system changes for market participants. For new parties the costs should be commensurate with the cost they would incur otherwise in integrating their systems.

The design authority will also ensure we develop systems that meet the needs of users who interface with the control room and wish to make use of the data we provide.

### Digital twin and shadow control room

We heard at an industry round table for decentralised market participants that our proposals for the digital twin, design authority and sandbox testing environment were enormously ambitious.

The ERSG said that it supported us using digital twin technology and could see great benefits in this approach to allow greater flexibility for innovation, particularly in future market architecture. The Challenge Group, did, however, comment that more clarity was needed on the roles of the digital twin and shadow control room, and interaction between them. As a result of this feedback, in the section above we have explained the role of each and provided a diagram in the *Control Centre architecture* section 4.2.3.3 (figure 20) to show how they interact. In addition, for this submission, we have included a case study (figure 19) of how digital twin technology will be used in the development of new Control Centre systems. It should be noted that there is no single digital twin. The systems we develop will each have their own digital twin. The costs of this are incorporated into the individual investment lines.

### Role and membership of the design authority

The ERSG asked how we intend to involve stakeholders in the development of systems. This will be primarily through the design authority, but we are also working with other organisations that use data heavily to adopt best practice.

The ERSG challenged us on what level the design authority will be at (e.g. working level or decision-making). A generator at our control centre round table event thought that it could take a project management approach to discussion, for example tracking milestones and risks. This feedback has helped inform our proposal for a dual-layered design authority, as described previously.

Also at our August control centre round table, we asked stakeholders how we could ensure that the design authority had strong industry representation.

Stakeholders from the renewable energy, consumer interest and generation sectors highlighted that smaller parties do not have the resource to participate in a lot of industry groups.

One suggestion was to involve trade associations so they could represent the needs of several organisations. A trade association told us that we must ensure that the design authority includes perspectives from small, innovative market participants. Through our IS Change Forum and RIIO-2 engagement meetings we have received some expressions of interest from stakeholders to be on the design authority; demonstrating stakeholders' commitment to the approach.

DNOs felt that they should each have a seat at the table, given the different network configurations and interactions with the ESO, although they recognised the practicalities of this. A consumer group noted that consumers were not represented in some of our initial proposals for the design authority even though they would ultimately pay for it.

We also heard that it was important that the design authority did not become a 'talking shop' with a DNO highlighting that it needs the right representation with the appropriate skills. Stakeholders across the board agreed that the design authority should be advisory, with the ESO having the decision-making power, but that the ESO needs to justify its actions.

We have used all of this feedback to inform our proposals and will consider them further when we open the design authority for external representation.

### 4.2.7. Cost-benefit analysis

We estimate the gross benefits to be £305 million over RIIO-2. This gives an NPV of £210 million over RIIO-2.

The main areas of the quantitative benefit above are the following:

- Estimating a five per cent improvement in managing constraints from enhanced situational awareness tools, delivering a gross benefit of £117 million.
- Lowering consumer bills through unlocking the benefits of greater flexibility, delivering £109 million of gross benefit.
- Reduced environmental damage from our control centre residual balancing actions, delivering a gross benefit of £51 million.
- Upgrading our tools to better handle greater levels of interconnection, delivering £12 million of gross consumer benefit.

This is against a baseline assumption of performing the ongoing maintenance to our legacy systems to remain compliant with our licence obligations, as detailed in the ongoing activities section 4.2.2.

This activity is dependent on the following transformational activities:

1. A2 Control Centre training and simulation (Theme 1) – Ensuing the control centre has fully trained staff to operate in a zero-carbon world
2. Digitalisation and A17 Open Data – Ensuring that the data flow between the ESO and participants is open allowing participants to understand system operability

This also enables, though economically optimal operation of a complex decentralised and decarbonised electricity system, the following transformational activities:

1. A2 Control centre training and simulation (Theme 1) - Providing real world experience for training and simulations
2. A4 Build the future balancing service and wholesale markets (Theme 2)
3. A15 Taking a whole electricity system approach to promote zero carbon operability (Theme 4)
4. Digitalisation and A17 Open Data - Providing additional data from real world system operation

Delivery of this activity will pass on benefits and costs to other parties. There may be a cost to DNOs, TOs and market participants integrating their systems and data to our new tools. However, for new market participants we believe that such a cost would be commensurate with any costs they would incur anyway. In all cases, the benefit of moving towards standardised technology and data should outweigh any additional cost.

Our analysis suggested that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £57 million and £404 million.

See the Annex 2 - CBA report section 2.1 for more details.

### 4.2.8. Other options considered

We considered four options for our control centre architecture and systems proposals based on whether we deliver transformational investment or simply maintain our current capabilities, and how we deliver it - either within the current architecture while the current control room is online, or offline with new architecture.

We are proposing option 4. Full details of the justification can be found in section 2.1.7 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.3 of Annex 3 – Stakeholder report.

## 4.2.9. Measuring performance

This section outlines a suite of metrics and annual reporting items that could be used to evaluate out performance. Taken together they measure the strategy, delivery and impact of our control centre architecture and systems proposals.

The balancing cost management metric and the Critical National Infrastructure (CNI) system reliability metric both align to the CBA benefits, as our CBA has assessed benefits from reduced balancing spend and reduced balancing mechanism outage downtime. Performance against the metrics will therefore demonstrate delivery of consumer benefit.

| Area | Metric/ reporting item | Type |
|---|---|---|
| Strategy | Design authority performance | Reporting |
| Delivery | Zero carbon operability | Metric |
| Impact | Balancing cost | Metric |
| | CNI system health reliability | Metric |
| | Demand forecasting accuracy | Metric |
| | Security of supply | Metric |

### 4.2.9.1. Performance metrics

#### Metric 1 - Balancing cost management

We recognise the impact that the cost of balancing the network has on end consumers. During our RIIO-2 engagement events stakeholders have fed back that it is important we work to minimise balancing costs. We propose measuring and reporting the total balancing costs monthly with a target to be lower than the five-year historic average, in line with feedback from stakeholders and consistent with the method currently used in the *Forward Plan 2019-21*. However, as there are areas of balancing costs that have external and environmental factors that can strongly influence the total cost of balancing the network we also propose creating a day-ahead balancing cost benchmark by running our scheduling tool at day-ahead. Post-day, we would then review and report on the actions we took in comparison to the benchmark.

This metric allows us to report on the real-time actions that we are undertaking in order to manage balancing spend while maintaining a stable network. Stakeholders value this, but also have concerns around its accuracy. To address this, we have looked to create a forecast that is over a shorter time period so that factors such as renewable generation can be better anticipated to create a more accurate forecast. We are proposing a target where our actual costs are lower than the day ahead forecast value, reported on a monthly basis.

Stakeholders at our October launch event agreed with the need to efficiently manage balancing costs. They are aware, however, that many of the drivers of balancing spend are outside of our control, which can limit its effectiveness as a measure of our performance. We feel that the day ahead benchmark would help demonstrate the impact that we are having in managing balancing costs.

This metric aligns with our cost-benefit analysis, where we set out that our proposals will reduce balancing spend. Full details are in Annex 2 – CBA report section 2.1.

#### Metric 2 - CNI system reliability

We propose considering a measure of the outages of our CNI systems (for example our network control, scheduling and dispatch tools). Outages of CNI systems increase costs for consumers due to reducing market fluidity which causes increased balancing costs. Our proposals under Theme 1 should reduce unplanned CNI outage time, so there is a direct link to our plan delivery, impact and consumer benefit. In our engagement, stakeholders have fed back that there is a lack of transparency from us on system health, which this metric would address.

The measure will be time of planned outage accuracy plus time of unplanned outages. In other words, we will be measured on how accurately we forecast and deliver planned outages, and also minimise unplanned outages. We consider an unplanned outage to be an early or late conclusion of a planned outage, or an outage that was not planned (for example due to system failure).

This metric aligns with our cost-benefit analysis, where we set out that our proposals will reduce balancing mechanism outage downtime. Full details are in Annex 2 – CBA report section 2.1.

#### Metric 3 – Day ahead demand forecasting accuracy

We propose measuring our demand forecasting accuracy. An improved forecast accuracy can directly deliver value to the end consumer through helping the market self-balance more and allowing the Control Centre to make more optimal decisions. For example this could be on appropriate levels of reserve and response products to hold.

We will continue with the approach taken in the *Forward Plan 2019-21* where our forecast accuracy is based on a monthly mean absolute error and a target to improve on the previous financial year's performance for that month. To achieve the benchmark we will be required to meet or exceed that target for six to eight months of the year.

We also propose to measure the annual mean absolute error of our day-ahead demand forecasts. This is in response to feedback from a supplier that solely focusing on the monthly mean absolute error may not demonstrate our performance year-on-year.

#### Metric 4 - Security of supply

We are proposing to measure the quality of service that we deliver in running the electricity network. This will be

measured by the number of voltage and frequency excursions we incur through running the network and will be reported monthly. This metric was first proposed in our *Forward Plan* but has since been suggested by members of ERSG

Currently, under licence condition C17, we publish data relating to our performance in maintaining the security standards set out in the Security and Quality of Supply Standards (SQSS) on an annual basis. As this information is a key metric for understanding our performance in ensuring reliable, safe and secure operation of the Great Britain electricity system it would be more appropriate to share this information more regularly with stakeholders. As the system evolves it will become even clearer to not only present information relating to the limits of the SQSS but also expand and show where the system is running at increased or decreased risk.

We believe that it is appropriate to have a target of zero excursions for both voltage and frequency as we are measuring our performance against the SQSS standards and therefore anything less than 100 per cent performance would not be appropriate.

#### Metric 5 – Delivery of zero carbon operability ambition

The ERSG has fed back to us that they believe we should be measuring the delivery towards our ambition to be able to operate a zero carbon system by 2025. In Annex 7 – Metrics and measuring performance, we have detailed which activities are critical milestones in delivering our ambition. We propose reporting annually against these deliverables through a RAG status. Our target will be for each status to be green. In the report, we will highlight the corrective actions we have planned for any deliverables that are marked as amber or red. Any formal changes to scope and cost would also be explained and proposed as part of our two-year funding cycle. We are proposing a target of having all milestones delivered to target date.

#### 4.2.9.2. Annual reporting items

Alongside our performance metrics we are also proposing to provide further visibility of the progress towards our ambitions. These items are not considered metrics to avoid any duplication of measurement or where we do not have direct control of the performance.

#### Design authority performance

We propose to publish an annual report on the work of the design authority. The design authority is a key component of our proposals to develop new balancing and control capability. It represents a step-change in levels of external transparency and accountability. The proposal for a design authority has been well received by stakeholders, especially due to concerns around our ability to deliver new control capability.

It is important the industry has confidence in the design authority and understands the work it will be undertaking. An annual report could help provide industry with this confidence, and we will invite industry feedback on it.

The annual report will provide details of:

- minutes, outputs and actions from design authority meetings
- performance against plan for the previous year
- plan for the forthcoming year.

## 4.3. A2 Control Centre training and simulation

Our Control Centre engineers play a vital role managing the electricity network. We must ensure they have the right training and simulation capabilities to operate the energy system of the future.

### 4.3.1. Costs

| Control training and simulation | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 0.0 | 0.0 | 1.2 | 2.3 | 2.3 |
| Opex (£m) | 1.9 | 2.1 | 2.6 | 3.2 | 3.8 | 4.2 |
| FTE | 18 | 23 | 25 | 26 | 24 | 23 |

#### Highlights

We propose to expand our training activities and start to design new simulators. This will ensure our Control Centre engineers can operate a carbon free system.

Our workforce capability team will increase by three FTE to deliver our transformational activity, including designing and delivering new courses to train students and ESO colleagues and new scenario writers to develop 'what-if' exercises to reflect the new operating environment our carbon-free ambition will deliver. We will engage with industry our how our training and simulation capabilities could be used to train distribution system operation control engineers. The latter could lead to a significant increase in the number of people we train, from around 30-40 FTE per year currently to approximately 120 FTE[63]. Given we do not expect this requirement until later in the RIIO-2 period, and are currently unsure of the DNO to distribution system operation transition, we would provide an updated FTE profile in a later submission. Without increasing

[63] Assuming 100 FTE in the ESO control room, 50 FTE in each of the 14 DSO control rooms and a 15% attrition rate due to retirement and career progression. This does not include other staff who may benefits from such training.

headcount to deliver enhanced training, we would need extra Control Centre staff due to the inefficiencies of training live in the Control Centre.

Our Technical Operations and Policy team will gain two FTE to carry out an increased number of system investigations, respond to customer queries on Control Centre matters and manage an increased workload from ENTSO-E System Operation Guideline. A greater volume of work is expected from an increase in the number of market participants and the move towards pan-European markets. For example, the number of investigations in 2019 is already 50 per cent higher than in 2017 and 2018, despite the responsibility for loss of supply incidents being moved out of the ESO post legal separation. We expect this trend to continue. We will be more proactive in sharing learnings across the ESO and industry and suggesting process improvements. This is so we can highlight any potential operational risks and lead on new operational policy development and implementation, which will help manage the number of investigations required.

### 4.3.2. A2.1 Ongoing activities and enhancements in RIIO-2

We will continue to:

- develop and drive Control Centre strategic resource planning, scheduling and training (D2.1.1)
- lead on incident analysis and investigations of abnormal events, implementing improvements where needed (D2.1.2)
- monitor and report on system performance to regulatory bodies and ENTSO-E (D2.1.3)
- provide guidance on operational policies for use in the Control Centre (D2.1.4).

### 4.3.3. Transformational activity

**The net present value of our Control Centre training and simulation proposals are estimated at £16 million and deliver £1.61 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2023/24 onwards.**

Our current training and simulation capabilities cannot continue in their current form. We will need to train Control Centre engineers on new tools, in new areas such as data science, and against a backdrop of an increasingly complex and unpredictable system.

We must also ensure we attract and retain talent. There will be competition for the skills we need as DNOs transition to distribution system operation, as well as externally in sectors such as banking and video game development.

We will focus on three areas: partnering with academia and industry to develop enhanced training material and attract talent, upgrading our training simulators, and; enhancing our workforce and change management tools.

An increase in FTE is needed during the first two years of RIIO-2 to allow us to be more proactive in working with academia and industry to develop new training material, above what we do today. Extra FTE are also required to develop the enhanced simulation capability, ensuring it is ready in conjunction with the delivery of our new Control Centre systems.

#### 4.3.3.1. A2.2 Enhanced training material

#### Academia (D2.2.1)

We will partner with academic institutions to enhance and accredit existing qualifications and courses. We will also look to develop new ones if necessary.

We will focus on institutions that already offer courses in relevant subjects such as power system engineering, data science and energy systems. Universities tell us that demand for such courses continues to grow. Our discussions have given us an overview of how we can partner with institutions to deliver more effective training and appeal to students as a future employer.

During the first two years of RIIO-2 we will consider how we can:

- Sponsor the dissertation process of existing university courses, allowing candidates to work on an ESO-relevant project and gain experience of the ESO as part of the development of their project.
- Design and deliver optional electricity system operation modules for existing university courses. These would give an overview of all elements of system operation, including power system engineering, market operation and commercial and regulatory frameworks. We would look to include ‘hands-on’ training through experience days at our control centres, including use of our training simulators.
- Offer candidates on these courses employment opportunities. This could be in the form of summer placements and / or post-qualification permanent positions.

Longer term, we will analyse the feedback from this and the continuing appetite for the modules. If there is demand and clear benefit, we would aim to run further modules or develop a new qualification or degree in electricity system operation.

Our proposal will benefit candidates by ensuring that existing qualifications remain relevant and providing potential post-qualification employment opportunities. It will also benefit the ESO by creating a pool of talented people with the skills for the future.

#### DNOs and wider industry (D2.2.2)

As distribution network operations evolve towards distribution system operation, there will be increasing demand for energy system operation skillsets across the industry.

We see the potential value of developing operating engineers in partnership to meet overall industry demand. A full DNO to distribution system operation transition could mean that 120 FTEs would need training each year, meaning there are likely to be efficiencies in combined training and benefits from greater collaboration and understanding of our networks, roles and interactions.

Regardless of our actual training relationship with DNOs, we will need to perform modelling and training on whole system solutions and interfaces.

During RIIO-2, we will engage with DNOs to understand how we can provide the initial training for distribution system operation control room engineers. In the first two years of RIIO-2, we will explore how to open our training to DNOs to support this transition, including:

- exploring the potential for joint simulator training sessions to develop best practice and incident management techniques
- providing and participating in cross-sector secondment opportunities to improve whole system decision-making, by better understanding the needs of other parties.

The benefits of this approach are cross-sector efficiency savings and better whole system decision making.

#### 4.3.3.2. A2.3 Training simulators and technology

We plan to develop new training simulators to accurately reflect the changing energy landscape. This will allow us to train Control Centre engineers on a range of past and future scenarios, including using real-time data as opposed to the current snapshots we use today.

We will build our simulation capabilities together with the new balancing and control tools. The simulators are a separate concept from the shadow control room. They provide an environment for training on new systems in real time and can capture post-event training scenarios. The shadow control room will allow new Control Centre processes and interfaces to be tested.

In the first two years of RIIO-2 we will:

- make upgrades to our current simulators to ensure they remain fit for purpose, ahead of developing new simulation capability, facilitated by digital twin technology (D2.3.1, and IT investment reference 200 Future simulator and tools)
- implement appropriate additional training options, including online and e-learning (D2.3.2).

This approach will benefit consumers by helping Control Centre engineers make better operational decisions, ensuring that the system continues to run safely and reliably on behalf of consumers, while minimising bills.

We will work with parties that already have simulation capabilities, for example the National HVDC Centre, where they have digital replicas of high-voltage, direct current (HVDC) links, including embedded links and interconnectors. There is likely to be significant consumer benefit in collaborating, where we would provide them with data and system operation experience, while they provide replicas of such links that we would then not need to duplicate. We will explore the potential for joint training and simulation sessions. We will send ESO representatives to projects where DNOs are looking to develop distribution system operation control rooms prototypes and simulators.

#### 4.3.3.3. A2.4 Workforce and change management tools

Given the impacts of shift work in a complex and stressful environment, we must ensure that we provide an environment that supports the wellbeing and at the same time continued development of our control centre engineers. During RIIO-2, we want to use greater automation in producing rotas and personalised training packages. Many of our current workforce and change management tools are undertaken using legacy tools or manually; we will update these. They will require investment to create an enhanced user experience to provide flexibility to both the trainee and the trainers through their authorisations and training needs (IT investment reference 190 Workforce and change management tools).

During the first two years of RIIO-2 we will:

- Develop document management improvements including personalised operational and process updates and automated shift logins, ahead of delivery in subsequent years of RIIO-2 along with our new balancing and control capabilities (D2.4.1)
- design and develop content and infrastructure for personalised training plans, which we will fully deploy in later years (D2.4.2).

## 4.3.4. Investment roadmap

The roadmap below shows the deliverables and activities we propose across the RIIO-2 period.

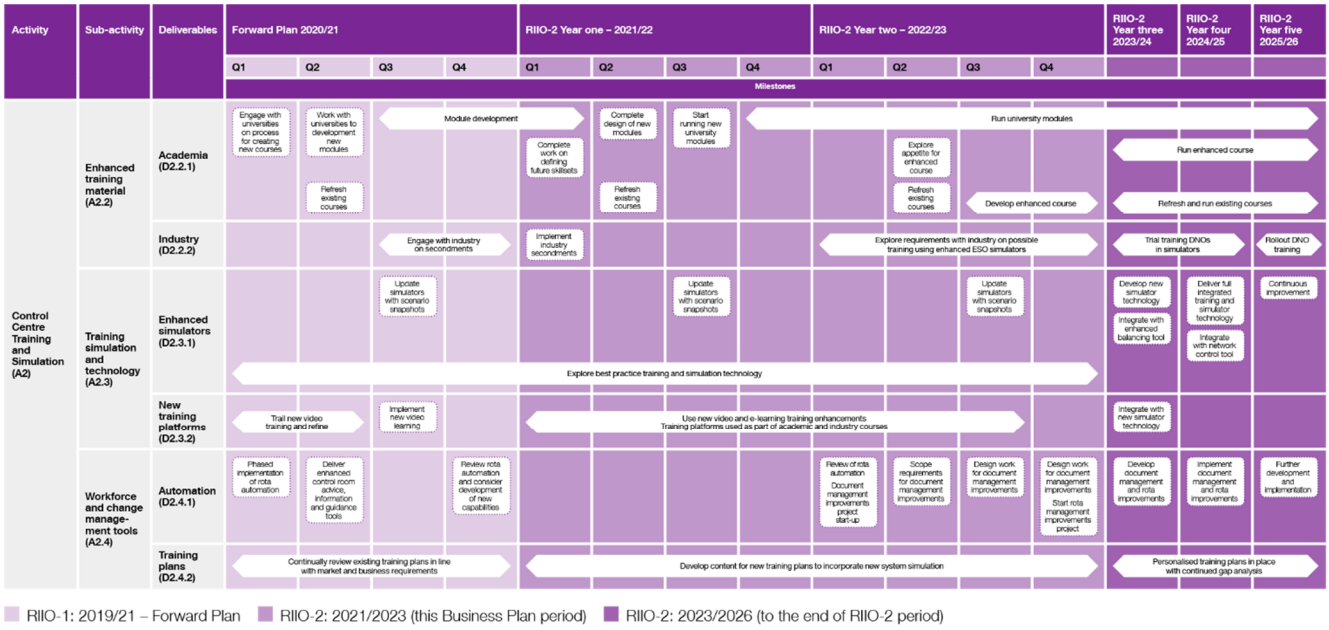



*Figure 22: Investment roadmap*

## 4.3.5. Stakeholder views

We sought stakeholders' views on how we plan to develop our people at the ESO RIIO-2 events in April and August 2019 and through *Our RIIO-2 Ambition* consultation document. We engaged in more detail on our training proposals at our Control Centre events in July and August 2019 and we spoke to universities and DNOs about how we could work together in the future.

Stakeholders generally agreed that our training simulators should match our balancing and control capabilities and that updated simulators would be a useful resource to share across industry. On resourcing, a supplier in response to *Our RIIO-2 Ambition* said that it was important for people capability, health and well-being to be 'upgraded' as well as systems.

More specifically on Control Centre skillsets, stakeholders agreed that we will increasingly need data and computer science skills to complement our power system engineering capabilities. They also felt that the development of distribution system operation capabilities across the wider industry will only increase demand for this type of resource.

There were some differing views on how to solve the skills gap issue, and whether it was our responsibility to solve wider industry resourcing issues.

Some stakeholders (from supplier and service provider sectors) felt it should be left to the market to solve. Other stakeholders (from generation, government and consultancy sectors) thought we should partner with the Energy Networks Association (ENA), universities, government initiatives and technology companies to train talent, building on our existing programmes.

One stakeholder said that the ESO had lots of energy trading experience which DNOs may want to learn from and participate in training on. Another comment was that we could tailor our training approach with different network companies depending on their needs.

The ERSG also said that in an international market, recruiting and retaining talent was difficult. They recommended we worked with universities and the ENA to build university capability and to ensure careers appeal to young people.

Following publication of our July draft Business Plan, we spoke to three universities (UCL, Manchester and Strathclyde) about the resourcing challenge that we and the wider industry may face in future.

We discussed how we could work together to attract and train our future control engineers. The universities were all positive about potential collaboration, with one academic saying that a partnership looking at system operation of the future could be 'world-leading'.

The universities agreed that a slightly different emphasis for system operation in terms of topics being taught was required (versus a more technically focussed qualification). There are several options for bespoke system operation qualifications, for example, through the dissertation process, through guest lecturing or setting up a module within an existing course.

One university also thought that we could work in partnership using our simulation facility to enhance teaching for an existing course. While we already do some work in this area, for example through the IET Power Academy, we believe there is scope to go further, and these discussions have directly informed our proposals.

We have used this feedback to inform our proposals for developing optional modules within existing courses at first, before moving on to developing new qualifications if there is sufficient appetite.

We have also engaged with parties that currently have control and training simulators, including the National HVDC Centre. We heard agreement that there is scope to collaborate on training and simulation capabilities to avoid duplication among industry parties. As a result of this engagement, we have included proposals to this effect in our Business Plan.

We engaged bilaterally with three DNOs in September and October to understand their views on our training proposals. They supported our proposals, and all agreed that we should work together on training. One also thought that collaboration on training could extend to more general wider market training. Another thought that we should have a more detailed discussion on the possible skillsets required so we will continue these conversations with DNOs in 2020/21.

In response to *Our RIIO-2 Ambition* consultation, a consumer interest body pointed out that we discussed training and developing our people but didn't mention retaining employees.

We agree that this is key to a resourcing strategy and have provided more details in Chapter 14, People, culture and capability. We know that talent retention is important, but we are also conscious that we need to future-proof against our current age profile in critical operational roles.

The ERSG commented that to keep high calibre people we need to offer a good work-life balance. This includes more flexible working practices in the Control Centre and ensuring Control Centre engineers remain 'in practice' while on maternity, paternity or adoption leave. It should also encompass more part-time working.

We agree with this, and we already have well-being support in place and conduct regular health checks. We have an on-site gym and look carefully at rota patterns to ensure staff well-being. We are committed to being at the leading edge in this area, especially in relation to the shift working needed for our round-the-clock operation. We will look to increase the amount of flexible working available, balancing this against the requirements of operational and shift work.

### 4.3.6. Cost-benefit analysis

We estimate the gross benefits to be £35 million over RIIO-2. This gives an net present value of £16 million over RIIO-2.

The quantitative benefits stated above have been calculated by:

- Estimating a two per cent improvement in managing response and reserve, from enhanced training and simulation capabilities, combined with new tools, resulting in £28 million of gross benefit.
- Updating our shift patterns, working arrangements and training delivers gross benefit of £7 million over RIIO-2.

This is against a baseline assumption of continuing with the as is state of limited training and simulation capability.

This activity is dependent on the following transformational activity:

1. A1 Control Centre architecture and systems (Theme 1) – Allowing high skilled engineers to use their training for zero carbon system operation

This also enables, through a highly skilled workforce which can operate a complex decentralised and decarbonised electricity system, the following transformational activity:

1. A1 Control Centre architecture and systems (Theme 1) - Providing real world experience for training and simulations

Delivery of this activity could pass on benefits and costs to third parties. There may be a cost to DNOs and TOs for training their staff using our facilities. However, this would likely be offset by savings from not having to run some or all of their own training programmes. They will benefit from having a greater pipeline of resource due to our enhanced academic partnerships attracting talent to the industry. Greater co-ordination and collaboration of training will help the industry make better whole system decision, particularly in areas such as restoration and disaster recovery.

Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between negative £2 million and £42 million.

See Annex 2 - CBA report section 2.2 for more details.

We discuss risks and mitigation to delivery in Annex 2 - CBA report, section 2.2.6.

### 4.3.7. Other options considered

We have not considered any alternative options, other than the proposal in section 4.3.3 and the status quo. Full details of why this is our preferred option can be found in section 2.2.7 of Annex 2 – CBA report and the corresponding stakeholder feedback is captured in section 5.5.3 of Annex 3 – Stakeholder report.

### 4.3.8. Measuring Performance

Metric 1 - Balancing cost management, Metric 4 – Security of supply and Metric 5 – Delivery of zero carbon ambitions from the Control Centre architecture and systems section are also relevant. Our proposals in this area will result in; lower balancing costs than would

otherwise have been the case, as demonstrated in the CBA, and they ensure our Control Centre engineers can safely and efficiently operate the increasingly complex system of the future.

This demonstrates alignment between our activities, the CBA and the proposed metrics.

Full details are in Annex 2 – CBA report section 2.2 and Annex 7 – Metrics and measuring performance, section 2.1

## 4.4. A3 Restoration

A safe, secure and reliable supply of electricity is vital to our economy and way of life. While extremely unlikely, a total loss of power could cost the UK £5.6 billion to £9.6 billion per day[64]. It is vital we have the right procedures to economically restore the system within acceptable timescales.

### 4.4.1. Costs

| Restoration | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 0.9 | 2.3 | 7.7 | 8.1 | 6.3 |
| Opex (£m) | 0.6 | 0.8 | 1.4 | 2.3 | 3.3 | 4.0 |
| FTE | 7 | 8 | 13 | 18 | 18 | 17 |

#### Highlights

We propose to open restoration services to more technologies and implement the new standard. This will allow quicker restoration, should the need ever arise.

Our ongoing restoration activities will not increase FTEs despite the number of restoration providers increasing as we open restoration services to wind and solar. This is due to efficiencies resulting from tenders replacing bilateral contracts for procurement and improvements to our Black Start testing methods.

Our transformation work is driving the need for more FTEs in future. In the first two years of RIIO-2, this includes extra resources to deliver the restoration standard and the restoration decision-making support tool. The increase from 2023/24 onwards covers the resources required to implement the proof of concept from the Distributed Restoration NIC project. The proposed transformational capex spend has been benchmarked to ensure it is efficient.

### 4.4.2. A3.1 Ongoing activities and enhancements

Our restoration and resilience teams will continue to:

- Provide the control centre with fully-tested skills, processes, plans and tools to support incident management and disaster recovery (D3.1.1).
- Develop and maintain restoration plans for Great Britain with the necessary stakeholders, ensuring these are validated and supported (D3.1.2).
- Engage and collaborate with industry to plan and develop the new Great Britain restoration standard, including the annual assurance framework, consistent with our licence obligations (D3.1.3). The standard will be implemented as part of our transformational proposals.
- Provide advice and oversight of Black Start and restoration strategy for the future (D3.1.4).
- Run a fully competitive Black Start procurement process with submissions from a wide range of technologies connected at different voltage levels on the network, with DNOs playing a more active role in the restoration approach (D3.1.5).

#### Enhancements made during RIIO-1

In response to stakeholder feedback on the future of balancing services, we published our *Product Roadmap for Restoration*[65] in May 2018. This outlined our commitments to improve the transparency of requirements, remove barriers to entry and explore alternative methods to procuring services. A core output of this is that we will trial a market approach for Black Start procurement from 2020/21 onwards.

To explore the provision of new technologies and services in restoration, we launched our Distributed Energy Resources (DER) Network Innovation Competition (NIC) Project, together with SP Energy Networks and TNEI, an energy consultancy. We released our initial findings from this in July 2019[66]. More details of how we would take the resulting proof of concept and implement it are below.

### 4.4.3. Transformational activity

**The net present value of our proposal is estimated at negative £8 million.**

System restoration is the ultimate backstop on which the country's economy relies. However, maintaining the ability to restore cannot be a blocker to achieving our ambition of being able to operate a carbon free network

[64] Calculated using a value of lost load of £7,000 to £12,000 per MWh and 0.8TWh daily demand https://www.ofgem.gov.uk/ofgem-publications/82293/london-economics-value-lost-load-electricity-gbpdf

[65] National Grid: Product Roadmap – Restoration https://www.nationalgrideso.com/sites/eso/files/documents/National%20Grid%20SO%20Product%20Roadmap%20for%20Restoration.pdf

[66] National Grid ESO: Power engineering and trials – report on the viability of restoration from DERs (Redacted) https://www.nationalgrideso.com/document/149961/download

by 2025 if we rely on old methods, processes and technologies.

We expect a significant increase in the number of restoration providers. As society shifts to a potentially more electrified future, we will likely see changing expectations for restoration too.

System restoration will need to become a much more 'self-healing' process. This would feature automated power supply recovery and a whole system process with the appropriate system control, simulation and training tools in place. It would also see highly trained power system engineers across all networks. Our transformational activities focus on implementing the new restoration standard and our DER NIC project.

#### 4.4.3.1. A3.2 Restoration standard

The Black Start Task Group, a cross-industry government-led group, is currently developing a national standard (with a potential regional requirement) for restoration. It uses an evidence-based methodology that includes socio-economic impacts and the likelihood of a shutdown event.

The date for the restoration standard being implemented is dependent on the Government. Once the Government confirms the standard, we will have 12 months to implement it. Our current estimates are for a standard to be confirmed in October 2020, meaning the ESO would have until October 2021 to implement it. The expected standard is likely to drive much shorter restoration timelines, and therefore more work and cost to achieve this, including changes to the SO-TO code, Distribution Code and Grid Code requirements. The assurance framework is far reaching into telecommunications and systems and will mean significant change for the ESO and industry. (IT investment reference 460 Restoration)

Once the GB restoration standard is implemented, our annual work will involve:

- facilitating and compiling, on behalf of the Great Britain electricity industry, an annual assurance process for Great Britain Black Start readiness (D3.2.1)
- validating restoration timelines for the Great Britain electricity system using the assurance data (D3.2.2)
- maintaining our obligations and requirements against the new standard for Black Start capability provision. (D3.2.3)

The decisions and instructions we make during a restoration event are vital to restoring the system quickly. To support our role, we will develop a decision-making support tool (D3.2.4) to advise our Control Centre engineers on the best route for restoration at any point. This will also enable them to manage potentially hundreds of restoration providers.

The tool would continually update and adjust if the first restoration plan was not followed. Reasons for this may be social, technological or political grounds, for example the instruction of the Secretary of State consistent with their powers, or technological grounds. During the first two years of RIIO-2 we will begin developing the tool, ahead of go-live in 2024/25 (IT investment reference 510 Restoration decision support).

#### 4.4.3.2. A3.3 Innovation project on restoration

Creating a collaborative and comprehensive solution developed jointly by the ESO and DNOs to allow DER to participate in the restoration market will bring significant financial benefits to consumers through increased competition, lower costs and quicker restoration.

We have secured funding through the NIC to explore how to provide restoration services via DER. This project, which ends in 2022, will produce a whole electricity system project output including the technology needed to support and dispatch DER. This will include tools and communications, and any regulatory and commercial framework changes needed.

We will:

- Trial case studies based on different technology types during 2020 and 2021 to look at feasibility and confirm costs (D3.3.1)
- Subject to the outcome of the project, we estimate that full implementation of the proof of concept findings will be completed by 2025/26. This will include new communication, control and visibility systems (D3.3.2) (IT investment reference 460 Restoration).

As restoration requirements evolve, we see the NIC project as an important way to improve our toolkit in line with the changing system.

## 4.4.4. Investment roadmap

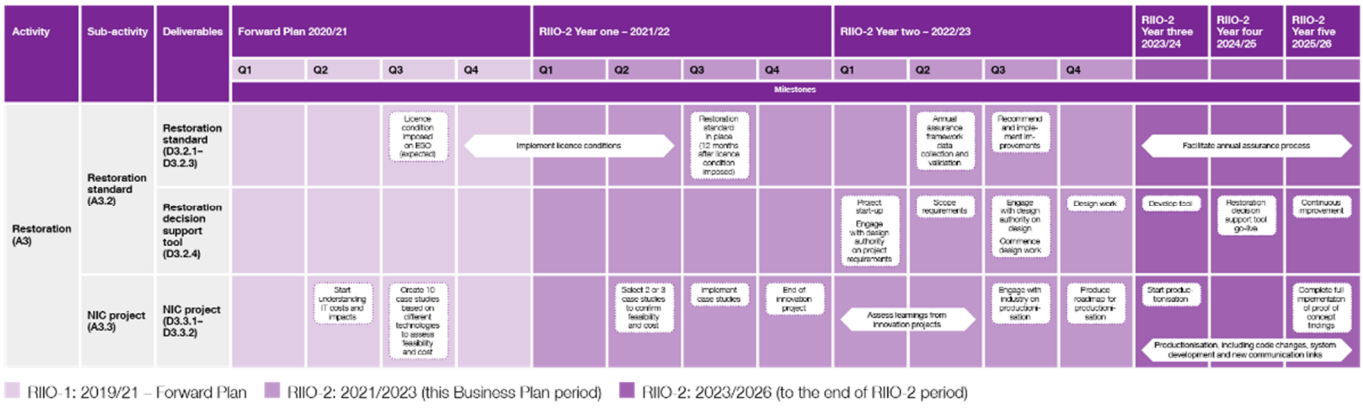



*Figure 23: Investment roadmap*

## 4.4.5. Stakeholder views

We have discussed the future system restoration standard at various industry forums. These include the Black Start Task Group, the Electricity Task Group, and the ENA-led Emergency Planning Managers Forum and Electricity Networks and Futures Group.

In general, stakeholders support faster restoration timescales, committing to a standard, and allowing new products and technologies to provide restoration services.

We discussed our RIIO-2 proposals at our RIIO-2 stakeholder event in April 2019 and received comments via our *RIIO-2 Ambition* consultation. At the event, there was some support expressed for our proposals, particularly from service providers, and a call for the ESO to be more creative in finding Black Start solutions to bring down the cost. We will continue to do this as part of our ongoing balancing services development activities, as we outline in the procurement methodology[67].

Ultimately it was determined that the physics of being able to restore the system are critical and that this could be tested using the proposed simulator. There were some conflicting views across generation companies about the role of different technologies, including renewables, in providing restoration services. We will consider these views in the development of Black Start markets.

A renewable developer commented that we talked a lot in our ambition about use of DER for Black Start but that there was a role to play for large-scale transmission connection renewables too. We agree, and through our competitive Black Start procurement events, any technology that meets the technical requirements can participate.

Also, in responding to *Our RIIO-2 Ambition* consultation document, a supplier said it was vital that learnings from innovation projects (such as the Distributed Energy NIC project) became business as usual. These lessons should be extended into future scenarios such as 'stationary' and 'cold' starts where there could be a high dependency on electricity for transport and heat respectively. A trade association also said that it welcomed our proposal to build on the findings from the innovation project.

We sought DNO views in bilateral meetings on our restoration proposals in September and October 2019.

These DNOs supported the black start NIC project and its direction and agreed that it will, quite rightly, have implications for DNOs when implemented. Two DNOs also highlighted that there is a NIC innovation project underway to look at islanding at a conceptual level for restoration[68] (or 'micro-resilience'). We will continue to engage with DNOs on the direction of this project and any interactions with or implications for the Distributed Energy NIC project.

## 4.4.6. Cost-benefit analysis

We estimate the gross benefits to be £5 million over RIIO-2. This gives a net present value of negative £8 million over RIIO-2. Despite our proposals having a negative net present value, it is important we open our restoration services to more providers including DER. We must also comply with the new restoration standard and build tools that can minimise restoration times.

Given the £115 million net benefit from 2025 to 2050 of our DER NIC project, we expect our proposals to deliver net benefits over the period to 2050. This is against a baseline assumption of continuing with current Black Start procurement activities.

This activity is not a strong enabler or dependency on any of our other activities. Our Distributed Energy NIC project complements our work in Theme 2 to transform participation in balancing markets. The restoration decision support tool will complement the other tools delivered by our Control Centre architecture and systems activities.

[67] National Grid Electricity System Operator: Black Start Strategy and Procurement Methodology

[68] https://www.ofgem.gov.uk/publications-and-updates/electricity-nic-initial-screening-submission-2019-resilience-service-shepd-npg

Our proposals may pass some costs onto third parties. DNOs, TOs and restoration service providers will need to make investment to comply with the restoration standard that we will be conducting the assurance process for. DNOs and service providers may need to implement communication systems, depending on the proof of concept findings from the DER NIC project, to participate in restoration services. We are confident that the benefits, including assurance of reduced restoration timelines, the ability for new technologies to provide restoration services and, for DNOs, the potential to be able to control restoration in their own area, outweigh these costs

See Annex 2 - CBA report section 2.3 for more details.

We discuss risks and mitigations to delivery in Annex 2 – CBA report section 2.3.6.

## 4.4.7. Other options considered

While developing this activity no other options, in addition to the proposal outlined in section 4.4.3 and the baseline assumption outlined in section 4.4.2 have been considered.

For more details please see section 2.3 of Annex 2 – CBA report and section 5.3 of Annex 3 – Stakeholder report for the corresponding stakeholder feedback.

## 4.4.8. Measuring performance

### 4.4.8.1. Performance metrics

Metric 5 – Delivery of zero carbon operability ambition, as described in the Control Centre architecture and systems section is also relevant for measuring our restoration proposals. To be able to operate a zero carbon system, we will need to open the restoration market to new providers and technologies, and ensure we have the tools and training to manage this.

### 4.4.8.2. Annual reporting items

**Number and type of parties tendering for restoration services**

We are proposing to report on the number and service provision for the parties providing restoration services. Due to stakeholder concerns on if this is a measure of our performance, we are proposing that this is an annual reporting item and not a metric.

To demonstrate the impact of the transformational activities we are proposing to report on the:

1. number and service provision of parties providing restoration services.
2. number of parties of each technology type tendering to provide restoration services.
3. proportion of restoration services procured competitively (as part of the relevant Theme 2 metric).

This is aligned to our ambition for carbon free operation, because many of these providers have traditionally been large thermal generation units. We see this measure as a reporting item instead of a performance metric due to the level of control that we have on the result. However, we believe it is appropriate to report annually as an indicator of the market.

Initially, we had only proposed to measure part 1 above. While this had some support, some stakeholders at our October event thought that we should also measure the technology type of service providers rather than just the number of them. We believe that measuring the number of providers tendering in, their technology type and the proportion that are competitively procured, should provide a good proxy for competition, hence the introduction of parts 2 and 3 above.

Reporting on these areas also demonstrates alignment to the CBA. In the CBA we outline how our proposals will reduce bills and result in lower $CO_2$ than would otherwise have been the case through opening restoration services to new technologies and services, many of which are likely to be low carbon.

# Role 2, Theme 2
# Market development and transactions
## Transforming participation in smart and sustainable markets

### Consumer priorities

- We want an affordable energy bill
- We want a decarbonised energy system, fit for the future
- We want a safe and secure energy system

### Stakeholder priorities

- I want transparent and forecastable charges
- I want efficient whole energy system operation
- I want you to enable the smart, flexible and low carbon energy system of the future
- I want you to be open, engaging and easy to work with
- I want you to be adaptable and innovative
- I want you to facilitate active markets for a wide range of products and services
- I want access to comprehensive accurate and user-friendly information

### The ESO RIIO-2 Stakeholder Group supports Theme 2.

"ERSG agrees that action should be taken on codes and Capacity Market arrangements. Decisions need to be taken at an industry level on exact scope and extent of the ESO's role in this."

## What this Theme covers

Transforming markets and the frameworks that govern them to ensure maximum participation and efficient costs of managing the system.

## What we propose to do

Deliver closer to real time markets for balancing services to which all market participants 1 MW and above will have equal access. The markets will be accessed through a single integrated ESO markets platform transforming the process for market participation.
We will transform the process to amend our codes. We will also make the codes we administer more accessible and aligned across the whole electricity system.

## What our Stakeholders have told us

Stakeholders have enthusiastically welcomed our proposals as they will transform the experience of participation in balancing markets, addressing many of their concerns with the burdensome nature of current arrangements. They have also welcomed our proposals that will enable them to more effectively drive and participate in code change.

## What are the key benefits?

In order to operate a carbon free electricity system we will need to attract significant volumes of additional flexibility services. Closer to real time markets accessed through a user-friendly platform will enable us to procure that flexibility at the lowest cost to the consumer. Codes that are more accessible to a wider group of stakeholders will facilitate greater overall market participation and more efficient outcomes for consumers.

# 5. Role 2, Theme 2: Market development and transactions. Transforming participation in smart and sustainable markets

## Role 2, Theme 2 delivers £414 million net present value of consumer benefits[69] and lowers consumer bills by £1.33 a year[70]. Investment[71] for this Theme (2 year) £93.8 million.

## 5.1. Five-year strategy

Efficient, well-functioning markets are essential if we are to operate a carbon free system by 2025.

**Net zero by 2050**

We will enable the UK to transition to net zero emissions by:

- ensuring we can procure the flexibility and capacity required to operate a zero carbon system at least cost to consumers
- delivering close to real-time markets for balancing services that promote participation of all technologies including renewable generators and demand side flexibility
- providing open and accessible tools and processes for balancing services and the Capacity Market to remove barriers to entry for renewable and distributed resources, promoting participation of a wide technology base
- delivering industry frameworks and associated change processes that are accessible and usable for all market participants.

We must operate the system and deliver economical security of supply with much higher volumes of low carbon generation, such as offshore wind increasing from 9 GW today to 24 GW in 2030, and flexible sources of energy such as demand-side response and storage doubling by 2030.

We have a vital role in delivering this complex task by working with a wide range of stakeholders to develop the balancing service markets, ensuring our codes and charging arrangements are fit for the future and promoting competition in wholesale and capacity markets.

### 5.1.1. A4[72] Build the future balancing service and wholesale markets

We know, through extensive stakeholder engagement, that in order to deliver the required flexibility at the lowest sustainable cost to consumers, we will need to transform the markets that we operate. Changes will also be needed to how existing and potential service providers interact with those markets.

Service providers have told us it is time-consuming to participate in the markets we operate and that there are too many barriers, particularly for smaller players.

By 2023, all market participants of 1 MW and above will have equal access to all our balancing service markets. These balancing markets as well as the Capacity Market will be accessed by a single integrated ESO markets platform.

Closer to real-time markets will allow us to procure more efficient volumes of balancing services and help more providers to participate, for example those with demand-side response, storage and renewable sources of energy. An integrated markets platform will expand to allow participants to access the full range of our markets in a co-ordinated way.

We will be transparent in everything we do, ensuring market participants are treated fairly, both in purchasing services and how they are dispatched.

Existing and prospective service providers have told us that as new markets develop, for example at a distribution or community level, participants must be able to stack value by participating across these markets, regardless of who owns or operates them.

Common standards, data models and interoperable systems will be central to how we design our markets and their interaction with other markets.

As we transform the markets we operate, we also need to consider wider markets and how they interact to ensure they are individually and collectively fit for purpose.

[69] Consumer benefits are the net present value (NPV) of Theme 2's transformational activities over the RIIO-2 period. Our analysis suggested that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £229 million and £908 million. When referring to the quantified benefits themselves, we refer to them as gross benefits. When summing benefits thought this document care should be taken that they are the same type and note rounding may mean values do not match precisely. See Annex 2 – CBA report for more details on how we have calculated the NPV.

[70] Relatively, on average over the RIIO-2 period

[71] The ESO will generate a net saving for consumers in RIIO-2. The proposed investment in this chapter will help to deliver this net saving

[72] These are the activity codes introduced earlier in this document. These unique identifiers help to link the activities, sub-activities and deliverables.

As part of our longer-term strategy, we propose to lead a review of wholesale, balancing and capacity markets. By 2026, there will be a clear view across industry of how these markets need to evolve to deliver price signals in a world of high volumes of zero marginal cost plant. For more details see section 3.2 of Annex 2 - CBA report.

### 5.1.2. A5 Transform access to the Capacity Market

By 2025, we will be trusted to deliver security of supply against a clear standard agreed with government, which is currently set at three hours Loss of Load Expectation (LOLE)[73]. We will be responsible for key elements of the auction, advising the Government on the volume to procure, running auctions and managing contracts.

By transforming how we facilitate these activities, we will achieve security of supply through a technology mix that supports the UK's net zero ambition at the lowest possible cost to consumers.

All technologies will be able to participate in the Capacity Market equally and participants will feel that they are fairly rewarded for their contribution to security of supply.

### 5.1.3. A6 Develop codes and charging arrangements that are fit for the future

We want our codes to facilitate the rapid change needed to meet the UK's net zero ambition. A wide range of stakeholders have told us, via the Code Administrators' Code of Practice Survey, that the process to change a code is too cumbersome and slow.

By 2025, our codes and code governance will be seen as an enabler of change, not a barrier. The codes we administer will be accessible and relevant to all users. Code modification will work for hundreds of market participants, rather than the tens of participants for which the current process was devised.

We will work with others to ensure that commercial, technical and regulatory arrangements across transmission and distribution will be far more joined up; for example, through a whole system Grid Code.

### 5.1.4. Costs and benefits

The graph in figure 24 shows our proposed capex, opex and employee full time equivalent (FTE) employee numbers. The increased spend in 2021/22 reflects the outputs and activities that are due to be delivered at the start of RIIO-2, in line with stakeholder requirements. Details on how we have incorporated efficiency assumptions and benchmarked these costs are in chapter 3 – Assumptions underpinning our plan.

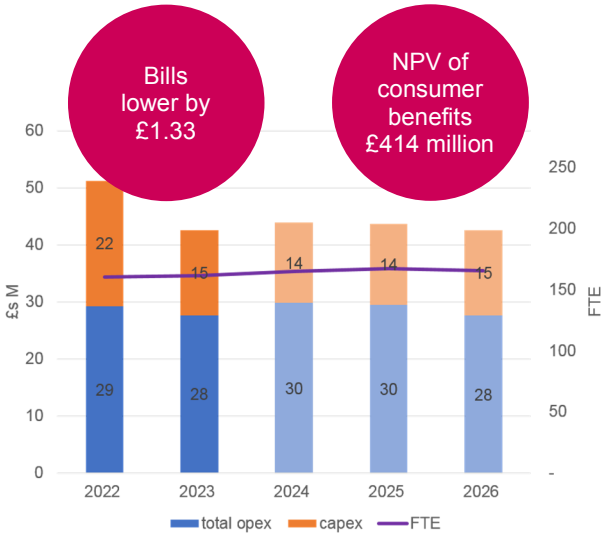



*Figure 24: Theme 2 costs, FTEs and benefits*

Our regulatory framework should facilitate the delivery of our outputs and benefits under this Theme through:

- A clear, targeted incentive scheme with *ex ante* clarity on how performance will be assessed.
- Supporting the increase in IT investment to deliver the integrated markets platform and other enabling investments. This includes supporting an innovative, agile programme of IT transformation where we can change and optimise the programme of investment, if this is in the best interests of consumers, without undue fear of disallowance.
- Ensuring we can raise appropriate levels of equity and debt finance to fund this investment.

Discussion on our regulatory framework can be found in chapter 9 – Financing our plan.

The main consumer benefits under this Theme are:

- A further five per cent reduction in the response and reserve prices, in combination with procuring optimised volumes, resulting in over £100 million in gross consumer benefits.
- Further two per cent improvements in Capacity Market modelling accuracy which could unlock approximately £74 million in gross benefits.
- Over £300 million in reduced risk premia through working with industry to reduce charging volatility and unpredictability.
- Realisation of FTE efficiencies across the energy industry for:
  - Capacity Market customers resulting from reduced barriers to entry for around 400 customers.
  - Grid Code users, around 800, totalling £10 million gross benefits over RIIO-2.

[73]https://www.ofgem.gov.uk/system/files/docs/2019/07/capacity_market_five_year_review_report.pdf

We will maintain a focus on consumer priorities:

- An affordable energy bill through:
  - closer to real time markets operated through a single market platform enabling optimised cost and volume procurement.
- Energy to be available when needed through:
  - opening up markets to new providers 1 MW and above.
  - an enhanced platform for the Capacity Market, integrated in the single markets platform and optimised using the latest data technologies.
- A decarbonised energy system, fit for the future through:
  - facilitating activities enabling a Capacity Market operating with a technology mix that economically drivers towards net zero
  - breaking down barriers to entry for participants crucial to meeting net zero targets such as renewable generation and providers of demand side flexibility.
- A safe and secure energy system through:
  - procurement of flexibility required to securely operate a carbon free electricity system at lowest cost to consumers.
  - a fully digitalised whole system Grid Code by 2025 and code governance that enables change, fit for all market participants.

We will measure our success by tracking:

- the proportion of balancing services procured through competitive markets
- market liquidity and concentration
- customer and stakeholder satisfaction.

## 5.2. A4 Build the future balancing service and wholesale markets

More flexible energy will need to be purchased in the future to manage a low carbon system. There will also be lower availability of flexible generation such as combined cycle gas turbines (CCGTs) and coal plants that have traditionally helped to manage the system. We need to attract significant sources of new flexibility onto the system such as demand-side response and storage.

Our stakeholders involved in providing balancing services have told us that our balancing products, markets, processes and IT infrastructure need to change. We have made significant progress and this will continue through our *Forward Plan 2019-21* over the next two years.

Much of the work to date has focused on simplifying and standardising products and this has led to significantly more competitive markets.

However, a step change is required to attract the volume of flexibility we will need in future and to manage the daily variation of this volume which depends on the generation mix on the system.

### 5.2.1. Costs

| **Build the future balancing service and wholesale markets** | | **Five-year strategy** | | | | |
|---|---|---|---|---|---|---|
| | | **Two-year Business Plan** | | | | |
| | **RIIO-1 average** | **2021/22** | **2022/23** | **2023/24** | **2024/25** | **2025/26** |
| Capex (£m) | 1.1 | 5.2 | 3.3 | 2.4 | 1.4 | 1.5 |
| Opex (£m) | 2.7 | 11.8 | 9.7 | 11.1 | 10.3 | 8.4 |
| FTE[74] | 34 | 55 | 53 | 55 | 56 | 55 |

#### Highlights

We will develop a single, integrated platform to transform access to our balancing markets and the Capacity Market. We will enhance participation and market efficiency through delivering a day ahead market for response and reserve.

Capex and opex in this area are driven by three major IT investments: single markets platform, auction capability and ancillary services settlement refresh. Each investment consists of both a capex and an opex element. Where an investment is anticipated to be met either partially or fully by a cloud solution, this is treated as opex. The fall in opex in year two is a result of a drop in the project opex for the auction capability and ancillary services settlement refresh investments. Further information on the IT investments referenced in this chapter (IT investment reference 400 - Single markets platform, IT investment reference 420 - Auction capability; and IT investment reference 410 - Ancillary services settlement refresh) can be found in Annex 4 - Technology investment report.

The remaining opex increases are a result of the additional people required to deliver enhanced capabilities to meet market requirements and the transformational activities in this section. More details are provided in section 5.2.3.

[74] RIIO-1 opex and FTE numbers are the average for the ESO since legal separation (years 2020 & 2021) which reflects the current ESO business. Capex figures are the average over the eight years of RIIO-1.

## 5.2.2. Ongoing activities and enhancements

### 5.2.2.1. A4.1 Manage existing balancing services markets

We manage an end-to-end process to ensure that balancing services are procured to deliver security of supply at lowest cost to consumers (D4.1). Our work to reduce barriers to entry has helped to facilitate an increase from around 75 service providers in 2017 to over 250 today, including:

- Rationalising our product suite to make it clearer to the market, and simplifying and standardising response and reserve contracts
- Enabling wider access to the Balancing Mechanism (BM), with updated procurement processes so new aggregators and battery providers can participate alongside traditional large generators.

We have consistently evolved our approach to managing existing balancing and ancillary service markets in the RIIO-1 period as well as providing enhanced support to providers, including:

- Streamlining the induction process for new service providers, including interactive guidance documents and webinars. We published an improved testing process for participation in our services
- Publishing a detailed guide to contracting, tendering, and providing response and reserve services.

We will continue to evolve our markets and support to ensure as many providers as possible participate. Further improvements will include:

- delivering Power Available[75] to facilitate the participation of renewable resources in providing frequency response
- enhancing provider support with interactive guidance for each balancing service
- completing the replacement of our ancillary services settlement system.

Of the 34 people in the cost table for RIIO-1 above, 26 are delivering the manage existing balancing services markets activity. For RIIO-2 we propose to increase the size of this team from 26 to 31 FTEs. We need more people to manage relationships and contracts with the growing volume and diversity of service providers. An additional two people will be required to support delivery of the Ancillary service refresh IT investment (IT investment reference 410).

In April 2017, we had 75 service providers. Work to remove barriers to market entry, such as reducing minimum participation size for Fast Frequency Response (FFR) from 10 MW to 1 MW, has led to a significant growth in service providers to over 250 in 2019. More efficient processes and systems have enabled us to serve more service providers with less resource. The ratio of service providers to employees in this area has risen from around three providers per FTE in 2017 estimated to rise to more than eight service providers per FTE in RIIO-2.

Our RIIO-2 proposals create new markets with lower barriers, such as procurement closer to real-time and reducing the minimum size of participation in all markets to 1 MW. We expect this approach to lead to significant growth and diversity of service providers during RIIO-2:

- One additional resource is required to support how we manage the increased volume of contracts as service provider numbers rise.
- One of the additional FTEs will manage the onboarding of new providers. This will include initial contact and query response as well as supporting providers through early testing and framework agreements.

Over the RIIO-2 period at least eight GW of new interconnectors are due to connect. Work will be needed so that agreements are in place in time for these connections.

Significant efforts are also required to better integrate interconnectors into markets. Three FTEs will manage commercial relationships with interconnectors. If we assume 0.5 FTEs per new connection, efficiency has already been built into this FTE number by assuming that not all projects will connect.

In RIIO-2, five people will continue with our current work to reform ancillary services markets. In addition to continuing work to standardise and simplify existing markets these resources will support the work to transform balancing services markets in section 5.2.3.1.

### 5.2.2.2. A4.2 Power Responsive

Power Responsive[76] is a stakeholder-led programme, that we facilitated to encourage more participation in balancing services markets from the different forms of demand side flexibility (DSF) such as demand side response (DSR) and storage (D4.2).

Power Responsive has played a significant role in transitioning demand side flexibility and provision of balancing services to become a mainstream proposition:

- We have moved from 20 to 30 participants in our original DSR provider group to regularly hosting over 200 attendees at our flexibility forums and summer events.
- Between 30 and 50 per cent of balancing services tenders in 2018/19 were received from demand side providers.

We will continue to evolve the work of the programme by introducing more regular and specific metrics and publications across:

- distribution system operation development and co-development of local flexibility markets through a variety of innovation projects (D4.2.1)
- multi sector approaches focusing on opportunities for household, community energy, small business

[75] https://www.nationalgrideso.com/codes/grid-code/modifications/gc0063-power-available

[76] http://powerresponsive.com/

participation, zero carbon technologies, and electrification of heat in DSF. (D4.2.2)

Three of the 34 RIIO-1 FTEs in the cost table are delivering our Power Responsive programme. The size of this team will remain unchanged in the RIIO-2 period. This reflects our increasing maturity in performing our role with greater numbers of stakeholders and how we are expanding our engagement to new stakeholder groups.

### 5.2.3. Transformational activities

**The net present value of build the future balancing service and wholesale markets is estimated at £67 million, and to deliver £2.89 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2023/24 onwards.**

We have made substantial progress in reforming balancing service markets in the RIIO-1 period. To be able to operate a zero carbon system by 2025 and meet stakeholders' needs we will need to transform both the markets where we procure balancing services and how service providers participate in those markets.

**Procurement approaches for balancing services**

Some system services, such as frequency response and reserve, are procured as commodities through relatively mature liquid markets with large numbers of participants. We will transform these markets through removing barriers to entry and procuring them closer to real time.

As the market and system dynamics change, we will increasingly need to procure other services such as stability (including inertia), voltage (reactive power) and thermal (to manage thermal constraints). For these less mature markets we are adopting a "learning by doing" approach. Pathfinder projects are allowing us to work with others to test different approaches to meeting these operability needs. Theme 3 sets out more detail on how we are introducing competition in to network development to identify the most efficient solution to longer term network needs. This could be a transmission or distribution network asset solution, a long-term contract with a service provider or a short-term market such as those for response and reserve. In this Business Plan our intention is to provide clarity on the key milestones in that process, signposting when key activities are happening and when learnings and next steps will be shared with the market.

**Interactions between Theme 1 and Theme 2**

Our proposals in Theme 2 will procure the flexibility services we need to be able to operate a carbon free system. Given the increased number of participants, and associated increase in volumes of data, new tools are needed in Theme 1 to ensure we can monitor, schedule and dispatch these participants.

The single day-ahead response and reserve market and the single markets platform will both go-live at the end of 2022/23. This will ensure that the additional flexibility required to operate a zero carbon system is there in 2025 when we need it.

Additionally, to fully realise the benefits of this work, we require the transformational investments in the Control Centre from Theme 1. These investments will allow us to assess, optimise and dispatch the diverse players in these new markets.

To deliver the transformational activities detailed below in RIIO-2 we have budgeted for a total of 13 additional FTEs starting in 2021/22, six delivering market development and seven supporting delivery of two IT projects.

To achieve our 2025 ambition, we need to progress on multiple, interlinked operability and market challenges. We have also been told by stakeholders that we need to deliver tangible change faster than our current capability allows. Competing priorities mean we currently face a bottleneck in being able to deliver multiple projects simultaneously.

The additional resources give us the core capability and capacity to do this while lessening the burden on teams delivering the manage existing balancing services markets activity.

#### 5.2.3.1. A4.3 A single day-ahead response and reserve market

Responding to stakeholder feedback received through our *System Needs and Product Strategy*[77] consultation, in this price control period, we have launched an innovation project to trial a weekly auction for frequency response. We will use the lessons from this to build the foundations for a move to day-ahead markets. This has received strong support and we have been pushed to go further and faster.

In RIIO-2 we will respond to the requirement for efficient, safe and secure system operation and stakeholder needs by delivering a single day-ahead response and reserve market.

This will provide a transparent, open and regular procurement opportunity for all market participants. It will also give a robust market signal to support business cases and investment decisions for new flexible assets. Day-ahead markets are an important step towards our goal of ever closer to real-time markets.

At present, we tender separately for response and reserve through competitive monthly and quarterly markets. This far ahead of real time, we cannot forecast the generation mix on the system on any single day. We buy access to minimum volumes of response and reserve which are towards the lower end of our daily requirement.

For frequency response, the daily variation above this level is managed using mandatory response capability on Combined Cycle Gas Turbines (CCGTs) and coal plant. This plant will run less frequently in the future, as all coal plant is expected to close before 2025 and CCGT generation is expected to fall by up to 90 per cent, so a new approach is needed.

In future, we could simply buy enough volume at the month or quarter-ahead stage to meet our view of the maximum we would need to buy on any single day. However, this would result in purchasing significantly more volume than we would require in practice and would dramatically increase costs to consumers.

A much more cost-effective way of managing the volume variation in the future is to move our response and reserve markets closer to real time. At the day-ahead stage there is more certainty about the plant mix that will be on the system.

By moving our markets to day-ahead, or even within-day, we can optimise the volume of response and reserve that we buy through competitive markets against the volume of response provided by mandatory products. This minimises the risk that market signals are distorted. These two factors will result in a liquid, transparent market that provides a clear and consistent price signal for investors and drives down costs to consumers.

In addition, these changes would also remove a barrier to entry for sources of flexibility such as wind, solar and DSR and as such they are strongly supported by these market participants. Such providers have told us they find it difficult to participate in the current monthly tenders. Their availability to provide services is highly uncertain at the month-ahead stage. There is greater certainty of their available volume at the day-ahead stage and so they can optimise their bidding into the markets much more effectively.

To maximise market participation and liquidity it is vital that providers can make informed decisions about participation in local and national markets. Consistency and alignment of local and national markets will also be important for maximising participation and consumer value. We will work with stakeholders, including Distribution Network Operators (DNOs), to ensure that ESO markets are consistent and coordinated with other markets (D4.3.1).

As part of this we are exploring the potential for launching a whole system flexibility programme, under the Power Responsive banner, for all parties to come together to support policy makers in the delivery of flexibility markets that are aligned across transmission and distribution.

In early 2021/22, we will start by procuring frequency response in day-ahead timescales (D4.3.2). At the end of 2021/22 we will begin procuring reserve through new products. (D4.3.3)

We will build on these steps to deliver the full co-optimised auction for response and reserve at day-ahead or even closer to real time in 2022/23. (D4.3.4)

In addition to the five people set out in section 5.2.2.1, our proposed headcount to deliver these activities is as follows:

- Of the 13 FTEs outlined above two people are required in 2021/22 for balancing services development. A further one person is required in 2022/23. This requirement drops later in the period back to two additional FTE in 2024/25 and one in 2025/26. These people will be delivering 'first of kind' commercial solutions solving long-term operability challenges. This represents a fundamental change from our current work to improve balancing services markets through standardisation and simplification.
- The increase in 2021/22 and 2022/23 reflects the level of upfront work in the first few years of RIIO-2 ahead of getting contracts in place to support zero carbon system operation in 2025. We assume efficiencies towards the end of the period, as markets and processes mature, allowing us to scale down resource.
- In order to deliver a whole system approach to ESO markets, starting in 2022/23, one FTE will primarily engage with distribution system operation and other stakeholders. This will involve defining new ways of working to ensure that local and national markets are consistent and aligned.
- We currently have less than one FTE available to cover the activity in this area. With the anticipated

[77] https://www.nationalgrideso.com/document/84261/download

increase in distributed generation and advent of flexibility procurement at the distribution level, in the RIIO-2 period we expect this activity to ramp up significantly. It is likely to require at least double the existing resource in this area from 2022/23. The number of FTEs working on whole system markets is expected to rise to three in the last years of the period. This reflects the developments of the electricity distribution price control and the expected increase in market development at the distribution level. Of the additional 13 FTEs in 2021/22 three people will be supporting delivery of the whole system aspects of the IT investments in this area including the single market platform, ensuring interoperability with other markets. This will drop to two FTEs and then zero in 2025 as the projects mature.

### A sandbox, experimental market environment

We will adopt a 'learning by doing' approach as we transform balancing services markets and enhance procurement through the single markets platform. This will include trialling potential solutions through an experimental market sandbox environment.

Alongside our established markets, we will use the sandbox to test ideas such as markets for new services with the industry in a dynamic way. The sandbox will open doors to more innovation, enabling us to work with third parties to find new market solutions that can be tested out in a similar way. The sandbox means we can support new market entrants and technologies, while increasing speed to market.

We currently trial new approaches through integration and testing with operational systems. This can be slow because we need to protect operational processes. The market sandbox is an offline environment allowing us to test new balancing services products and markets with a subset of market participants.

We will be able to see if the approaches tested provide the outcomes required to operate the system securely at least cost. It will also tell us if the new approaches meet the needs of service providers. With the insight from the sandbox we can better target investments in operational systems with higher confidence that they will deliver the desired outcomes. Using this approach, we will reduce the 'regret spend' in developing and testing new products and ultimately drive down costs to consumers.

The market sandbox will be able to use live data from a market subset to test the impact of new products. This will inform us on which services we need to procure to operate a secure system.

Of the additional 13 FTEs, two people will be supporting adoption and delivery of the sandbox environment.

### Stakeholder views

We sought views from stakeholders on our approach to transforming markets through industry association roundtables, the Power Responsive Steering Group, bilateral meetings and at our RIIO-2 engagement events.

Many stakeholders, particularly renewable and decentralised parties, endorsed our approach to markets because deep, liquid markets can provide a strong investment signal.

We have received some feedback from an ERSG member that we should go closer to real time than day-ahead i.e. within-day. Conversely, some stakeholders, including generators, have told us that long-term contracts are needed to incentivise investment in new assets to provide services.

While we believe that close to real-time markets will be our standard for established balancing services markets, longer-term contracts may be appropriate for procuring services to meet long-term system needs (see box – procurement approaches for balancing services).

We have also heard from current and potential service providers, suppliers, an automotive company and BEIS that we need to be clearer on how our RIIO-2 proposals will build on work we have already started including:

- our *System Needs and Product Strategy* (*SNAPS*)
- current proposals for response and reserve
- ongoing development of the Platform for Ancillary services (PAS).

Further detail on the timeline for reactive power markets was also requested. Our delivery roadmap (section 5.2.4) now shows how the market platform will build on our ongoing work to reform markets in RIIO-1.

#### 5.2.3.2. A4.4 A single, integrated platform for ESO markets

The single markets platform (D4.4.1) is designed to remove the current pinch points identified by stakeholders and make participating in a range of markets easier.

This one-stop-shop will provide a portal as the focal point for parties of 1 MW and above to participate in all our balancing service markets. It will also provide access to the Capacity Market and the Contracts for Difference (CfD) auctions.

The platform will provide both historical and forecast data to support market participants' investment cases and decision-making. We will expand the platform as other markets develop, to allow the integration and data sharing required for efficient decisions across markets.

While our markets platform will provide a route to participate in all of our markets, service providers have impressed upon us the importance of common standards with other flexibility platforms, particularly at the distribution level. We will work with DNOs and others to ensure that common standards, including interoperable systems, a common data model and shared minimum specifications are central to the design and delivery of the single markets platform. This interface will also allow us and DSOs better visibility of

what services are being provided to whom, as well as any network limitations on service provision.

The foundation of the platform will be an asset register identifying each unique asset on the transmission or distribution system that is participating in the markets.

Participants will be able to manage their portfolio by aggregating assets from these underlying components to participate in the markets. Extensive stakeholder engagement has told us that this will transform the experience and make participating much more efficient for service providers.

Our intention is to build on our existing asset registers, including the Transmission Entry Capacity (TEC) register as well as the PAS register.

In addition, we will coordinate the development of asset register functionality to facilitate ESO markets with wider industry developments including a sector wide asset registration strategy as part of the delivery of Energy Data Taskforce Recommendation 4: Coordination of asset registration.[78]

Many of the existing processes require service providers to use different methods and systems to register and take part in our balancing markets. This creates an administrative burden on both market participants and ourselves. Manual input also increases the risk of human error and associated rework.

The market platform will significantly reduce the time and effort required to participate in markets:

- Communications on processes including contracting, testing, procurement events, performance monitoring and reporting, payment and portfolio management will all move from email to communication via the portal. This will put all the relevant information in one place.
- Data input and management for processes including procurement events and performance monitoring will move from offline spreadsheets to data management and communication via the single markets platform.
- Messaging capabilities and validation rules will enable online decision support, for example by telling market participants which markets their assets are eligible for. The system will also notify them if they are submitting non-compliant information.

The markets platform will significantly reduce the overhead of market participation by streamlining the number of process steps, manual input and checking. This will make market outcomes more efficient.

A range of service providers, suppliers and DNOs have expressed concern about the prospect of large centralised IT projects. Consistent with the approach to IT delivery outlined in Theme 1 and Annex 4 - Technology investment report, the single markets platform will be a modular system delivered in an agile way. In addition, it is expected that much of the development and integration will be outsourced to our delivery partners.

It will build on the Platform for Ancillary Services (PAS) project in RIIO-1. We will integrate the single markets platform with our Control Centre capabilities. More services and functionality will be added incrementally through the first two years of RIIO-2, starting with frequency response in day-ahead timescales early in 2021/22. New reserve products will be procured through the platform towards the end of 2021/22.

The markets platform will also employ the user interface capabilities delivered through the digital engagement platform investment. This will provide ESO stakeholders with a common experience across all our digital interfaces, including the data portal and the connections portal.

Of the 13 additional resources proposed, two will be focused on delivering auction functionality for closer to real-time markets as well as ensuring that access to new markets is integrated through the market platform. This is a new activity. An additional four people will be required to support the delivery of single market platform in 2022 and 2023. This will tail off in the later years as the project is delivered.

### Stakeholder views

We sought stakeholders' views on our approach to transforming access to our markets via the markets platform through trade association roundtables, the Power Responsive Steering Group, bilateral meetings and at our RIIO-2 engagement events.

A broad range of stakeholders, including generators, suppliers and aggregators, endorsed our proposal to streamline market participation through the markets platform. They find the current approach of managing assets, particularly aggregated assets, in the markets extremely cumbersome.

Smaller market participants have welcomed this proposal too because a significant amount of their time is spent participating across different markets. The markets platform is seen as important in making the process faster.

Our proposal to register individual rather than aggregated assets was widely welcomed by a diverse range of service providers. Together, these changes allow participants to manage their portfolio of assets flexibly in a single location. It will significantly reduce the cost of participating in markets. A number of stakeholders, including a supplier and an automotive company, questioned why we think 1 MW is the appropriate threshold for registration on the single markets platform. Further engagement with service providers suggested that this is a sensible number as it allows a wide range of service providers to contract with us. They thought that below 1 MW the ESO would not be adding additional value and that aggregators are better placed to interface with smaller resources. A community energy group has also told us that market entry down to 1 MW would encourage participation from community energy-scale generation sites.

We have also been asked to provide clarity on how the asset register underpinning the single markets platform

[78] https://es.catapult.org.uk/news/energy-data-taskforce-report/

relates to other industry initiatives on asset registers. We have articulated how our proposals support the recommendations of the Energy Data Taskforce for a sector-wide asset registration strategy.

Many parties participate in both the balancing services markets and the Capacity Market. Looking at their feedback on the separate markets, we recognised that they experience similar pain points in both. There is significant duplication of effort in managing their participation across both markets.

We have responded to stakeholder feedback by moving away from our original proposal of a new platform for balancing alongside an improved Capacity Market portal. Instead, we will create a single integrated platform to access both markets. This approach will also be simpler to build and maintain than two separate systems.

We have been told consistently by service providers that we need a joined-up approach to flexibility procurement with distribution markets. At the same time, we were cautioned not to over-extend ourselves by trying to provide one route for procurement of flexibility services for both transmission and distribution system needs.

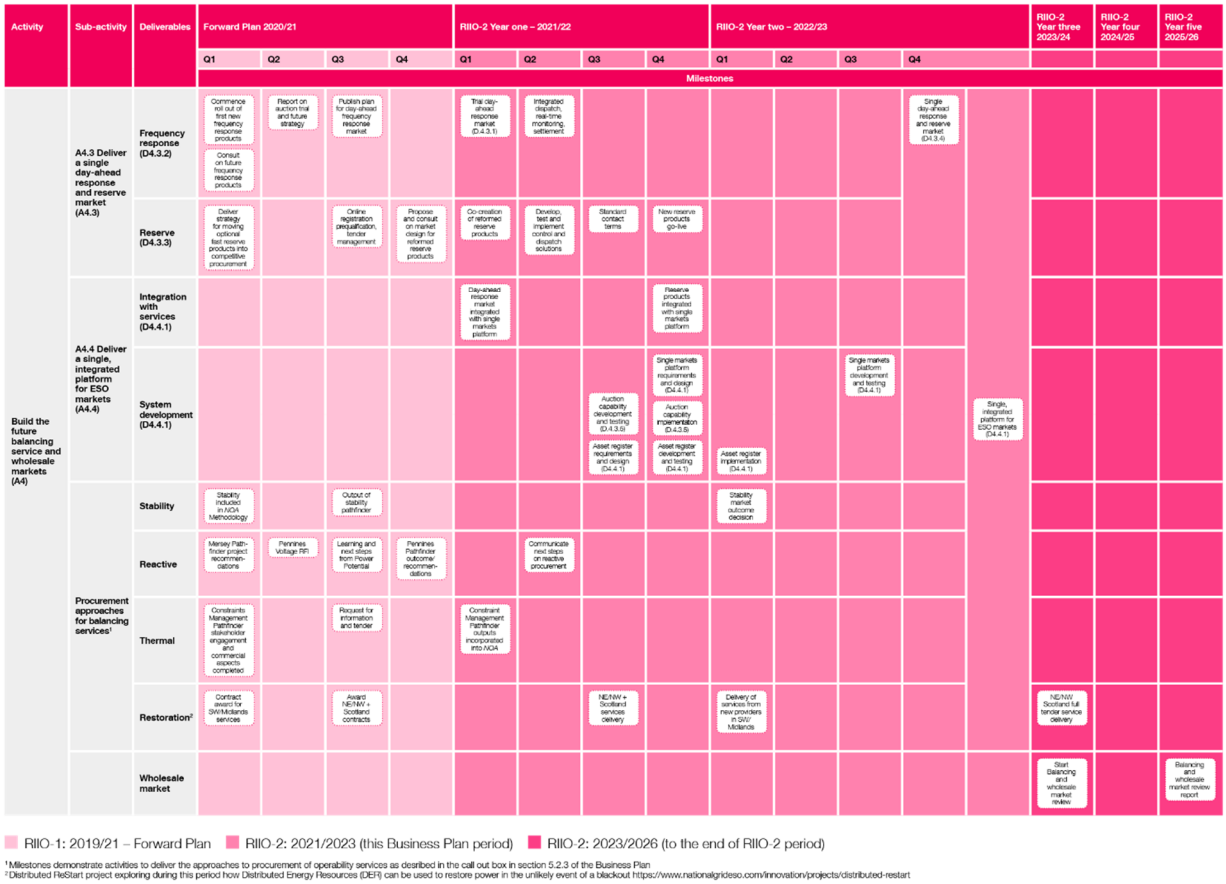
Therefore, in this Business Plan we have clarified that the single markets platform will provide access to markets administered by the ESO. We have also heard from a number of service providers and a DNO that we should draw out more clearly the transmission-distribution aspects of our proposals and reflect the importance of aligning national and local flexibility markets. We have made it clearer that our single markets platform will interface with other market platforms, including those at the distribution level, and that we will work closely with DNOs when the distribution level is involved.

Whilst acknowledging the stretching ambition of the single markets platform, service providers and DNOs have expressed concern about “monolithic” IT projects. Consistent with the IT strategy underpinning our RIIO-2 plans, we have been clear that the single markets platform will be delivered in an agile and modular fashion.

Service providers and an industry association have also emphasised the importance of a robust consultation process with industry throughout the design of the platform. They said that IT system development must be pursued in a way that avoids missed deadlines or delivery failures.

In order to achieve this objective, delivery of the market platform will align closely with the design authority described in Theme 1.

## 5.2.4. Investment roadmap




[1] Milestones demonstrate activities to deliver the approaches to procurement of operability services as described in the call out box in section 5.2.3 of the Business Plan
[2] Distributed ReStart project exploring during this period how Distributed Energy Resources (DER) can be used to restore power in the unlikely event of a blackout https://www.nationalgrideso.com/innovation/projects/distributed-restart

*Figure 25: Investment roadmap*

## 5.2.5. Cost-benefit analysis

We estimate the gross benefits of the transformational activities set out in section 5.2.3 to be £106 million over RIIO-2. This gives a net present value (NPV) of £67 million over RIIO-2.

The quantitative gross benefits were calculated firstly by considering the liquidity of the reserve and response market – about £500 million on a 12-year average. Based on our Power Responsive work we have seen prices drop and estimate that a further five per cent reduction is credible for these activities.

Secondly, we have looked at buying optimal volumes of response – about £190 million on a 12-year average. Again, based on our previous experience of moving closer to real time we estimate a further five per cent reduction is credible.

This is against a baseline assumption of the existing participation in balancing and capacity markets without a single platform or reduced participant size to 1 MW.

This activity is dependent on the following transformational activities:

1. A1 Control centre architecture and systems (Theme 1) – Ensuing the Control Centre has the tools required to dispatch new players in the reserve and response markets
2. A16 Digitalisation and Open Data – Ensuring that the data flow between the ESO and participants is open allowing participants to understand the market requirements.

This also enables, through competitive flexible markets, the following transformational activities:

1. A1 Control Centre architecture and systems (Theme 1) – Ensuring the Control Centre has the short-term tools required to dispatch new players in the reserve and response markets.
2. A5 Transform access to the Capacity Market (Theme 2) – Sharing the single markets platform.
3. A9 – A11 *NOA* enhancements (Theme 3) - Ensuring commercial solutions have the markets.
4. A15 Taking a whole electricity system approach to promote zero carbon operability (Theme 4) - Ensuring longer term operability issues could be address by commercial, market-based solutions.
5. A17 Digitalisation and Open Data - Providing additional data from competitive markets.

In order to deliver this activity, we require third parties to engage with the new system and markets. There may be small costs associated with adapting to these new arrangements, but we believe these are within the scope of third parties' ongoing investments.

Our analysis suggested that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £3 million and £115 million.

See Annex 2 - CBA Report section 3.1 for more details.

## 5.2.6. Other options considered

We considered three options for building the future balancing service and wholesale market:

1. A single, integrated platform for all ESO markets including the EMR Capacity Market.
2. A single, integrated platform for ESO markets not including the Capacity Market: The new integrated platform would include the ESO markets noted above, apart from the EMR Capacity Market, which would continue to develop its own standalone platform.
3. Ongoing activities and enhancements only to maintain current approach of monthly and quarterly tenders for balancing services with a separate system for the Capacity Market.

We have taken forward option 1. Full details of the options considered are in section 3 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.4.1 of Annex 3 – Stakeholder report.

## 5.2.7. Measuring performance

### 5.2.7.1. Performance metrics

**Metric 6 - Proportion of balancing services procured through competitive means**

We will measure the proportion of balancing services that are procured through competitive markets.

We are proposing a suite of measures to give visibility of the level of competition in our balancing services markets. It is proposed to use three different metrics updated every quarter, covering the total spend, the total volume procured (where applicable), and the average market price paid. The measures will be by service area rather than individual market (e.g. 'frequency response' rather than FFR) to give a holistic view of comparable products and markets.

The data for each measure will be split into two categories:

- competitively procured
- bilateral competitively procured.

This includes all regularly held markets open to prequalified providers, such as Mandatory Frequency Response, Firm Frequency Response (FFR), STOR, Fast Reserve, the Auction trial and others. It also includes any procurement that involved an open and competitive tendering process, including but not limited to Enhanced Frequency Response, Black Start Competitive Procurement Events and Pathfinders.

Measures 1 and 2 (spend and volume) will also include a target percentage for competitively procured. This target represents our ambition to move as much of our balancing service procurement activity into competitive markets as possible, and the targets have been

identified based on an estimate of the effect of our deliverables and developments on the markets.

We will do this firstly by identifying all the services that we think should be procured through markets to deliver the best outcome for consumers. For more details on the procurement approach, see section 5.2.3.

This will promote consumer benefit by ensuring we are striving to buy the optimal volume of balancing services via the lowest cost approach. We believe this is a good measure because while many factors influencing the ultimate cost of balancing services are outside our control, the means of procurement are within our control.

Service providers and trade associations have told us that this would be an appropriate measure. Both have said that the transparency of performance in this area is important and that this metric and associated target will help to provide greater clarity on the current number of bilateral contracts and our proposed investments during RIIO-2.

We are proposing a target of 90 per cent for contracts procured competitively by spend for frequency response and reserve by April 2022. This is against a current baseline of 81 per cent. We are also targeting for reactive power, Black Start and constraint management to have ten per cent, 20 per cent and 20 per cent respectively of contracts procured through competitive means respectively; all of which currently have no contracts competitively tendered.

## 5.3. A5 Transform access to the Capacity Market

We manage an end-to-end process for all Capacity Market participants, supporting them through pre-qualification and multiple annual auctions through to the issuing and management of capacity agreements. We are also responsible for running the pre-qualification and auctions for CfDs.

The number of applications for participation in the Capacity Market has risen fourfold since the start of Electricity Market Reform (EMR) in 2014, and the number of units below 100 MW has increased by 200 per cent. In 2017/18 we received almost 2,000 applications of which 91 per cent were below 100 MW.

By 2025, we will deliver security of supply against a clear standard agreed with the Government - currently three hours Loss of Load Expectation (LOLE). We will be responsible for key elements of the Capacity Market; advising the Government on the volume to purchase, running auctions and managing agreements.

By transforming our approach to these activities, we will ensure security of supply through a technology mix that supports the UK's 2050 carbon reduction target at the lowest possible cost to consumers.

All technologies will be able to participate in the Capacity Market fairly and participants will feel that they are appropriately rewarded for their contribution to security of supply.

We will deliver an enhanced platform for the Capacity Market within the single, integrated platform for ESO markets. This will build on the new EMR portal we are currently developing. It will also use the latest data technology to guide participants through the process.

In addition, we will improve our security of supply modelling to keep pace with technological and market changes.

CfDs are a key mechanism to incentivise investment in new low carbon generation. We will continue to play a leading role in running the CfD process and facilitate the move towards a net zero carbon future.

The EMR function is split into three areas: EMR Stakeholder and Compliance; Capacity Market (CM) and CfD Auctions; and EMR Modelling.

### 5.3.1. Costs

| Transform access to the Capacity Market | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 4.6 | 1.2 | 0.9 | 0.9 | 0.9 | 0.9 |
| Opex (£m) | 2.7 | 4.2 | 3.9 | 3.9 | 3.6 | 3.6 |
| FTE | 32 | 35 | 34 | 34 | 31 | 31 |

**Highlights**

We propose to improve our security of supply modelling capability to account for greater interconnection, intermittent and distributed generation. We will continue to support the Capacity Market process though improving the service we provide to customers and making our online-based services more efficient and able to support our customers more effectively.

Further information on the IT investments referenced in this chapter (IT reference 320 - EMR and CfD Improvements) can be found in Annex 4 -Technology investment report.

### 5.3.2. A5.1 Ongoing activities and enhancements

#### 5.3.2.1. EMR stakeholder and Compliance, CM and CfD auctions

In the changing energy landscape, we support new and existing participants that wish to compete in evolving capacity and CfD markets (D5.1). We ensure that our processes and systems comply with all EMR rules and regulations, and we support stakeholders to ensure that

they are compliant through the EMR processes. Our ongoing activities include:

- creating guidance documents, hosting workshops and surgeries and running a dedicated help desk to deal with customer queries
- working with BEIS, Ofgem and stakeholders to ensure rules, regulations and processes enable competitive capacity procurement and facilitate participation of new technologies and players
- working with BEIS and Ofgem to implement the longer-term solutions identified in their Five-Year Reviews. As part of this, we will support the development, and drive the implementation, of the Capacity Market and CfD rules.

We are running a project to improve the EMR portal significantly during the RIIO-1 period. This will facilitate the implementation of rule changes in a swift and efficient way. We are enhancing the portal in response to stakeholder feedback. Parties want a system that is easy to use and enables them to navigate the process painlessly. Initially this will require one additional FTE to support. As improvements and operational efficiencies are realised the number of FTE will reduce by three from today's level.

Simpler rules and the latest data technologies will enable participants increasingly to use the portal for self-service. Together with greater automation of our processes, this will enable us to focus on dealing with more complex customer queries.

We provide modelling expertise to inform government decisions on future Capacity Market auction parameters and electricity security of supply. We will continue to improve our modelling in RIIO-1 and we will engage with stakeholders to develop our analysis.

## 5.3.3. Transformational activities

**The net present value of activities to transform access to the Capacity Market is estimated at £62 million, and to deliver £8 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2022/23 onwards.**

As shown above we continue to improve our approach to compliance and stakeholder engagement in RIIO-1. To achieve our ambition to be able to operate a zero carbon system by 2025 and meet stakeholders' needs, we will need to transform the processes to help facilitate market participation.

### 5.3.3.1. A4.4 Deliver an enhanced platform for the Capacity Market within the single, integrated ESO markets platform

In future, we will need to maintain security of supply with much higher volumes of low carbon generation, for example at least 24 GW of offshore wind and 19 GW of solar by 2030. There will also be an increase in flexible sources of energy, such as demand side response and storage at least doubling by 2030.

We will work with stakeholders to improve the experience of customers and ensure our systems and processes do not act as a barrier to entry. Instead, they should facilitate wider market participation.

As described under the single markets platform (A4.4), participants have told us that this platform will improve their experience of market participation, improving decision making, reducing costs and ultimately will help to drive further market efficiencies by reducing barriers to entry for all Capacity Market participants (D4.4). The latest data technologies will be used to help participants understand how they can participate in the Capacity Market and will guide them through the process.

#### Stakeholder views

Stakeholders have broadly welcomed the inclusion of the Capacity Market in the single markets platform. This makes it easier for them to make decisions to optimise their participation across multiple markets and reduces administration.

### 5.3.3.2. A5.3 Improve our security of supply modelling capability

In a world of rapidly evolving energy systems, we will need two additional FTE highly skilled analysts capable of employing the latest modelling techniques so that we can keep pace with these changes.

We will need to develop new data sets, models and methods to correctly model the growing interactions of new generation and the demand side (D5.3). This will ensure their contributions to security of supply remain appropriate and help to ensure the GB Reliability Standard of three hours LOLE[79] is met.

To facilitate this enhanced modelling, we need access to granular data for all demand and generation sites' output. We also require capacity data so that smaller flexible sources can be modelled correctly. Our models will need further development to model the contribution from new combinations of technologies e.g. co-located or hybrid sites where there is a network connection limitation.

With growing interconnection across Europe and between Great Britain and other countries, expected to be at least 16 GW by 2030 compared with 4 GW today, our pan-European modelling needs to be able to better model different markets. In anticipation of this, and the implementation of the European Clean Energy Package, we expect to improve our pan-European modelling in 2021 and 2022. This will include participation of interconnectors and/or European generators in the Capacity Market.

It will require significant development of the model and data collection to correctly model the interactions of future plant mixes within Europe. It will have to factor in the different operating regimes and security of supply

[79] https://www.ofgem.gov.uk/system/files/docs/2019/07/capacity_market_five_year_review_report.pdf

standards across the various European capacity markets.

We intend to continue to use the established prioritisation process with BEIS, Ofgem and the Panel of Technical Experts (PTE) to decide which modelling developments to undertake.

However, in 2021 and 2022 it is likely that these will focus on enhancing the modelling for distributed generation, duration-limited storage and demand response. We will maximise use of the data from upcoming distribution code modifications[80] scheduled for approval in 2020.

### Stakeholder views

At the Capacity Market launch event, Capacity Market participants recognised the need for us to enhance our modelling tools to better analyse the growing interactions of new technologies.

Market participants agreed that to facilitate this enhanced modelling we require access to more granular data for all demand and supply sources and that our analysis needs to be developed to be able to model the contribution from new combinations of technologies such as co-located or hybrid sites.

## 5.3.4. Investment roadmap

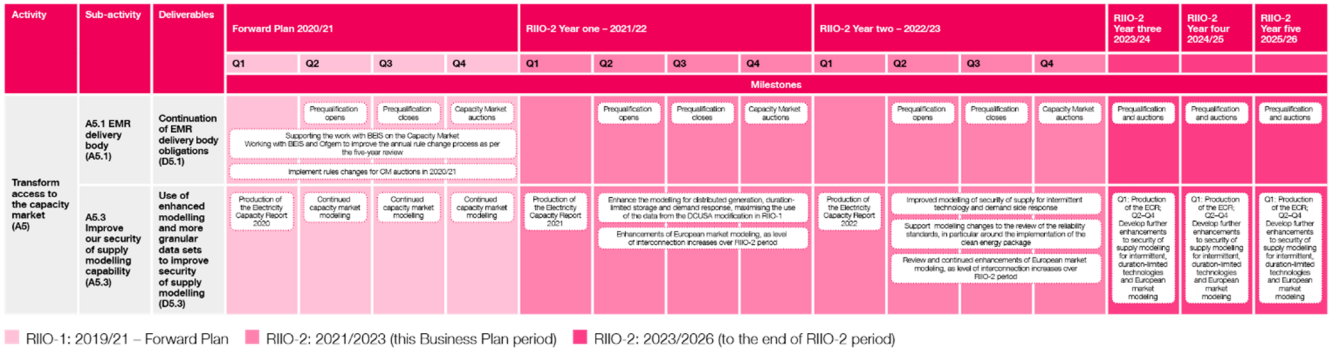



*Figure 26: Investment roadmap*

## 5.3.5. Cost-benefit analysis

We estimate the gross benefits of this activity to be £74 million over RIIO-2. This gives an NPV of £62 million over RIIO-2.

We calculated these quantitative benefits by firstly considering the enhanced modelling capability.

In our analysis we consider the two possible scenarios of reduced risk of our recommendations on the capacity to secure being too low or too high:

1. Reduced risk of recommendations being too low: Save consumers the equivalent of purchasing at four-year ahead (T-4) an additional 1 GW of capacity, instead of at year ahead (T-1) or short-term balancing markets.
2. Reduced risk of recommendations being too high: Save consumers the equivalent purchase cost of 1 GW of capacity at T-4.

Given the complexity (with limited data and more uncertainty) in determining scenario one's benefits we have used scenario two's benefit in our CBA calculation. The average clearing price over the four T-4 auctions held to date, £17.08/kW, applied to 1 GW[81] this would save consumers £17 million per year.

Secondly, by reducing barriers to entry, we will remove the need for unnecessary resource for the around 400 Capacity Market customers, and this saving will ultimately be passed through to consumers.

This is against a baseline assumption of the existing participation in capacity markets and only ongoing modelling capability.

This activity is dependent on the following transformational activity:

1. A4 Build the future balancing service and wholesale markets (Theme 2) – Sharing the single markets platform. All of the costs for the single markets platform are realised in this activity.

In order to deliver this activity, we require third parties to fully engage with the new system. There may be small costs associated with adapting to these new arrangements, but we believe these are within the scope of third parties' ongoing investments.

Our analysis suggests that, accounting for market, delivery and third-party uncertainty, the net present value could credibly be between £22 million and £94 million.

See Annex 2 - CBA report section 3.3 for more details.

[80] https://www.dcusa.co.uk/

[81] This saving is equivalent to approximately two percent of the average volume purchased in the last four T-4 auctions. This percentage is comparable with EMR demand forecasting incentives as a benchmark; See Special Condition 4L. Financial incentives on EMR at https://www.ofgem.gov.uk/licences-industry-codes-and-standards/licences/licence-conditions

### 5.3.6. Other options considered

We considered three options for transform access to the Capacity Market;

- A single, integrated platform for all ESO market, including the EMR Capacity Market and enhanced modelling capability.
- Enhanced modelling capability only. This option would only look to enhance our modelling capability, while not integrating EMR within the single markets platform detailed above.

We have taken forward option 1. Full details of the options considered are in section 3.3 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.4.2 Annex 3 – Stakeholder report.

### 5.3.7. Measuring performance

#### 5.3.7.1. Performance metrics

**Metric 7 – EMR decision quality**

We propose to measure the proportion (per cent) of prequalification decisions we make that get overturned by Ofgem in the Tier 2 disputes process. The lower the proportion of our prequalification decisions overturned by Ofgem, the more efficient the prequalification process is, particularly for applicants. The measure will be evaluated *ex post* and happen after each annual auction. Stakeholders have told us they want us to have an efficient and transparent process that delivers quality decisions in line with government and Ofgem requirements. The quality of decision-making is a measure that supports these objectives and builds on the current metrics on EMR outside the *Forward Plan* framework. We are proposing a target for the number of items overturned to be lower than the previous two year average.

**Metric 8 – EMR demand forecast accuracy**

We also propose a metric on the accuracy of both the T-1 and T-4 peak demand forecasts where we will measure the percentage difference between our peak demand forecast and outturn peak demand. The accuracy of our forecasts affects how much capacity is secured in the auction, and therefore how much consumers pay. There is therefore a direct benefit to consumers in the measurement and increased accuracy of the T-1 and T-4 forecast. We will measure the target and report on T-1 and T-4 separately for the same reasons above. Service providers and trade associations consulted have told us that this would be an appropriate measure. These also reflect the current metrics on EMR, outside the Forward Plan framework. We are proposing to have a target of between two and four per cent error on our T-1 forecast and four to eight per cent on our T-4 forecast. The difference is due to the longer time periods that are required for the T-4 forecast and the greater difficulty in forecasting as a result.

## 5.4. A6 Develop code and charging arrangements that are fit for the future

Stakeholders have consistently told us that the current codes and code processes are not fit for purpose. There are currently 11 separate industry codes and over 10,000 pages of codes and other licence documentation which participants must follow.

**BEIS-Ofgem Energy Codes Review**

The Government and Ofgem have launched the Energy Codes Review, which is a joint comprehensive review into the energy codes that govern our energy system. The aim of the review is to consider options for improving the existing arrangements, including scope for fundamental reform.
This suggests a range of options for improving code processes and governance. There is the potential for merging some codes and enhancing the role of code bodies, or even radically changing the structure of code governance, for example, through introducing a strategic body or an integrated rule-making body.
We are taking a leadership position in this review and have recently published a thought piece containing our views[82]. We will advocate for changes aligned with our desire to transform the process to amend our codes and continue to review the scope of this transformational activity as our thoughts on the Energy Codes Review develop in future.

We want our codes to facilitate the rapid change needed to deliver the UK's 2050 net zero commitment. By 2025, our codes and code governance will no longer be seen as a barrier to change. Code modification will work for hundreds of market participants, rather than the tens of participants for which the current process was devised.

We sought views on our ambitions and proposals at our RIIO-2 stakeholder events, and on the proposals in the July and October draft Business Plans at stakeholder events and meetings with industry associations.

The aim of this work is to transform the process to amend our codes. It will allow strategic change to be prioritised and implemented efficiently, while ensuring that it is much simpler and less time-consuming to make incremental improvements. This will improve access for all participants and give us the flexibility to deliver forward-looking change much more quickly.

Transforming the codes process will also deliver important consumer benefits in both the near term and in the longer term. Modifications will be delivered more efficiently, innovation encouraged and there will be greater harmonisation across systems. This all

[82] https://www.nationalgrideso.com/sites/eso/files/documents/ESO%20Reforming%20Code%20Content.pdf

ultimately contributes to more efficient and competitive markets, reducing wholesale market costs and creating consumer benefits.

The ongoing Energy Codes Review[83] could have the potential to change some of our plans in this section. As a result, our draft costs and deliverables may be updated ahead of RIIO-2.

## 5.4.1. Costs

| Develop code and charging arrangements that are fit for the future | Five-year strategy | | | | |
|---|---|---|---|---|---|
| | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 8.6 | 15.5 | 10.8 | 11.0 | 11.9 | 12.6 |
| Opex (£m) | 6.7 | 13.2 | 14.0 | 14.8 | 15.6 | 15.6 |
| FTE | 50 | 70 | 74 | 76 | 80 | 79 |

### Highlights

We will step up our European engagement as code changes here will support zero carbon operation in Great Britain and across Europe. We will also need to invest in IT to support these changes across the ESO. We will drive our ambition to transform the codes process, with an increasing focus on customer service, prioritisation of code modifications and strategic thinking. An investment in 2021/22 is for our charging and billing asset health project.

Further information on the IT investments referenced in this chapter (IT reference 270 - EU regulation; IT reference 280 - GB regulation, IT reference 290 - Charging and billing asset health; IT reference 300 - Charging regime and CUSC changes; IT ref 330 - Digitalised code management) can be found in Annex 4 - Technology investment report.

## 5.4.2. A6.1 Ongoing activities and enhancements

### 5.4.2.1. Code management / market development and change

We facilitate changes to the Grid Code, Connection and Use of System Code (CUSC), System Operator Transmission Owner Code (STC) and Security and Quality of Supply Standard (SQSS) (D6.1), in line with the principles of being open and transparent about the change process and enabling all parties to contribute their views. We also deliver and support regulatory change across key markets and codes to better facilitate competition and deliver strong consumer benefits. Our ongoing activities include:

- providing thought leadership and working with key stakeholders to enable the prioritisation and delivery of key future framework changes over a ten-year timescale.
- administering our codes as a code manager with enhanced legal capabilities to help drive strategic change. We will also increase our ambition to deliver both strategic and incremental change to facilitate competition and deliver consumer value.

Transformational activities in this area will be covered by the 'transform the process to amend our codes' activity (A6.4) described below. This also includes further details on our code manager proposals. This activity requires no change in FTE over the RIIO-2 period.

### 5.4.2.2. A6.2 EU code change and relationships

The Great Britain electricity system is interconnected with our European counterparts. We therefore play an important role working with domestic and European institutions and stakeholders to support a well-functioning market that delivers in the interest of consumers.

Our deliverables range from advocacy and shaping emerging legislation, to implementing requirements in our processes, systems and frameworks, and delivering ongoing compliance and reporting obligations (D6.2).

There are numerous ENTSO-E working groups and expected consultations from ENTSO-E and institutions such as the European Commission, the Agency for the Cooperation of Energy Regulators (ACER) and Ofgem that will affect Great Britain's consumers over the RIIO-2 period.

This includes the continued implementation of changes related to the Third Energy Package, new changes as a result of the Clean Energy Package, and a potential new legislative package in future under the new European Commission. The scale of the energy transition has meant that ENTSO-E's remit has been growing year on year. Today there are more priorities and topic areas than ever before and we provide resource to around 50 working groups at any one time.

Over RIIO-2, we will increase the size of the team supporting this area to step up our presence in the key working groups and ensure we respond to consultations where we can influence on behalf of Great Britain's consumers. We believe the current team is under-resourced to deliver today's workload; this has been noted by stakeholders in terms of attendance at meetings and contributions to EU consultations. This activity needs support from across the ESO, as EU driven change affects various parts of the business. This resource would sit within those teams to support the EU changes. We estimate that seven FTE are required across the business to support the level of EU change expected. Based on the increased workload identified, we think a central team of seven FTE would be able to fully engage in EU meetings and contribute to

[83] https://www.ofgem.gov.uk/publications-and-updates/energy-codes-review

consultations. Thus, a fully resourced team to deliver EU obligations is an additional 14 FTE, assuming the UK remains closely aligned to ENTSO-E. This means seven additional FTE to support the increase in European engagement required and seven FTE to support the requirements to support European code change IT investments which are required to deliver this change into the ESO. This level is based on our previous experience in implementing European code changes, with, for example, efficiencies learnt from the new EU market for replacement reserves (project TERRE) lowering IT costs for implementation of manual frequency restoration reserves (Project MARI), even though MARI is a larger and more complex project than TERRE. See Annex 4 – Technology investment for more details.

#### 5.4.2.3. A6.3 Industry revenue management

We are responsible for managing, collecting and disbursing charges relating to the operation of the transmission system with an annual value of around £4 billion (D6.3). We are committed to having charging and billing processes that meet the needs of our customers. As the market changes, and as transmission and balancing charges evolve, we recognise the need to ensure that arrangements for how parties pay their charges keep pace.

Over the RIIO-2 period the focus will continue to be on transforming the experience of customers working with us, whilst also ensuring that we can deliver efficiencies in how we run the processes over time. This will include delivery of new charging tools and processes such as better digital interfaces for our customers and more flexible processes and systems to implement the pipeline of changes to network charges as they come into force over this period. An investment in 2021/22 in our charging and billing asset health project will require an additional three FTE for one year to support.

Ofgem's 25 October decision document on the ESO's RIIO-2 financial methodology and roles framework states that it will consult on where the cash flow risk associated with Transmission Network Use of System (TNUoS) collection charges would be best held; whether by the ESO or another party. Ahead of further consideration of this issue, our Business Plan assumes that the revenue management role remains with the ESO. For more discussion on the cash flow risk of this role see chapter 9 – Financing our plan.

### Enhancements made during RIIO-1

#### Code management

We are facilitating significantly more modifications a year, from an average of 24 new modifications a year across 2013-15 to 42 being raised in 2018. In 2017 we launched Charging Futures[84] to facilitate balanced industry-wide debate on future network charging reform. More recently we have been working with our customers to set out our plan for further improvements to our processes and service.

#### Market development and change

Throughout RIIO-1 we led and supported significant changes to industry codes to better facilitate competition and to deliver significant consumer benefits. We continued to do so despite the increasing scale and complexity of change and the significant changes to markets we have seen over the RIIO-1 period. The breadth of these changes varied from targeted changes to more fundamental reforms such as in relation to Project TransmiT[85] or through revisions to the User Commitment Methodology. In recent years, due to the increasing challenges and expectations of others and ourselves, we have also become more ambitious in our change, such as with the launch of the Wider Access to the BM programme. We expect this ambition to continue to increase in future.

#### EU code change and relationships

We have implemented requirements from the Third Energy Package and European Network Codes, which include improvements to support to cross-border trading of electricity and approach to integrating renewable energy. To support our activities, we have introduced an annual prioritisation processes to ensure we are effectively participating in ENTSO-E working groups and engaging with stakeholders in Great Britain. We have also re-structured and re-prioritised our internal operating model for European activities. More recently we have been conducting EU Exit preparatory activities internally and externally, including engaging with government, Ofgem and stakeholders.

#### Charging arrangements

Our focus is to transform the customer experience for network charging; helping our customers be successful ultimately driving down costs to end consumers. This is being achieved through delivery of a pipeline of improvements including the way we deal with charging queries, improved guidance and education materials and a licence change to allow us the option to roll the reconciliation of adjustment to our incentive outcome to future years. This will increase certainty around the Balancing Services Use of System (BSUoS) charges that market participants face as a result of incentive payments awarded to the ESO.

Our *Forward Plan 2019-21* highlights the further enhancements we will undertake throughout the rest of the RIIO-1 period.

## 5.4.3. Transformational activities

#### 5.4.3.1. A6.4 Transform the process to amend our codes

This activity will allow the strategic change that stakeholders are really pushing to be prioritised and implemented efficiently, while ensuring that it is much

[84] http://www.chargingfutures.com/

[85] https://www.ofgem.gov.uk/electricity/transmission-networks/charging/project-transmit

simpler and less time consuming to make incremental improvements. We will develop a transparent prioritisation process and agreed criteria that are aligned to the strategic direction set by BEIS and Ofgem. Stakeholder-led change will continue to be important and will feed into this process.

The electricity system is currently transitioning from a world with large, transmission connected thermal plant to small, distribution-connected renewables. It is also changing from a static, passive consumer base to a dynamic, engaged one. The existing code system is not fit for purpose in this new world. Without action, it will continue to be an increasing barrier to innovation, competition and consumer value.

Effective involvement in the code system and the code change process requires technical expertise and significant resource. This means that engagement with the codes system is disproportionately low for newer and smaller parties due to resource constraints and the high costs of participation. In turn, this allows larger incumbents to dominate the code change process.

Overcoming these challenges requires greater accessibility for all participants and the flexibility to deliver forward-looking change at much greater pace. Codes and code governance processes need to transform from being viewed as a blocker to change, to becoming a key enabler to facilitate this transformation and the ability to operate a zero carbon system from 2025.

As code manager under a transformed process to amend our codes and building upon our code management foundations, we will (D6.4):

- create and own a strategic and incremental industry change plan for our codes.
- seek more explicit powers to assess and prioritise code change to ensure the delivery of more strategic change which is expected to be of benefit to consumers.
- seek more explicit powers for managing the change process. This will help ensure change is delivered at pace, relevant modelling is undertaken if not available, and we have more ownership of change development and delivery throughout the process.
- place more emphasis on engagement with wider stakeholders outside our standard working groups. For example, by continuing to embed and learn lessons from the approach taken through Charging Futures.
- make better use of technology through initiatives such as code digitalisation, a more customer-friendly and accessible website, and better information management and communication channels.
- provide better user guidance and supporting documents that support self-service, but also have a service-focused and well-resourced team available to be a great critical friend where stakeholders require. Support could include an allocated code account manager as well as industry training events on certain elements of the code.
- take on additional responsibilities for developing code modification and directing incremental improvements for our own codes. For example, analysing and modelling change proposals, engaging stakeholders on proposals and developing options.

Building on the foundations of market development and change, we will also:

- place extra emphasis on larger and more coordinated programmes of work for our codes, in line with wider industry strategy. For example, we would take a more active and leading role in strategic change, particularly in relation to ongoing charging and access reforms, and Charging Futures responsibilities.
- give more focus to other industry change, which is less directly relevant to ESO but where we feel we could add value to the process. For example, for incremental and strategic change we could become more involved in other markets and codes, such as the Balancing and Settlement Code (BSC[86]) or DCUSA changes as and where we believe we could add value as ESO. In one example, Elexon[87] is currently leading a design working group for market-wide settlement reform. This is expected to have significant positive consumer impact, unlock flexibility and impact our own codes and processes, but we have had limited involvement to date. In our transformed position, we would aim to be much more involved in similar programmes in the future and bring an additional ESO perspective.

Therefore, in 2021 and 2022 under new regulatory and funding arrangements provided by RIIO-2, we will seek a licence change to support the code transformation process. We will enhance our code management powers and responsibilities and, in parallel, further drive the agenda for both strategic and incremental code change. We expect that an element of this change will be reform of the code change process itself. This will ensure it facilitates agile, consumer-focused change, and is not an obstacle to such change. This will initially require an additional three FTE in each year of RIIO-2 who will, in collaboration with the wider industry, start to transform code processes to begin our transition into a code manager. Further details of the activities that will be undertaken by our code manager role are highlighted in this section, but key early focus of the team will be on process development to create and own a strategic and incremental industry change plan in respect of our codes.

In addition, we will also be seeking more explicit powers to assess and prioritise code change and seek necessary amendments to the management of the change process. We believe an incremental approach, rather than a one-step implementation, will best deliver this process transformation allowing the gradual build-

[86] https://www.elexon.co.uk/bsc-and-codes/balancing-settlement-code/

[87] https://www.elexon.co.uk/

up of skills and capabilities alongside the corresponding legislative changes required to fully fulfil our ambition.

An incremental transformational programme will also allow the current FTEs to continue to focus on implementing important industry change. The increase has been developed by considering: benchmarking against other code administrators such as for the Smart Energy Code; the volume of potential code change driven by the low carbon transformation; as well as the volume of resource committed by Ofgem to support Significant Code Reviews which we believe is a large undertaking for a code manager that will require significant knowledge and expertise.

For this activity, we have undertaken a break-even analysis, for details see section 3.4 of Annex 2 - CBA report.

### Stakeholder views

As previously noted, stakeholders, including market participants and Ofgem, have welcomed our proposal to take a more proactive role in driving industry change.

Throughout our engagements via trade association meetings, our RIIO-2 engagement events and code panel meetings we consistently heard common concerns on the existing market frameworks in terms of too much complexity, the slow pace of change and limited opportunity for smaller or new players to participate in modifications.

We also heard that parties require more support in the code modification process. In one of our RIIO-2 webinars we asked a poll question on the potential characteristics of a code manager. Most respondents agreed that the characteristics we had presented were appropriate.

The stretching level of ambition was also noted in code reform and a couple of stakeholders were concerned that we would not have the appropriate level of resource to deliver this activity effectively. We have planned to resource this activity appropriately to support delivery.

We have been asked to be clearer on our delivery plans for this activity and for more detail on what is involved, particularly on how and why certain code modifications would be prioritised. We have provided this in the section above.

### Other options considered

We considered four options for transform the process to amend our codes;

1. Step up to code manager for the codes we currently administer, Grid Code, CUSC and STC.
2. Step up to code manager for the codes we currently administer, Grid Code, CUSC and STC and additional codes. This option would be similar to option 1, but with additional codes managed.
3. Hand over responsibility for ESO code administration for the Grid Code, CUSC and STC to third parties.
4. Ongoing activities and enhancements only to maintain current approach for code administration.

We have taken forward option 1. Full details of the options considered are in section 3 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in Annex 3 – Stakeholder report.

#### 5.4.3.2. A6.5 Work with all stakeholders to create a fully-digitalised, whole system Grid Code by 2025

**The net present value of work with all stakeholders to create a fully-digitalised, whole system Grid Code by 2025 is estimated at £4 million and deliver £1.65 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2025/26 onwards.**

We will develop a single technical code for distribution and transmission (D6.5). It will focus on providing minimum standards to allow safe and secure operation of the electricity systems. We will use the latest data technologies to support navigation of the codes, being tailored to each code user's individual needs. Supporting documents will provide examples of how the requirements might be met. While noting the complexity of bringing together transmission and distribution codes and creating an IT system to support them, we believe we can achieve this by 2025.

The benefits of a digitalised, whole system Grid Code include having a more user-friendly, inclusive and tailored experience that will meet the diverse needs of our customers.

A whole system Grid Code that is easier to understand will increase the pace at which important decisions are taken throughout the connection journey. Crucially, it will provide more targeted and customised information as and when customers need it.

Removing this barrier of complex to understand and navigate industry codes will also aid the support for new, smaller entrants and encourage innovation in the market.

The first step in delivering this activity will be to determine the scope, objectives and approach together with all stakeholders at the start of this activity in 2021/22. This will ensure that there is a consensus on the direction of this work from the beginning. From 2022/23 for three years a project team of five FTE will be responsible for its delivery.

### Stakeholder views

We sought views on our proposals to create a digitalised Grid Code at our stakeholder workshops, with trade associations, at our Control Centre engagement events, in bilateral meetings with DNOs and received feedback on the *Our RIIO-2 Ambition* consultation. Consistent with the views above on the current state of industry codes and code governance, there is general support for our ambition to create a fully-digitalised, whole system Grid Code by 2025. Many stakeholders noted this would increase the efficiency

within their organisation, while reducing barriers to entry.

Some stakeholders felt this was extremely ambitious. At one of our stakeholder events in July, a trade association representative noted the need for both extensive stakeholder engagement and suitable resourcing. We recognise these challenges and have sought to resource the activity appropriately in this Business Plan.

There was support for the final product, but also general agreement on the need to make it clear that regulatory compliance is still the responsibility of industry participants. This proposal does not remove the requirement for due diligence from the industry in terms of compliance.

Some stakeholders, including a trade association, have asked if this activity aims to change the content of the code or look only at the accessibility. We are not in a position to answer this question now and have made it clear that the first step in delivering this activity will be to determine scope and objectives with stakeholders

A DNO advised it was comfortable with the proposal to bring the transmission and distribution grid codes together but would want to be comfortable with where the decision-making power sits. The proposal would also need to be developed with agile and inclusive governance.

### Cost-benefit analysis

We estimate the gross benefits of this proposal to be £10 million over RIIO-2. This gives an NPV of £4 million over RIIO-2.

These quantitative benefits have been calculated by considering how the reduced barriers to entry will save resource for Grid Code users, as it will be less complicated and easier to navigate, find, and use the relevant information. We estimate there are around 800 potential projects, based on around 400 transmission applications and an additional estimated 400 from distribution applications, which would need to access the Grid Code per year. Each resource saving will ultimately be passed through to consumers.

This is against a baseline assumption of the Grid Code not being digitalised, with access remaining as it is today. It would also not extend to consider the whole energy system.

This activity is dependent on the following transformational activity:

1. A6.4 Transform the process to amend our codes (Theme 2) – Allowing us to manage codes more efficiently, prioritising change and maximising synergies across all ESO managed codes
2. A16 Digitalisation and Open Data - Ensuring that the new digital platform is in place to deliver this capability.

This activity will require third parties, in particular the DNOs, to engage with the process to create the whole system element, and for current and future Grid Code users to fully participate in the process. There may be small costs associated with adapting to these new arrangements, but we believe these are within the scope of third parties ongoing investments.

Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between negative £1 million and £9 million.

See Annex 2 - CBA report section 3.5 for more details.

### Other options considered

We considered three options for work with all stakeholders to create a fully-digitalised, whole system Grid Code by 2025:

- Taking the current Grid Code, expanding to distribution and using the latest data technologies to support navigation of the codes, being tailored to each code user's individual needs.
- Taking the current Grid Code and using the latest data technologies to support navigation of the codes, being tailored to each code user's individual needs. This option would only look to fully-digitalise the Grid Code for transmission participants.
- Ongoing activities and enhancements only to maintain current approach for Grid Code management.

We have taken forward option 1. Full details of the options considered are in section 3 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.4.3 of Annex 3 – Stakeholder report.

## 5.4.3.3. A6.6 Look at fully or partially fixing one or more components of Balancing Services Use of System (BSUoS) charges

**The net present value of A6.6 is estimated at £280 million. The net present value is positive from 2022/23 onwards.**

Partially fixing BSUoS will provide the greater stability that our customers want, if this is demonstrated to be in the best interests of consumers.

BSUoS is one element of the existing code system that is scrutinised regularly by industry stakeholders. Due to the increasing volatility, complexity and difficulty in forecasting these charges, which are set after the costs have been incurred, stakeholders have suggested moving to an arrangement whereby charges are set on the basis of an ESO forecast.

This, in effect, transfers forecasting risk from industry to the ESO. It also fixes the charge in a given period, with any under or over-recovery being accounted for in a subsequent chargeable period.

A modification to fix BSUoS was raised in August 2015 and rejected by Ofgem in October 2018. This was because Ofgem wanted to explore whether some elements of BSUoS could provide a stronger, forward-

looking signal. There was also a concern that the analysis on risk premia was not sufficiently robust.

However, recent work by the Balancing Services Charges Task Force has concluded that BSUoS does not have a role in providing a forward signal that can influence the behaviour of market participants and drive down costs. If Ofgem agrees with this conclusion, as part of its Targeted Charging Review, this suggests that BSUoS is focused purely on cost recovery. It would therefore be appropriate to revisit the subject of fixing these charges.

If an updated CBA shows consumer benefits from fixing some or all elements of BSUoS, then there should be suitable arrangements for the ESO through RIIO-2 to facilitate these changes. This would consist of the costs of managing the increased cashflow risk for the ESO.

The ESO would commit to raising a CUSC modification in this incentive period to allow fixing to commence as close to the start of RIIO-2 as possible. We currently believe that a start date of 1 April 2022 would be possible (D6.6).

### Stakeholder views

We sought views on our proposals for BSUoS at the Transmission Charging Methodology Forum, our stakeholder workshops, with trade associations, at our Control Centre engagement events and received feedback to *Our RIIO-2 ambition* consultation.

Payers of BSUoS have consistently told us that the lack of predictability in the way it is currently charged exposes them to risk premia that are passed on to consumers. A majority expressed support for our proposal to look at fully or partially fixing one or more components of BSUoS charges in the RIIO-2 period. We have therefore taken this activity forward in our Business Plan.

In response to the *Our RIIO-2 ambition* consultation one stakeholder did not support this activity in isolation from other industry developments.

We were also challenged to better understand the risk premia that suppliers pass on to consumers to validate our assumptions on the consumer value of this work. As industry work is ongoing here we will continue to review the benefits and delivery of this proposal to ensure is stays aligned with industry developments. We have included more detail in section 5.4.4 of Annex 3 – Stakeholder report.

We have also been asked to consider the implications of this activity on our funding and regulatory arrangements. In particular, the significant new cashflow costs due to the challenge of forecasting BSUoS to a sufficient degree of accuracy. In Annex 2 - CBA report section 3.6 – we have provided further information on the likely costs of financing this activity throughout RIIO-2.

### Cost-benefit analysis

We estimate the gross benefits of this activity to be £324 million over RIIO-2. This gives an NPV of £280 million over RIIO-2.

These quantitative benefits have been calculated by considering the ongoing industry work that is focused on reducing BSUoS volatility and unpredictability[88]. As this work is continuing – and we will work with industry and Ofgem to further refine it – we have used the lower estimates of gross benefits from the scenarios considered. This amounts to around £81 million per year in reduced risk premia held by industry. We also considered the higher ESO financing costs required to manage any new BSUoS arrangements – again to reflect the uncertainty – of around £4.8 million per year. This is an early estimate and is not reflected in our analysis of overall ESO financing costs, which is detailed in chapter 9 – Financing our plan. The difference in ESO financing costs, and benefits savings from reduced industry risk premia, is due to the number of parties that hold risk premia for BSUoS, which is now being managed though a single party, the ESO.

This is against a baseline assumption of BSUoS arrangements remaining as they are today, with the price being set after the spending has taken place.

In order to deliver this activity, we require the ongoing work to demonstrate that any changes to BSUoS result in a positive benefit to consumers. We also require that BSUoS being confirmed to be cost recovery by Ofgem. Finally, that BSUoS payers need to pass any reduced operational costs onto consumers.

Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £206 million and £730 million.

See the Annex 2 - CBA report section 3.6 for more details.

### Other options considered

We considered two options for Look at fully or partially fixing one or more components of BSUoS charges:

1. Implement the recommendations to fix BSUoS, subject to positive CBA outcome from review.
2. Ongoing activities and enhancements only to maintain current approach for BSUoS charges.

We have taken forward option 1. Full details of the options considered are in section 3 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.4.4 of Annex 3 – Stakeholder report.

[88] https://www.nationalgrideso.com/document/106876/download

## 5.4.4. Investment roadmap

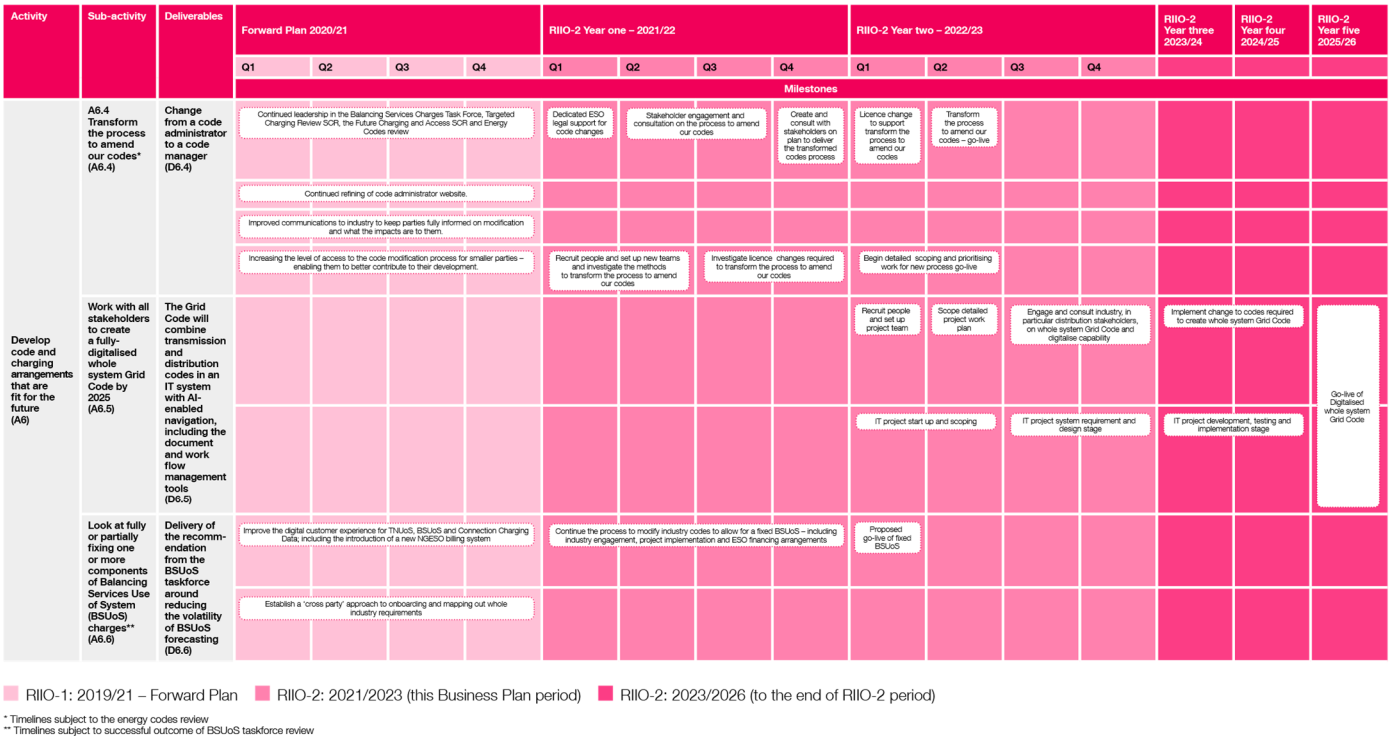



*Figure 27: Investment roadmap*

## 5.4.5. Measuring performance

### 5.4.5.1. Performance metrics

#### Metric 9 – Code Administrator Code of Practice survey

We are proposing to continue the Forward Plan metric to survey our customer as part of the Code Administrator Code of Practice (CACoP) process

We will then be able to monitor our progress over time and track the impact of key actions. Our performance on code administration will be reported separately from our Customer and stakeholder survey process. The CACoP survey follows a separate process that is consistent with the other code administrators.

We are proposing a target of increased overall survey performance across three of the codes we administer (STC/CUSC/Grid Code). This will allow us to take the most recent performance information from the last year of the *Forward Plan* into account.

### 5.4.5.2. Annual reporting items

For our code manager role, we will investigate whether consumer benefits can be measured for modifications, with high-value consumer benefits being targeted.

All of this will mean greater benefits for consumers. By making sure we improve the quality of service for our customers, they will either directly or indirectly pass any savings onto consumers. We will also ensure we prioritise the code modifications that deliver the most benefits to consumers. While many of the factors that drive the ultimate costs of code administration and management are outside our control, the level of service provided and the prioritisation of code modifications are within our control. Stakeholders have fed back to us that they have concerns over the ability of this measure to demonstrate the performance of the ESO. As such we are proposing to make this an item that we report annually to demonstrate the savings taking place for consumers, rather than making it a performance metric

# Role 3: System insight, planning and network development

## **Theme 3** Unlocking consumer value through competition

### Consumer priorities

- We want an affordable energy bill
- We want energy to be available when we need it

### Stakeholder priorities

- I want efficient whole energy system operation
- I want you to enable the smart, flexible and low carbon energy system of the future
- I want you to be open, engaging and easy to work with
- I want you to be adaptable and innovative
- I want to provide more balancing and ancillary services

### The ESO RIIO-2 Stakeholder Group supports Theme 3.

"Important and worthwhile proposals which are heading in the right direction. The ESO role in the development of CATO plans is no longer in scope of the Business Plan. Stakeholders are supportive of the ESO being more proactive" in this area."

## What this Theme covers

Transforming network planning through competition and extending *Network Options Assessment* to other areas of network development.

## What we propose to do

Enhance and expand the *NOA* process to look at more connections wider works and end-of-life asset replacement. Carry out a targeted review of the SQSS.

## What our Stakeholders have told us

Stakeholders agree that we should introduce competition into network development, expand the *NOA* approach to look at wider transmission system needs and support assessments for lower voltage networks. They agree that we should review the SQSS but had mixed views on the scale of such review.

## What are the key benefits?

Wider investment options are identified on the distribution network and commercially. Improve the reliability of the system, embed efficient competitive processes, enhance communications with the network operators and improve service quality to help reduce consumer bills.

# 6. Role 3, Theme 3: Unlocking consumer value through competition

## Theme 3 delivers £663 million net present value of consumer benefits[89] and lowers consumer bills by £1.78 a year[90]. Investment[91] for this Theme (two year), £13.6 million.

## 6.1. Five-year strategy

Our five-year strategy is to use competition to support the development of a network that is always ready for the demands placed on it and can operate securely as we transition to a zero carbon electricity system. Competition is also fundamental to our proposals to transform participation in smart and sustainable markets. We have focused on this in the previous chapter.

To achieve our network competition proposals, we must:

- transform network planning by extending and enhancing competition across network development.
- invest in capabilities so we can operate a carbon free network in 2025.

**Net zero by 2050**

We will enable the UK to transition to net zero emissions by:

- increasing competition to drive innovation and better network solutions to unlock consumer value.
- enhancing our network modelling to help manage the increasing complexity of a carbon free network.
- leading work to ensure the standards that underpin the network are appropriate.

### 6.1.1. Extending and enhancing competition

Competition can unlock significant consumer benefits by finding solutions to network challenges. Our unique, position means we are well placed to drive this process.

Currently, when there is a need on the transmission network, the relevant Transmission Owner (TO) will develop and implement the solution. However, when we take a whole system view, there may be better options available on distribution networks or through commercial arrangements that do not involve transmission investment. We have already begun to investigate these through our pathfinder projects e.g. our stability pathfinder project[92], but we intend to go much further. In the final two years of RIIO-1, we will run two or three pathfinding tenders each year. From the beginning of the RIIO-2 period we will be running several tenders each year across a range of network needs, to ensure we unlock the broadest range of potential solutions that maximise consumer value.

We are fully committed to introducing competition everywhere, including supporting Ofgem to develop and implement competition for onshore transmission. We recognise we have a key role both in supporting the introduction of Competitively Appointed Transmission Owners (CATO) and in supporting alternative approaches prior to the introduction of the legislative changes required for the CATO regime.

In May 2019, Ofgem asked us in their Sector Specific Methodology and further consultation[93], to develop an 'Early Competition Plan' setting out how early forms of competition for onshore transmission could be introduced. They have since clarified their expectations in their open letter, dated 24 September 2019[94].

Early competition has the potential to deliver significant consumer benefits through identifying the best value solutions for major transmission investment needs. Through the Early Competition Plan we will explore a range of options for how different forms of early competition could be introduced in order to unlock this value for consumers. This could include competitions for non-network solutions, design-only competitions and CATO competitions. The Early Competition Plan will also explore the roles and responsibilities of different industry parties, including the role we should play in the process. In addition, the plan will set out how early

[89] Consumer benefits are the net present value (NPV) of Theme 3's transformational activities over the RIIO-2 period. When referring to the quantified benefits themselves, we refer to the as gross benefits. When summing benefits thought this document care should be taken they are the same type and note rounding may mean values do not match precisely. See Annex 2 - CBA report for more details on how we have calculated NPV. Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £463 million and £906 million

[90] Relatively, on average over the RIIO-2 period

[91] We will generate a net saving for consumers in RIIO-2. The proposed investment in this chapter will help to deliver this net saving

92 https://www.nationalgrideso.com/insights/network-options-assessment-noa/network-development-roadmap

[93] https://www.ofgem.gov.uk/system/files/docs/2019/05/riio-2_sector_specific_methodoloy_decision_-_eso.pdf

[94] https://www.ofgem.gov.uk/system/files/docs/2019/09/electricity_system_operators_early_competition_plan_letter_0.pdf

competition could be implemented, including timeframes, costs and legislative or framework changes that would be required.
Following submission of the Early Competition Plan in February 2021, Ofgem will then determine how early competition should be progressed, including our role. Therefore, while we anticipate that there will be additional roles and resource requirements for us relating to this in RIIO-2, they cannot yet be determined and so are not included in this Business Plan. If Ofgem decides to proceed with the proposals submitted, any new roles will be built into our wider performance and incentives framework. We are continuing to work iteratively with Ofgem to develop this proposal and engage widely with stakeholders to ensure proposals are practical and maximise consumer value. We are also exploring how the enhanced engagement approach developed for the RIIO-2 Business Plan could be best utilised to provide a more formalised role for stakeholders.

Further details on how we intend to progress the Early Competition Plan during RIIO-2 are available on our website[95] and although not a RIIO-2 proposed activity, we have outlined our proposed development approach in section 6.4.

By the end of RIIO-2, competition will be the established approach for most new transmission investment. This will create fresh solutions, including commercial ones, for network issues. Our analysis this year suggests that using solutions, such as intertrip schemes, could create significant savings for consumers over the next ten years[96]. We expect that further savings can be unlocked by using competition to address other network needs, such as voltage and stability.

Today our network planning creates significant benefits for consumers; our 2018/19 *Network Options Assessment* (*NOA)* recommends a set of investment options to increase the transfer capability of key transmission boundaries. This could save consumers between £1.85 billion and £2.67 billion over the next 11 years. Our five-year strategy is therefore to expand the *NOA* and the evaluation techniques (such as network analysis and economic modelling) that support the process and consumer value creation to other areas of network investment. By the end of RIIO-2, we will also use *NOA* to assess major end-of-asset-life decisions as well as all wider works on connections. We will also provide support to Distribution Network Operators (DNOs) to establish their own *NOA*-type processes.

We continue to see ourselves playing a pivotal role in the economic assessment of network options that will meet future transmission network needs. These assessments include the *NOA*, Strategic Wider Works (SWW), Connection Infrastructure Options Notes (CION) and small scale cost benefit analysis. Whilst we have incremental proposals for the development of the *NOA*, our baseline for the other economic assessment activities and network analysis remains as is based on no formalised changes in these areas.

Our proposals to expand our *NOA* assessments to cover some end of asset life decisions and all connections wider works will be dependent upon receiving information from the TOs. We have discussed this with them and will work closely with them during the first years of RIIO-2 to establish efficient exchange processes. Our lower voltage proposals are dependent upon DNOs moving to establish *NOA*-type assessments and requiring our support in doing so. We will continue to discuss this with DNOs.

By enabling more efficient decisions to be taken on what network assets to invest in and when, consumer bills will be lower than would otherwise be the case. Improving competition and securing sufficient investment in network capacity will reduce costs further as an increased number of players develop new network and non-network solutions. This increased participation can also help identify innovations that unlock more efficiencies and enable further decarbonisation of the energy system.

### 6.1.2. Investing in capabilities so we can operate a carbon free network in 2025

As well as introducing competition and expanding our *NOA* assessments, we will prepare to operate a carbon free network in 2025. The continuing growth of distributed generation, expected to increase by at least 50 per cent by 2030, and new technologies, makes the network more challenging to operate. This is due to reduced system inertia and changing reactive power requirements[97], among numerous other challenges. The overall operability costs of these growing needs are forecast to be £596 million per year between 2021 and 2026.

Effective network planning will allow us to reduce these costs in the future. Across RIIO-2, we will increase our network modelling capabilities to respond to the increased volume and complexity of network challenges. During RIIO-2, there will be an increased focus on both the potential for an integrated offshore network, as offshore wind is expected to increase to at least 24 GW by 2030 from 9 GW today, and also on interactions between different energy sources, such as gas and electricity. We will need to provide expert input into early thinking around both these developments. By better understanding these interactions, we will be able to plan more effectively and tender for solutions that meet multiple needs.

Early in the RIIO-2 period we also intend to embed and enhance the ongoing work we are doing to explore probabilistic modelling. The tools and techniques we are investigating will allow us to identify thermal constraints for year-round conditions, including looking at multiple generation and demand eventualities for each hour in a matter of minutes. This will result in a wider and more

[95] https://www.nationalgrideso.com/publications/network-options-assessment-noa/network-development-roadmap

[96] https://www.nationalgrideso.com/document/137321/download This is the suggested saving against a counterfactual where the TOs do not build in line with to our recommendations.

[97] The glossary provides an explanation of these terms

refined view of network needs across the year rather than focusing on a point in time, such as winter peak capacity.

### 6.1.3. Costs and benefits

Figure 28 summarises our proposed capex, opex and employee full time equivalent (FTE) numbers over the RIIO-2 period. This covers both our ongoing and transformational activities. Further justification for the costs associated with these activities is set out in the relevant sections that follow. Details on how we have incorporated efficiency assumptions and benchmarked these costs are in chapter 3 – Assumptions underpinning our plan.

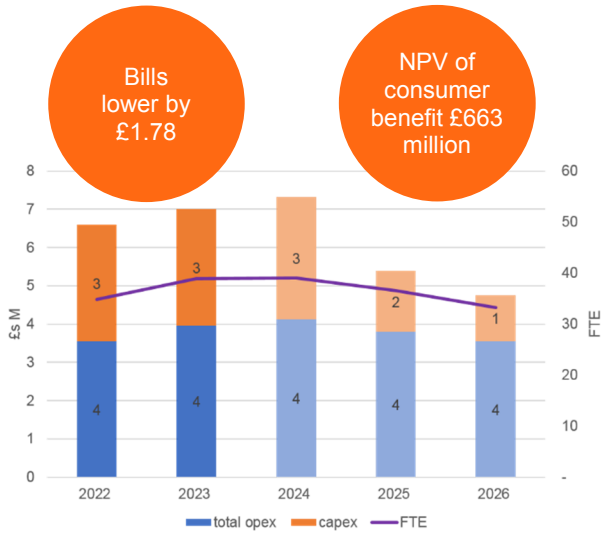



*Figure 28: Theme 3 costs, benefits and FTEs*

Our regulatory framework should facilitate the delivery of our outputs and benefits under this Theme through a clear, targeted incentive scheme with *ex ante* clarity on how performance will be assessed. It should also ensure that the ESO is able to raise adequate equity and debt finance to make the necessary investments. Our proposals for how to achieve this are in chapter 9 – Financing our plan.

The main consumer benefits under this Theme are:

- Support at least twice as many participants in the *NOA* tender process, ensuring the service quality encourages more participants to offer and deliver competitive solutions, potentially delivering £429 million in gross benefits to consumers and enabling the path to net zero by 2050.
- Extending *NOA* to look at end-of-life asset replacement decisions and connection wider works, delivering £266 million gross benefits.
- Delivering £30 million in gross benefits through increasing engagement and coordination with distribution-level parties across network planning and the *NOA* methodology.

We will maintain a focus on consumer priorities:

- An affordable energy bill - realising savings through choosing the most economic option for solving network issues.
- Energy to be available when needed - enhancing the robustness of the *NOA* process using new analytical tools.
- A decarbonised energy system, fit for the future through - network planning to support ability to operate the network carbon free by 2025.
- A safe and secure energy system through - incorporating more probabilistic modelling capabilities, giving a more refined view of network needs, ensuring its resilience.

We will measure our success by tracking:

- benefits/savings created for consumers
- diversity of participants in the *NOA* process
- stakeholder satisfaction survey.

## 6.2. Network development

Our ongoing activities, and the improvements we propose to them, will underpin both elements of our five-year strategy.

### 6.2.1. Costs

| Network development | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 3.0 | 3.0 | 3.2 | 1.6 | 1.2 |
| Opex (£m) | 1.5 | 3.4 | 3.7 | 3.9 | 3.6 | 3.5 |
| FTE[98] | 27 | 33 | 36 | 36 | 35 | 32 |

#### Highlights

We propose to invest in enhancing our analytical and modelling capabilities. This will enable us to analyse more than twice the number of tenders and undertake network modelling across all solution types.

### 6.2.2. A7 Ongoing activities

Through our planning processes, we advise which investments will deliver the greatest benefit for consumers and at what point in time.

[98] Opex and FTE numbers are the average for the ESO since legal separation (years 2020 & 2021), which reflects the current ESO business. Capex figures are the average over the eight years of RIIO-1.

We analyse and communicate future network needs, published in our annual *Electricity Ten Year Statement*[99] *(ETYS*– D7.1[100]). This information allows TOs to develop appropriate solutions. We are developing these processes so that a broader range of participants can engage with the information, potentially provide competitive solutions and prepare for CATO.

We use our unique position to advise on economically efficient ways to address network needs, published in our annual *NOA* report (D7.2). For example, we consider whether TOs should build new transmission assets now, or whether investment should be delayed, and we manage the challenge in other ways.

We also analyse and publish (in *NOA*) the optimal level of interconnection for the Great Britain market, which helps to show developers what investments could be of value. In addition, we support the development of European regional investment plans and ten-year network development plan. Finally, we also undertake additional *ad hoc* analysis (D7.3) of:

- Strategic Wider Works projects
- Boundary studies for the CION process covering offshore connections.
- Cost-benefit Analysis (CBAs) for small schemes (*ad hoc* assessments for localised network issues).

Activity within our network development teams also helps support Theme 4 through the analysis of constraint costs which helps optimise outage planning.

The network development costs for our ongoing activities in RIIO-2, as set out above, will increase by one FTE. Costs increase by £1 million due to the increased FTE and the mix of workload changing from opex and capex in RIIO-1, to purely opex in RIIO-2. Costs will remain flat for the remainder of RIIO-2 reflecting the continuation of reviewing our processes and incorporating efficiency initiatives in RIIO

This will enable us to:

- Analyse double the number of network solutions.
- Manage a significant increase in the complexity of the network needs we will model. This complexity is driven by the continuing growth of distributed generation and new technologies, which create operability challenges such as system inertia and reactive power demand[101].
- Accommodate the potential for integrated offshore networks, and interactions between different energy sources, such as gas and electricity.

Our baseline FTEs, covering our ongoing activities, increase from 27 to 28 in 2021/22 and then remain at 28 for the remainder of the RIIO-2 plan period. The further increase in FTEs, as illustrated in section 6.2.1, reflect our transformational proposals as detailed in the following section.

### Enhancements made in RIIO-1 and innovation into RIIO-2

During RIIO-1 we improved how we unlocked consumer value by introducing *NOA*. This saves billions of pounds for consumers by recommending which network investments provide the most value to consumers, and the most appropriate timing for them. We also expanded the *NOA* approach to cover Scotland, as well as England and Wales.

We have built on the independence of our investment recommendations through legal separation of the ESO from National Grid's Transmission Operator (TO). This underpins our transformational ambition to introduce competition across network development. We have already begun this transformation with our *Network Development Roadmap*[102] pathfinders. Through these, we are trialling competitive approaches to meet certain transmission needs, which have been welcomed by market participants. Our Early Competition Plan, exploring competition for major network investment aims to further expand this transformation.

We have also responded to the changing needs on our network, which are driven by the move towards zero carbon. The network needs have become more challenging and we are developing our analysis in order to improve our understanding and modelling of voltage and stability. We have also made big steps in moving towards a probabilistic analytical approach. This provides a more refined assessment of network needs across the year, rather than at a single point.

Through two innovation projects, we are exploring ways to improve our existing modelling techniques for use in our ongoing activities. The aim here is to be able to better identify the right level of investment needed on the networks. We will establish new and more efficient ways to undertake increasing and more complex analysis, while ensuring we reflect and assess the growing number of interactions between different network issues.

The projects are:

**Application of Convex Optimisation to Enhance the *NOA* Process**: We have launched a Network Innovation Allowance (NIA) funded project in collaboration with Strathclyde University. This will develop an algorithm and code to include in our existing voltage assessment tools, which once embedded in our tools will enable us to analyse voltage requirements and develop solutions faster. This work is in response to the following energy challenges: the forecast level of electricity decentralisation, a need to consider a whole system approach to network development, a need to support

[99] https://www.nationalgrideso.com/publications/electricity-ten-year-statement-etys
[100] These are the activity codes introduced earlier in this document. These unique identifiers help to link the activities, sub-activities and deliverables.
[101] The glossary provides an explanation of these terms
[102] https://www.nationalgrideso.com/insights/network-options-assessment-noa/network-development-roadmap

different energy vectors, and increased uncertainty across the year due to low carbon generation.

**Study of Advanced Modelling for Network Planning Under Uncertainty:** We are running an NIA funded innovation project focused on decision-making. It specifically explores questions around the 'least worst regrets' process, such as whether this is still fit for purpose against the uncertainty of planning timescales, and whether deterministic planning is still applicable. The project is reviewing state-of-the-art planning techniques, which include probabilistic or risk-based approaches in decision-making. It is also exploring the benefits of integrating technical and economic assessments into a single platform.

## 6.2.3. *NOA* transformational activities

**The net present value of our proposals is estimated at £663 million and delivers £45 of gross benefits for every £1 spent. The net present value is positive from 2021/22 onwards.**

To deliver the benefits from competition outlined in our five-year strategy, we propose four new areas of work. This section provides more detail on our proposals, the rationale, and the stakeholder feedback that underpins them.

### Embedding competition and expanding the *NOA*

1. A8 Implement and enhance competition to enable all solution types to compete to meet transmission needs.
2. A9 Extend the *NOA* approach to end-of-life asset replacement decisions and connections wider works.
3. A10 Support decision-making for investment at the distribution level.
4. A11 Enhance our analytical capabilities to support these activities.

The following sections provide further details on these activities and their associated costs. We recognise that fulfilment of these has interdependencies with different industry participants. Firstly, Ofgem will need to ensure network company regulatory funding reflects the uncertainty around which solutions each network company will provide. Other framework changes are also likely to be needed and these should be progressed through industry working groups. We will work closely with those groups to identify likely changes and ensure sufficient time for any changes to be made.

Delivery of our proposals and their associated consumer benefits will rely on industry participants being willing to compete to provide network solutions. We have received a lot of feedback to suggest that this is the case, and we will work with those participants to ensure that any barriers to entry are minimised. We will also need those participants to deliver upon any commitments they make in winning bids. This will be overseen through ongoing contract management arrangements.

#### 6.2.3.1. A8 Implement and enhance competition to enable all solution types to compete to meet transmission needs

**The gross benefit of this activity is £429 million.** During the first two years of RIIO-2, we want to at least double the number of competitive tenders for transmission needs from the three to four pathfinders that will be run in RIIO-1. Building on this, competition for alternatives to solutions to network investment needs will become the norm by the end of RIIO-2. Our *Network Development Roadmap,* which we previously consulted on, has started this transformation. Stakeholders, particularly potential service providers, are strongly supportive of these developments and keen for them to be delivered as soon as possible. While we expect the number of tenders to more than double, as competition grows, we will limit additional costs by improving our tendering approach. We expect to reduce associated costs by the end of RIIO-2 as we capitalise on process improvements.

Creating competition between asset solutions and non-network solutions, and regulated businesses with non-regulated businesses, is challenging due to different funding and regulatory regimes. Alongside this, the network needs for which we are assessing competing solutions is becoming more complex. Our pathfinder work in RIIO-1 will have given us a large amount of learning, which we can use to address the technical, commercial and regulatory challenges. However, much more will need to be done to maximise benefits from this transformation.

**We welcome proposals to build on the *NOA* process and facilitate competition in delivery of solutions to network challenges, including through market solutions and non-network assets.**
**Supplier, in response to *Our RIIO-2 Ambition* consultation**

We have assumed that appropriate funding arrangements will be in place to support delivery of solutions, regardless of the provider type. This includes network companies having appropriate arrangements to support the necessary preparation of options to feed into assessments of proposed solutions. It also includes appropriate funding routes for commercial solutions so costs are recovered from the appropriate customers. We have also assumed that the licence conditions on whole system working across TOs, DNOs and the ESO will be implemented, alongside appropriate funding mechanisms.

For this specific activity, two additional FTEs are required in 2021/22, representing an increase from 28 to 30 of the 33 FTEs in 2021/22. We plan to scale back this activity in 2023/24 by one FTE due to process efficiencies. We have estimated these resources based on historical levels of *NOA* activity and current team size. In addition to supporting double the number of tenders, these FTEs will undertake the following:

- **A8.1 Optimise the assessment and communication of future needs**

Stakeholders, particularly potential service providers and also one of the TOs, have told us that they want us to communicate future needs to them more clearly, so they can participate in those markets. As our modelling of network issues and potential solutions grows, we will need to incorporate the outputs from our Pathfinder Projects into our *NOA* methodology (D8.1) and continue to improve how we communicate these future needs.

- **A8.2 Enhance tendering models**

To maximise participation in tenders, including from potential new technologies and new market entrants, we will need to incorporate the outputs from our Pathfinder Projects into our *NOA* methodology (D8.1) and continue to develop and embed improved – or potentially new – tendering processes (D8.2.2). We know stakeholders want to see better alignment across the tendering processes that we use to meet different network and service needs, so that they better support their business cases for new investments. We are beginning work on this now, but much of the implementation and ongoing enhancements will occur in RIIO-2. We will prepare and run tenders on the areas we have identified (D8.2.2) and embed improved tender approaches that enable more participants to enter the market (D8.2.3).

- **A8.3 Support and respond to changing regulatory frameworks**

Existing regulatory and funding frameworks were designed to support a regime where longer-term network needs were addressed by the relevant TO, with funding allocated through their price controls.

This landscape is now changing, so the supporting frameworks also need to change to make sure appropriate funding can be made available for all possible solutions. During the rest of RIIO-1, we will work with Ofgem to identify the framework and funding changes that are needed and support their delivery (D8.2.1).

Some of these changes are expected to begin at the start of RIIO-2 and the ESO will need to support and respond to them. There will also be transitional arrangements to manage, such as bridging the gap between RIIO-1 and RIIO-2 and RIIO-ED2[103]. We will work with industry to implement any framework changes and support Ofgem to consider any funding implications in respect to RIIO-ED2 (D8.3.2).

## Investment roadmap

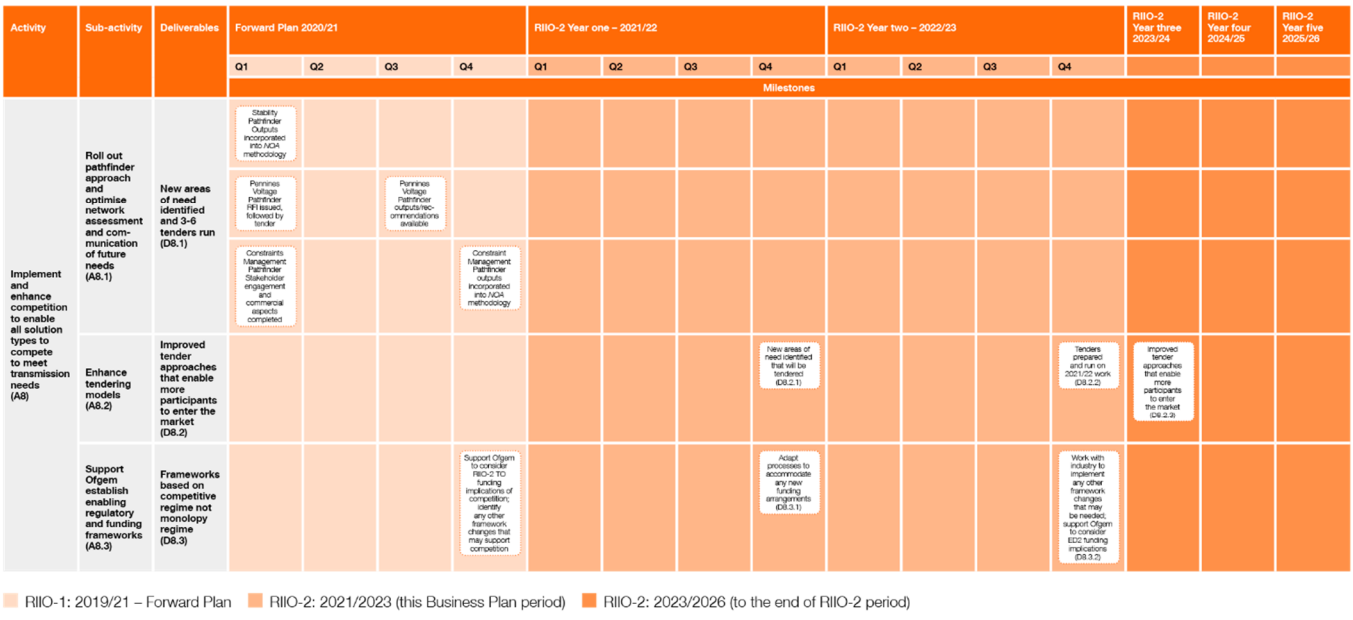



*Figure 29: Investment roadmap*

[103] Price control for electricity Distribution Network Operators, scheduled to commence in April 2023

### Stakeholder views

We have engaged stakeholders on this topic through our RIIO-2 engagement events, including a more technically focussed event in December 2018, RIIO-2 webinars, at our customer connections seminars and via dedicated network development channels. Given the possible impact on network companies of this activity, we have also engaged bilaterally with TOs and some DNOs.

Overall, we have heard that stakeholders want us to introduce competition for transmission solutions in network planning. In response to the 2018 consultation on our *Network Development Roadmap*[104], three-quarters of respondents from networks and renewable generation sectors supported our proposals to expand our approach to seek both network and non-network solutions.

Most stakeholders at our RIIO-2 event in April 2019 confirmed this view. They expressed support for us to embed competition in network planning – and for expanding the *NOA* approach to a wider set of transmission network needs. However, two generator stakeholders said that we need to be careful of the impact this could have on energy markets, in terms of service provision through contracting with providers in particular locations, for example thermal, voltage or stability requirements. This is something that we will consider further.

At our Network Development event on 16 May 2019, several of the 21 stakeholders who attended, particularly service providers, felt that we could significantly help more providers enter the market by optimising the alignment of how we communicate and tender different needs. This, they said, would support the business case needed to invest in new assets. We also heard this from generators at our customer connections seminar round tables in November 2019.

As our modelling of these issues and potential solutions grows, we will need to continue to improve how we communicate future needs and we will continue to engage stakeholders on our approach.

### Cost- benefit analysis

Our proposed investment in extra resources will enable us to support at least twice as many tenders. It will ensure they receive a quality service that encourages them to participate, offer and deliver competitive solutions. Solutions that will ensure we have a network that is always ready for the demands placed on it and can operate securely as we transition to a zero carbon electricity system.

The £429 million gross benefit has been calculated by comparing the outputs of the *NOA* process with and without commercial solutions added in. We have used historic costs of previous commercial solutions as the benchmark for our analysis.

This is against a baseline assumption of the current *NOA* process, without commercial solutions and only current network solutions considered, in line with our licence conditions.

All *NOA* transformational activities are dependent on activity A4 Build the future balancing services and wholesale markets (Theme 2)

Delivery of this activity will pass on benefits and costs to other parties. There is likely to be increased analysis for TOs and DNOs in creating options and running new processes. However, we expect that the cost of this should be offset by the overall benefits realised and that there would be potential benefits for network companies to carry out this work because of their regulatory and incentive frameworks.

Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £462 million and £906 million.

See Annex 2- CBA report section 4.1 for more details, including the key risks and mitigations we have identified in respect to the delivery of this activity.

#### 6.2.3.2. A9 Extending *NOA* to end-of-life asset replacement decisions and connections wider works[105]

**The gross benefit of this activity is £266 million comprising £118 million end-of-life asset replacement and £148 million connections wider works.**

We propose to expand our network-planning processes to look at end-of-life asset replacement decisions for large assets (A9.1), with the first recommendations to being *NOA* 2024. These decisions will therefore inform investment beyond the end of RIIO-2. We will work closely with the TOs to develop an efficient route to input our analysis into their decision making processes. (D9.1)

As with our *NOA* recommendations, our analysis will be informed by the significant data volumes and types we have access to. This covers our NOA economic models, historic operational data and the insights derived from developing our *Future Energy Scenarios*. As a result we are likely to be able to offer additional insight beyond the TOs' own analysis and therefore may be able to recommend a more efficient outcome. For example, there may be occasions when there is value in replacing or upgrading an asset earlier, to address a wider issue on the network.

We already deliver millions of pounds of value for consumers by assessing many connections wider works

[104] This consultation can be found on our website here: https://www.nationalgrideso.com/publications/network-options-assessment-noa/network-development-roadmap

[105] See Glossary for definition of Connections Wider Works

through the *NOA*. However, not all wider works are included.

The transmission system is split by regional boundaries. These define important power-flow paths where there are limitations to capability or where we expect additional bulk-power transfer capability will be needed. These boundaries were set at the start of RIIO-1. The subsequent evolution of the network means that the originally defined boundaries no longer capture all areas of the network where significant enhancements in capability are required to be assessed. This means that while most connections wider works are subject to *NOA* assessments, some are not. We therefore propose to change our processes so that all connections wider works are assessed (A9.2). We intend to assess a trial region in *NOA* 2022/23, (D9.2) expanding to all wider works by *NOA* 2025/26, (D9.4) starting with making recommendations in Q4 2022/23 (D9.3).

Our costs include both end-of-life assets and connections wider works. These activities are extensions of our ongoing work. To forecast our costs, we have applied the same resourcing assumptions as for our ongoing activities, including the embedded efficiencies resulting from RIIO-1. To undertake these activities, we require two additional FTEs in 2022/23 and three over 2023/25, representing the increase in our FTEs from 30 in 2021/22 to 33 in 2022/23. We plan to reduce these additional required FTEs by one by the end of the RIIO-2 period due to process efficiency gains and improved tools. We have estimated these resources based on historical levels of *NOA* activity and current team size.

## Investment roadmap

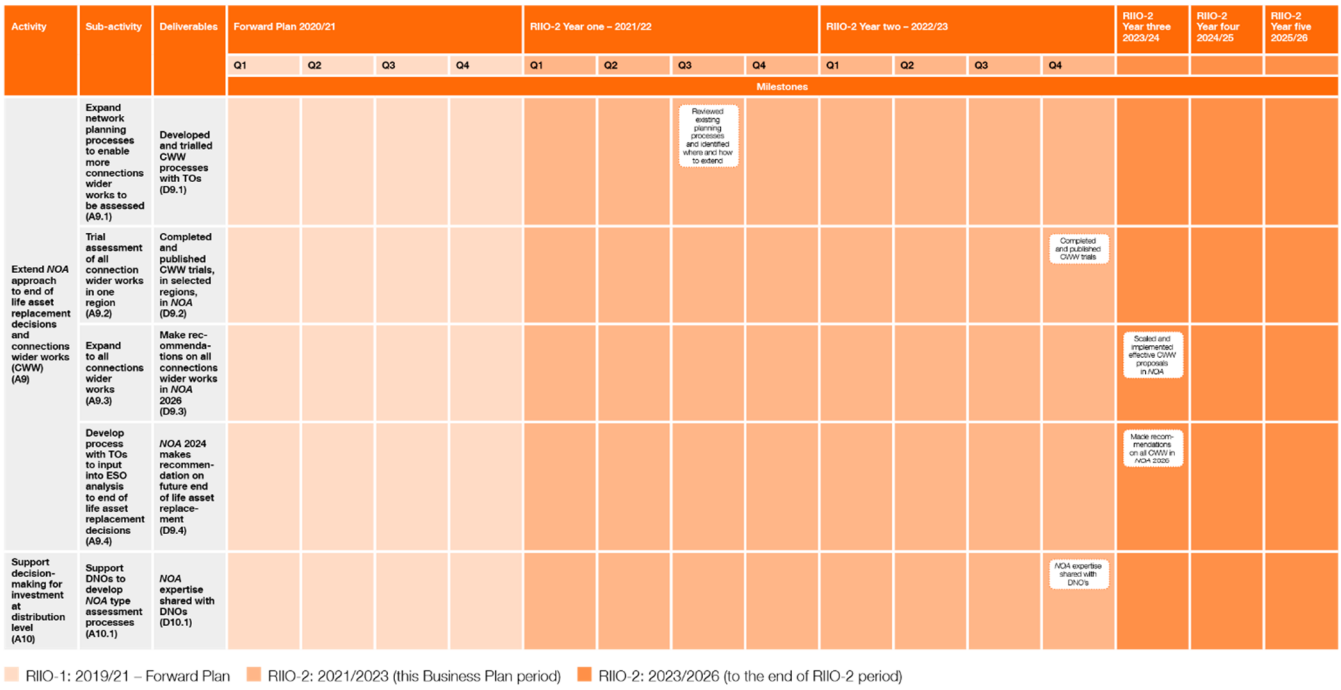



*Figure 30: Investment roadmap*

## Stakeholder views

During our *Network Development Roadmap* consultation, we asked which further areas of network planning a *NOA*-type approach could be applied to. Respondents thought we could apply a *NOA*-type approach to end-of-life assets and connections wider works. At our December 2018 RIIO-2 event, stakeholders similarly supported this.

Specific views about each of the proposed expansion areas were as follows.

### End-of-life assets

Almost all stakeholders at our April 2019 event supported our proposal to expand our processes

At our October 2019 engagement event, a service provider asked if we were proposing to assess end-of-life assets in the *NOA* because there was a known problem with the process. We are likely to be able to offer additional insight beyond the TOs' own analysis and therefore may be able to recommend a more efficient outcome than the current process. This stakeholder and a TO were also concerned that there may be double counting of benefit between the ESO's and the TO's Business Plans associated with end-of-life asset replacement. We confirm in Annex 2 – CBA report that this is not double counting but that the ESO benefits identified in this Business Plan will likely be in addition to the TO identified benefits.

We have spoken to all the TOs through our RIIO-2 engagement to explain our proposed activities in this area. Some TOs wanted to know how our end-of-life assets assessment proposal would complement or change the established assessment processes that they already carry out for their own assets and to the assumptions they are making in their RIIO-2 Business Plans. We have advised them that our assessment would complement the TOs' own work, because we have access to additional operational data. TOs also wanted to better understand how the process and timing of this activity might work and in particular how it might affect their own RIIO-2 business planning. We have held further focussed discussions with TOs to discuss this. We set out that this process will focus on a small number of large investments, and that any recommendations made by the ESO during RIIO-2 would relate to investment within RIIO-3, not RIIO-2. Our Business Plan proposal has been clarified in response to the TO feedback. We will continue to work with TOs to establish the process for inputting our analysis into end-of-life asset replacement decision-making in accordance with the timescales set out in this plan.

### Connections wider works

Some stakeholders were interested to understand how our proposals would affect timeframes in connections wider works. Most connections wider works are already assessed by the *NOA*, so our proposals would bring the remaining elements in line with that process. Almost all stakeholders at our April event supported our proposal to expand our processes at the transmission level, subject to more detail on the costs and benefits, which we provide here.

### Cost-benefit analysis

Extending our *NOA* assessment to these additional areas will enable us to identify the most efficient investment options. This will help reduce costs to the consumer.

### End-of-life assets

The £118 million gross benefit has been calculated by using historic data from *NOA* We have looked at assets whose end of life was due to be within five years. By using the best available information, we have profiled the cost of a TO bringing forward an asset upgrade to negate the need for a like-for-like replacement. This delivers a benefit, because the asset-replacement saving is greater than the additional cost of the upgrade resulting from bringing it forward. It is very difficult to forecast the exact benefit, because we do not hold asset price data or long-term asset replacement information. In RIIO-2 we would request this information from TOs. Therefore, we have made our estimates from *NOA*, based on a similar profile.

This is against a baseline assumption of the current *NOA* process, without the addition of end-of-life asset considerations.

See Annex 2 - CBA report section 4.1 for more details, including the key risks and mitigations we have identified in respect to delivery of this activity.

### Connections wider works

The £148 million gross benefit has been calculated by comparing the output of the *NOA* with wider works, which are not currently considered within the *NOA* document. This comparison has identified options that were in customer offers, but not in the *NOA*, suggesting boundaries could be added to the *NOA* to cover these. For our *NOA* analysis we split the transmission system into around 30 boundaries and currently only use certain boundaries as this considers the majority of the network issues. However, as our modelling gets more advanced and the network becomes more dynamic, we believe we should assess more areas of potential bottlenecks, especially those areas identified in the connection wider works. We believe the *NOA* could look at ten per cent more boundaries, which equates to three to six boundaries where we suspect problems. We have made a conservative assumption that this would deliver two per cent more consumer benefit given the uncertain relationship between looking at more boundaries and consumer benefit. Two per cent equates to £37 million of gross consumer benefit each year.

This is against a baseline assumption of the current *NOA* process, without increasing the number of boundaries analysed.

See Annex 2 - CBA report section 4.1 for more details, including the key risks and mitigations we have identified in respect to delivery of this activity.

#### 6.2.3.3. A10 Support decision-making for investment at the distribution level

**The gross benefit of our proposals is £30 million.**

We currently assess investment decisions for transmission networks, which includes the 132 kV networks in Scotland. We considered whether there would be value in expanding our role further to also undertake a *NOA*-type process at the 132 kV networks in England and Wales.

The 132 kV networks in England and Wales are different in nature to the transmission networks, so we would need to gain a thorough understanding of these networks and develop relevant modelling and analytical tools. The amount of investment at this voltage level is expected to be relatively low (around £40 million a year, compared with around £1 billion a year at the transmission level). However, we do believe further consumer value can be generated by the DNOs adopting a *NOA*-type approach by ensuring optimum timing of their investment decisions.

Given the ESO's experience in delivering *NOA*-type assessments, we believe we could add value to network planning at the distribution level, by collaborating with DNOs to develop effective processes (D10.1). We already work closely with DNOs through the Energy Networks Association (ENA) Open Networks project to

share learning and we publish our *NOA* methodology annually.

We propose to take on an additional specific role to ensure consistency of methodologies, where appropriate, across the different networks. Consistency will help support cross-network planning. It will also help third parties to engage more easily with planning across the networks. This will result in an overall, coordinated approach as both transmission and distribution system needs evolve and help to provide consistency for consumers.

We will also provide bespoke support to individual DNOs, on request, to help them develop their own processes. We expect DNOs would begin undertaking such assessments from the start of RIIO-ED2. Therefore, we believe our support would be required from the first quarter of 2022/23 to help DNOs prepare to implement this activity. This would run to the second half of 2025/26 in order to support all DNOs who may introduce this at different times.

The additional FTE proposed for this activity has been included in the wider *NOA* enhancements. This represents the minimum resource we feel is needed to make this a meaningful proposition. Any less would make it a struggle to build the specialist knowledge of the challenges of lower voltage networks to be able to support in a significant way. The timeline for supporting decision making for investment at the distribution level, is included in the investment roadmap covering end-of-life assets and connections wider works decisions in section 6.2.3.2.

### Stakeholder views

During our more technically focussed RIIO-2 engagement event in December 2018, a range of stakeholders, including DNOs, told us they had limited appetite for us to undertake assessments at lower-voltage networks - noting how different they were to the transmission networks. This view has been echoed by the ENA, which said it believed that at distribution level DNOs are better placed to make these decisions. The ENA added that expansion of the *NOA*'s current remit to distribution voltages could be inappropriate, particularly as work continues to establish the future 'world' and the transition to distribution system operation (DSO).

We were, therefore, minded not to take the proposal forward, but were challenged by our ESO RIIO-2 stakeholder group (ERSG) to explore the option with stakeholders further. As a result, at our April RIIO-2 event, we asked stakeholders if we should have a role looking at lower voltages. Most stakeholders agreed that we were not best placed to undertake the assessments at lower voltages. However some, from networks, local government and generation sectors, were supportive of us having a role in providing support and a consistent analytical approach to network planning at lower voltage levels. Two DNOs agreed that we should not be undertaking lower voltage assessments and that it should be more of a co-ordination exercise. One DNO added that the ESO has a lot of knowledge in this area and can support DNOs to transition to DSOs.

Conversely, one generator felt that we could undertake these assessments, depending on the respective future roles of DSOs and the ESO, which still need to be clarified. As a result of this feedback and given the majority view we have refined our proposal, as set out above, to provide support to DNOs to do their own assessments rather than undertake the assessments ourselves.

In September and October 2019 we engaged further with three DNOs to discuss our proposal to support their own assessments. These DNOs supported and were keen to work towards a *NOA*-type approach. One thought that there is probably more value to be gained from applying the *NOA* to transmission rather than distribution investments. They also thought that our methodology document could be more detailed and easy to follow. We will review our methodology in light of this feedback.

### Cost-benefit analysis

Distribution-level organisations, including DNOs, will be able to engage more easily with us as a result of a more coordinated approach to planning across the networks and a consistent *NOA* methodology. This will include being able to access best practice in economic evaluations. We would expect DNOs to develop their processes and will share our experience of *NOA* assessment to help them ensure they are effective.

We estimate DNO investment at the 132kV level of £40 million per year. At a transmission level, around 40 per cent of options do not make it onto the optimal path for any of the *FES* scenarios. Assuming the same is true at a distribution level, this would mean £16 million of investment would be recommended to not proceed each year. Given the uncertainty in this, we have assumed £10 million gross benefit a year would be realised. Based on starting this activity in 2023/24, this activity would bring £30 million of gross consumer benefit.

This is against a baseline assumption of not supporting DNOs to deliver *NOA*-type benefits on the distribution networks.

See Annex 2 - CBA report section 4.1 for more details, including the key risks and mitigations we have identified in respect to delivery of this activity.

### 6.2.3.4. A11 Enhance our analytical capabilities to support these activities

Our modelling capabilities underpin most of what we intend to deliver in Theme 3 and many in Theme 4, enabling us to unlock significant benefits. We need to be able to manage the rising number of scenarios and increased modelling complexity that are driven by the growing interaction between different network needs, such as voltage and stability. The better we understand likely needs, the better we can identify where and when to efficiently invest.

Our current analytical tools focus on thermal needs[106] and some voltage issues. We need to expand our tools to cover all energy-related network issues. Work is already under way to develop our capabilities, but we are only at the beginning of this journey. To deliver these tools we will require two new FTEs from the start of RIIO-2, reducing down as the tools are delivered.

The innovative techniques currently being explored will need to be implemented in RIIO-2 and we expect further benefits can be gained as we build on these techniques. For example, greater integration between the different modelling tools will allow us to better understand the interactions between different network needs and optimise our economic decision-making.

Specific tools we will develop are:

- **A11.1 Economic assessment**. This tool enables us to identify the most efficient time to invest in our networks, to address the future needs identified through our network modelling.

  Our current tool is scheduled to be refreshed before the end of RIIO-1. As part of this, we will transform our economic modelling capability to go beyond its current limited assessments to evaluate all energy-related network challenges, such as all voltage issues, stability and rate of change of frequency (RoCoF)

  We will refresh the tool every three years. The first economic assessment tool refresh will start at the beginning of RIIO-2 (D11.1.1), include gathering new requirements and designing the new tool (D11.1.2) and completing the development and testing of the tool (D11.1.3) prior to implementation in the fourth quarter 2022/23 (D11.1.4). This process will be repeated to ensure we are able to support the evolving network development requirements. We will start the next refresh process in the second half of 2025/26 (D11.1.5). We will also integrate our economic-assessment tools with our power-system modelling tools, building in the processing power to solve ever more complicated network optimisations.

  These enhancements will allow us to further pinpoint the most economical time to invest in the networks – and the most efficient solution. Correctly identifying the best time to invest saves consumers many millions of pounds (D11.1).

  In addition to our future network planning, this tool will support our year-ahead outage planning by providing a more refined understanding of the networks.

- **A11.2 Probabilistic modelling**. This approach allows detailed statistical analysis of network flows and other system conditions. It is a significant step forward, as we will be able to not just understand that a circuit is overloaded, but also when, how often and under what prevailing conditions. This will support better decision-making to prevent over or under-investment.

  Proof of concept work is currently under way to develop these techniques for thermal issues. We will gather further probabilistic modelling requirements and complete the design in the first quarter of 2021/22 (D11.2.1); develop and test the full model by the fourth quarter of 2021/22 (D11.2.2); and implement the model in the fourth quarter of 2022/23 (D11.2.3).

  This model will account for the actions the we take to optimise the capability of the network. For example, using network assets to direct and control the power flows across the network.

  We also intend to model potential alternatives to traditional transmission reinforcement. These include commercial options, flexible power-flow devices and energy storage, which will enhance our capability to compare multiple options in the *NOA* process.

  Also, by integrating this tool with our other network planning tools, we will better optimise the decision-making process by combining the economic and technical studies within a single platform.

  Subject to the success of our probabilistic modelling and voltage optimisation activities (see below), from 2024 onwards we will provide an online portal (D11.2.4) that enables stakeholders to see a visual representation of network needs and to potentially test high-level solutions. (D11.2.5)

- **A11.3 Voltage optimisation**. As set out earlier, voltage issues on the network have grown significantly. Our current tools for voltage assessment need to be developed to be able to manage the increased volume of analysis that needs to be carried out in a short space of time.

  We are currently investigating the possibility of an enhanced voltage-assessment tool that can examine more scenarios quicker. If this proof of academic concept is successful, an enhanced voltage-optimisation tool will be implemented by the second half of 2023/24.

  We will commence full development of the tool in the fourth quarter of 2021/22 (D11.3.1); complete gathering requirements and tool design by the second quarter of 2022/23 (D11.3.2); develop and test the tool by the fourth quarter of 2022/23 (D11.3.3); and implement the enhanced tool by the second half of 2023/24 (D11.3.4)

  In addition to enhancing this tool further we are keen to integrate it with other tools to allow us to look across a range of system needs at the same time, such as thermal, dynamic and steady-state voltage requirements. (D11.3.4)

  The voltage optimisation tool will allow us to identify where and when this need occurs, which in turn helps us to identify the most efficient solution. We anticipate this could contribute to the savings across all of the operability constraints in RIIO-2 as detailed in Annex 2 - CBA report.

- **A11.4 Stability assessment**. Stability is the inherent ability of the system to quickly return to acceptable operation following a disturbance. The increasing contribution of non-synchronous generation

[106] Thermal needs – Where the amount of power that would flow exceeds the design rating (or capacity) of any network components E.g. Overhead lines, cable circuits, transformers and circuit breakers.

technology[107], and the corresponding decline of synchronous generation, means that we have had to enhance our capabilities in monitoring, understanding and maintaining stability. This is essential to provide a reliable network.

Investigation is currently under way into new algorithms that allow faster assessment of stability for our Control Centre. We also need improved tools that allow us to identify and plan for future stability issues.

We will commence development of a stability assessment tool in the second quarter of 2022/23 (D11.4.1); complete gathering requirements and tool design by the second quarter of 2022/23 (D11.4.2); develop and test the tool in 2023/24 (D11.4.3); and implement the tool in 2024/25 (D11.4.4).

These requirements are even more complex than the algorithms being developed, as our ability to rely on established generation equipment for stability reduces. Investment is required in RIIO-2 to allow us to develop and implement new tools to assess future stability needs. New stability assessment tools will be in place in the first half of 2024/25 (D11.4.1 to D11.4.4 see IT investment reference 390 *NOA* enhancements).

## Investment roadmap

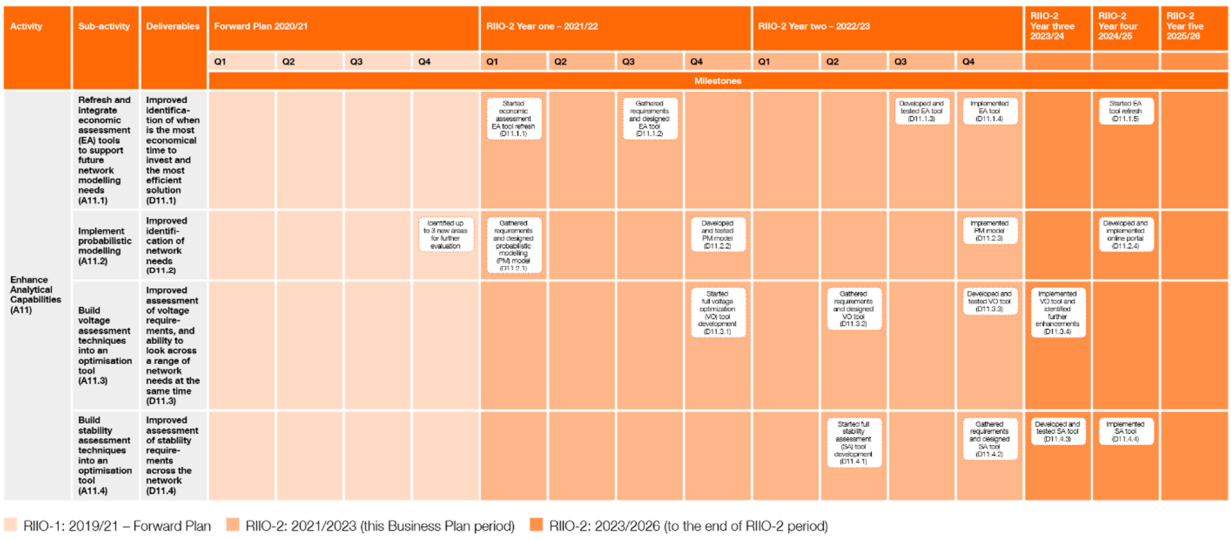



*Figure 31: Investment roadmap*

## Other options considered

As shown in figure 32, the transformational activities set out above are all proposed additions to the *NOA*: either expanding the scope of *NOA* or expanding the solutions that can be inputted. As such, any combination of them defines a suite of options, against a baseline of continuing with the current *NOA* process as is. Our preferred option is to carry out all of them. In line with Ofgem's guidance, we made this decision through a consideration of cost-benefit analysis, stakeholder feedback and our own commercial and technical judgement. This is summarised above and more details are available in section 4.1 of Annex 2 -CBA report and in section 5.5.1 of Annex 3 - Stakeholder report.

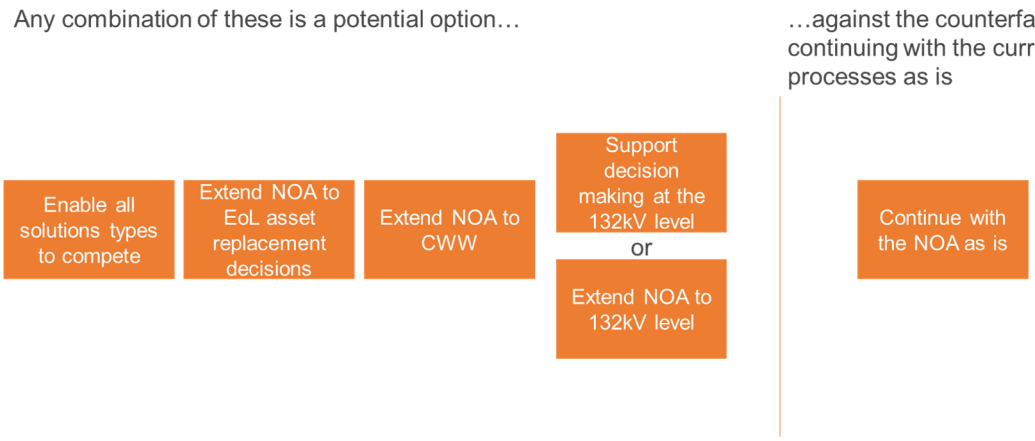



*Figure 32: Options considered for NOA enhancements*

[107] Non-synchronous generation technologies – NSG technologies are de-coupled from the grid and do not contribute to the system inertia. Examples include wind turbines, solar PV, and high voltage direct current (HVDC) Converters.

## 6.3. A12 Review of the SQSS

| Review of the SQSS | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex (£m) | 0.0 | 0.2 | 0.3 | 0.3 | 0.2 | 0.1 |
| FTE | 0 | 2 | 3 | 3 | 2 | 1 |

### Highlights

We propose to invest in supporting a targeted review of the Security and Quality of Supply Standard (SQSS), to ensure it is designed to enable decarbonisation of the electricty system. We will invest to scope and manage the technical developments, and then scale them back through implementation.

In order to make a review worthwhile, we will need sufficient resources to ensure we can effectively support and action the meaningful improvements identified.

Two additional FTEs are required to establish the initial scope of the SQSS review, informed by Department for Business, Energy and Industrial Strategy (BEIS) engineering standards recommendations and considering the potential for whole electricity system alignment. This is expected to start in 2021/22, with the review fully scoped and target issues identified by the second quarter of 2021/22 (D12.1.1).

We will engage with relevant stakeholders to validate the scope and agree the target issues to be addressed in the fourth quarter of 2021/22 (D12.1.2). One additional FTE will be required over 2022/24 to manage the content changes and potential solution developments (D12.2.3).

We anticipate a decreasing FTE profile to continue the implementation of any changes. Key changes to the SQSS will be made or be in progress through 2025/26, including reporting to Ofgem on proposed SQSS changes and implementation plan; and implementing ESO-related changes (D12.3.4).

The SQSS sets the technical standards that the TOs and ESO must meet. The energy industry has changed significantly since the SQSS was introduced. As we move towards a decarbonised energy system, it is important that industry codes and standards reflect this.

There are a number of areas of the SQSS where improvements could be made, including reviewing its approach to deterministic standards to ensure it reflects the *NOA*, and developing the offshore transmission section to reflect the growth of this sector.

In line with the majority of stakeholder views, we suggested in our July Business Plan draft that a focused review of the SQSS – addressing a targeted set of known concerns – would be an effective first step. Since then, BEIS has announced that its review of engineering standards will include the SQSS within its scope. We expect that this review will outline key areas of change that are required, but not explore these in detail. We therefore continue to propose a targeted SQSS review, building on the recommendations from the BEIS work, and to drive forward the changes with the highest consumer benefit.

We expect the BEIS review to complete within RIIO-1 and so we expect a targeted SQSS review would begin at the start of RIIO-2 and run for four years. Potentially, we would move to a larger-scale review if the BEIS work recommends this, or if the early stages of the targeted SQSS review indicate a need. Costs and timeframes for this are not accounted for here.

The review could potentially go beyond SQSS to include the distribution standard P2/6[108], and would need to be supported by TOs, DNOs and other affected stakeholders. We are mindful of the feedback we have received, particularly in Themes 2 and 4, of the need to take a broader, whole system view of technical codes and frameworks, along with the need to make these areas more accessible. We will therefore be considering how we can make timely changes in this area while a broader review is developed.

Our proposal assumes that BEIS's review of standards will have completed and provides an indicative direction of the areas to explore. If this does not happen more work may be required in the early stages of the SQSS review.

[108] P2/6 is the distribution network planning standard. DNOs have a licence obligation to plan and develop their systems in accordance with this standard.

## 6.3.1. Investment roadmap

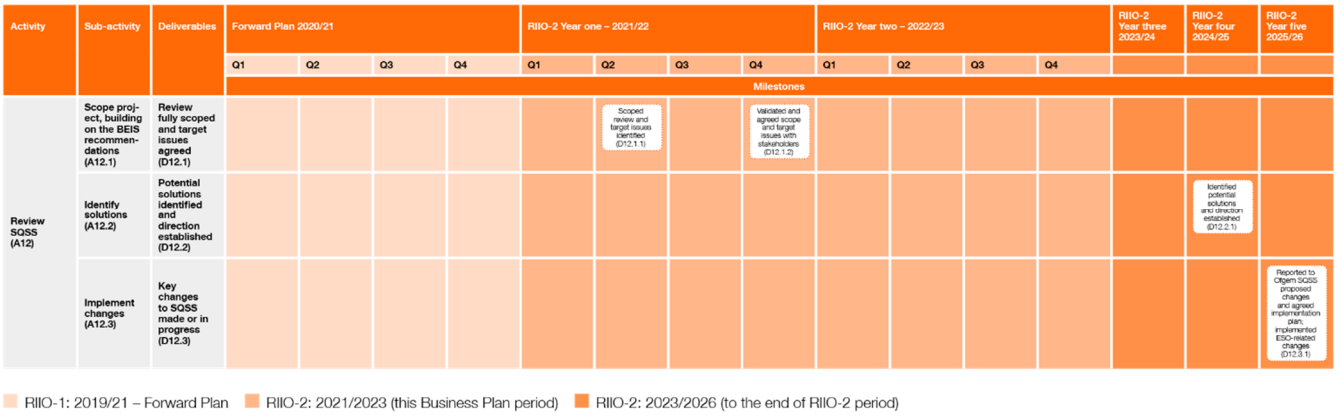



*Figure 33: Investment roadmap*

## 6.3.2. Stakeholder views

We engaged stakeholders on our proposal to review the SQSS at our webinar in November 2018, our December 2018 RIIO-2 event, and our RIIO-2 workshop in April 2019. We have had discussions with the TOs on the scope of the review and with DNOs to gain a distribution perspective.

**As SQSS sets the rules for the *NOA* it is very important that the SQSS is up to date with current technology and capability, so that it is a level playing field for all technologies.**
**Generator, in response to the Our RIIO-2 Ambition consultation**

Stakeholder views were mixed on whether a fundamental review was necessary. In our November 2018 webinar, six out of eight participants supported a fundamental review of some form. However, at our December 2018 event, there was no clear agreement on whether a fundamental review was required.

Several stakeholders, particularly DNOs and TOs, felt that a fundamental review was unnecessary and potentially lengthy, whereas others felt that undertaking a review would benefit the industry. At our April event, of the seven stakeholders who gave an opinion, the majority supported some form of review. But there were no definitive thoughts on whether this should be a light-touch or fundamental. These stakeholders were from a range of sectors, including generation, networks, government and renewable energy. A generator highlighted that changes to the SQSS would have an impact on system charges and we agreed that this is something we need to consider.

A service provider questioned the need for the SQSS at all, citing other countries that do not have a standard. We think there is a continued need for a security and quality standard and that a review is more appropriate than removal of the standard. Feedback from some offshore parties has suggested that the offshore section of the SQSS may benefit from a significant level of review and so this will be factored into our scoping of the project.

We also explored different possible approaches with the TOs. All agreed that a more focused review would be more appropriate than a fundamental one. It was felt that a fundamental review could slow down the benefits that could be achieved by addressing known issues. They also said it could also be bureaucratic and that it was unclear what we would expect to be radically different at the end. It was noted that a fundamental review was started around ten years ago and continued for around nine years. We therefore agree with the TOs that a more targeted review would be more efficient and have amended our proposal accordingly. We have also spoken to DNOs about this proposal. They have highlighted the need to consider what impact a review of the SQSS may have on the transmission-distribution interface. We agree that any change made to the SQSS following a targeted review will need to consider the distribution interface.

## 6.3.3. Cost-benefit analysis

We have conducted a breakeven analysis of the SQSS review, rather than a full cost-benefit analysis. We have conducted a breakeven analysis because the SQSS review does not deliver consumer benefit by itself. It is the implementation of the review recommendations (if any) that provide consumer benefit, and we cannot say at this stage what these could to be. Based on the stakeholder feedback we propose a targeted review.

For more details see Annex 2 - CBA report section 4.2. This also includes the key risks and mitigations we have identified in respect to delivery of this activity.

#### 6.3.3.1. Other options considered

We considered three options:

1. Undertaking a fundamental review of SQSS
2. Undertaking a focused, targeted review of SQSS
3. Status quo - not undertaking a review

We have taken forward option 2. Full details of the options considered are in section 4.2 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.5.1 of Annex 3 – Stakeholder report.

## 6.4. Supporting the design and delivery of an early competition plan

We believe that the best outcome for consumers will be achieved through early models of competition in onshore transmission network build; whereby competition can be used to drive innovation in the options proposed to meet future needs, including addressing high-value transmission network requirements. We are therefore very positive about and supportive of the introduction of a Competitively Appointed Transmission Owner (CATO) regime, due to the potential it has to deliver significant benefits for consumers.

By February 2021, we will be presenting an Early Competition Plan, setting out how early models of such competition could be introduced. This will cover models of CATO competition and alternative approaches that could be used prior to the introduction of the legislation required for CATO. We have agreed the development scope with Ofgem, in line with the request in their open letter dated 24 September 2019.

The Early Competition Plan, along with Ofgem's own thinking, will help inform Ofgem's decisions on how to introduce this competition. This in turn will affect the resource requirements we need to deliver the chosen approach. Therefore, we have agreed with Ofgem that CATO will be considered separately to this Business Plan.

The Early Competition Plan is being developed with the support of interested stakeholders. Stage one of the development phase, to December 2019, explores a wide range of options to determine the preferred models to explore in more detail. This will be submitted to Ofgem in December 2019. Stages two to four will run from January to February 2021 and will cover detailed model development, implementation planning and formal stakeholder consultation.

Throughout this process we will undertake stakeholder engagement, including webinars and workshops and an equivalent enhanced engagement approach to RIIO-2, to ensure the development is informed by all relevant and interested parties.

## 6.5. Measuring performance

### 6.5.1. Performance metrics

### 6.5.2. Metric 10 – Consumer value savings from *NOA*

Our *NOA* process drives economic and efficient outcomes from planning, developing and investing in the network. We have received positive feedback on our *Forward Plan* metric of the value savings that are passed on to the customer.

We propose to measure the value that undertaking the *NOA* delivers by analysing the increase in constraint costs that we would expect to incur if none of the options in the optimal path were proceeded for one year. This will highlight the importance of delivering both the ESO-determined optimal solution at the correct time according to our analysis. We do not believe it is appropriate to have a target against this as the value is very dependent on the level of network investment which is required. This can vary significantly over time and is not something we have direct control over.

We propose targets around elements over which we have control. This is in the options that are put into the *NOA* process and are recommended as part of the optimal paths. We propose a metric measuring the options which are submitted as part of the *NOA* process, categorising options into the following categories:

- ESO exclusive options – These are options which are exclusively developed or sought by the ESO. These will include operational options, commercial services and options from other interested parties, such as DNOs.
- ESO collaborative options – These are options which we have collaborated with a TO on. This could be in influencing the design or location of a particular option, influencing build order of options or working more collaboratively with a TO to propose new technology solutions. This can include both reduced build and asset build solutions as there is value in us helping unlock variations to asset build options if it can result in consumer benefits.
- TO exclusive options – These are options which are submitted by the TOs and which have had no direct input from us. These will include a mix of both reduced-build and asset-build options.

We believe it is appropriate for us to have targets around the options which appear in the ESO exclusive and ESO collaborative options category. We propose this is both a numerical target and value. As the number of options and consumer value will vary year on year

influenced by the level of reinforcement required on the network, we propose to target a consumer value saving of £50 million per ESO exclusive and collaborate option. We propose to apply this metric to the *NOA* published annually every January.

### 6.5.3. Annual reporting items

Alongside our measure of consumer benefit saved through the *NOA*, we also propose reporting on the percentage of different participant types that are in the *NOA* process. Stakeholders have questioned if this measure represents our performance so as a result this measure will form part of our annual reporting process instead of being considered a performance metric.

We also propose supporting the participant-mix metric with a routine stakeholder satisfaction (SSAT) measure, which would help to inform how the *NOA* methodology develops in the future. As the expected variety of participants involved in the *NOA* process becomes more diverse, a measure of satisfaction from stakeholders regarding our process will give us a wider range of perspectives from which to drive further improvements in the methodology. This will be included as part of Metric 17 - Customer and stakeholder satisfaction that will cover all of the ESO but will be reported separately on an annual basis to ensure visibility. Our proposed metrics in this area align to the expansion of the *NOA* to other areas of network development and support our ambition to create competition everywhere.

# Role 3: System insight, planning and network development

## **Theme 4** Driving towards a sustainable, whole-energy future

### Consumer priorities

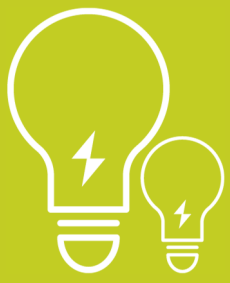
- We want an affordable energy bill
- We want energy to be available when we need it
- We want a decarbonised energy system, fit for the future

### Stakeholder priorities

- I want efficient whole energy system operation
- I want you to enable the smart, flexible and low carbon energy system of the future
- I want you to be open, engaging and easy to work with
- I want you to be adaptable and innovative
- I want to connect to the electricity network in a timely manner

### The ESO RIIO-2 Stakeholder Group supports Theme 4

"ERSG feels strongly that the ESO has a central role to play in the energy transformation and acting as a trusted advisor to government on how the UK gets there."



## What this Theme covers

Adopting a whole system approach to drive the whole energy system transition of the industry and realise Great Britain's carbon and net zero ambitions.

## What we propose to do

Provide deeper insights to inform key policy areas. Work with other network organisations to develop consistent and coordinated processes for customers that facilitate efficient connection and access to the system, and ensure we have the tools to manage overall system operability.

## What our Stakeholders have told us

Stakeholders had mixed views on the extent to which we should develop policy recommendations from our *FES* analysis on key industry topics. They think that whole energy system solutions are essential to the transformation of the energy landscape and that our connections and system access proposals can assist the transition.

## What are the key benefits?

Providing the industry with a clear and detailed view of the future energy system and pathways to inform their plans and investment decisions. Facilitating efficient whole system ways of working that drive consumer value and the connection of low carbon energy resources. Allowing customers to access a more supportive, coordinated connections experience.

# 7. Role 3,Theme 4: Driving towards a sustainable, whole energy future

## Theme 4 delivers £673 million net present value of consumer benefits[109] and lowers consumer bills by £1.13 a year[110]. Investment[111] for this Theme (two years): £56.7 million.

## 7.1. Five-year strategy

**Net zero by 2050**

We will enable the UK to transition to net zero emissions by:

- informing policy development, pathways and strategies related to clean heat and zero carbon electricity grid operation.
- rolling out our Enhanced Frequency Control Capability system to our National Control Centre.
- building and enhancing relationships with other network organisations to facilitate decarbonisation opportunities.

We will take a whole energy system view of the changing energy landscape to operate a zero carbon electricity system by 2025 that delivers maximum consumer value and develop broader cross vector ways of working as we move towards net zero in 2050. We define a whole energy system as covering more than a single fuel source, extending into areas such as the decarbonisation of heat and transport.

The following significant changes since the start of RIIO-1 have increased the challenges we face in planning and operating the system:

- **The number and mix of parties connecting to the system:** in the last 12 months applications from new market participants have increased by 60 per cent, driven by new small generation units for battery storage and solar connections, new interconnectors and new demand points. We forecast that this trend will continue in RIIO-2, with distributed capacity expected to increase by at least 50 per cent by 2030, and an increasing number of applicants being small, new players that require more support
- **The generation mix:** declining levels of traditional generation are bringing increased operability challenges, for example due to lower levels of system inertia. In the first quarter of 2019 renewable generation was the second highest on record and in line with the trend that has seen renewable generation rise 70 per cent since 2014[112] while fossil fuels have declined by 26 per cent.
- **Significant increases in distribution-connected generation:** this requires us to be able to model the operational characteristics of distribution networks with much higher volumes of data. Distribution-connected generation capacity has increased by 80 per cent since 2013 and in 2018, 77 per cent of this capacity was renewable[113].

To deliver our strategy for this Theme, our proposals initially focus on enhancing the way we work across the transmission and distribution networks and using a whole energy system view to provide insight on policy issues and pathways to net zero by 2050. We expect to take an increasingly broader view from a whole electricity to a whole energy system approach through RIIO-2. We will:

- A13[114] Lead the debate – providing insights and policy pathways to achieve the UK's low carbon goals.
- A14 Take a whole electricity system approach to connections - to accommodate the growing numbers of parties seeking to connect to the network, and their more complex needs.
- A15 Use a whole energy system approach for zero carbon operability – investing in our capability to undertake more complex system modelling and data exchange to allow us to assess future operability needs.
- A16 Deliver consumer benefits from improved network access planning - optimising outage requirements across the transmission and distribution networks.

While longer-term development will be around whole energy system approaches, our delivery focus for the early part of RIIO-2 will be on whole electricity system solutions. We define the whole electricity system as covering electricity transmission and distribution, including all parties involved in delivering for consumers.

[109] Consumer benefits are the net present value (NPV) of Theme 4's transformational activities over the RIIO-2 period. When referring to the quantified benefits themselves, we refer to them as gross benefits. When summing benefits thought this document care should be taken they are the same type and note rounding may mean values do not match precisely. See Annex 2 CBA report for more details on how we have calculated NPV. Our analysis suggested that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £916 million and £427 million.

[110] Relatively, on average over the RIIO-2 period

[111] The ESO will generate a net saving for consumers in RIIO-2. The proposed investment in this chapter will help to deliver this net saving

[112] Digest of UK Energy Statistics 2019 table 5.1 https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

[113] Digest of UK Energy Statistics 2019 table 5.12

[114] These are the activity codes introduced earlier in this document. These unique identifiers help to link the activities, sub-activities and deliverables.

The whole electricity system transition will affect all stakeholders within the sector, and this Theme primarily considers how our role will change in relation to other network organisations. Other impacts, such as the development of flexibility markets, are considered elsewhere in our proposals.

Each of the actions we have proposed aim to drive efficiency in areas where cross-business working currently poses a risk to the efficient delivery of a low carbon power system. They should ensure the industry works better together, for the benefit of consumers, delivering lower bills than would otherwise be the case. They also support the other proposals in this Business Plan, including the development of flexibility markets for Distributed Energy Resources, as well as facilitating zero carbon operability.

In particular, we propose to strengthen the way we coordinate with Distribution Network Operators (DNOs), as a natural evolution of our existing role. This will enable us to take a whole electricity system view that will enhance consumer benefits. This approach is consistent with the ethos of the Energy Networks Association (ENA) *Future Worlds 'World B*[115]', which is supported by a wide stakeholder base and consistent with the least-regrets approach taken by Ofgem in their position paper on distribution system operation (DSO)[116]. The approach is also supported by our ESO RIIO-2 Stakeholder Group (ERSG) and forms the basis of our strategy. Our relationship with Transmission Owners (TOs) will remain similar to today. However, we will continue to enhance this relationship, looking for incremental opportunities to unlock consumer benefits in a changing energy landscape and co-ordinate to deliver efficient outcomes.

To ensure enhanced electricity system coordination and effective management of operational issues at the transmission-distribution interface, we expect DNOs and TOs to have access to funding and resources to establish new ways of working. This includes information technology (IT) system changes to appropriately interface with our systems, so the required data exchanges can take place. For example, in relation to system conditions and the use of flexibility services. We are working with network organisations, both bilaterally and through the ENA Open Networks project, to ensure that that the activities we are doing to enable DSOs are co-ordinated. To that end we are also engaging with TOs to ensure a coordinated approach to our RIIO-2 Business Plans. We will look to ensure similar engagement with DNOs as they develop their plans for RIIO-ED2.

### 7.1.1. Proposed investment

The chart in figure 34 summarises our proposed investment over the RIIO-2 period. It covers both our ongoing and transformational activities. Further justification for the costs associated with these is set out in the relevant sections that follow. Details on how we have included efficiency assumptions and benchmarked these costs are in chapter three – Assumptions underpinning our plan.

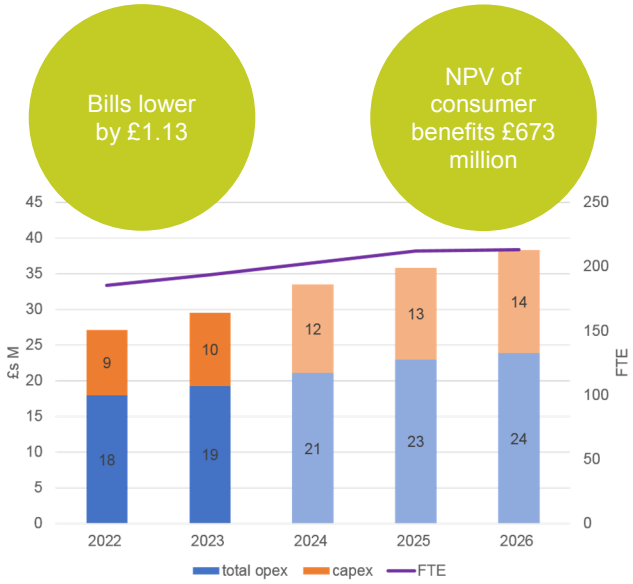



*Figure 34: Theme 4 costs, benefits and FTEs*

Our regulatory framework should facilitate the delivery of our outputs and benefits under this Theme through:

- A clear, targeted incentive scheme with *ex ante* clarity on how performance will be assessed
- Supporting the increase in IT investment to deliver enhanced modelling capability and other investments so that our planning and operability approaches reflect a whole system view, as well as the significant changes to generation mix and number of parties connecting to the system. This includes supporting an innovative, agile programme of IT transformation where we can change and optimise the programme of investment, if this is in the best interests of consumers, without undue fear of disallowance.
- Ensuring we can raise appropriate levels of equity and debt finance to fund this investment.

Discussion on our regulatory framework can be found in chapter 9 – Financing our plan.

The main consumer benefits under this Theme are:

- Improved customer efficiency in the connections process through easier access to front-line support and coordinated information, resulting in £8 million in gross consumer benefits
- Realising significant value through identifying and opening up potential new market opportunities to address network operability challenges, which could unlock around £500 million in gross benefits
- Continued deployment of Regional Development Programmes (RDPs) saving consumers over £40 million and saving over half a million tonnes of carbon

[115]http://www.energynetworks.org/assets/files/14969_ENA_FutureWorlds_AW06_INT.pdf

[116]https://www.ofgem.gov.uk/system/files/docs/2019/08/position_paper_on_distribution_system_operation.pdf

- Improved access planning processes to facilitate efficient delivery of work on assets, releasing £224 million in gross consumer benefits.

We will maintain a focus on consumer priorities:

- An affordable energy bill:
  - We will develop and share an understanding of the whole system cost of different heat decarbonisation pathways. This will allow Great Britain to avoid choices that would lead to overspending and stranded assets.
  - Increased sharing of network data and models, particularly between network organisations, will help us develop and operate the transmission system more efficiently. It will reduce the need to take expensive actions to manage congestion or build unnecessary assets.
  - We will roll out the enhanced SO-TO cost-recovery mechanism for system access across Great Britain. This will optimise access to the network in the long and short term, while ensuring appropriate recovery of costs by network organisations.
- Energy to be available when needed
  - By providing a clear view of the future, we help steer the energy system away from pathways that could lead to safety and reliability problems before they become an issue.
- A decarbonised energy system, fit for the future through:
  - Providing better information on available transmission capacity will help low carbon developers understand where they can quickly connect to networks. This will speed up the decarbonisation of the energy sector.
  - Deepening our relationship with DNOs in the design and development process will embed the Regional Development Programme ethos and facilitate the faster connection of low carbon generation.
- A safe and secure energy system through:
  - Ensuring future operability of initially the whole electricity system but then more broadly the whole energy system, with clearly defined roles and responsibilities for both the ESO and DNOs as they develop DSO competencies.
  - Increased coordination and optimisation of network access will facilitate timely construction and maintenance of assets, improving safety and reliability.

We will measure our success by tracking:

- cost of balancing.
- outage timeliness.
- outage value.
- customer satisfaction surveys.

### 7.1.2. A13 Leading the debate: providing energy analysis and market insights to drive the energy transition

We have an important role to play in leading the debate on the energy revolution across the industry. We will inform and work with our stakeholders to make sure we have a safe, secure and reliable energy future. This includes our wide range of publications that provide energy insight and analysis that we are seeking to enhance over the RIIO-2 period.

We are uniquely positioned to use our expertise and share our analysis to lead the debate and help drive the whole energy transition that will support the UK's 2050 net zero commitment. We will deliver deep and targeted analysis and industry engagement, so we can support and inform the development of specific energy policy. These will build on the valued insights we already produce through our *Future Energy Scenarios (FES)* and associated documents. As we stated in our 2019 *FES*, we believe that net zero is achievable. We will continue to support the Department for Business Energy and Industrial Strategy (BEIS) to ensure the timely development of its clean heat strategy, providing key inputs from a whole energy system perspective. Also, as indicated in our *Towards 2030* document, we will play an instrumental role – and work with the industry – in the delivery of a smart, flexible energy system. We will focus discussion on the many constituent areas of a whole energy system transition to net zero, including clean heat, Carbon Capture Use and Storage (CCUS), electric vehicles, and energy data. While the content of this activity analyses the uncertainty and impact of policy, the work itself has no specific policy dependencies.

### 7.1.3. Costs

| Leading the debate | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0 | 0 | 0 | 0 | 0 | 0 |
| Opex (£m) | 2.1 | 3.7 | 3.8 | 3.8 | 3.9 | 3.6 |
| FTE[117] | 17 | 31 | 33 | 34 | 35 | 32 |

#### Highlights

Our opex will ensure we can build on our *FES*, undertake deeper, targeted analysis and industry engagements, inform policy development, support DNOs and TOs to develop their regional *FES.* This will also support the end consumer through the energy transition.

[117] Opex and FTE numbers are the average for the ESO since legal separation (years 2020 & 2021), which reflects the current ESO business. Capex figures are the average over the eight years of RIIO-1.

Capital investments associated with this activity include the need for our proposed data and analytics platform. This platform forms part of our Theme 1 investments as the platform will be developed and deployed to support wider ESO requirements. Our opex reflects our proposed increase in full time equivalent (FTE) employees explained in section 7.1.4 below.

## 7.1.4. A13.1 – A13.3 Ongoing activities

We will continue to bring energy, customer and stakeholder insights together. This will underpin and help inform our strategic thinking, as well as how we plan investments and how we operate to meet decarbonisation targets. Activities in this area include:

- A13.1 Carry out analysis and scenario modelling on future energy demand. This will be through undertaking research and engaging with stakeholders to understand their key considerations through calls for evidence and network forums. The outputs from this will be shared through the provision of expert advice and insights in publications including FES, Winter Outlook and Review, Summer Outlook and other thought-leadership pieces (D13.1).
- A13.2 Conduct electricity and energy mathematical modelling and market research, such as analysis on pan-European models and geographical demand information, to understand how the landscape in which we operate could change This will result in the creation of pan-European and country level electricity and energy demand models (D13.2).
- A13.3 Maintain external communication channels with consumers and stakeholders. This will enable us to capture and share insights on future energy expectations and requirements (D13.3).

### Enhancements to our ongoing work

We carry out significant stakeholder engagement to develop the *FES* and we publish the feedback we receive annually[118]. Stakeholders consistently tell us that whole energy system considerations are crucial to enabling the transition to the energy system of the future. Our analysis will expand its scope to include interdependent sources of energy supply and demand, such as hydrogen. In developing *FES* for 2019, we engaged more than 630 individual stakeholders from 415 organisations.

In RIIO-1, we made several improvements to our ongoing activities, without requiring additional resources. For example:

- We launched an annual *FES* stakeholder feedback document.
- We grew the number, and range of stakeholders we engaged with.
- We developed new data and techniques to model growing levels of distributed energy, renewable generation and interconnectors.
- We improved the visibility and transparency of our *FES* data. This included providing a regional breakdown of *FES* electricity data, including the impact of electric vehicle and heat pump penetrations by grid supply point for each of the four *FES* scenarios.
- We played an active role in the ENA Open Networks Project, including leading the whole energy system workstream.

Of the 31 FTEs in 2021/22 in the cost table above an additional three FTEs are required to deliver our ongoing activities and work enhancements in 2021/22. The increase, from our baseline 17 to 20 FTEs, includes two to deliver additional requirements from the *FES*, ensure our analysis and modelling keeps up with the rapidly changing landscape and meets the increased analysis demands from other teams. These demands, against our current priorities, include probabilistic modelling, heat improvements and demand profiling. The remaining one additional FTE is required to deliver the strategic inputs needed to address the increased volume of work required from a more frequent ESO RIIO cycle and ensure alignment to external changes.

### Innovation funding during RIIO-1 has contributed to our proposals

Our ability to lead this debate is built on data-driven analysis, including data from our innovation projects. One example is our Network Innovation Allowance (NIA) project on electric vehicles charging behaviour, which has brought a step change in our modelling of electricity demand from electric vehicles. Another is our self-funded carbon intensity forecasting project. This used machine learning and automation to provide more accurate forecasts, which we publish continuously to enable consumers, academics and industry stakeholders to make more informed choices, and ultimately move the industry towards optimising the use of renewable electricity.

In RIIO-2, we will continue to enhance our ongoing work, including delivering modelling improvements such as a spatial heat model, while incorporating demand curve developments. This will enable a more regional approach to be employed to understand the locational impact of heat decarbonisation. This will in turn allow better network planning outcomes and faster adoption of optimised decarbonisation solutions.

We will also look to establish targeted engagements to understand specific areas of importance in meeting the net zero target and to develop insights from a broader range of stakeholders.

## 7.1.5. Transformational activities

We will respond to stakeholder feedback to carry out deeper analysis and broader industry engagement, and

[118] More information on our engagement approach for *FES* can be found here: http://fes.nationalgrid.com/stakeholder-feedback/

where appropriate, develop evidence-based recommendations that support the development, successful implementation and execution of energy policy. Our work in this space will build on the valued insights we already produce through the *FES* and associated documents. We will do this in partnership with key decision makers and stakeholders. Our focus will be on insights to facilitate the delivery of a smart, flexible low carbon energy system, zero carbon electricity grid operation, and the development of a clean heat strategy. These areas will focus discussions on how we can achieve the best outcomes for consumers across areas, which may include clean heat, CCUS, electric vehicles and energy data.

**ESO's core role should move beyond keeping the lights on, to also include facilitating the energy transition.**
**Flexibility provider**

By developing and sharing our understanding of the whole system implications of different heat decarbonisation pathways, we can also inform investment choices in new network assets or other market solutions. We expect this to translate into lower bills and reduced environmental impact.

We will provide broader and deeper insights, which will be underpinned by enhanced long-term modelling and improved analysis tools, capabilities and processes. Our capabilities and processes will need to change to make efficient use of a vast range of energy system data which will become increasingly open as the recommendations from the Energy Data Taskforce[119] are implemented. We will use new techniques, such as artificial intelligence and machine learning, to derive new insights from it. The IT investments required to provide this are included in IT reference 220 Data & Analytics Platform (See Annex 4 - Technology investment report), which is covered in more detail in Theme 1. We plan to deliver new demand models and whole system model enhancements in the period to 2023, followed by further enhancements to demand models, heat models and probabilistic models in the period to 2026.

#### 7.1.5.1. A13.4 FES: Bridging the gap to net zero

Of the 31 FTEs for 2021/22, in section 7.1.3, four are additional FTEs required from 2021/22 to 2022/23. These are required to enable us to build on the results of our *FES* and delve further into specific decisions facing policy makers such as BEIS, Office for Low Emissions Vehicles (OLEV), Ofgem; and industry (D13.4). We will require one further FTE in 2024/25 as our insights work broadens to encompass new insights from the increasing volumes of data we will see. See Annex 4 -Technology investment report, investment reference 220 - data and analytics platform.

Through the *FES*: Bridging the gap to net zero work, we will work collaboratively across the energy industry, to look in more detail at areas of uncertainty in *FES* and support industry conversations that will progress the UK towards net zero. The additional FTEs will work with partners, including energy suppliers, technology providers and academia. They will also engage with a broader range of stakeholders inside and outside of the energy industry to explore the whole energy system challenges that are inherent to specific policy and industry decisions. They will also build a shared understanding of these across industry through events and publications so that high quality decisions are made across industry for the benefit of the consumer (D13.4.1). Additional opportunities created through this work will include highlighting and reporting on whole energy system insights, the need for collaborative innovation projects, studies, and informing the scope of existing work across industry so that a whole system lens becomes the norm when considering energy challenges, such as BEIS' 2025 Clean Heat goal (D13.4.2).

#### 7.1.5.2. A13.5 *FES:* Integrating with other networks

Consistent with the Energy Data Task Force[120] recommendations we will publish our data, analysis and insight to further facilitate and progress debate across a range of different audiences. This will include deepening our relationships and co-ordination with DNOs and TOs as they embed their own regional future scenarios. This will enable them to better understand and asses the implications of our *FES* assumptions, at their local level, and further improve their investment decisions. This proposal is referred to below as Regional *FES*.

Of the 31 FTEs in 2021/22, seven are additional FTEs required from 2021/22 to support DNOs to develop their regional *FES* by aligning our energy data capture, analysis and modelling processes, where appropriate. Five are opex, rising to seven FTEs in 2022/23 and two capex, supporting *FES* investment. This is the equivalent of half an FTE to support each DNO licence area. We will limit this to where it makes sense and is in the consumer interest for us to do so, as we recognise that as *FES* develops we will seek to answer different questions. There is however an opportunity and benefits to be gained from understanding different approaches and scenario assumptions, and from independent analysis and outputs reporting.

In addition to stepping up our engagement and collaboration with DNOs and a wider range of stakeholders, the additional FTEs are required to enable us to build and develop more granular models. These are both geographical and temporal, and incorporate increasing volumes of data, such as from smart meters.

This will involve replacing our electricity demand model, to enable us to publish more data, analysis and insights

[119] https://www.gov.uk/government/groups/energy-data-taskforce

[120] https://es.catapult.org.uk/news/energy-data-taskforce-report/

to facilitate development of regional *FES* (D13.5.1). We will also develop a new energy demand model to enable us to create a longer-term model, covering annual profiles and vectors, including transport (D13.5.2).

This will enable us to develop local models with DNOs and Gas Distribution Networks. This will cover energy future growth and over the year, not just at peak demand, modelling along the demand curve to better reflect how it may change due to increasing solar power demand and use of electric vehicles.

We have estimated these resource needs based on historical activity levels and existing modelling team sizes. Once we have built the new models and established the capability to manage the increased data volumes we expect to realise efficiencies in our modelling processes and will scale back our resources. This will be enabled by our proposed investment in a data and analytics platform (see Annex 4 - Technology investment report, Investment reference 220 - data and analytics platform).

## 7.1.6. Investment roadmap

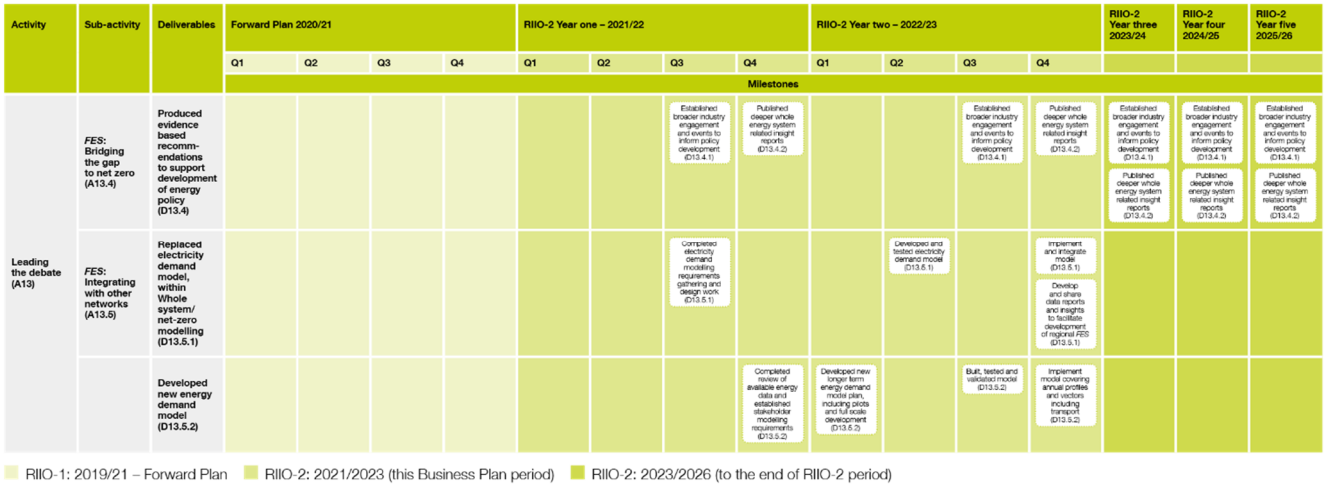



*Figure 35: Investment roadmap*

## 7.1.7. Stakeholder views

We have engaged on this subject at our *FES* events, through *Our RIIO-2 Ambition* consultation, and more recently at our Electricity National Control Centre workshops in July and August 2019 and trade association meetings.

Through our annual *FES* engagement cycle, we have been challenged to provide greater insight and direction on how different pathways could be realised. In response to *Our RIIO-2 Ambition* publication, stakeholders expressed a range of views on our role. All respondents were supportive of us providing insight and analysis to support the government in the formation of energy policy. However, one large supplier felt that our proposals to make policy recommendations went beyond the boundary of our role. In contrast, a large renewable generator highlighted that we have a unique position as the interface between multiple organisations in the energy market, so we should be offering guidance on how to address decarbonisation.

The ERSG felt strongly that the ESO has a central role to play in the energy transformation and acting as a trusted advisor to government on how the UK gets there.

**We strongly support the need to decarbonise the energy system and the critical role the ESO has to play to support government with insight and advice on their areas of expertise.**
**Supplier, in response to *Our RIIO-2 Ambition* consultation**

Given the differing views we had received up to the publication of our July plan, we sought to engage stakeholders further on this topic. We did this at our Control Centre round table events in July and August 2019, at the *FES* 2019 launch event in July in Birmingham, and with trade associations. Following review of our July plan, the ERSG also said that we should engage further on this topic and seek to clarify our role.

At the *FES* launch event, most people we spoke to about our proposals were supportive of us stepping into a role where we make policy recommendations from the *FES* analysis. These included stakeholders from the

renewable energy, supplier, and gas distribution network sectors. Similarly, at our Control Centre events, two consultants, a generator, an energy technology company and a member of local government thought we should go further and start to make recommendations from our analysis, saying that we are well placed to do so.

**ESO being a second government is not as valuable as laying out all the information and analysis.**

**Consultant, Control Centre engagement event**

Conversely, two generation companies and a consultant thought that we should not be making value judgements from the *FES*. Instead, we should just provide our analysis and data (in raw, dissectible form) for others to scrutinise and draw their own conclusions. A consumer body also thought we should be facilitating debate, rather than leading, but that we could perhaps take more of a role on the subject of heat. Members of a trade association thought it could look like we were trying to position ourselves at the centre of the system by making policy recommendations. They questioned whether, instead, we could make our assumptions within the *FES* more explicit. Or set out what policies would need to be in place to achieve a particular scenario.

As a result of this feedback we have reviewed and clarified our proposal for leading the debate, which is develop evidence-based recommendations that support the development of policy rather than to make policy recommendations. We agree that making policy recommendations goes beyond our role and expertise but also that we are in a strong position to provide policy makers, such as BEIS, Ofgem and local governments, with analysis and insight to support their policy development processes. We tested our amended proposal with some DNOs and they agreed that we should be going further than the current *FES* but not straying into telling others how to do their jobs.

At our Control Centre events, we also discussed our role in the development of regional *FES*, on which different views were expressed. Some stakeholders, including a DNO and supplier, thought that regional *FES* should build on each other and 'add up' to the national picture. Others, including a supplier, member of local government and a renewables company, felt that regional differences should exist; and that we just need to understand how assumptions differ across them. A consultant thought that we should take a leading role in ensuring consistency across regional scenarios, which can very quickly become misleading for industry. We agree that there is significant value in having different regional approaches to *FES* but acknowledge that there may be benefit associated with aligning some aspects of *FES* development. We have therefore proposed to align our energy data capture, analysis and modelling processes, with other parties developing *FES* where it is in consumers' interests to do so.

We spoke to some DNOs in September and October 2019 about regional *FES* development. One thought that FES is going to become more regionalised rather than less and that there could be merit in aligning timescales of development across the various parties. Another thought that the process of data exchange could be more formal in the future. We will use this feedback as we continue to work with DNOs and other parties on our regional *FES* proposals.

### 7.1.8. Cost-benefit analysis.

For this activity we have undertaken a break-even analysis, for details see Annex 2 - CBA report section 5.1. Additionally, we have identified and detailed the specific risks and mitigations associated with 'Leading the Debate' in Annex 2 – CBA report.

### 7.1.9. Other options considered

We considered several options for our Leading the Debate activities:

1. Keeping *FES* as it is
2. Expanding *FES* to consider policy, including:
    a. Bridging the gap to net zero
    b. Making policy recommendations
3. Supporting development of a more regional *FES*.

We have taken forward option 2. Full details of the options considered are in section 5.1 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.6.1 of Annex 3 – Stakeholder report.

## 7.2. A14 Taking a whole electricity system approach to connections

Our connections team manages all aspects of contracts for connections to use the National Electricity Transmission System (NETS). We also manage the impact on the transmission network of connections at distribution level, through liaison with DNOs. We propose to enhance the way we carry out our connections activities, so that we can continue to meet the needs of customers through RIIO-2.

## 7.2.1. Costs

| Whole system approach to connections | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 0.7 | 0.7 | 0.2 | 0.1 | 0.1 |
| Opex (£m) | 2.8 | 4.4 | 4.4 | 4.1 | 4.1 | 4.1 |
| FTE | 40 | 47 | 47 | 47 | 49 | 49 |

### Highlights

We will continue to ensure we support the ongoing increase in numbers and variety of market participants looking to connect to the network. This will be assisted by capital investment in a connections hub to help customers engage through the connections process along with additional customer service and contract management for smaller parties. The connections hub will be developed in co-ordination with network organisations to ensure efficient delivery and an experience that is seamless for the customer. To that end, costs shown are the ESO costs of delivery of this co-ordinated approach.

## 7.2.2. Ongoing activities

We provide a valued service to energy businesses wishing to connect to the transmission system through delivering:

- A14.1 Provide contractual expertise and management of connection contracts. This will allow us to make connection offers to customers and contract manage the connections agreements (D14.1.1)
- A14.2 Ensure Grid Code compliance of new connections. We will undertake Grid Code compliance monitoring of new connections to ensure they comply with the code (D14.2.1)

Our relationships extend across the whole asset lifecycle; from initial investment discussions, to the connections process and contract relationships, through to the asset's operation and decommissioning.

We are seeing a wider range and number of customers wishing to connect. Many of these are smaller and new to the industry frameworks, so they require additional support. In the past 12 months, we have seen a 60 per cent increase in applications from new market participants from 210 to over 350. This is primarily driven by new, small generation units for battery storage and solar connections, new interconnectors and new demand points for data centres.

We expect this trend to continue into RIIO-2 as the increased activity and interest in developing distributed energy resource and the move away from centralised generation continues, with distributed capacity expect to increase to at least 48 GW by 2030, from 31 GW today. In RIIO-1 the activity in this area commenced in the south-east and south-west of the UK, this has continued to increase and move through the country geographically. Through RIIO-1 we have managed this increase through efficiency gains including customer journey mapping to improve outcomes and the quality of experience. However, given the continued changing nature of our customer base and level of support we need to give to these customers, we need to increase our resources by two FTEs from 2021/22 to maintain an appropriate level of dedicated service. This is in addition to the transformational activities described in section 7.2.3.

We will continue to adapt our service to meet the requirements of a changing customer base and evolving customer expectations. The enhancements we have detailed summarise the improvements we are delivering during RIIO-1 and propose for RIIO-2. These are in addition to the larger changes required to significantly enhance the customer connections experience, which are set out later in the section.

In RIIO-1, we made the following enhancements to our service. We:

- Delivered efficiencies to the connection process for parties connecting to distribution networks, who may cause a need for transmission investment. The introduction of the Appendix G process allows DNO's to offer connections to embedded customers much more quickly and without the need to engage the ESO through the Statement of Works process. This reduces the connections application process by up to six months and reduces costs of the individual customer applicants and DNOs.
- Provided more information to our customers to improve their experience. We now engage in pre-application conversations to ensure customers know what they are requesting when they go through the full application process. We run customer seminars twice a year to provide information about the industry and the connections process.
- Worked with DNOs to develop new types of connection for energy storage. This has improved the speed at which certain embedded customers get connected.
- Worked with TOs to develop faster connection application processes. We developed offer sprints with National Grid Electricity Transmission (NGET) to provide customer connection offers more quickly. The licence standard is three months, but with the sprint approach, when it is right for the customer, we are now able to do this within one month. We did this for many offers during 2018/19 but learned that most customers did not require us to respond in those timescales, some even asked us to take the full three months as it fitted with their investment timescales.

In RIIO-2, we will further enhance our service through:

- Tailoring our contract management service to ensure appropriate assistance can be efficiently provided to less experienced customers.
- Working with TOs to enhance the overall customer experience of connection, compliance and contract management processes.

### 7.2.3. Transformational proposals

**The net present value of taking a whole electricity system approach to connections is estimated at £2 million, and will deliver £1.27 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2025/26 onwards.**

We will step up the level of support provided to smaller parties, helping them to navigate the complex connection processes that exist across Great Britain (A14.3).

This will include dedicated account management for smaller parties who may have transmission-related issues with their connection applications (D14.3.1). It will also include extension of our successful customer connections seminars to take a whole electricity system view. This extension will incorporate DNO input in addition to the existing involvement from the TOs (D14.3.2, D14.3.3).

We will develop, in co-ordination with other network organisations, a connections hub providing a seamless connections experience to electricity networks across Great Britain that will help navigate customers through the connection process (A14.4). This is consistent with our role as the contractual counterparty for all Great Britain transmission connections.

The connections hub will enable participants to access specific information such as available network capacity as well as manage the accounts online. Currently account management still follows a largely offline paper-based system. Our proposal will allow them to facilitate and accelerate their decision-making around connections and establish an ongoing relationship with us. For example, being able to quickly understand where network capacity exists should help low carbon developers more quickly navigate the connections process. This will help drive the decarbonisation of the energy sector.

The connections hub will feature information provided by different parties as well as links to the appropriate network organisation for customers' needs whether a party wants to connect at the transmission or distribution level. For example, a party wishing to connect to a distribution network will be signposted to the relevant DNO's connection site. Through facilitating customers by providing access to information across the whole electricity system, we believe this will allow informed efficient connection decisions to be made, whether to connect to the transmission system or a distribution network. We received support for this type of connections tool at our April 2019 engagement event, particularly from small generators and project developers who thought it would be useful for location-neutral projects.

The connections hub will be fully integrated with our external digital engagement and customer relationship management (CRM) tools to provide a seamless experience to customers and stakeholders (IT investment reference 380 - Connections Platform). This capability will build on our investments in open data and digital engagement.

We propose to build this capability incrementally, working with other network organisations to minimise duplication while ensuring customers have a positive experience. Initially this will primarily be with TOs to ensure our developments are co-ordinated with their initiatives and work efficiently for the customer. As a result of this coordinated approach, we anticipate that the first phase will be delivered in early 2023 (D14.4.1, D14.4.2).

To deliver the connections hub, resource its ongoing use and maintenance, and deliver our proposed customer service activities will require an increase in opex of £1.6 million in the first year of RIIO-2. Part of this increase will be through the recruitment of six additional FTEs from 2021/22 to:

- enhance the customer connection experience. This will include dedicated account management for distributed energy resources (DER), and the provision of a broader, whole electricity system view at our customer seminars.
- develop the connections hub.

We derived these costs from our experience of similar work programmes and they have been benchmarked to ensure they represent value for money. For more detail on the benchmarking we have carried out, please see Annex 4 - Technology investment report investment reference 380 - Connections Platform.

We expect resource requirements to rise by a further two FTEs by 2024/25, to support the enhancement of the customer connection experience, as the number of new market participants and the volume of new connections continues to increase. A proportion of the increasing resourcing requirement will be offset by the increasing volume of connection application fees from new customers wishing to connect to the National Electricity Transmission System. We expect the rate of connections applications will continue to grow by 20 per cent at the start of the RIIO-2 period, potentially reducing to eight per cent after five-years. We also expect the customer base to evolve further, with a continuing move towards new and smaller customers that require more support through the connections process.

We have estimated that we will realise direct resource efficiencies of ten per cent by providing initial support through the proposed connections hub in development with the TOs; and a further 30 per cent from the roll-out of account management. We expect these efficiencies to be offset by the ongoing increase in the number and variety of applications.

## 7.2.4. Investment roadmap

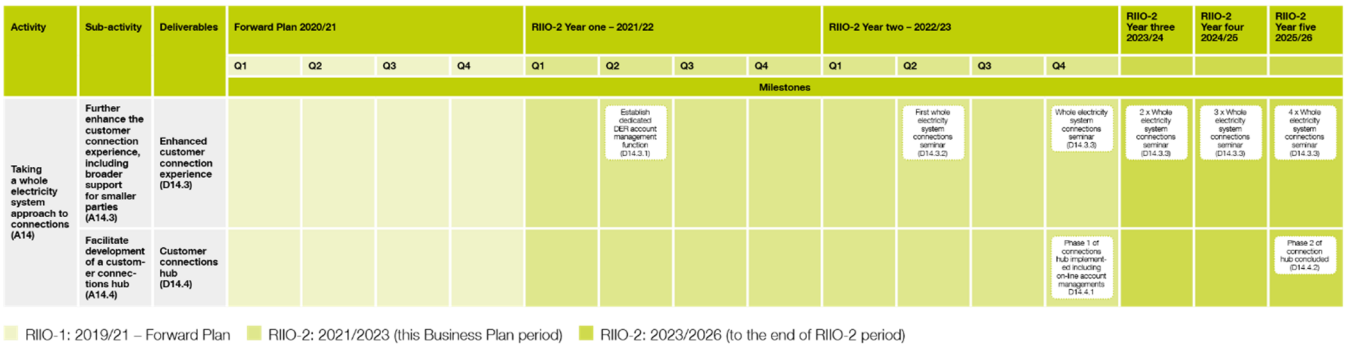



*Figure 36: Investment roadmap*

## 7.2.5. Stakeholder views

We have engaged on this subject with network companies, generators, suppliers, trade associations, a consumer interest body, and network users more widely. We undertook engagement at our RIIO-2 webinars, *Our RIIO-2 Ambition* consultation and workshop, and more specifically at our customer connections seminars. The need for consistent, whole electricity system approaches and collaborative working was highlighted in our engagement on customer connections, particularly with DNOs. Smaller parties, such as those connected to distribution networks, talked about the value of receiving appropriate support to help facilitate their connection.

Our connections proposals were welcomed by several stakeholders at our customer seminars in March 2019 (a TO, DNO and two renewable energy developers), at our RIIO-2 event in April 2019 (small and large generators and network companies), and in some of the responses to *Our RIIO-2 Ambition* consultation document (a trade association and supplier). We have received stakeholder support for our connections hub proposal from smaller connected parties and service providers, who could see benefit in having a single location to find all connection-related information regardless of voltage level.

In response to *Our RIIO-2 Ambition* consultation document, we also received questions from a trade association and network companies. They wanted to know whether the support provided to smaller parties who have transmission-related issues to their connections should come from the ESO or whether it potentially duplicates the work of other network companies. We think we have a coordination role to play, so we have maintained proposals to support new parties in navigating the connections processes. We believe that we can add value for customers when there are connection-related issues across the transmission-distribution interface.

**This ambition must not undermine the existing role of the TO or DNO in the connection process to avoid any duplication of effort.**

**Network company, in response to *Our RIIO-2 Ambition* consultation**

Following publication of our draft Business Plan in July, we have spoken further with the onshore TOs, NGET SP Transmission (SPT) and Scottish and Southern Energy (SSE), about our respective proposals for connections. We are aware that across all plans, there are proposals to develop online customer connection portals. These are designed to enhance the service that we collectively provide to customers for different aspects of the Great Britain connections process. In our discussions, we have recognised the need to be coordinated on our proposals. By doing so, we will ensure that all portals are developed in a consistent and customer-led way. We also all agreed that there could be a central, online access or landing point for the Great Britain connections process. From there, customers would be directed to the appropriate party to progress their connection query or application (for transmission or distribution, as appropriate). We have received agreement from the TOs to continue to work together to scope our respective proposals and engage jointly with customers on the direction of their development.

We talked to customers at round table sessions at our customer connections seminars in October and November 2019 about our proposed Great Britain connections landing point and showed them what functionality this could contain. Customers provided positive feedback on the portal proposal and landing page. Customers from DNO, generation and developer sectors also had views on how the ESO and TO portals should be developed with the customer experience in mind e.g. by ensuring common language across the

portals and providing status updates on the connection application process.

The question was raised by three renewables customers at separate sessions as to why the TOs were proposing portals given that the ESO is the contractual counterparty and whether we should be the only online interface with the customer ("a one stop shop"). We understand why the TOs are proposing their own portals and consider that each portal should reflect the role of that party in the connections process e.g. we understand that one TO is looking to pilot functionality around the pre-application process where TOs are more heavily involved in customer discussions. They are also involved through the pre-connection build phase on project progress and costs.

Two customers offered to be part of a customer focus group to help test the system when available.

### 7.2.6. Cost-benefit analysis

We estimate the gross benefits to be £8 million over RIIO-2. This gives a net present value of £2 million over RIIO-2.

Our proposal enhances and extends our current connections processes. It establishes new online systems to provide more support in coordination with distribution network organisations for parties wishing to connect to networks. They will benefit from easier access to front-line support and coordinated information, making it simpler to navigate around complex industry processes.

These quantitative benefits have been calculated by considering the efficiency savings for customers who use the connections process (estimated at around 450 applications per year) and the resulting reduction in FTE requirements, with these savings being passed on to consumers.

This is against a baseline assumption of continuing with our ongoing connections process, with no additional online support or connections hub.

In order to deliver this activity, we will require customers to engage with the new hub and systems and that connections customers pass any reduced operational costs onto consumers.

Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between negative £2 million and.£3 million.

Annex 2 - CBA report section 5.2 provides more details. Additionally, we have identified and detailed the specific risks and mitigations associated with 'Taking a whole electricity system approach to connections' in Annex 2 – CBA report.

### 7.2.7. Other options considered

In development of the connections hub we have considered three options:

1) Status quo – do not develop a connections hub

2) Develop a connections hub, with options to include some combination of:

- Additional support material
- Online access
- Alignment with TO initiatives

3) In addition to the above, develop a connections hub that provides whole system electricity guidance by either:

- Working with DNOs
- Creating a national portal for distribution connections

We have taken forward option 2. Full details of the options considered are in section 5.2 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.6.2 of Annex 3 – Stakeholder report.

### 7.2.8. Measuring performance

#### 7.2.8.1. Performance metrics

**Metric 11 - Right first time**

We are proposing to measure the number of times we are right first time on our connection offers. This metric will be carried forward from our *Forward Plan 2019-21.* Trade Associations have fed back that this is an important metric to demonstrate our performance and have requested it to be included in our proposals for RIIO-2. We will continue our current performance target of 95 per cent right first time for our connection offers. Currently we are achieving 89 per cent so this target is still sufficiency stretching considering the volume increase in applications as previously mentioned.

#### 7.2.8.2. Annual reporting items

We are proposing a periodic customer satisfaction (CSAT) measure, where customers can rate and comment on their connections experience. This will provide us with an understanding of both our performance and how we can improve our service to our customers. This will be included as part of the Metric 17 – Customer and stakeholder satisfaction that will cover all of the ESO but will be reported separately on an annual basis for visibility.

## 7.3. A15 Taking a whole energy system approach to promote zero carbon operability

In this area we use our engineering expertise to ensure the National Electricity Transmission System remains operable in the longer term and appropriate market solutions are developed ahead of need in a timely manner. In the later years of RIIO-2 we will increasingly look beyond electricity transmission and distribution to understand how whole energy approaches can contribute towards this objective, for example considering opportunities created by the electrification of transport.

Underpinning our work in this area is a need to use system data and models to analyse future network needs and operability solutions. These are

communicated to stakeholders through our *System Operability Framework*[121] (*SOF*) publications as required. We also need to ensure technical codes and frameworks facilitate these changes.

We progress our thinking through 'design by doing' using a blend of innovation routes including Network Innovation Competition (NIC) projects like Power Potential and Enhanced Frequency Control and Capability (EFCC) as well as our Regional Development Programmes (RDPs).

In RIIO-1 these initiatives have looked across the whole electricity system, In RIIO-2, our development of whole energy system thinking will similarly be extended into 'design by doing'. Initially, we will do this through the targeted use of innovation projects that will explore questions such as whether the gas sector contribute to electricity system operability. In later years, we will use what we learn to inform our core business activities. Work here will be driven by emerging policy-topic needs, including the decarbonisation of heat and transport.

As we drive towards net zero in 2050 we recognise the need to facilitate all forms of zero carbon energy. To that end we will lead a review and development of an integrated offshore regime considering technical, commercial and regulatory aspects of how we can efficiently connect large scale offshore wind power. Further details on this activity are set out in section 7.3.3.5.

### 7.3.1. Costs

The growth of low carbon and renewable generation, for example offshore wind increasing to at least 24 GW by 2030, closures of all coal power stations by 2025 and changing interactions across the whole of the power system are just a few of the areas that will impact the operability of the power system through RIIO-2. In co-ordination with our proposed activities in Theme 1, these proposals seek to enable us to address these challenges so we are able to operate a zero carbon power system by 2025 and beyond towards net zero.

| Whole electricity system approach to promote zero carbon operability | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 3.3 | 8.1 | 9.1 | 11.0 | 11.3 | 13.0 |
| Opex (£m) | 3.1 | 5.2 | 6.3 | 8.0 | 9.8 | 10.9 |
| FTE | 38 | 47 | 51 | 54 | 61 | 65 |

**Highlights**

We will facilitate zero carbon operability through the continued roll-out of our RDPs including extension across energy vectors.

We will embed learnings from our recent innovation projects, EFCC and Power Potential, to ensure we have market based solutions that allow us to operate a zero carbon system.

### 7.3.2. A15.1-5 Ongoing activities

In RIIO-2 we will continue to:

- A15.1 Develop the *SOF* to identify and quantify operability needs in both long and short-term planning timescales, encouraging the development of market-based solutions wherever possible. This will be presented within *SOF* documentation (D15.1.1) and may include the use of external innovation funding, such as NIA (D15.1.2).
- A15.2 Provide technical support to the connections process through assessment of connection offers to determine future operability needs. (D15.2.1)
- A15.3 Provide technical expertise into the development of codes and standards. This will include changes to business procedures and processes, following framework developments (D15.3.1).
- A15.4 Manage our operational data and modelling capabilities to underpin all the offline network analysis within the ESO. This will enable us to support data transfers between network organisations in accordance with Grid Code requirements (D15.4.1) and technical modelling for use across the ESO D15.4.2).

In RIIO-1, we enhanced our activities in this area through:

- Introducing the RDPs (A15.5), which look across the whole system landscape to identify key areas of development. This approach unlocks additional

[121] https://www.nationalgrideso.com/publications/system-operability-framework-sof

network capacity, reduces constraints, and opens up new revenue streams for market participants. The first RDP is bringing a net saving of £13 million by eliminating the need to build new assets. Our second RDP provides network capacity for new low carbon energy resource, without the need for additional network infrastructure, thereby facilitating an extra 278 MW of renewable generation across four grid supply points[122].

- Developing an automated dispatch capability for generation in highly constrained areas.
- Leading a national programme to change Distributed Energy Resources (DER) protection from Vector Shift to RoCoF. This will reduce the risk of inadvertent DER tripping and reduce system-balancing costs.
- Completing the EFCC[123] project, the learnings from which will be taken forward as a transformational activity in RIIO-2 to provide wide area monitoring of the grid which will better co-ordinate our frequency response needs.
- Embedding efficiency through increased automation of certain data and modelling activities, with associated process reviews.

In RIIO-1 we also set up a project to explore the potential benefits of transferring some of our modelling processes offshore. We will continue to explore the potential for this 'right sourcing' approach to improve our capability and deliver efficiency benefits in RIIO-2. For more details please see the efficiency case study in chapter 3 – Assumptions underpinning our plan.

In RIIO-2, we will further enhance our activities through:

- Continuing to work with other network organisations to roll out RDPs facilitating the connection of new low carbon energy sources in capacity constrained network areas targeting areas. This will facilitate connection of DER and unlock consumer benefits. Through the first two years of RIIO-2 we are planning to establish three new RDPs across GB.
  - The first in Q1 2021/22 (D15.5.1)
  - The second in Q1 2022/23 (D15.5.2)
  - The third in Q3 2022/23 (D15.5.3).
- Continuing to look for opportunities to further outsource and automate processes.
- Making efficient use of the increased availability of data to enhance our ways of working and generate consumer benefit.

Through these enhancements, and synergies with the transformational activities described below, we anticipate a reduction in one FTE for ongoing activities in this area in 2021/22. Resource numbers are based on the efficient delivery of our ongoing activities including RDPs.

A significant cost aspect in this area is our work on RDPs and we have looked at how we can improve efficiencies in this area. In RIIO-2 the overall programme will have, on average, three RDPs in progress at any time, which will be enabled by investment in IT (IT Investment Reference 340 - RDP Implementation & Extension) and our FTE numbers reflect this delivery profile (a team of three FTEs will be required within our core business activities). Our current RDP delivery costs are approximately £4 million per RDP in RIIO-1. We believe we can realise efficiencies and reduce this to around £2.4 million per RDP. We can achieve this by establishing a repeatable approach to delivering the required capabilities within our systems and processes. On this basis, we have assumed an RDP will take, on average, two-and-a-half years to deliver. With three RDPs in development at any time, we have budgeted £17.5 million for delivery of six RDPs during RIIO-2.

**Innovation funding during RIIO-1 has contributed to these proposals**

Our work to develop the capability to operate a zero carbon electricity system will use the learning from our EFCC and Power Potential[124] innovation projects – and potentially our recently funded Distributed ReStart[125] NIC project.

### 7.3.3. Transformational proposals

**The net present value of taking a whole energy system approach to promote zero carbon operability is estimated at £466 million and will deliver £7.15 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2021/22 onwards.**

Our transformational proposals will:

- Transform our capability in modelling and data management, enhancing data-sharing across transmission and distribution networks. This will require one additional FTE in 2021/22 rising to two FTEs in 2022/23. This work will enable enhancements in Themes 1 and 4. 1 additional FTE will be recruited in 2021/22 to provide technical support to delivery of A14.4 Facilitate development of the customer connections hub (see section 7.2.3).
- Provide technical input into broader industry work to align and simplify industry codes and standards and facilitate the development of DSO. This will require two additional FTEs from 2021/22.
- Roll out our innovation project, EFCC, into our Control Centre environment, supporting an operable zero carbon system by 2025. (IT investment reference 500 - Zero Carbon Operability). This will require three

[122] https://www.nationalgrideso.com/insights/whole-electricity-system/regional-development-programmes
[123] https://www.nationalgrideso.com/innovation/projects/enhanced-frequency-control-capability-efcc
[124] https://www.nationalgrideso.com/innovation/projects/power-potential
[125] https://www.nationalgrideso.com/innovation/projects/distributed-restart

additional FTEs in 2021/22 rising to five FTEs in 2022/23.

- Identify future operability needs, looking beyond our need to operate a zero carbon system by 2025. We believe that, in the long term, consumer value will be realised through harnessing opportunities created from electrification of heat and transport and the increasing digitalisation of the energy sectors. Through development of a whole system operability framework and extending the RDP philosophy across energy vectors we will explore these opportunities. No additional FTEs will be required for this activity until 2023/24.
- Develop, with others, a regime to facilitate the development of an integrated offshore grid. This will require a multifunctional team of commercial, regulatory and technical experts. The initial team of three FTEs will be established in 2021/22, rising to a team of five from 2022/23.

#### 7.3.3.1. A15.6 Transform our capability in modelling and data management

We recognise that, consistent with the Energy Data Taskforce (EDTF) recommendations, in RIIO-2 we will have access to much more information and data relating to networks and parties across the whole electricity system. Such information can help us more efficiently plan and operate the National Electricity Transmission System.

This transition is already starting through developmental work with others in the ENA Open Networks project. A recent Open Networks report[126] has proposed to build on the current Grid Code data requirements (week 24 data) to exchange more granular information on distribution networks and DER. This data will help us more efficiently identify future transmission system needs and support timely connection of DER through the Statement of Works process.

We recognise, consistent with Open Networks, that this is just a first phase and that in RIIO-2 more granular data can help us work with other network organisations to efficiently manage an increasingly decentralised grid. These will be developed further through industry forums including Open Networks and the EDTF ahead of RIIO-2.

We are already aware that modelling and data enhancements will enable many of our activities including;

- our zero carbon operability ambitions (Theme 1)
- real-time optimisation of transmission and distribution assets. (Theme 1)
- the development and delivery of new RDPs (Theme 4)
- more extensive system access arrangements across the transmission – distribution interface (Theme 4) (D15.6.7)

This work will utilise the functionality developed through our planned data and analytics platform (see Annex 4 – Technology investment report, investment reference 220 Data and analytics platform). This will enable:

- Phase one and two model scoping, to feed into the data and analytics platform (D15.6.1) and its extension
- Grid Code modifications to support transmission-distribution data exchange (D15.6.2)
- Completion of the data platform foundation (D15.6.4) and extension (D15.6.5).

To achieve this added functionality, recognising the much higher volumes of data to be managed, we will take a probabilistic approach to modelling. This will see us develop the ability to undertake more complex modelling, where a greater number of scenarios are considered. We envisage that these changes will help to accelerate scenario planning, including closer-to-real-time planning. We will also consider the use of artificial intelligence and automation to enable improvements in modelling. This work will be coordinated with the *NOA* enhancements described in Theme 3 to provide a seamless exchange, facilitating efficient approaches and consistent outputs. Further information can be found in Annex 4 – Technology investment report, investment references 360 - Offline network modelling and 350 - Planning and outage data exchange.

To achieve this, in the period 2021 to 2023, we plan to deliver a major upgrade to our offline modelling tools, which will allow us to model a more complex system. The IT investment for this is included in the cost table in section 7.3.1. This upgrade will also facilitate compliance with the European Capacity Allocation and Congestion Management (CACM) regulations, which is covered under IT investment reference 270 EU Regulation and will be carried out in coordination with TOs (D15.6.6). We will continue to invest in ongoing enhancements, with another major upgrade to follow in the period 2023-26 in-line with the additional drive to DSO expected during RIIO-ED2. This will enable deeper outage planning with DNOs, and zero carbon operational readiness (D15.6.7). See Annex 4 - Technology investment report, investment references 360 - Offline network modelling and 350 - Planning and Outage data exchange. This improved capability will build on our investments in open data and digital engagement. In total during RIIO-2, we propose to invest £7 million in IT developments to facilitate our modelling and data management proposals.

FTE requirements to deliver this work will increase from a single FTE in 2021/22 through to a total of six FTEs at the end of RIIO-2, when we will be considering broader whole energy system implications and data sets. To manage these costs, we will continue to adopt an approach of right-sourcing capability to allow us to efficiently manage this increased scope of work.

[126] http://www.energynetworks.org/assets/files/ONP-WS1B-P4%20Data%20Scope%20-%20Final%20Report-FINAL.pdf

However, given the breadth of change required, we expect these costs to have doubled by 2024/25.

#### 7.3.3.2. A15.7 Deliver an operable zero carbon system by 2025

Our whole electricity system innovation projects, EFCC and Power Potential, will be complete by the start of RIIO-2. We will use the learnings from these, as well as other insights from DNO innovation projects and the ENA Open Networks project, to inform our operability development in RIIO-2. We see EFCC[127] as particularly critical in the development of our zero carbon operability ambition and will roll out its functionality in our Control Centre ahead of 2025. Through implementation of the project's monitoring and control system we will be able to monitor the electricity network at a regional level and coordinate regional frequency response from a range of service providers as necessary[128].

The cost of our proposed staged roll-out of the EFCC project's monitoring and control system (MCS) is budgeted to be £24.9 million. The majority of this spend will be before the system is fully implemented in 2025 and will require a team of up to six FTEs to deliver. See Annex 4 - Technology investment report investment reference 500 - Zero carbon operability. This work will be carried out in co-ordination with the other proposed activities affecting our control systems as described in Theme 1. The first stage MCS roll out will be in 2024/25 (D15.7.1) and the second stage in 2025/26 (D15.7.2).

#### 7.3.3.3. A15.8 Provide technical support to DSO and whole electricity system alignment

We recognise the need to support network organisations and the wider industry in the transition to (DSO. We have budgeted a single FTE to support this development ahead of RIIO-ED2 in April 2023 (D15.8.1).

The transition to DSO will need development of existing standards and frameworks on a whole electricity system basis. To that end stakeholder have told us that they want alignment of standards and frameworks. We have therefore budgeted one FTE in 2021/22 to provide technical input into such a broader review. This will rise to two FTEs from 2023/24. This will ensure there is alignment of operational standards across the whole electricity system (D15.8.2).

#### 7.3.3.4. A15.9 Identify future operability needs across the whole energy system

We believe that, in the long term, consumer value will be realised through harnessing opportunities created from electrification of heat and transport and the increasing digitalisation of the energy sectors. In RIIO-2 we will begin looking at how we can take advantage of opportunities from related energy sectors to develop new operability tools to help us efficiently manage the electricity system.

We will do this through working with others in forums like the ENA Open Networks programme to gain insights from experts in other sectors. This will allow us to develop:

- new innovation projects to trial whole energy system operability tools. These will be funded from existing innovation routes (D15.9.1) and will take place from quarter one 2022/23.
- regional programmes that make best use of opportunities to develop cross sector operability solutions to facilitate the UK's 2050 carbon reduction targets. These will build on the ethos and approach we have developed in the electricity sector's RDPs. This will require an initial scoping resource in 2023/24 with four FTEs required in 2024/25 and eight in 2025/26. This reflects our plan to commence an RDP approach to whole energy system challenges in 2024/25 (D15.9.2) and launch our second whole energy system RDP in 2025/26. This reflects our plan to commence an RDP approach to whole energy system challenges in 2024/25 (D15.9.2) and launch our second whole energy system RDP in 2025/26 (D15.9.3).
- a whole energy *System Operability Framework*. This will require five additional FTEs from 2024/25. This will be delivered in 2025/26. (D15.9.4)

We have also accounted for IT spend on these broader whole energy system projects with £2.5 million in 2024/25 and £6.8 million in 2025/26. There is no additional spend in the first two years in RIIO-2 for this activity (D15.9.2 and D15.9.3).

#### 7.3.3.5. A15.10 Develop a regime for an integrated offshore grid

Earlier this year the Committee for Climate Change reported that Great Britain would need 75 GW of offshore wind by 2050 to achieve the Government's net zero ambition We believe timely connection of this high scale of offshore windfarm projects can most efficiently be discharged through a strategic integrated approach considering the whole electricity system. Such an approach will both minimise the costs of offshore connections and also the disruption to local communities. Feedback from local communities on the east coast has indicated that the current piecemeal approach is disjointed and we recognise that appropriate landing points are limited. We propose to work with stakeholders to develop arrangements that will facilitate the timely delivery of an efficient offshore grid that will support the 2050 net zero target.

[127] https://www.nationalgrideso.com/innovation/projects/enhanced-frequency-control-capability-efcc

[128] When a variance in frequency occurs on the system, a response needs to be achieved within fractions of a second to be effective. Over the fast timeframes that this frequency response is being calculated and deployed, there is a difference between the frequencies that are seen at the points where these technologies connect. The MCS provides the bridge of information between the different technologies and the System Operator and can deploy the right response from these technologies at the right time to support the stability of the power system. This provides greater visibility of what is happening on the grid by using real time data.

**This growth of offshore wind will require a substantial step-change in the way connection to the onshore transmission network is considered.**

**Renewable developer in response to *Our Ambition* consultation**

This activity would build on previous work undertaken with stakeholders through the Integrated Offshore Transmission Project (East)[129], which concluded in August 2015. The conclusions of this report indicated that an integrated approach to development of offshore networks off the east coast of England would be more efficient providing there was sufficient volume of wind connecting (the report considered the then contracted view of 17.2 GW by 2030 would be sufficient to trigger this). However, this contracted position was not considered a realistic outcome by 2030. Following both the publication of the Government's net zero ambition and also the recent opening of the Round four offshore leasing competition by the Crown Estate, we believe it would now be appropriate to re-evaluate this position.

From the start of RIIO-2 we will work with stakeholders to develop the appropriate commercial, technical and regulatory arrangements that will facilitate an efficient integrated offshore grid. In the first year, this will see scoping by an initial team of three FTEs, working with industry to build on previous work undertaken and formulate a collective whole system plan (D15.10.1). An interim scoping report would be published following this (D15.10.2). Subject to the conclusions of this report the team would increase to five FTEs the following year to develop more detailed arrangements for an integrated offshore grid (D15.10.3). We anticipate a further interim report would be published in 2023/24 with final conclusions in the following year. Roll out could commence from 2025/26, recognising the inherent uncertainties in the development of a new industry regime (D15.10.4).

## 7.3.4. Investment roadmap

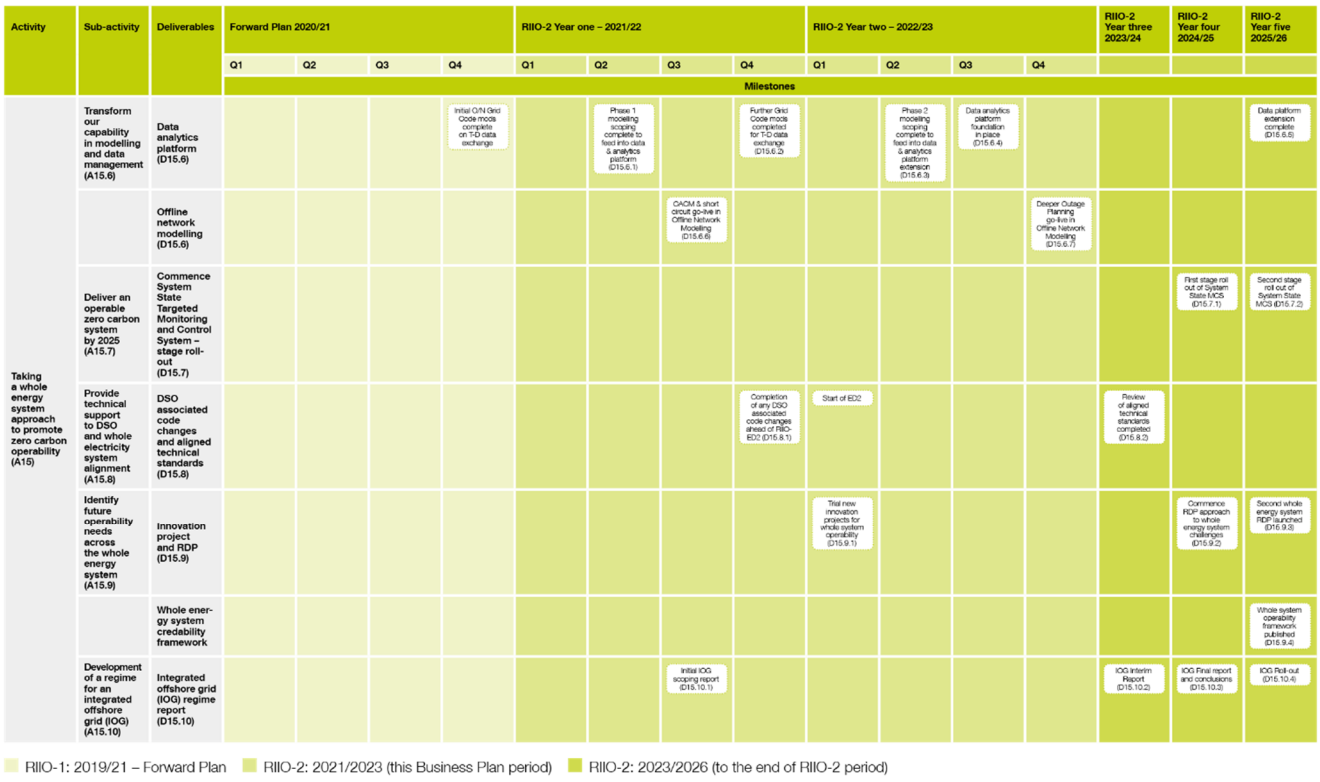



*Figure 37: Investment roadmap*

## 7.3.5. Stakeholder views

We have explored whole electricity system questions in more detail at our own events and through the ENA Open Networks Project. Both commercial entities and network organisations recognise the inherent value of a whole electricity system perspective – and the benefits of finding common ways of working across all network organisations. We reviewed the 47 responses to the 2018 ENA Future Worlds consultation[130] and used this

[129] https://www.nationalgrideso.com/document/125331/download

[130] http://www.energynetworks.org/assets/files/14969_ENA_FutureWorlds_AW06_INT.pdf

to develop our thinking on both the ESO's role in RIIO-2 and the transformational activities needed. While there has been support for all five future worlds developed, responses indicate that the strongest consensus – and particularly from commercial entities – is for the coordinated and collaborative future provided through 'World B'. This is consistent with our Business Plan approach to distribution system operation.

Ofgem, in its recently published position paper[131], Distribution System Operation, highlighted the need to focus on a 'least-regrets' development of this new landscape. We believe that, in RIIO-2 timescales, this is consistent with the direction we have taken, through consideration of World B and the ENA's approach. Our approach builds on the current industry ways of working, including developments in RIIO-1. It can be progressed with a minimum of industry reform, but also allows optionality for future arrangements.

Responses to the Future Worlds consultation also highlighted the importance of working with other network companies to ensure consistent processes, efficient and appropriate exchange of data and information, and coordinated, and standardised experiences that work for customers. This is something that many of our stakeholders in our RIIO-2 engagement have shown support for, in particular at our 2030 Ambition workshop in September 2018. Here, they saw potential benefits for both the ESO's customers and DNOs as they develop their RIIO-ED2 Business Plans. Stakeholders, such as renewable energy companies and a consumer interest body, indicated a need for aligned codes and frameworks to support the energy transition. They highlighted that the ESO should continue to play a role in overall management of the national electricity system, including in times of system stress and emergencies.

Stakeholders at our April 2019 and October 2019 workshop events, including DNOs, developers and a renewable energy company, similarly recognised that we need to work with emerging DSOs. They felt this would ensure efficient design and operation of the whole electricity system, with some seeing our existing skills as complementary, and potential benefits from closer working. There was also support for using the first two years of RIIO-2 to test and embed new ways of working, prior to the start of RIIO-ED2.

Respondents to *Our RIIO-2 Ambition,* including generation and trade association stakeholders, were generally supportive of our operability proposals and the intent to work more closely with network parties to take a whole system view. A trade association thought that all of our proposed activities would support delivery of our ambitions. On RDPs, a generation stakeholder recognised that a RDP cannot be assumed to always deliver the best value for consumers and should be tested against other solutions. We agree with this and will look to assess all options before taking a RDP forward. At our April 2019 RIIO-2 workshop stakeholders thought that learnings should be shared more widely from RDPs and that they could cover more whole system issues such as heat or transport. This feedback has shaped our proposal to identify future operability needs across the whole energy system.

With regard to the development of integrated offshore networks, we heard in response to *Our RIIO-2 Ambition* consultation from a large offshore renewable developer that they wanted to see more about activities to coordinate between onshore and offshore grid connections. And that closer coordination on strategic reinforcements to the onshore network will be required to ensure an optimal solution for consumers. We have been working with this and two other developers over the last 12 months, along with Ofgem, BEIS and the Crown Estate, to provide information on the type of infrastructure and market frameworks required to enable future renewable targets to be realised. We will continue to engage with these stakeholders and to inform policy development on this topic, in accordance with our lead the debate activity.

The development of offshore networks is also a key area of concern from environmental groups. For example, a group, Save Our Sandlings[132], has recently highlighted its concerns over planned developments for the Suffolk coast saying that substations could be built offshore with a single landing point to a brownfield site rather than building large substations in the middle of the countryside. We think we have a role to play in this coordination process.

### 7.3.6. Cost-benefit analysis

The cost-benefit analysis detailed below has been developed by considering the activities outlined in sections 7.3.3.1 to 7.3.3.4 together. It does not include the development of the integrated offshore grid, which is covered in the section that follows.

We estimate the gross benefits in this area to be £548 million over RIIO-2. This gives a net present value of £466 million over RIIO-2. This is from quantifying benefits in two areas, RDPs and conducting a whole system operability *NOA*-type assessment.

#### Regional development plans

RDPs provide significant value in this area. For future RDPs, we have assumed they deliver the same benefit from avoiding build costs as the RDPs in RIIO 1. This is £13 million and the carbon savings from the extra renewable generation of 278 MW. We have avoided 'double counting' by assuming half the RDPs have avoided build savings with the other half achieving carbon savings. This is against a baseline assumption of operating the system as today and not embedding RDPs.

This gives gross benefits of £39 million over RIIO-2.

More broadly, our responsibilities for system operability mean that we need to ensure we are looking for new ways of sourcing system needs. Increasingly we are

[131] https://www.ofgem.gov.uk/system/files/docs/2019/08/position_paper_on_distribution_system_operation.pdf

[132] https://www.saveoursandlings.org.uk/

considering market-based solutions and in a decentralised and digitalised future this provides many new opportunities. Examples of this work include Power Potential, where we are working with UK Power Networks to develop a coordinated market solution for transmission and distribution voltage needs. We are also exploring new markets through our voltage and stability pathfinder projects.

Whole system operability *NOA*-type assessment

The quantitative benefits for this area have been calculated by first considering the EFCC innovation, which forecasts benefits of £420 million over the RIIO-2 period. This gives a benchmark as to the scale of the benefits we could find in whole system operability.

As EFFC provides a single aspect of system operability this CBA looks more generally at how system operability can be improved. This is by considering the cost of the current operability challenges, of around £600 million. As an example, in our recent stability pathfinder[133] we estimate that these challenges could be solved with an investment of £2.25 billion[134]. We further assume that this cost will be spread over a potential 40-year asset life, which leads to a discounted net benefit of around £10 billion over 40 years. To reflect the uncertainty here, we have assumed that 50 per cent of these net benefits are realised, giving £125.5 million a year net benefits from 2022/23, which equates to £503 million over RIIO-2. This is commensurate with the EFCC benchmark.

Our work in this area depends on two other transformational activities:

1. A1 Control Centre architecture and systems (Theme 1) – ensuing the Control Centre has the tools required to operate a zero carbon system
2. A4 Build the future balancing service and wholesale markets (Theme 2) - ensuing the new markets have been developed to support zero carbon system operation

In order to deliver in this area, we require third parties to deliver solutions, which could either be investment in assets or commercial solutions.

Our analysis suggests that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £331 million and £603 million.

See Annex 2 - CBA report section 5.3 for more details. Additionally we have identified and detailed the specific risks and mitigations associated with 'Taking a whole energy system approach to promote zero carbon operability' in Annex 2 – CBA report.

Breakeven analysis: develop a regime for an integrated offshore grid

We have conducted a breakeven analysis rather than a full cost-benefit analysis because this activity does not deliver quantitative consumer benefits itself. It is the establishment of the regime that will provide consumer benefits (if that is what our analysis and scoping recommends) such as realising efficiencies and minimising the costs of offshore connections by taking an integrated approach.

The benefits of us undertaking this activity are:

- Utilising our position at the heart of the energy system to coordinate and facilitate multiple industry parties, including TOs, OFTOs, DNOs and generation providers.
- Availability of data and system operation experience necessary to conduct analysis and provide recommendations on the development of an integrated offshore network.

Should our recommendations lead to the implementation of an integrated offshore network, we expect the qualitative benefits to be:

- Timely delivery of an efficient, integrated offshore network that will support the UK's net zero target through efficient facilitation of new offshore wind connections.
- Optimised development of the limited number of suitable landing points for offshore networks, through adopting a coordinated approach, minimising cost and reducing disruption to local communities.
- A consistent and efficient connections process, aligned with whole energy thinking and followed by all network parties.

We believe it is beneficial to proceed with this activity because:

- The cost of conducting the review is low in comparison to the potential benefits.
- There is stakeholder support for us leading this work.

Full details are in Annex 2 - CBA report section 5.5.

## 7.3.7. Other options considered

We have considered two overarching areas in the development of our work to take a whole energy system approach to promote zero carbon operability;

- transition to DSO
- facilitating zero carbon operability.

More detail can be found in section 5.3 of Annex 2 – CBA report and the corresponding stakeholder views are recorded in section 5.6.3 of Annex 3 – Stakeholder report.

## 7.3.8. Measuring performance

### 7.3.8.1. Performance metrics

**Metric 12 - Future balancing costs saved by operability solutions**

We are proposing to measure the savings in balancing costs that have been achieved through our new

[133] https://www.nationalgrideso.com/insights/network-options-assessment-noa/network-development-roadmap

[134] Note – this solution is an example and does not reflect our view of what an optimal solution is.

operability approaches. We will measure this through comparing balancing costs and forecast, with the forecast to be taken at a specified time. The implementation of new operability tools will help to reduce the cost of managing the network, which ultimately will mean increased value for consumers. We are proposing a target of £75 million of balancing costs saving through operability in the first year of RIIO-2.

A TO fed back that they would like additional clarity on the potential overlap between this metric and our balancing cost management metric in Theme 1 (Metric 1). Our proposals are designed to complement each other rather than double count as the two metrics work over different time horizons. Balancing costs saved through new operability solutions are measured over years 2-30 and have already been saved by the time the Control Centre activities are working to reduce balancing costs closer to real time.

### Metric 13 - Capacity saved through operability solutions

Additionally, we propose to measure the network capacity unlocked through projects such as RDPs. These create more space for more potential participants to enter the market by optimising the utilisation of existing infrastructure. Providing that the market is able to fill this capacity the increased competition could lead to a more diverse market through new connections resulting in a potential reduction in bills to end consumers. We are targeting a saving of £22 million in the first year of RIIO-2 following a trial to establish a baseline figure in the last year of the *Forward Plan.* Following this trial we will also review the proposed targets to make sure that they are suitably ambitious

## 7.4. A16 Delivering consumer benefits from improved network access planning

Our network access planning team works with stakeholders to develop outage plans that facilitate TOs' access to their equipment for construction and maintenance activities.

Forward planning of such work is complex, involving the efficient delivery of large infrastructure schemes. System outages reduce the capacity of the transmission network which can lead to increased constraints and therefore balancing costs.

To do this role we will work with others to minimise the cost impact of outages as well as the impact on our customers' operations.

Looking forwards we will increasingly be working across the transmission–distribution interface to develop efficient whole system outage plans and look for opportunities to minimise operational costs

### 7.4.1. Costs

We facilitate efficient access to the transmission network to allow TOs to undertake maintenance and construction activities. We do this through assessing the security of the system for a wide range of potential scenarios to ensure overall system resilience and working with DNOs to coordinate activities across transmission–distribution interfaces. Our RIIO-2 plans seek to enhance these capabilities for the benefit of network owners and consumers.

| Network access planning | | Five-Year Strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-Year BP | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 0.4 | 0.4 | 1.2 | 1.4 | 1.4 |
| Opex (£m) | 3.8 | 4.7 | 4.8 | 5.2 | 5.2 | 5.2 |
| FTE | 60 | 61 | 63 | 67 | 66 | 66 |

#### Highlights

We will roll out the best practice access planning process developed in Scotland in RIIO-1 across the whole Great Britain transmission system. We will support increased levels of co-ordination across the transmission-distribution interface to deliver significant consumer benefits, facilitating the connection of low carbon generation and the development of new flexibility market opportunities.

### 7.4.2. A16.1 Ongoing activities and enhancements

Network owners need access to their assets to carry out maintenance, as well as to deliver major infrastructure projects. However, taking transmission equipment out of service reduces the capacity of the transmission grid. Our Network Access Planning (NAP) function ensures that this is coordinated with the needs of parties connected to the network, while maintaining security of supply and minimising balancing costs. Longer-term plans are developed from eight years ahead and at year ahead timescales are developed into detailed outage programmes (D16.1.1). To meet customer needs and overall efficiency, we optimise the overall programme up to a day ahead, after which it is led by our Control Centre (D16.1.2). This means that TO and customer needs for access to the system are coordinated, whilst also maintaining security of supply and minimising the balancing costs associated with outages on the network.

There is a significant, customer-facing aspect to this role as outages are planned in coordination with parties connected to the network wherever possible. Customers, including generators and DNOs, are expecting increased levels of service both from ourselves and TOs to minimise disruptions made at

short notice and to improve communication of any changes as ultimately this leads to additional cost.

Our role with DNOs also has a coordination aspect, because we need to ensure distribution and transmission access programmes are planned on a whole system basis. Additionally, the increasingly active role played by distribution networks present opportunities for market-based solutions to system access.

### 7.4.3. Enhancements made in RIIO-1 to our ongoing service:

During RIIO-1 we:

- Developed specifications for, and started agile delivery of, the replacement of our outage notification and planning tool (TOGA). This followed extensive engagement to understand user needs and will provide better service to customers.
- Carried out a customer-journey mapping exercise with the NGET, to better understand our customers' requirements.
- Communicated with all affected parties to understand the reasons for and to reduce the overall volume of outage changes particularly at short notice.
- Established a coordinated approach to access planning with the TOs, to facilitate efficient outage delivery for customers (the NAP process).
- Increased efficiency through the automation of selected processes.
- Trialled deeper access coordination for major infrastructure projects.

### 7.4.4. Enhancements proposed in RIIO-2

In RIIO-2 we will build on our automation techniques to optimise access planning solutions, taking full advantage of the greater availability of data and modelling. We will use machine learning to set up and undertake system analysis studies more quickly.

Through facilitating these enhancements, and synergies with the transformational projects below, we believe our FTE headcount for business as usual activities can be reduced by one in 2021/22.

### 7.4.5. Transformational proposals

**The net present value of delivering consumer benefits from improved network access planning is estimated at £204 million and will deliver £29 of gross benefits for every £1 spent over RIIO-2. The net present value is positive from 2021/22 onwards.**

Our transformational proposals build on much of the work we have been undertaking in RIIO-1 to enhance ways of working across the whole electricity system.

#### 7.4.5.1. A16.2 Enhance the NAP process with TOs

We recognise the potential consumer benefits that can be unlocked by transforming our approach to system access. The SO-TO mechanism, which was introduced through the System Operator Transmission Owner Code (STC) and allows Scottish TOs to recover the cost of moving outages on request from the ESO, has brought significant consumer benefit. We forecast that this mechanism will have provided between £16 million and £37 million of gross consumer benefit in 2018/19 alone.

We believe that the extension of these Scottish cost-recovery mechanisms, in conjunction with the NAP process across England and Wales, will deliver considerable benefits, as shown in the Annex 2 – CBA report section 5.4. Therefore, we will look to progress this as quickly as possible to ensure it is in place at the start of RIIO-2 (D16.2.1). We will also provide greater visibility of the costs associated with changing outages, through increased system analysis and cost assessments. This will enhance our ability to understand, and make the right trade-offs, between spending to ensure secure system operation during outages, and spending to defer outages to times where securing them might be cheaper.

We will deliver the above activity with one additional FTE from 2021/22.

Whilst the existing NAP process has already created significant consumer value we are mindful that there is very likely additional value to be unlocked from a broader view of system access. We have been working with the TOs on their proposals as to how system access can be managed more effectively to ensure that we each have the right drivers to minimise the impacts on consumers' costs. This should include much more than just system access, the review should look to a whole range of solutions that minimise outage duration, or minimise the costs of the outages by enhancing affected constraint boundaries during an outage.

Any new methodology will need to be well designed to drive optimal value, encourage the right behaviours and ultimately be fair to consumers through appropriate consideration of all risks involved. This will be a key priority for us to continue to drive down constraint costs and we want to be proactive and ambitious in identifying, developing and executing any such mechanism and we will work with all TOs to understand what is possible and what it would take to implement. This will be alongside our work with the TOs as they further develop and engage on the single GB NAP in early 2020 to review its effectiveness in supporting processes for driving consumer value in all timescales with a view to having a complete proposal agreed with the TOs by July 2020.

#### 7.4.5.2. A16.3 Working more closely with DNOs and DER to facilitate network access

Distribution networks are becoming increasingly active, as greater volumes of DER connect to the system. As a result, DNOs are developing system operation capabilities and enhancing their abilities in areas such as demand transfer and substation reconfigurations. Additionally, both ourselves and DNOs will be increasingly procuring flexibility services from DER to

help us collectively manage the system, particularly at times of system access when network capacity is reduced. We will need to work more closely with DNOs to both coordinate these requirements and ensure we are collectively optimising flows across all network assets. Our proposal will improve network safety and reliability, through increased coordination and optimisation of network access, and will facilitate timely construction and maintenance of assets.

Increased collaboration will enable a more efficient and coordinated approach to developing and operating both the transmission system as well as distribution networks. This will help lower system operator costs, such as congestion management, that would otherwise be incurred and could lead to extension of the NAP process across the T-D interface.

Further we believe that working with other network organisations we can help develop co-ordinated markets for flexibility. This will support the establishment of new ways to provide network access, which minimises operational costs and the impact on customers. It will also ensure that any potential conflicts of services arising from flexibility services can be resolved in a timely and efficient manner, well in advance of service delivery.

Two FTEs will be required from 2022/23 as we develop more extensive working relationships with DNOs to use DSO techniques and DER markets to facilitate efficient access for network owners across the transmission - distribution interface. This will include the development of flexibility markets across the transmission-distribution interface for co-ordinated transmission and distribution system needs and potentially extending the Network Access Planning (NAP) philosophy across the whole electricity system. These FTEs will be recruited on a staged basis from 2022/23 to a total of four FTEs in 2023/34.

This will initially be progressed on a trial basis in the third quarter of 2021/22, continuing work commenced in RIIO-1 (D16.3.1) with learning from trials published alongside recommendations for roll-out across Great Britain in the fourth quarter of 2021/22 (D16.3.2)

We expect that the process to complete code changes will be completed by the fourth quarter of 2022/23 (D16.3.3) and we will go live with deeper access planning in 2023/23 (D16.3.4) including functionality associated with 350 Offline network modelling (D15.6.7)

#### 7.4.5.3. A16.4 TOGA / Outage Notification

In order to provide potential flexibility services, providers will need information on forward looking requirements. To stimulate potential flexibility markets, we believe there is value in extending our current advanced outage notification system (TOGA), which has been recently upgraded, to cover a wider range of stakeholders, with differing business models and needs. As part of this, we will develop TOGA to become a more interactive experience for customers, stakeholders and the market. For example, by using mobile apps, alerts, social media feeds and new, digital-enabler technologies. We propose the investment for this system will be £6 million across the RIIO-2 period. One additional FTE will scope this project from 2021/22 (D16.4.1). A team of three FTEs will be required to deliver this project from 2023/24 onwards, dropping to two FTEs as the project enters delivery phase in 2024/25 (D16.4.2). See Annex 4 - Technology investment report, investment reference 350 - Planning and outage data exchange.

### 7.4.6. Investment roadmap

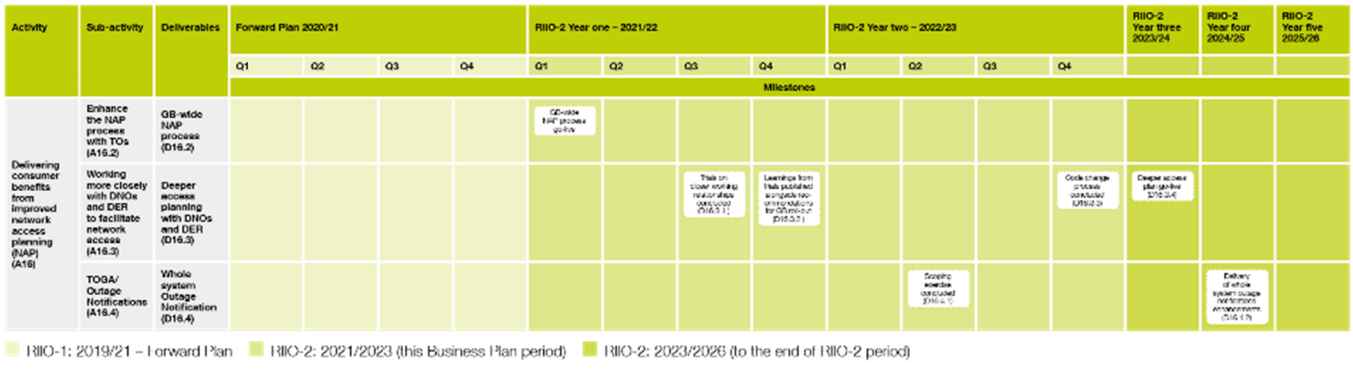



*Figure 38: Investment roadmap*

### 7.4.7. Stakeholder views

Stakeholders, including generators, DNOs and TOs, recognise the importance of closer working relationships across the transmission-distribution interface when planning system access. Some also see the potential for new market opportunities for congestion management.

In developing our transformational proposals, we have engaged with both users of the network and parties who need to take outages to work on their assets. We have talked to large and small generation and demand companies, DNOs, TOs and a consumer interest organisation. We sought wider feedback through our RIIO-2 webinars and workshops and *Our RIIO-2 Ambition* consultation. In addition, we presented our proposals at our OC2 Forum on 1 May 2019, which is an event that focuses specifically on the subject of system access.

Early in the engagement process, we talked to stakeholders at our RIIO-2 events in December 2018 and April 2019. Discussions focused on possible incentives related to system access planning, whether we should consider developing them further, and whether they should apply to the TOs or ESO. Network companies had mixed views on whether a new incentive was required. Some cited existing obligations as sufficient for driving the right behaviours in access planning.

Some other stakeholders, such as generators and developers, supported a greater role for incentives in signalling the cost of system access to TOs. They felt that such a mechanism would facilitate lower congestion levels and be of benefit in either the short or long term. We agree that such signals may unlock consumer benefits. However, we also recognise the need to think carefully about the design of any such incentive, to minimise the potential for unintended consequences. DNOs and a consumer interest organisation in particular agreed that an incentive would need to be carefully considered to avoid negative outcomes for consumers.

Since publication of our July draft Business Plan, we have engaged further with TOs on the subject of incentives in this area. Two of the TOs told us that existing SO-TO code obligations and processes provide sufficient incentive to deliver value for consumers. One TO also thought that a new financial incentive could provide the focus to deliver further benefit to consumers around system access. We think there could be merit in an incentive but that this should be symmetrical in nature to reward and penalise behaviour as appropriate and be designed in a way that avoids unintended consequences.

We therefore propose to review and develop current mechanisms and to work more closely with network companies, rather than proposing a financial incentive in this area at this time. One TO also thought that the ESO and TOs could do more to work together two to three years ahead to influence outage durations and ways of working – and bring further benefits to consumers. We agree and will have further conversations with TOs ahead of RIIO-2 as they develop the single Great Britain NAP.

We also talked to stakeholders about extending our TOGA system to cover a wider range of users at our RIIO-2 event in April 2019. Potential distribution-connected service providers could see merit in such enhanced capability, but only when arrangements exist to allow them to participate in constraint management services. For this reason, we propose to introduce these system changes towards the end of the RIIO-2 period in 2025/26, giving time for such markets to emerge. Two network companies were concerned that any notifications to parties connected to their systems should go via their network company, to avoid confusion. We will continue to engage with networks as we develop the scope of these system developments further.

We have discussed our proposals for increased coordination with DNOs at bilateral meetings, which have been met with broad agreement. Two said that there was definitely a role for greater liaison between the ESO and DNOs to facilitate outages. DNOs have also expressed interest in extending the NAP process to cross transmission-distribution coordination and said that this would require a funding mechanism to facilitate it. More generally they also support the need for more clearly identified roles and responsibilities across the transmission-distribution interface, and between network owners and operators.

### 7.4.8. Cost-benefit analysis

We estimate the gross benefits to be £224 million over RIIO-2. This gives a net present value of £204 million over RIIO-2.

Our proposal will bring significant benefits. For example, transmission and distribution connected parties will receive better notification of planned outages and their impacts on the networks. DNOs, meanwhile, will benefit from increased liaison, including greater procurement and coordination of flexibility services from DER.

The quantitative benefits stated above have been calculated by taking the benefits realised though rolling this proposal out through Scotland then extrapolating that the percentage savings across England and Wales. This saving has been calculated at 11.5 per cent. Taking these percentage savings, we then used forecast constraint costs from *NOA* for England and Wales to estimate the consumer benefits. Further benefits could potentially be derived from extension of NAP process across transmission and distribution.

This is against a baseline assumption of not rolling out the STC cost recovery mechanism to England and Wales.

This activity requires code modifications and financial arrangements to be in place to support it. We also require DNOs and TOs to engage with the new process, for which there may be a cost to implement the new arrangements.

Our analysis suggested that accounting for market, delivery and third-party uncertainty the net present value could credibly be between £310 million and £98 million.

See Annex 2 - CBA report section 5.4 for more details.

## 7.4.9. Other options considered

We considered the following options for the improvement of network access planning, all against a counterfactual of the status-quo.

1. Extending the Scottish STC cost recovery mechanism to England and Wales.
2. Incentivising TOs to promote SO-TO management of outages.
3. Working more closely with DNOs to optimise system outages across the transmission and distribution interface.

We are proposing to take forward options 1 and 3. Full details of the justification can be found in Section 5.4 of Annex 2 – CBA report and the corresponding stakeholder feedback can be found in section 5.6.4 of Annex 3 – Stakeholder report.

## 7.4.10. Measuring performance

### 7.4.10.1. Performance metrics

#### Metric 14 –Capacity saved through our access planning actions

We will measure the customer value that has been created through innovative ways of working with TOs and DNOs to release capacity across the whole electricity system. This will enable us to demonstrate that we are establishing a zero carbon network and improving our service quality. This also has a direct positive impact on our customer satisfaction (CSAT) scores and results in savings to Balancing Services Use of System (BSUoS) costs which should lead to lower bills for the consumer.

We will measure that we are delivering a more efficient outage planning process by measuring the MWhs of capacity created from our actions. This will be derived from our outage planning process and measured on a quarterly basis. This will include the value created for customers by innovative ways of working with TOs and DNOs to release capacity across the whole electricity system; and exclude the monetary value created for customers.

We are proposing a target of an increase of ten per cent in the MWhrs saving from the previous year, this allows us to take the most recent performance year into account.

#### Metric 15 – Number of short notice changes to planned outages

A trade association fed back the importance of the system access management metric that was included in our *Forward Plan 2019-21* in driving positive behaviours for industry in network outages. This metric aims to drive down the number of planned outages that are delayed by more than an hour or cancelled by us in the control phase due to process failure. This should drive us to investigate the reason for cancellations and put in place changes into the process where appropriate to prevent a repeat occurrence of the outage change. We are proposing to continue our target identified in the *Forward Plan 2018-19* of less than 5 changes per 1000 outages.

# 8. Digitalisation and open data unlocking zero carbon system operation and markets

## 8.1. Five-year strategy

Digitalisation of the energy system is key to capturing the benefits of the low carbon energy transition for consumers. Open data is the lifeblood of efficient markets and plays a crucial role in enabling innovation. As digitalisation continues to expand, the availability of quality data will be increasingly fundamental to developing new markets and empowering efficient decision-making.

Harnessing the power of open data and digital technologies such as artificial intelligence and machine learning will be crucial to delivering our RIIO-2 Business Plan and achieving our goal of whole system, zero carbon system operation underpinned by efficient markets.

We will deploy data and digital technologies to drive the energy transition and realisation of consumer value. In our Digitalisation Strategy[135], published alongside this Business Plan, we have set out our strategic intent to:

> *Accelerate our evolution as a world leading system operator through the application of digital technology to drive design and operation of the energy system and markets*

**The ESO RIIO-2 Stakeholder Group supports the open data proposals.**

"There is stakeholder preference for data being made available earlier rather than receiving formatted/ analysed data."

Digitalisation is a key enabler of business transformation that runs through all of our proposals. We will fulfill this strategic intent through delivering the three pillars of our digital strategy:

1. **Delivering open data and digital market enablement**

Adopting the principle of "presumed open" and making all of our shareable data available in an accessible format to inform efficient business decision making across the industry and drive innovation. This should remove barriers to market participation and transform the customer experience through digital enablement.

2. **Building our core capability through digital technology**

Transforming our business processes such as energy forecasting, system operation and network planning to enable secure and efficient operation of the electricity system and markets.

3. **Transforming our organisational culture and digital ways of working**

Developing the right capabilities and skills in our workforce alongside a supporting culture and behaviours to foster an agile, innovative and experimental operating environment

The details of how we will deliver digital market enablement, build our core capability and transform our culture can be found in the relevant chapters of this document. Relevant content is signposted in the graphic below.

[135] https://www.nationalgrideso.com/document/157931/download

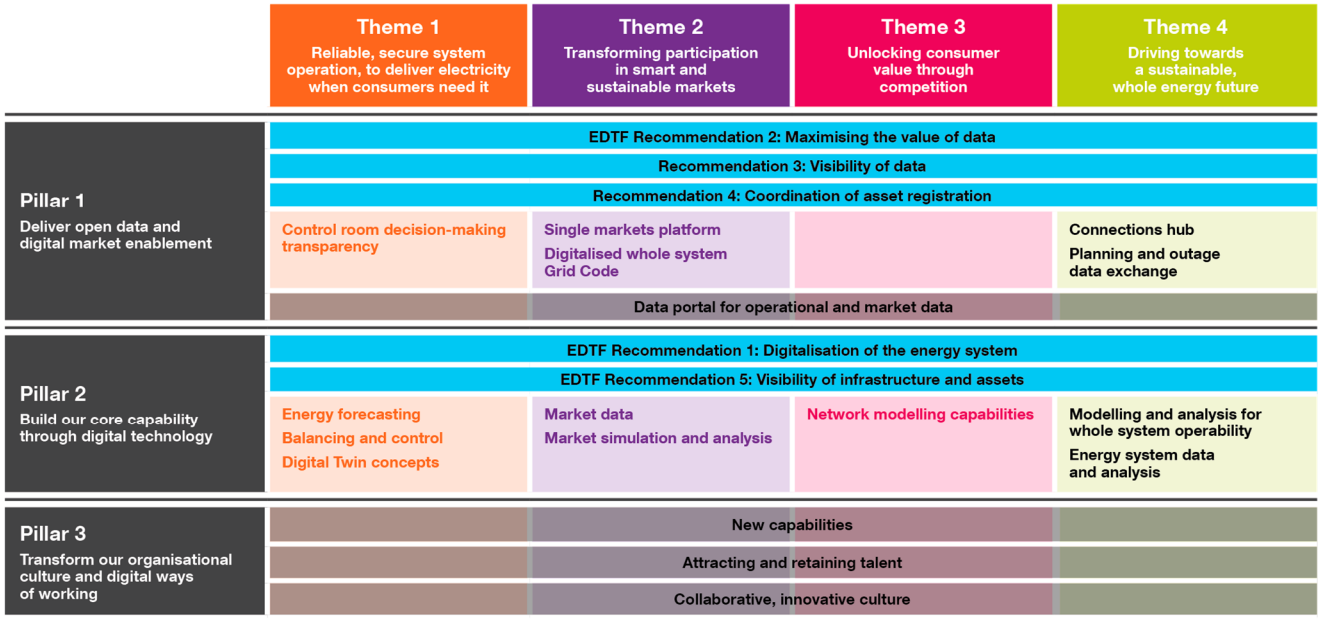



*Figure 39: Digitalisation across the Themes*

The rest of this chapter focuses on “open data”, how we will transform the data we make available, to facilitate new and efficient markets and zero carbon system operation.

**Open data supporting net zero**

Access to usable data will drive the development of innovative solutions to network and market challenges, and enable efficient and reliable system operation in a net zero world with large volumes of renewable and decentralised generation.

To realise the potential that data can unlock, our stakeholders have told us that the we and the broader energy industry must transform the way data is managed, structured and shared. We need to move from a world where there is very limited access to usable data, to one where data is seen as open and shareable by default and is both accessible and fit for purpose.

The Energy Data Taskforce (EDTF) was established to provide the Government, Ofgem and Industry with a set of recommendations on how data can assist with unlocking the opportunities provided by a modern, decarbonised and decentralised energy system at the best value to consumers. Our proposals on open data are anchored in the group’s recommendations and have referenced how our proposals support their delivery throughout our Business Plan.

We will work closely with other relevant data-sharing projects. Our work on open data will support the development of industry-wide data-management tools. Alongside ourselves, we expect a wide range of parties to innovate based on the data we share, developing new solutions to system operability challenges and optimising market efficiency.

As one of the main custodians of energy data in Great Britain, we will play a central role in fulfilling its potential. As the number and diversity of market participants continues to increase, as system operations move closer to real-time, and as we develop whole electricity system solutions, the data sources that we use to operate the system will also increase. In line with the EDTF recommendations, to maximise the value of the data that we hold and to respond to our stakeholders’ needs our default approach will be that all our data should be presumed open unless subject to commercial, legal, network or cybersecurity risks or restrictions.

Building on initial steps taken in the RIIO-1 period, in the first two years of RIIO-2 we will develop a data portal (A17) to provide easy access to our data and share it in a user-friendly format. Enabled by the data platform (described in Theme 1), from the start of RIIO-2 we will follow a process to assess, validate and structure all of the operational and market data that we hold, sharing it according to published criteria. Our initial focus will be on data sets that are identified as of highest value to stakeholders and we will aim to have published all of our relevant data by the end of the period.

### Investment roadmap

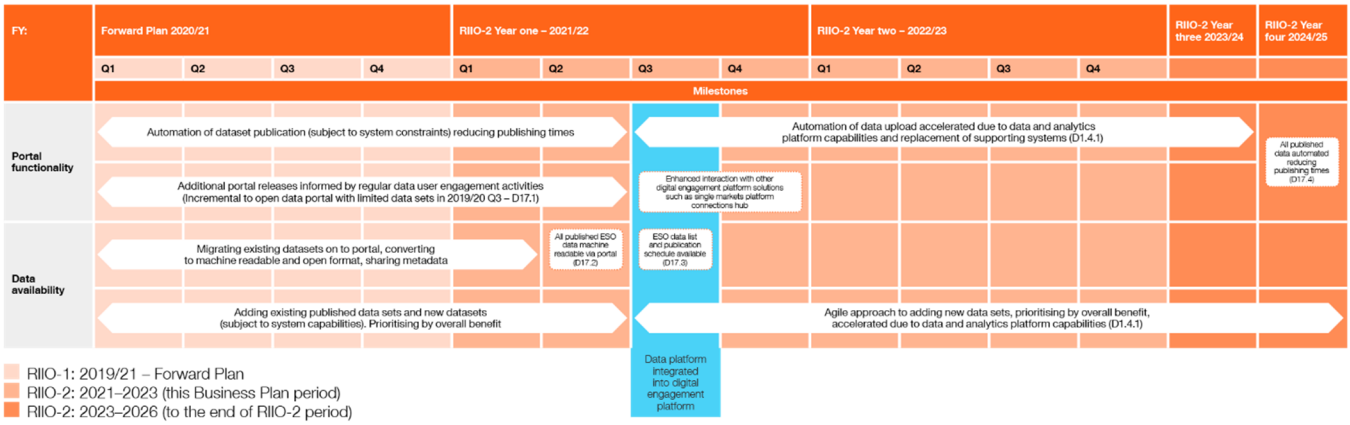



*Figure 40: Investment roadmap*

## 8.2. Costs

| Open data | | Five-year strategy | | | | |
|---|---|---|---|---|---|---|
| | | Two-year Business Plan | | | | |
| | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
| Capex (£m) | 0.0 | 1.3 | 1.3 | 1.1 | 0.6 | 0.0 |
| Opex (£m) | 0.0 | 1.8 | 1.9 | 1.8 | 1.6 | 1.2 |
| FTE | 0 | 9 | 9 | 9 | 8 | 7 |

### Highlights

The investment covered in this section will deliver a digital engagement capability supporting a number of our external facing activities including the data portal (this chapter), single markets platform (Theme 2) and connections hub (Theme 4).

A majority of the investment in this area will deliver our digital market engagement platform. This will create a single point of access for all our data and services, including the balancing services and capacity markets, connections, digitalised Grid Code management, and data portal. It sits at the heart of our vision for digital enablement across all of our Themes, providing a common engagement experience for stakeholders. More detail on this investment is provided in the Annex 4 -Technology investment report.

The volume of data we will be managing, along with our interaction with data consumers, will increase significantly from our work in RIIO-1. We will need a dedicated team of specialists to transform, adapt and manage the data. These resources will be brought in from the first year of the RIIO-2 period. We propose setting up a dedicated data stewardship team to deliver this activity. Further information on the activities of this team is provided in section 8.3.

### 8.2.1. Our current role

We currently facilitate the market by providing information and insights that support the transparency of our actions. This includes:

- developing reports, forecasts and insight in areas such as demand, balancing costs and ancillary services
- managing the interface with Elexon for data provision
- delivering systems and process changes to support data publishing
- providing review, challenge and reporting on our balancing actions
- supporting Electricity Operational Forums three times a year to share our insight and engage with stakeholders on balancing actions and associated costs.

These activities are currently delivered by three FTEs who are part of the performance reporting team that is accounted for under Theme 1.

#### 8.2.1.1. Ongoing activities

We have consistently evolved our approach to sharing the data that we hold through:

- publishing roadmaps on the data we plan to share
- publishing half-hourly photovoltaic (solar) forecasts and trade data at near real-time
- providing access to an explorer page on our website, which makes it easier to navigate our data

- holding monthly visits to our Control Centre to provide insight into our commercial operations and support greater transparency
- adding 'insight into control room difficult days' as a standing agenda item at our Electricity Operational Forums to explain the control room decision making process.

#### 8.2.1.2. Further enhancements we will deliver in the RIIO-1 period

A wide range of stakeholders including generators, service providers and suppliers have told us that where our data is currently published, its aggregated nature, format and structure often makes it difficult to reuse or manipulate. It is also frequently insufficient and difficult to locate, leading to inefficiencies and frustration. Stakeholders would like 'one source of the truth' and a one-stop shop to access all the data that we publish.

They have encouraged us to share as much of our operational and market data in its raw format as possible. This will allow them to perform their own analysis and interpretation.

In RIIO-1, we will deliver a foundational portal capability for data publishing (A17.1). We will proactively engage with our stakeholders to understand the features and structure that best suit their needs. We will use their feedback to inform the development of our RIIO-2 solution.

In this period, we will start to move the data that we share onto the foundational portal. We will also share new datasets, including data on constraint boundaries as detailed in our *Forward Plan 2019-21*. Where we can remove manual uploading of our datasets through automation efficiently, we will do so. However, during this period, the provision of automated data feeds will be constrained by our underlying data-management solutions. The replacement of these systems (more detail in Theme 1) will be a key enabler for automated and real-time data publishing in RIIO-2 (D17.4).

We will continue to make improvements in this period and start to share new datasets and insight. These activities will include:

- Publishing information on voltage constraint, thermal constraint and day-ahead constraint boundaries, signalling where there is insufficient network capacity to transfer electricity.
- Making improvements to the Monthly Balancing Services Summary (MBSS).
- Publishing four additional wind forecasts and an additional day-ahead demand update as documented in our Forward Plan 2019-21 136.
- Engaging with stakeholders to find out what data is valuable, sharing complementary analysis and insight of how we make decisions and support stakeholders in understanding this data and using webinars to enhance transparency of Control Centre decision-making

## 8.3. Transformational activities

In chapter 5 - Transforming participation in smart and sustainable markets, we have highlighted the need to attract new sources of flexibility to the market, to support the operation of a reliable and secure system at the least cost to consumers.

Existing and potential market participants have told us that enhanced data and insight are essential for price discovery, efficient investment and operational decision-making. Understanding current and future trends in both the technical characteristics of system operation (such as constraints and inertia) and market dynamics (such as prices and volumes), can help market participants identify future opportunities.

This will lead to investments in the kinds of services that society needs, meaning those services will be there when consumers need them. This information also supports the optimisation of operational and commercial decisions, within market timescales, which drives market efficiency.

Supported by underlying changes to our data-management capabilities, in RIIO-2 we will build on the steps we have taken in RIIO-1 and transform the quantity and quality of datasets we can make available. The implementation of our data and analytics platform will allow real-time access to all of our operational data. It will enable us to automate data, publish all of our raw data, and add new datasets quickly and efficiently.

Stakeholders have told us that, initially, we should focus on providing a forward-looking view of system requirements. This would include a whole electricity system view of constraints and real-time margins and utilisation. By providing insights into future balancing service requirements, these datasets will enable better investment decisions. They will also help market participants to identify innovative solutions to managing operability issues at the least cost to consumers. Throughout this period, we will continue to work with stakeholders to prioritise the data we publish, so we deliver the highest value datasets first.

When our stakeholders identify a need, we will continue to provide analysis, insight and guidance to them, and help them understand the data we provide. In one example, balancing market participants have asked for more transparency around the decision-making processes in our Control Centre. As a result, we will explain how Control Centre decisions were made, referencing the relevant data.

All published datasets will meet defined quality standards and we will provide powerful and logical search capabilities that make it faster and easier to navigate our data. All of our data will be available

[136] https://www.nationalgrideso.com/about-us/business-plans/forward-plans-2021

through an application programming interface (API) and the raw data for all visualisations or insights will be provided (D17.2).

The data portal will become a tool for sharing the outputs of our enhanced data and modelling collaborations with other organisations.

While we will adopt a 'presumed-open' philosophy, we will remain a champion for data security and data privacy. We will stay vigilant to potential misuse of data, which might threaten the system or distort markets. We will implement a transparent process for assessing any requirement for aggregation or anonymisation of datasets, according to published criteria, including:

- consumer privacy – for example, personally identifiable information not publicly available
- security – for example, the location of critical national infrastructure (CNI) assets and systems, not otherwise generally visible directly or through other sources
- commercially sensitive – for example, Capacity Market auction bid information and Business Plans
- negative consumer impact – for example, data that is likely to drive actions, intentional or otherwise, which will negatively impact consumers

To help users understand and make the best use of our data, the portal will allow them to actively engage with us on the datasets we share, with functionality provided to comment and ask questions.

In the first year of the RIIO-2 period, we will publish a schedule for sharing our data on the data portal (D17.3). This will provide a clear roadmap for when we will make datasets available. We hold a considerable volume of operational and commercial data, which will need to be assessed in advance of sharing. It will take significant effort to conduct the necessary preparation work, including system interfaces, risk assessment, analysis and presentation to ensure it is fit for sharing with the market.

In the first year of RIIO-2, all of our published data will be available in one place on the portal (D17.2). Tools and processes to facilitate reuse of data will also go live, for example through standard (APIs).

Achieving the outputs that our stakeholders want in this area will require wholesale changes to our IT infrastructure.

We will need to replace our internal data management systems with a new platform that pulls together data from a variety of CNI and non-CNI sources.

Our new, underlying data management capability will be designed to be extendable, scalable and interoperable. It will integrate with the data portal, which will enable rapid and scalable publication of our operational data.

To deliver the activities described above we will create a new data stewardship team.

This will include two data analysts to:

- Administer data platform management and operate cataloguing tools to ensure a single source of operational data is used across multiple systems, applications, and/or processes.
- Carry out master data profiling and analysis to review source data and understand its structure, content and interrelationships.
- Maintain guidelines and ensure proper training of end users of data sources.
- Lead and/or support projects related to master-data management and drive further improvements as part of continuous progress.
- Investigate gaps around the creation and change of master data, which leads to inaccurate reporting. Our analysts will initiate measures for improvement and support the IT team during development and implementation.

The team will also include two data engagement and transformation officers to:

- engage with stakeholders on new data requirements
- lead on code changes needed to support sharing of new datasets
- create new datasets on the portal
- maintain existing datasets
- respond to internal and external queries and comments
- manage our data publishing pipeline
- carry out external engagement to support future developments.

It will also include two data quality and assurance officers to:

- ensure appropriate governance and standards for data publishing
- analyse data to ensure it meets agreed standards
- lead on exercises which improve data quality
- create data assurance reports
- liaise with stakeholders and IT to progress change, and maintain and improve data integrity
- guide and support data cleansing projects for older and less accessible data
- ensure the data dictionary, the set of information describing the contents, format, relationships and structure of data, and metadata standards, descriptive or contextual information for a piece of data, are applied correctly
- manage and monitor the access rights to datasets via the data portal.

Our views here are informed by the experiences of organisations that have embarked on similar transformations, such as the Office for National Statistics. We have developed our resourcing plans for

this activity in reference to those organisations and believe our delivery model is efficient. For example, the Office for National Statistics is currently undertaking a digital and technology transformation. This includes an upgrade to user experience, efficient and secure platforms for data processing, and simpler and cheaper ways for data to be collected and verified.

To deliver these changes, for transformation alone, the UK Statistics Authority has forecasted an average of 253 FTEs per year over a five-year period. While this activity is not directly comparable with the data transformation we are undertaking, there are many similarities.

## 8.4. Stakeholder views

A wide range of stakeholders, including suppliers, generators, aggregators, and demand-side service providers, have consistently called on us to share all of our data. However, there is a wider range of opinions on whether sharing data is sufficient.

The vast majority of stakeholders agree that sharing as much raw data as possible, in a format easily interpreted by their own systems, should be our immediate priority.

Both large and small market participants, as well as project developers, also told us that some level of analysis and insight, to explain the data and what it means, is needed.

While many parties would also like to have more leading-edge functionality, such as advanced analytics and sophisticated data-manipulation tools, this was generally considered a 'nice to have'. In addition, several stakeholders observed that this is not our core competence. They felt that by providing advanced analytics and insight we may be squeezing out potential innovation that other parties could deliver better than us. All the stakeholder views that were captured have informed our proposal.

For this activity we have undertaken a break-even analysis, for details see, Annex 2 - CBA report section 6.1.

### McKinsey Global Institute[137]

Research by the McKinsey Global Institute. suggests that open data can help create $3 trillion (£2.4 trillion) a year of value in seven areas of the global economy, with the potential to add between $340 billion (£276 billion) and $580 billion (£470 billion) of value annually across the electricity sector. By clarifying current inefficiencies and potential opportunities, open data can help support the innovation and improvements needed to drive considerable efficiencies.

### Transport for London (TfL) [138]

Research conducted by Deloitte shows that by providing open data to developers, TfL is improving journeys, saving people time, supporting innovation and creating jobs. This approach is also generating annual economic benefits and savings of up to £130 million a year.

TfL has adopted a strategy of making its open data freely available to third parties and engaging with developers to deliver new products, apps and services for customers.

The provision of its data and APIs has driven innovation, by enabling thousands of developers to work on designing and building applications, services and tools, leading to the significant economic benefits and savings stated above.

There are many similarities in the transformation undertaken by TfL and our ambition for open data. This provides confidence around our view that the costs of this activity are far outweighed by the potential benefits.

## 8.5. Measuring performance

### Performance metrics

#### Metric 16 – Proportion of ESO data shared

We are proposing to measure the proportion of our shareable datasets that we have published.

As noted above, we will document the datasets that we hold and publish this list. In line with our presumed-open policy, we will work through the datasets and publish those that do not have any commercial, security, privacy or sensitivity risks. This metric will measure the proportion of the datasets, identified through this process as shareable, that we publish over time and have a target to deliver on time against all of the delivery milestones.

We have consistently been told that transparency of data is a key enabler of efficient markets and innovation. Our progress in data sharing is therefore a good measure of our contribution to efficient, competitive markets and our role as a key facilitator of innovation across the whole energy system.

Service providers and industry associations consulted have welcomed a metric along these lines.

[137] https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/open-data-unlocking-innovation-and-performance-with-liquid-information

[138] http://content.tfl.gov.uk/deloitte-report-tfl-open-data.pdf

# Part 3
# Setting the ESO up for success



# 9. Financing our plan

In this chapter, we consider our financing arrangements for our plan: the funding model, the financial assumptions, the financeability of the plan, our revenues, and their impact on consumer bills.

RIIO-2 represents a rare opportunity to design a tailored regulatory framework for the ESO, which is a unique enabling business that provides specialist services. We manage significant risk and deliver, and encourage others to deliver, real value for consumers.

In April 2019, the ESO was legally separated from National Grid Electricity Transmission (NGET). This new price control is critical to the success of legal separation; to encouraging us to be ambitious and innovative and take risks on behalf of industry and consumers; and to making sure we can demonstrate that we are a financeable, credit-worthy and sustainable business.

To achieve this we must be able to maintain an investment grade credit rating, operate on a standalone basis, cover the costs of our own financing, and provide a fair return to investors for the services we deliver and the risks we take on behalf of industry and consumers.

The funding model has a key role to play in creating the optimal conditions within which we will operate. This is the first ESO-specific price control, and it is important to create the conditions that encourage us to be the ambitious, proactive and efficient business we, and our stakeholders, want us to be. The financial package is key to facilitating delivery of the ambitious plan and the significant consumer value outlined in this document.

Although there have been differing views on the exact mechanisms used to fund us and how these are packaged with an incentive scheme, the overriding view of stakeholders is that we should have a regulatory framework that ensures we are financeable, remunerated fairly for the risks we carry and activities we undertake, and incentivised to drive the energy transition. Stakeholders want an ambitious and agile ESO with a financial framework that encourages this, rather than stifles it.

**We believe our funding framework needs to fully and fairly remunerate the services we provide and to encourage the ambition and innovation needed for the successful delivery of our Business Plan.**

The full funding model outlined by Ofgem has the potential to deliver this. The model could be applied in a way that:

- discourages inefficiency without encouraging a risk-averse culture
- encourages us to undertake new services and innovate for the benefit of industry participants
- encourages us to think long-term
- adequately remunerates investors for the risks they face
- rewards ambition and great performance.

This chapter explains how to deliver these objectives. This is possible within the framework proposed by Ofgem, but it requires amendments to some of Ofgem's working assumptions, in particular around remuneration for some industry roles such as revenue management.

Our financeability assessment, based on Ofgem's working assumptions, shows that the business is debt financeable, but does not offer an attractive equity proposition.

Amendments to the key funding parameters would put in place a framework that is financeable and appropriate for the roles we undertake. It would appropriately remunerate the risks we manage on behalf of industry, and would ensure and incentivise ambition, innovation and great performance – creating the culture necessary in a flexible, proactive ESO facilitating the energy transition.

**We would be supportive of the ESO's proposal, which will allow for profit margin to be applied and encourage the ESO to be much more service-driven and innovative.**
**Trade Association**

## 9.1. Context

Ofgem consulted on its proposed regulatory framework for the ESO in December 2018, May and August 2019, and published decisions in May, August and October 2019.[139] We published our consultation responses on our website.[140]

In line with Ofgem's guidance, our Business Plan is based on the financial assumptions set out in the August ESO methodology decision and consultation document (ESOMDD) and confirmed in the October decision document. We have also presented alternative proposals as allowed under Ofgem's process.

In this chapter, we outline:

1. our funding model, and how we recover our costs
2. Ofgem's working assumptions for our financial package
3. our financeability assessment, based on Ofgem's current working assumptions
4. our analysis and evidence for proposed alternative assumptions and a financeability assessment of them
5. the impact our Business Plan will have on consumer bills
6. an explanation of how we have treated other financial policies and costs.

Ofgem will confirm the value of our financial parameters and incentive scheme in draft determinations in the second quarter of 2020.

We received a final version of Ofgem's business plan financial model (BPFM) on 21 November. All the analysis in this plan uses that model on a best endeavours basis.

## 9.2. The funding model

RIIO-2 is the regulatory process that will set the amounts we can recover from customers for the services we provide. It makes sure the costs we incur are appropriately shared between current and future consumers. Our price control framework defines how this will be done.

Our revenues are recovered through use of system charges levied on generators and suppliers. We have two main streams of revenue:

- Revenues associated with our internal costs to deliver our licence commitments, which are the main focus of RIIO-2, such as RAV and totex-related revenues, business rates and pensions costs.[141]
- Revenues associated with the direct cost of undertaking electricity balancing activities (BSUoS[142]). These are recovered from balancing participants.

We also perform an industry revenue management role, where we collect other charges from network users on behalf of the transmission owners (TOs). These include TNUoS[143] charges, assistance for areas with high distribution costs and connection charges. The relative size of these flows is shown below.

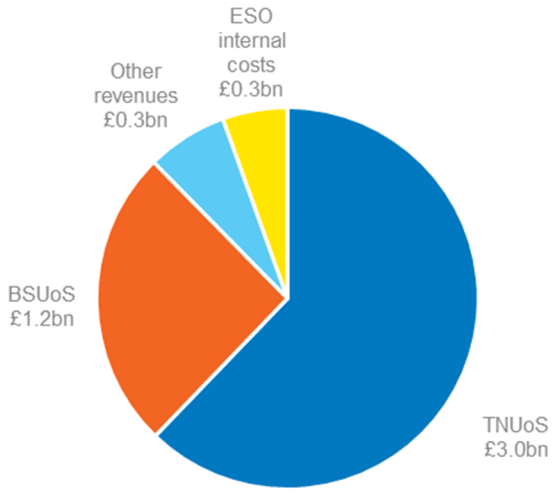



*Figure 41: Breakdown of ESO average RIIO-2 revenue streams in 2018/19 prices*

Ofgem has confirmed its intent to use a RAV-based funding model, coupled with an ex post incentive scheme, to remunerate us. This model splits our expenditure between what is paid for by customers over time ('slow money'), and what is paid for immediately ('fast money'); and combines it with a baseline return intended to cover the cost of financing the plan. Ofgem has retained an option to include additional funding to account for any risks that cannot be appropriately remunerated through the WACC. The figure below sets out the building blocks of our price control framework.

[139] https://www.ofgem.gov.uk/publications-and-updates/riio-2-sector-specific-methodology-decision; https://www.ofgem.gov.uk/system/files/docs/2019/08/riio-2_methodology_for_the_electricity_system_operator_-_decision_and_further_consultation.pdf; https://www.ofgem.gov.uk/publications-and-updates/riio-2-financial-methodology-and-roles-framework-electricity-system-operator

[140] https://www.nationalgrideso.com/document/139766/download; https://www.nationalgrideso.com/document/147026/download; https://www.nationalgrideso.com/media-test/esos-response-ofgems-riio-2-finance-methodology

[141] We have assumed that Innovation related costs such as Network Innovation Allowance will continue to be recovered via TNUoS charges

[142] Balancing Services Use of System charges

[143] Transmission Network Use of System charges

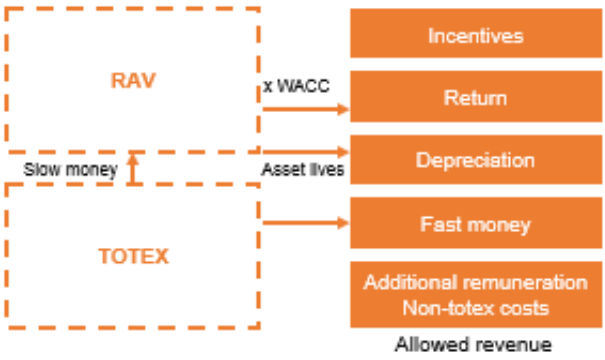



*Figure 42: ESO price control framework*

Details of our totex plans are set out throughout this Business Plan; pass-through costs are covered in Annex 5; and incentive plans will be developed in more detail next year as we continue to discuss the scheme with Ofgem and stakeholders. This chapter focuses on our review and assessment of the appropriate financial parameters to ensure a financeable ESO that can deliver significant consumer benefits; these parameters include return, depreciation and the ratio of fast and slow money. It also covers the requirement for additional remuneration.

Our view, shared by the majority of stakeholders, is that a RAV-based model alone is not sufficient for the ESO and, rather than encouraging us to be ambitious and innovative on behalf of consumers, is more likely to drive a risk-averse culture. Over the past 18 months, we have engaged with many stakeholders on our funding model through workshops, webinars and bilateral meetings, and seen their views through responses to Ofgem's consultations. There is an overwhelming consensus from DNOs, trade associations, generators and consumer representatives that a pure RAV*WACC model alone is not appropriate for us as an asset-light, services business.

We have also worked closely with the ESO RIIO-2 Stakeholder Group (ERSG) to develop our regulatory framework and have provided regular updates on our analysis and Ofgem's decisions throughout the process. ERSG has challenged us when we have disagreed with some of Ofgem's decisions, and has asked us to look at alternative solutions or better demonstrate why options would not work. Feedback from ERSG and other stakeholders is that we need a financial framework that allows us to invest, be financeable as a standalone company, be innovative, and does not drive an unduly risk-averse culture due to the cost disallowance mechanism.

ERSG has also acknowledged that incentives are an important part of the overall framework and that they need to be developed and executed in way that drives outperformance; they should not be used to pay for activities within the plan or to fund unremunerated risk associated with delivering core activities.

**We believe the overall increased exposure to volatile revenues and the risk of disallowance will result in an extremely risk-averse ESO – an ESO that favours conservative options that may result in a failure to accomplish its ambitions in the required timeframe.**

**Generator**

We have consistently heard that stakeholders want us to be agile, ambitious, innovative and strongly incentivised. We believe that our proposals in this chapter will deliver these behaviours.

Further details on our stakeholder engagement can be found in Annex 3 and Annex 5, section A.2.

## 9.3. Ofgem's working assumptions and the ESO's financial package

We are an asset-light company providing a suite of services, including operating and balancing services, market and industry services, and an industry revenue management service (shown in the box below). We have a mix of largely intangible assets, including IT systems, delivered through the skills and expertise of our workforce and the enabling information systems that underpin our services.

**Operating and balancing the system** – generation despatch to meet demand and balance the system in real time. This ensures that the lights stay on across GB in a safe and cost-effective manner.

**Market and industry services –** activities to support the wider system and industry including long-term network planning and administering industry codes and standards.

**Industry revenue management –** collecting, managing and distributing over £4bn of TNUoS, BSUoS and Connection charges annually.

*Figure 43: Our three core functions*

Our financing requirements are therefore more centered around funding shorter-term needs: investment in our workforce and our systems to ensure we maintain (and improve) the reliable level of service expected of us, and to ensure we are proactive in finding ways to improve our services.

The intention of the recent legal separation from NGET was to establish an ESO with a governance structure that mitigates potential or perceived conflicts of interest and that can adapt further to the changing energy system. It is important that our framework reflects this by funding us as a standalone business, without support

from National Grid plc. This new price control is critical to the success of legal separation and to making sure we can demonstrate we are a financeable, credit-worthy and sustainable business that is ambitious and proactive in unlocking benefits for consumers.

We are a unique investment offering given the roles we undertake and our central position within the industry. We have a licence obligation to hold an investment grade credit rating, to provide confidence to our counterparties and other stakeholders in relation to our critical role at the heart of the industry.

**The ESO needs to be financeable as a standalone business. The Business Plan and funding model need to lead to a proposition that remunerates both equity and debt. The ESO should not rely on the rest of the National Grid group. It needs to be a standalone business that a rational investor would put money into.**
**ERSG**

We must be able to attract both equity and debt investors so we can finance the services we provide and take risks on behalf of industry and consumers to deliver benefits. It is critical to consider both our equity and debt investor propositions as we set out our financial package.

## 9.3.1. Cost of equity and investor return

The cost of equity is an estimate of the return equity investors expect for the risks they take when investing in us. Investors receive their return through dividends and asset growth funded by the cost of equity allowance, additional remuneration and incentive performance.

Ofgem's working assumption is that a cost of equity of 7.81 per cent should ensure a financeable ESO. Ofgem's approach is to continue to apply the Capital Asset Pricing Model (CAPM), supplementing it with additional remuneration as required. This provides a return to equity holders aligned with the capital invested in the RAV. For the purposes of this Business Plan we have adopted Ofgem's working assumptions of 7.81 per cent cost of equity and no additional remuneration, but include our thoughts on those assumptions below.

The CAPM approach involves three different elements to calculate the cost of equity in the following formula:

$$\begin{matrix}\text{Cost} \\ \text{of} \\ \text{equity}\end{matrix} = \begin{matrix}\text{Risk-} \\ \text{free} \\ \text{rate}\end{matrix} + \begin{matrix}\text{Equity} \\ \text{beta}\end{matrix} X \left( \begin{matrix}\text{Total} \\ \text{market} \\ \text{return}\end{matrix} - \begin{matrix}\text{Risk-} \\ \text{free} \\ \text{rate}\end{matrix} \right)$$

The equity beta represents the level of systematic risk within an organisation for which investors expect a return and is estimated using the formula below.

$$Equity\ beta = \frac{asset\ beta}{1 - gearing} - debt\ beta\ x \frac{gearing}{1 - gearing}$$

### 9.3.1.1. Asset beta

For the purposes of calculating a cost of equity to apply to the RAV, we agree with Ofgem's ESO-specific working assumption of 0.6 asset beta, aligning with recent System Operator of Northern Ireland (SONI) precedent. We agree that SONI is a good comparison to us, undertaking many similar roles and providing similar services.

We commissioned Oxera to write an independent report into the appropriate cost of equity for us, and this informs our views on asset beta. Within its report, Oxera estimated an appropriate asset beta range for us of 0.60-0.65,[144] based on observing comparator organisations and regulatory precedent. We therefore agree with Ofgem's working assumption of 0.6.

### 9.3.1.2. Total market return (TMR), debt beta and risk-free rate (RFR)

We have used Ofgem's working assumptions for TMR, debt beta and RFR in our Business Plan. We share the views of the ENA members, as presented in various ENA submissions during RIIO-2 engagement,[145] in not agreeing with Ofgem's position on some parameters. We have not suggested alternatives as these are not ESO-specific parameters; the key issue for our financial package is that some of our risks are not remunerated under a RAV*WACC model because they do not correlate to our RAV.

### 9.3.1.3. Notional gearing

Gearing is a measure of the financial leverage of an organisation. Notional gearing represents the percentage of net debt in relation to RAV for the notional company. It is a key consideration in setting a price control as it links many of the financial parameters together.

Notional gearing for RIIO-1 provided a range of 55-65 per cent. As a significantly more asset-light organisation than the network companies, with high operational gearing, economic theory suggests that we would not be able to bear as much debt as these organisations. Ofgem recognised this in its ESOMDD consultation, which set out a working assumption of 55 per cent notional gearing to RAV for us. Ofgem will continue to review this in light of the risk of the overall price control settlement and the ability of the notional ESO to sustain downsides.

As outlined in our consultation response,[146] we anticipate an appropriate range in notional gearing of 50-55 per cent and have retained Ofgem's working assumption of 55 per cent. We have considered the

[144] https://www.nationalgrideso.com/document/153396/download
[145] https://www.oxera.com/publications/, search for 'The cost of equity for RIIO-2'
[146] https://www.nationalgrideso.com/media-test/esos-response-ofgems-riio-2-finance-methodology

impact of both higher and lower gearing on our plan within our financeability assessment.

#### 9.3.1.4. Our overall cost of equity

We have retained Ofgem's working assumptions for the cost of equity and have not proposed an alternative.

We include a scenario in our submitted results that shows the impact of alternative assumptions for the non ESO-specific parameters of TMR and debt beta.

### 9.3.2. Cost of debt

We are structurally and operationally different to the RIIO network companies: we are relatively asset-light, with IT systems being our main assets rather than large electricity infrastructure. We carry a very significant risk of working capital fluctuation due to our industry revenue management role and relative size of pass-through costs. These risks, and our high operational gearing, mean that we have two main sources of debt financing: financing our RAV, and financing working capital fluctuations.

We agree with Ofgem that we need a bespoke cost of debt mechanism to reflect these unique characteristics and the significant growth in RAV that our ambitious Business Plan represents. This was also supported by stakeholders in their responses to Ofgem's ESOMDD.[147]

#### 9.3.2.1. Approach to financing our RAV

Our RAV consists predominantly of IT-related assets in managing our highly complex balancing activities. We expect high levels of capital growth in the RIIO-2 period, with the RAV almost doubling. A key requirement is to ensure that we can service our efficiently incurred debt.

We currently hold medium term debt of £120 million. Although this is expected to steadily increase across RIIO-2, each individual issue is likely to be modest in market terms, and below the level required for efficient access to the bond markets. We anticipate that we will rely more heavily on bank debt.

We have used Ofgem's working assumption of an average cost of debt of 0.25 per cent (CPIH stripped).

We respect Ofgem's decision to retain full indexation of cost of debt allowances to reduce risk to consumers and ourselves. Setting a cost of debt allowance based on relevant market benchmarks, reflecting the circumstances of the relevant business, incentivises efficient debt finance for the benefit of consumers.

Ofgem's October decision left open the question of whether the cost of debt index would be based on a trailing average of bond rates, or the use of bank debt benchmarks, with no associated trailing average.

We propose a cost of debt allowance that approximates the efficiently incurred costs associated with bank debt, which we believe is more reflective of our business characteristics and borrowing needs, and is therefore in consumers' interests. It comprises an allowance based on LIBOR,[148] or its subsequent replacement, plus a credit spread associated with the five to seven and seven to ten-year BBB rated UK non-financial iBoxx indices.

At present, Ofgem's working assumption does not include any allowance for the transaction costs of borrowing. Previous regulatory precedent from Ofgem and other regulators[149] has included these. We propose the inclusion of funding accordingly. Further details are included in Annex 5.

For the credit rating impact, we believe it would be appropriate to use only BBB rated UK non-financial corporates as comparators for us. Not only are we actually rated within the BBB range, a credit rating agency (Moody's Investors Service ("Moody's")) has cited an assumed level of National Grid plc support in determining this rating; the clear implication is that the notional ESO has a lower rating than the one awarded. Any use of combined A/BBB rated bonds would leave us exposed to under-funding.

#### 9.3.2.2. Working capital facility

A working capital facility (WCF) is key to managing our short-term liquidity. Such a facility for us differs to most businesses because of our industry revenue management role and the scale of revenues we transact (over £4 billion per annum in network charges), compared to the size of our asset base (around £225 million[150]) or our internal expenditure (around £260 million per annum[151]).

Our WCF has been sized predominantly to cover the major risks associated with revenue management, where there is a significant risk of under-collection, with often a two-year delay in being able to recover cash from customers. These risks include TNUoS charges collection risk ('K' term) as well as risks around customer estimated billings, large termination payments and customer insolvency.

We have prepared our Business Plan on the basis of a £550 million WCF.[152] This does not cover the maximum possible cash exposure; it reflects the size of our plausible exposure rather than probable exposure and reflects the facility we have in place today. This gives comfort that we can meet our licence obligation around sufficiency of resources with minimal additional cost to consumers.

This facility is sized in line with our current risk exposure. We are aware that Ofgem is planning to consult on whether to transfer our TNUoS revenue collection risk to other parties, and note that our

[147] https://www.ofgem.gov.uk/publications-and-updates/riio-2-methodology-electricity-system-operator-decision-and-further-consultation
[148] The London inter-bank offered rate (LIBOR) is a benchmark interest rate at which major global banks lend to one another in the international interbank market for short-term loans. It serves as a key benchmark interest rate.
[149] https://www.ofgem.gov.uk/ofgem-publications/92249/riio-ed1finaldeterminationoverview-updatedfrontcoverpdf and https://www.uregni.gov.uk/sites/uregni.gov.uk/files/media-files/2016-2-22_SONI_PC_Final_Determination_2015-2020_Final.pdf
[150] Based on our opening RAV in nominal prices
[151] Average totex across RIIO-2 in 2018/19 prices
[152] The size of the facility is assumed in 2018/19 prices to remain at the same level throughout the RIIO-2 period

Business Plan contemplates additional risk in BSUoS charges revenue collection as a result of any conclusions from the charging task force. We estimate that transferring the TNUoS risk to onshore TOs could reduce the WCF requirements by approximately £300 million. The remaining facility would predominantly cover the OFTO[153] TNUoS billing and credit risks as well as the significant cash flow risk for termination payments. We would expect funding to cover the appropriate facility size, taking into account our exposure for RIIO-2, and recognise that the current facility will remain in place for the first year of RIIO-2.

**We view the liquidity of NG ESO as satisfactory, despite its highly volatile cash flow, reflecting the large revolving credit facilitate that has been put in place to manage the risk associated with TNUoS charges.**
**Moody's**

We note Ofgem's proposed funding mechanisms for a WCF in the ESOMDD.[154] We do not believe that a pass-through mechanism that recovers only the fixed facility fees[155] would fairly remunerate all the revenue risks we manage. For example:

- Risks mitigated through a WCF attract interest funding at different rates according to specific provisions in the licence or Connection and Use of System Code (CUSC). For example, any shortfall in recovery of revenues as a result of inaccurate customer forecasts would attract interest at the Bank of England base rate, which is lower than the cost of funding the shortfall through our WCF.
- Borrowing costs on the WCF are linked to LIBOR, so we would be taking on additional interest rate risk.
- There is no recognition of the contingent equity capital that underpins any WCF. Exposure could exceed the value of the WCF, and accessing additional funding at short notice would likely carry a cost premium, as well as affecting our credit rating and investor confidence. Consequently, the shareholder has further contingent equity invested in the business.

We have assumed, for the purposes of this Business Plan and our financeability assessment under Ofgem's working assumptions, that all fixed costs of the WCF are passed through. Interest on amounts drawn is not included in any recovery modelled in the BPFM supplied by Ofgem. As described in our response to Ofgem's ESOMDD, we consider that the WCF fees should be funded through additional remuneration rather than by a pass-through mechanism.

### 9.3.3. Capitalisation rates

The capitalisation rate is the proportion of totex expenditure added to the RAV each year and paid for by future customers via a regulatory depreciation allowance as part of our revenue.

The ESOMDD indicated that the capitalisation rate would be based on operational practice to date, with consideration of the expected ratio of capex to totex; but would be set through ESO Business Plan submissions every two years.

In RIIO-2 we anticipate that capital investment will form a greater proportion of our activities, with a capitalisation rate of 34 per cent[156] across the five years, or 36 per cent for the first two years.

We have included this assumption in our Business Plan and considered the impact of a lower capitalisation rate within our financeability assessment.

### 9.3.4. Asset lives and regulatory depreciation

Previous price controls set out that charges to consumers should balance the interests of current and future consumers.

In line with Ofgem's guidance, we have modelled regulatory depreciation using an average asset life of seven years on a straight-line basis. This is in line with the historic average useful economic life of our assets.

Our plan does not adjust the regulatory asset life, although we have considered the impact of different asset lives within our financeability assessment.

[153] Offshore transmission owners
[154] https://www.ofgem.gov.uk/system/files/docs/2019/08/riio-2_methodology_for_the_electricity_system_operator_-_decision_and_further_consultation.pdf
[155] 'Fixed' fees are arrangement fee, extension fee and annual commitment fee.
[156] Total capex for the five years of RIIO-2 divided by totex for the five years of RIIO-2

## 9.4. Our financeability assessment

We have proposed an ambitious plan to deliver against the needs of industry and consumers across the RIIO-2 period. It requires investment over and above RIIO-1 levels to ensure these ambitions are met and that we can be innovative and deliver benefits for consumers. We need a framework that supports rather than discourages that ambition.

Ofgem has a statutory duty to have regard to the need to secure that the company is able to finance its licensed activities. We also have a duty to maintain an investment grade credit rating.

Our financeability assessment, based on Ofgem's working assumptions, shows that the business is debt financeable, but does not offer an attractive equity proposition.

As a counterparty to more than £4 billion of industry revenues, and in order to ensure the efficient functioning of the market, we must maintain the confidence of industry. One aspect of this is our ability to maintain a strong investment grade credit rating for the actual company.

**The assessment of financeability should be based on obtaining a strong credit rating in line with Ofgem policy during RIIO-1. Ofgem has not sufficiently justified why it has deviated from this policy position for RIIO-2 and at this stage appears to believe marginal investment grade is considered appropriate.**
**Distribution Network Operator**

To achieve efficient financing costs, it is essential that investors have confidence both in the regulatory framework and the returns they expect to receive. Part of this is ensuring sufficient flexibility and financial headroom in the event of shock events or economic downturn. This also facilitates continued access to capital markets, so we can finance new investments for the benefit of stakeholders and ultimately consumers, without recourse either to Ofgem or shareholders, thus mitigating the risk of potentially postponing investment. It is not in the interest of consumers for us to be unable to remain a strong counterparty to industry.

### 9.4.1. Assessing financeability

To be financeable, both equity and debt need to be considered. Our financeability assessment considers whether we can meet the expectations of both our equity and debt investors.

This is the first price control framework and financeability assessment for the legally separate ESO. We have reviewed metrics used by credit rating agencies, and a suite of other credit and equity metrics, to consider the different investor positions. We believe that additional metrics are important given our asset-light nature and cash flow volatility. Where appropriate, we have set out the thresholds against which we have tested our Business Plan. These are outlined in the figure below.

| Assessment criteria | Threshold |
|---|---|
| Alignment with regulatory principles | Qualitative factor[157] |
| Enables required culture | Qualitative factor[158] |
| Moody's grid rating | A1/A2 |
| Adjusted Interest Cover Ratio | 1.8x |
| EBIT margin (controllable revenue) | 10% |
| Dividend yield | 5% |
| Dividend cover | 1.5x |

*Figure 44: Financeability assessment criteria*

Our financeability assessment considers two qualitative aspects.

The first seeks alignment with the principles of good regulatory practice applied by Ofgem. It considers the sustainability of the package and whether it can be expected to endure as a financial framework rather than introduce short-term amendments. It also asks whether it creates a financially sustainable framework.

The second is considering whether the desired culture is enabled. Investors are increasingly interested, not just in the returns on their investments, but in the underlying activities and culture of the organisations they finance, as demonstrated by the growth in socially responsible investing. This criterion considers whether the regulatory framework aligns the interests of investors and stakeholders and helps create the desired culture. Ofgem set out the below objectives in its October decision document, namely for us to:

[157] This is a subjective assessment and we have chosen to apply a green, amber or red rating to it based respectively on whether the principle has been adhered to, moves away from or whether one or more of the principles is broken.

[158] We apply only a red or green rating to this assessment based on our belief as to whether the framework enables the required behaviours

- be ambitious, forward-looking and proactive in maintaining a reliable, resilient and efficient system throughout the energy system transition
- work with Ofgem and other industry parties to solve system challenges
- be dynamic and flexible in adapting to emerging issues and new developments.

We have applied Moody's approach in its review of qualitative and quantitative metrics to achieve a grid rating score. Moody's has applied considerable judgement when rating the ESO due to the high levels of volatility seen historically, as a result of our industry revenue management role. It has not issued any quantitative guidance for the ESO, which we believe is because of the volatility in our metrics. This makes a quantitative assessment of ESO credit strength challenging. As a result, we have considered the grid rating relative to that achieved in our actual rating.

Moody's indicated a grid rating score of A1 based on the qualitative and quantitate metrics used under the Regulated Electricity and Gas Utilities Methodology. This A1 grid rating was then reduced by three notches to its final rating of Baa1.

**The outcome of the methodology grid is A1 on a forward-looking basis [following the legal separation of NG ESO from NGET]. The assigned rating is three notches lower, reflecting NG ESO's unusually high cash flow volatility and associated liquidity risks, offset by its ownership by National Grid plc.**

**Moody's**

The clear implication is that the standalone company has a weaker credit profile than implied by our published rating. Recent market evidence suggests that this rating is lower than that obtained and targeted by some peers. For example, Moody's notes in its 2019 rating of the ESO that "[NG ESO's] peers are rated between Aa2 and A1, reflecting the essential natures of their services and timely cost recovery under strong regulatory frameworks." This suggests that Baa1/BBB+ is the minimum rating required for the ESO and that it would be inappropriate to target a lower rating.

Despite peers providing similarly essential services being rated more strongly than us, we have targeted maintaining a grid rating of A1/A2, in the expectation that this allows us to maintain the Baa1 rating achieved by Moody's in its last evaluation of the company.

We have also focused on the Adjusted Interest Cover Ratio (AICR), which is used widely in rating methodologies and considers the largely non-discretionary nature of our capital expenditure on cash availability. Moody's standard regulated networks guidance, and that applied to other more asset-light organisations like NATS, leads to the use of 1.8x as a Baa threshold.

For companies with limited tangible assets reflected in the RAV, it is difficult to quantify the total capital employed. Investors and financiers typically assess asset-light businesses based on margins. Margins are a critical measure of financeability from an equity and debt perspective. We have highlighted EBIT margin as it avoids issues associated with comparability and interpretation of capital charges across different sectors. We apply a threshold of ten per cent based on analysis by our independent advisors.[159]

We also consider two dividend-based metrics. We have engaged with equity investors through individual meetings and National Grid plc's annual investor survey. Coupled with analyst commentary, the emerging themes relevant to the ESO at this stage in the RIIO-2 process are:

- dividends are of fundamental importance to equity investors
- political and regulatory risk are increasing compared with the lead up to RIIO-1.

Ofgem's working assumptions for network companies include a three per cent dividend yield[160] and 4.8 per cent return to equity. Applying the same pay-out ratio, the ESO dividend yield would be around 4.9 per cent based on Ofgem's working assumption of 7.81 per cent cost of equity. In the UK, National Grid is predominantly an asset-based organisation remunerated extensively through RAV*WACC based methodologies. Dividend yields have been calculated with reference to the notional equity proportion of the RAV, but investors will also require a return from the activities that are not remunerated by a return on the RAV.

A stable dividend policy sends a strong signal of confidence to investors. We believe a stable dividend policy of five per cent and 1.5x dividend cover is appropriate for the ESO.[161] This is consistent with our UK and European peer group over the last ten years, against which we would be competing for investment.

We focus on these criteria in this chapter and have submitted a wider range of financial ratios, including those set out within Ofgem's guidance, as part of our BPFM and supporting schedules.

As well as considering a baseline position, we need to ensure that we will remain financeable in a range of circumstances given the inherent political and economic uncertainty across the RIIO-2 period, as well as the

[159] KPMG's report is included as Appendix C to Annex 5 of this business plan. Oxera's report can be found at the following link: https://www.nationalgrideso.com/document/153396/download

[160] A three per cent yield has been agreed with Ofgem in line with the network company working assumption for notional company financeability modelling purposes in the absence of a specific working assumption being set out in the ESOMDD

[161] We have assumed this as five per cent of equity RAV for the notional company

uncertainty within the totex plan itself. We have considered the range of sensitives set out by Ofgem to test the impact of downside risk. These are:

1. interest rate sensitivity based on +/- 1 per cent compared to rates implied per base case in each year based on a trailing average cost of debt
2. inflation rate based on +/- 1 per cent in each year
3. 10 per cent totex variation to base plan
4. high RoRE and low RoRE with movement of two per cent around baseline
5. impact of sustained revenue under-collection of £75 million per annum.

We have also assessed additional sensitivities, including considering the impact of different notional gearing levels on the plan. We set out the results of these sensitivities below and in Annex 5.

### 9.4.2. Financeability assessment of the notional company

We have initially considered the financeability of the notionally efficient company. We assume the notional company is an efficient standalone organisation that sits outside National Grid plc, and does not benefit from any parental support. Its finances are influenced by an assumed capital structure and include regulatory depreciation of its assets.

We have used Ofgem's working assumptions and BPFM for the base case notional company.

In the BPFM, Ofgem has classified WCF fees outside of financing costs, meaning they are not fully considered in a number of core metrics, e.g. AICR and (CFO+Interest) / Interest. We do not believe this treatment would be applied by rating agencies, and we present an additional view of AICR in Annex 5. For the purposes of calculating a Moody's grid rating for the notional company we have assumed that debt/capitalisation can be approximated to total debt (including WCF drawings)/RAV. This approximation is necessary as the BPFM does not contain a full balance sheet

The figure below sets out the main assumptions used in our analysis. All return numbers quoted are CPIH stripped.

| Parameter | Core assumption |
|---|---|
| Cost of equity | 7.81% |
| Cost of debt allowance | 25bps |
| Index linked debt | 0% |
| Working capital facility expense | Pass-through of facility costs, assumed with zero draw down |
| Working capital drawdown | None assumed |
| Interest expense | Equal to cost of debt (but incurred nominal) |
| Gearing | 55% opening position |
| Inflation | CPIH of 2% |
| Dividend yield | 3% on notional equity RAV |
| Capitalisation rate | Aligned to capex proportion of totex, reset every 2 years |
| Regulatory depreciation period | 7 years |
| Incentive performance | No under- /over-performance[162] |
| Additional remuneration | None assumed |

*Figure 45: Notional company base case working assumptions*

Our analysis shows that gearing rises above notional levels, indicating the need for equity injections to deliver our plan. We have assumed equity injections to maintain gearing within a tolerance of five per cent of notional levels of 55 per cent.

This, combined with re-gearing to the new notional level of 55 per cent, drives a requirement for £43.3 million of new equity across RIIO-2.

If we assume this new equity, the resulting metrics indicate a Moody's grid rating of A1, consistent with the previous Moody's rating assessment. While credit rating assessments involve considerable judgement, our analysis suggests the ESO should be debt financeable using Ofgem's working assumptions.

[162] Ofgem is currently developing the ESO's incentive scheme. No financial parameters have been consulted on or set as working assumptions for business planning purposes.

| Assessment criteria | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 | Avge [163] |
|---|---|---|---|---|---|---|
| Alignment to regulatory principles | | | | | | |
| Behavioural driver | | | | | | |
| Moody's grid rating | A2 | A2 | A2 | A2 | A1 | A1 |
| AICR | 2.8 | 2.9 | 2.8 | 2.7 | 3.0 | 2.8 |
| EBIT margin | 4.0% | 4.4% | 5.1% | 5.2% | 5.8% | 4.9% |
| Dividend yield | 3% | 3% | 3% | 3% | 3% | 3% |
| Dividend cover | 1.6x | 1.6x | 1.6x | 1.6x | 1.8x | 1.6x |

*Figure 46: Notional company base case financeability assessment*

Although credit metrics indicate that we are debt financeable under Ofgem's working assumptions, there is an apparent lack of equity investor offering.

This indicates a challenge in ensuring a sustainably financeable organisation.

The lack of investor offering is demonstrated by the low EBIT margins of less than five per cent on average across the plan. This is significantly below the threshold of ten per cent and the benchmark positions set out by Oxera and KPMG in their independent reports.

Dividends can be covered at the Ofgem working assumption level of three per cent yield (against the equity portion of RAV) and also maintain a cover ratio of 1.6x, but this is only possible with the injection of the £43.3m of new equity. This means no cash return is provided to the shareholder across the five-year RIIO-2 period. We do not believe a rational investor would provide this equity injection, given the poor investor offering, with some services not being remunerated appropriately under a RAV*WACC framework.

Using Ofgem's working assumptions, the regulatory framework does not incentivise and encourage the innovative, ambitious, proactive behaviours desired of us. Firstly, the assumptions encourage risk aversion. Faced with an option of investing additional operating cost to further consumer interests through additional activities, we can only hope to recover our costs; yet we face a risk of cost disallowance. Secondly, there is no reward for additional activities, or remuneration for any additional risks they may introduce, should the RAV not increase as a result. Thirdly, while the incentive scheme has the potential to offer reward, the fact that it is an ex post evaluative scheme makes any reward unpredictable and, based on recent experience, unreliable.

The notional company may find it challenging to raise new equity, with investors choosing instead to put their money in alternative sectors (or countries) where they can achieve higher dividends for lower risk. This may be exacerbated due to the ESO being a newly separate entity without the benefit of an established regulatory framework, which may increase investors' perception of risk around our ambitious plan to support net zero carbon delivery and the current uncertain political climate.

We conclude that the notional company under Ofgem's financial framework and working assumptions is debt financeable, but we do not believe it represents an adequate equity investor proposition. Being debt financeable is not sufficient to enable the ambitious, proactive and agile ESO that stakeholders want.

Further detail on the investor position and the importance of appropriate return is provided in Annex 5.

#### 9.4.2.1. Sensitivity analysis

We have considered the impact of changing circumstances on our plan, taking account of both equity and debt metrics, running sensitivities against the notional company under Ofgem's working assumptions and assessing them against the quantitative criteria used earlier. A selection of results is presented in the figure below.[164] These are based on the RIIO-2 five-year average.[165]

In most of the sensitivities run, we can maintain a Moody's grid rating of A1/A2 on average across the five-year RIIO-2 period. However, if we consider the impact of differences in revenue collection in the form of a sustained under-recovery of £75 million per annum, we see the Moody's grid rating reduce to Baa1. We note that the notching approach taken by Moody's in our actual rating reflects the potential for such high levels of volatility, and also the importance of our WCF to help manage this risk while it resides in the ESO.

This scenario also highlights the challenge in providing a stable dividend to the equity holder due to the potential volatility of accounting profits as a result of timing issues. This may make it more difficult to attract equity investment and may increase the required cost of equity.

We understand that Ofgem is considering the transfer of all, or part, of our TNUoS revenue cash collection risk to other parties. This would reduce the risk of revenue timing impacts and would be expected to be credit positive, reducing the magnitude of rating agents' current assumption of implicit support from National Grid plc, but would still leave us with the role of collecting the revenues.

[163] Average presented is a simple (not weighted) average of annual metrics results

[164] The 'alignment to regulatory principles' and 'enables desired culture' criteria described in Annex 5 section A.6.1 are not affected by these sensitivities

[165] All results are presented as a simple average of metrics over the five-year RIIO-2 period

| Sensitivity | Base notional case | High interest rate | High inflation | Totex over-spend | Low RoRE | Sustained under-recovery | High gearing (60%) | High gearing & inflation | Ex post disallowance |
|---|---|---|---|---|---|---|---|---|---|
| Moody's grid rating | A1 | A2 | A2 | A2 | A2 | Baa1 | A2 | A2 | A2 |
| AICR | 2.8 | 2.3 | 2.0 | 1.2 | 2.2 | (5.0) | 2.3 | 1.6 | 1.5 |
| EBIT margin | 4.9% | 5.2% | 4.9% | 2.1% | 3.8% | (7.6)% | 4.4% | 4.3% | 2.7% |
| Dividend yield | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% | 3% |
| Dividend cover | 1.6x | 1.6x | 1.3x | 0.2x | 1.1x | (6.6)x | 1.5x | 1.0x | 0.5x |

*Figure 47: Notional company sensitivities around base case*

If we explore the scenario where totex expenditure exceeds allowances set on an ex ante basis by ten per cent, we see a Moody's grid rating of A2. However, underpinning this is a requirement for significant additional equity injection, increasing required injections to around £77 million to maintain gearing within notional tolerance, with this additional equity unable to extract a dividend return over the period due to the lack of cover. The negative impact of any spend over initial allowances shows that we are discouraged from investing additional opex (even if we discount the risk of disallowance), due to the impact on EBIT.

One of the metrics that shows the most movement between scenarios is AICR. AICR is used as a core metric in many regulated sectors rating methodologies. Although not explicitly part of the Utilities methodology applied to us, it is possible that given our RAV*WACC framework it will also be considered in any rating assessment. Figure 48 below[166] shows how AICR performs against economic, framework and performance sensitivities. We can see that, in some scenarios, AICR dips below our threshold level of 1.8x, suggesting a risk to debt financeability under some highly plausible scenarios, such as an ex post cost disallowance of two per cent.

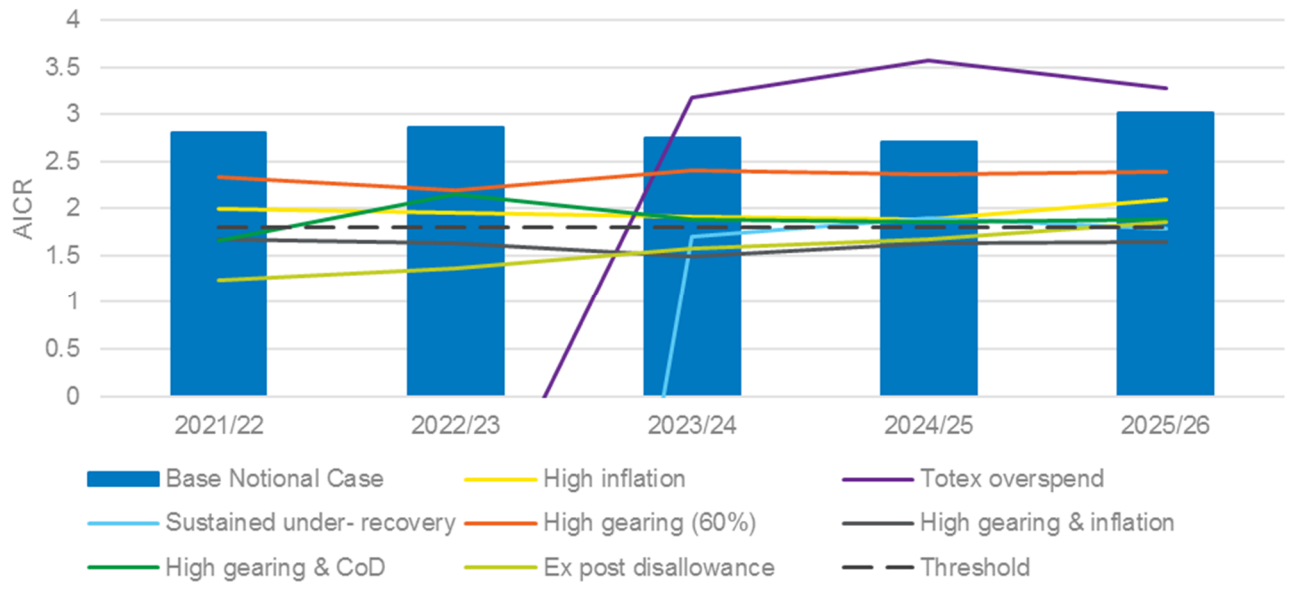



*Figure 48: Notional company AICR sensitivities*

[166] Graph depicts AICR per BPFM calculation. Scenarios displaying consistent results above threshold have not been displayed. The first two data points for totex overspend and sustained under-recovery scenarios are significantly below zero and have not been displayed for presentational purposes.

We have also considered the impact of a higher notional gearing level. An increase in notional gearing to 60 per cent appears to maintain a debt financeable position when considering credit metrics, but with reduced headroom. When stress-tested under different economic conditions, headroom falls away, suggesting that the organisation may not be financially robust enough under this parameter.

A notional gearing assumption of 60 per cent would mean one of the quantitative rating metrics being accepted as sub-investment grade.[167]

Further details of the notional company results are in Annex 5.

### 9.4.3. Making the notional ESO financeable

The first price control for the legally separate ESO must put in place a sustainable framework that encourages us to focus on the long-term, strategic issues facing the organisation and the industry, rather than one that leaves us waiting for decisions by Ofgem or beholden to a parent company for additional finance.

As explained in section 9.4.2, the baseline position is debt financeable without the need for additional measures, but does not offer an attractive equity proposition and puts the sustainability of the framework in doubt.

Ofgem set out potential levers in the ESOMDD consultation to improve financeability. We have assessed each of these against the criteria we set out earlier.

| Assessment criteria | Base case | No dividends | Capitalisation rates | Regulatory asset lives[168] | Additional remuneration[169] |
|---|---|---|---|---|---|
| Alignment to regulatory principles | | | | | |
| Behavioural driver | | | | | |
| Moody's grid rating | A1 | A1 | A1 | A1 | A1 |
| AICR | 2.8 | 2.9 | 2.8 | 3.0 | 6.8 |
| EBIT margin on controllable revenues | 4.9% | 5.0% | 5.0% | 5.5% | 10.3% |
| Dividend yield | 3% | 0% | 3% | 3% | 3% |
| Dividend Cover | 1.6x | n/a | 1.7x | 1.8x | 4.8[170]x |

*Figure 49: Notional company financeability lever assessment*

[167] Moody's Regulated Utilities Methodology sets general Baa threshold on debt/capitalisation at 59% within the low business risk grid
[168] All results are presented as a simple average of metrics over the five-year RIIO-2 period
[169] This scenario considers the impact of additional revenues required to achieve target EBIT margin levels
[170] The BPFM assumes fixed dividend yield to equity RAV and so assumes no distribution of the additional return achieved

- No dividend yield – moving away from the stable three per cent assumption in the modelling and removing the payment of any dividend has no significant effect on key metrics, although it does reduce the amount of equity injection required over the period from £43.3 million to £27.2 million. This option does not improve the equity proposition.
- Adjusted capitalisation rate – this is informed by our ratio of capex to totex. Across RIIO-2, that rate averages at 34 per cent but is reset biannually. Any reduction effectively pulls forward future revenues, with more spend reimbursed through fast money rather than deferred in the RAV as slow money. Although this change will improve cash-based metrics, it will not support an improvement to EBIT. Under Ofgem modelling conditions, in the notional company, fast money revenues are assumed to equal operating costs in the profit and loss statement, meaning that any benefit from the acceleration of revenue is offset by the presumption of cost. However, if we assume an accounting position, an average EBIT margin level of 10% could be achieved by reducing the capitalisation rate to 29 per cent. Although this option allows us to achieve our financeability thresholds, it does not solve the underlying equity proposition challenge or encourage the required culture.

  The option to adjust the capitalisation rate could be used to a small degree for short-term support, but is not a long-term solution and cannot be deployed to a significant extent without breaking alignment with regulatory principles.
- Reduced regulatory asset life – the shortening of regulatory asset lives would release slow money into revenue earlier and improve short-term, cash-based metrics. However, within the notional company equivalent, improvement is not seen in profit related metrics, as depreciation charges also move by a corresponding amount. We consider further the impact of changes to the regulatory asset lives in our assessment of the actual company om section 9.4.4 below.
- Additional remuneration – the inclusion of additional remuneration for the services we deliver and the risks we hold would improve financeability on a sustainable basis. The addition of at least £13 million of additional remuneration per annum would achieve the EBIT margin threshold, allow greater protection against downside risk impacts, and encourage us to be ambitious and innovative. A fuller review of this scenario is in Annex 5.

To summarise, many of the potential levers to support financeability are focused on enabling the acceleration of cash from future periods. This can improve certain metrics in the short-term, but they present a number of challenges:

- They ignore the principles of intergenerational fairness and approximating revenues over the lives of the assets in use.
- They do not provide a sustainable solution to a lack of appropriate return for activities and risks.
- They do not encourage the ambitious, proactive, forward-looking culture desired of the ESO, or remove the current disincentives.
- Rating agencies can look through this ‘excess cash’ to the underlying business dynamics and confer no rating benefit.

Of the options reviewed, we believe the only solution that creates the conditions to support the type of ESO that stakeholders want, and provides for a more sustainable ESO, is additional remuneration for our services and risks that are not fully funded.

### 9.4.4. Financeability assessment of the actual company

The financeability assessment of the actual company differs to that of the notional company in a number of ways. It seeks to consider the actual financing structure of the company and to reflect its actual accounting positions. We also include any cash flows recovered or incurred during RIIO-2 that are related to the RIIO-1 period.

We have assessed the actual company on the same basis as the notional company.

Two major items affect the results of our analysis.

- The inclusion of revenue timing adjustments, which bring additional revenues of around £75 million into RIIO-2 and demonstrate some of the volatility we can experience.
- A divergence between the accounting depreciation expense and the regulatory depreciation in revenues, driving a profit impact in RIIO-2 as depreciation expense outstrips regulatory depreciation.

| Assessment criteria | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 | Average |
|---|---|---|---|---|---|---|
| Alignment to regulatory principles | | | | | | |
| Behavioural driver | | | | | | |
| Moody's grid rating | A1 | A1 | A1 | A2 | A1 | A1 |
| AICR | 14.3 | 9.3 | 3.1 | 1.9 | 2.6 | 6.2 |
| EBIT margin on controllable revenues | 18.9% | 12.6% | 2.0% | 0.5% | 1.9% | 7.2% |
| Dividend yield | 20% | 15% | 5% | 5% | 5% | 5% |
| Dividend cover | 1.7x | 1.2x | (0.2)x | (0.7)x | (0.5)x | 0.3x |

*Figure 50: Actual company base case financeability assessment*

In the first two years of RIIO-2, we have assumed a higher dividend distribution, recognising the receipt of back-dated revenues from RIIO-1. These dividends have been calculated to maintain regulatory gearing levels close to notional levels, returning later in the plan to a five per cent yield assumption in line with equity investor expectation. This results in a forecast dividend yield in the actual company of ten per cent. No equity injections are assumed to be needed in the base case actual company as a result.

We consider the actual company base case to be debt financeable under Ofgem's working assumptions, supported by the additional revenues expected as a result of SOMOD[171] and other revenue timing items.

Equity financeability deteriorates significantly across the plan as the impact of RIIO-1 forecast revenue timing items unwind, leaving the actual company loss-making in the latter years of RIIO-2 and unable to satisfy investors through in-year profits.

Additional consideration of the actual company and its sensitivity to changes in economic factors, performance and capital structure are set out in Annex 5. These depict a declining profile over the plan as the benefit seen from increased revenues in the near-term from SOMOD and timing items unwind.

If we consider the potential levers to support financeability as set out earlier, we note a similar impact. Use of capitalisation and depreciation rates will bring revenues forward and, in the actual company, will also show an EBIT improvement due to recognition of accounting treatments. The capitalisation rate would need to reduce to 29 per cent on average to allow an EBIT margin of ten per cent, with the capitalisation rate reaching a low of 22 per cent in the final year of the plan. A reduction in regulatory asset lives to four years (from seven) would be needed to allow an EBIT margin of ten per cent on a sustainable basis, i.e. before the consideration of RIIO-1 revenues[172].

[171] SOMOD is the value of the incremental change from the ESO's Opening Base Revenue Allowance as derived in accordance with Ofgem's Annual Iteration Process

[172] This scenario assumes a longer-term change in the principle and therefore discounts the impact of RIIO-1 revenue timing items. Should the impact of RIIO-1 revenues be taken into consideration, the regulatory asset life would need to be reduced to five years to achieve the 10% threshold

| Assessment criteria | Base case | No dividends | Capitalisation rates | Regulatory asset lives[173] | Additional remuneration[174] |
|---|---|---|---|---|---|
| Alignment to regulatory principles | | | | | |
| Behavioural driver | | | | | |
| Moody's grid rating | A1 | A1 | A1 | A1 | A1 |
| AICR | 6.2 | 7.7 | 6.4 | 6.5 | 10.6 |
| EBIT margin on controllable revenues | 7.2% | 7.2% | 10.1% | 14.3% | 12.1% |
| Dividend yield | 10% | 0% | 10% | 10% | 10% |
| Dividend cover | 0.3x | n/a | 1.8x | 3.2x | 1.6x |

*Figure 51: Actual company financeability lever assessment*

The option to adjust the capitalisation rate could be used to a small degree for short-term support, but is not a long-term solution and should not be deployed to a significant extent.

As outlined earlier, using these levers goes against regulatory principles given the magnitude of adjustment required in either approach, as revenues are no longer being approximated over the lives of the assets in use.

Neither of these levers creates the incentives to encourage the ambitious, proactive, forward-looking culture desired of us, or to remove the current disincentives in place.

Again, the inclusion of additional remuneration is the only lever that allows the achievement of thresholds without compromising regulatory principles, while enabling the ambitious, proactive and agile ESO stakeholders are looking for.

## 9.5. Proposed alternative assumptions

As explained earlier, we have predominantly used Ofgem's working assumptions for the relevant financial parameters in the RAV*WACC model. Our rationale for a dividend assumption of five per cent and belief that the cost of debt index should include an allowance for transaction costs are covered in sections 9.4.1 and 9.3.1.

This is our first specific price control, and we and Ofgem need to agree a framework that enables us to be the ambitious, proactive and agile business we and our stakeholders want. We have a responsibility to agree a funding model, not just for RIIO-2, but one that is sustainable on a long-term basis and does not leave delivery of Business Plan objectives dependent on support from our parent company, or subject to a check with Ofgem that specific courses of action will be deemed efficient.

The proposed funding model could be applied in a way that:

- discourages inefficiency without encouraging a risk-averse culture
- encourages us to undertake new services and innovate for the benefit of industry participants
- encourages us to think long-term
- adequately remunerates investors for the risks they face

[173] This scenario assumes a longer-term change in the principle and therefore discounts the impact of RIIO-1 revenue timing times. Should the impact of RIIO-1 revenues be taken into consideration the regulatory asset life would need to be reduced to five years to achieve the 10% threshold.
[174] This scenario considers the impact of additional revenues required to achieve target EBIT margin levels

- rewards ambition and great performance.

As set out in section 9.1, we do not believe that a RAV-based model alone is sufficient for us. We are a legally separate, for-profit business; an asset-light, people and services business, unlike the network companies. We are also different to the majority of system operators who are not-for-profit, integrated with transmission businesses, or state-owned.

**An asset-light, services business should have a funding model that provides a cost pass through plus an appropriate margin to provide a return based on risk and a clear incentive regime which is focused towards increasing customer value.**
**Distribution Network Operator**

A RAV-based model provides a return to investors based on the value of the assets in the RAV. It does not provide remuneration for those risks or activities that do not rely on these assets, and does not provide sufficient reward in those areas to encourage us to take risks and innovate to deliver new benefits for consumers. We know stakeholders want us to do these things.

Economic literature refers to the Principal-Agent problem and the risk that the interests of the Agent (ESO) and Principal (stakeholders) may not be fully aligned. The key to mitigating this problem is to closely align those interests.

The current working assumptions encourage risk aversion. For example, faced with an option of investing to potentially further consumer interests through additional activities, we can only hope to recover our costs; yet we face a risk of cost disallowance. It is important that we are incentivised to be efficient, and the potential for cost disallowance achieves this, but there can be very little assurance that a regulator will agree that costs are efficient and only disallow costs in exceptional circumstances. This disallowance risk is exacerbated because a significant proportion of our spend in RIIO-2 will be linked to innovative, bespoke IT investment. Furthermore, the risk is higher for us than for network companies precisely because costs are not subject to a sharing mechanism. There is an inevitable tension between the risk of disallowance being real enough to drive efficiency, and so great as to drive a risk-averse culture. Equally, this risk is asymmetric and so not covered by CAPM.

Secondly, there is no reward for performing additional activities, or remuneration for any additional risks they may introduce to the business should the RAV not increase as a result. Our best outcome is cost recovery. While disallowance drives risk aversion, a lack of motivation to perform additional activity has an opportunity cost: it can cause a failure to take decisions that may benefit stakeholders.

While it is true that an incentive scheme theoretically offers the potential for reward, the fact that it is an ex post evaluative scheme makes any reward unpredictable and, based on recent experience, unreliable.

Ofgem has made provision within our framework for additional remuneration as well as the RAV*WACC model. If calibrated appropriately, this can address these issues and better align our interests with those of our stakeholders:

- It can provide return to compensate for risks and activities not adequately funded by the RAV*WACC model due, for example, to no or limited value in the RAV related to those activities.
- While it does not remove the risk of disallowance, additional remuneration (calibrated, for example, as a margin on controllable costs) can provide a return to compensate for the risk.
- This can also encourage the provision of existing and new activities through a margin on the costs incurred.

It is important to distinguish between additional remuneration and incentives. Additional remuneration is required to compensate for and mitigate the activities and risks not covered by the RAV*WACC model. It better aligns our interests with those of stakeholders. The incentive scheme challenges us to take appropriate actions to earn further revenue while protecting consumers against poor or inefficient performance.

#### 9.5.1.1. Putting a value on additional remuneration

We have explored alternative ways to consider what might be an appropriate level of additional remuneration, below. This is supported by independent expert reports from KPMG and Oxera. Further detail is in Annex 5.

In our engagement with external consultants and studies of relevant regulatory precedents, we can conclude that there is no consensus on one particular methodology. The CMA noted this in its decision in the SONI case.

**Some form of regulatory judgment is likely to be required – either in the choice of an approach from a range of possible valid approaches, or in the weighting given to a particular value from a range of potentially valid values for a given valid approach.**
**Competition and Markets Authority**

For this reason, we have considered a variety of different approaches to derive an appropriate range for the level of additional remuneration. Rather than concluding on a definitive value, these approaches

triangulate the range within which a value would sit. We anticipate continuing discussions with Ofgem to agree a suitable position in time for draft determinations in summer 2020.

Our triangulation considers regulatory precedent, capital and risk approaches, and the use of margin benchmarks as illustrated below.

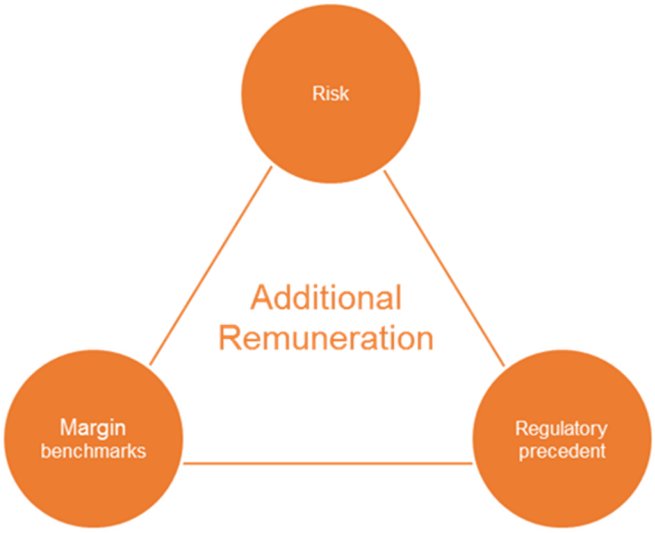



*Figure 52:* points of triangulation for assessing additional revenue requirements

#### 9.5.1.2. Regulatory precedent

The most relevant regulatory precedent can be found in the SONI / CMA determination. In this case, SONI had argued that:

- a RAV*WACC approach alone was not suitable for an asset-light business such as SONI
- the Utility Regulator (UR) had failed to properly remunerate SONI for all the layers of capital invested in its activities, both actual and committed
- the UR had failed to take account of the non-systematic and asymmetric risks SONI faced when using CAPM to set its cost of capital.

The CMA sought to remedy SONI on each of these grounds, which are all comparable to the limitations of the RAV*WACC model currently proposed for us. The outcome of these remedies was:

- A fixed annual amount to recognise the asymmetric risk associated with SONI's expenditure. This was based on a three per cent uplift to costs subject to disallowance risk.
- An annual amount equivalent to 0.5 per cent of revenues to recognise revenue collection risks.
- A 1.75 per cent return on the parent company guarantee to remunerate the contingent capital supporting SONI's credit facility.

Applying these parameters from the SONI case to our business plan would imply an additional return of £34 million per annum[175]. While the scale of our operations may be several times larger than SONI's, we believe these principles are relevant. For this reason, we have refined these parameters and applied the principles when developing our approaches to assessing remuneration.

We understand that Ofgem also intends to draw on precedent in the recent CMA energy market investigation. When assessing returns for energy retailers, the CMA recognised the need to consider distinct risks that did not correlate to the size of the businesses' asset base. The CMA acknowledged that when considering profitability on the basis of ROCE,[176] some capital may not be reflected on the balance sheet, but where appropriate would still need to be taken into account. The CMA took that investigation into account in its final determination for SONI.

#### 9.5.1.3. Risk

A second category of approaches considers identifiable risks not currently captured by the RAV*WACC model; for example, within activities where there is no RAV on which a return is earned. Ofgem has set out a three-step process to analyse seven different ESO risk categories and assess whether additional remuneration is necessary.

We have used two risk-based approaches to estimate the level of additional remuneration:

1. Our October Business Plan submission included a first attempt to provide a quantitative analysis of additional remuneration. We commissioned independent analysis from KPMG, which identified the underlying drivers and consequences of our risks, and quantified a plausible range of downsides. This assessment indicated that our total capital requirement is in the range of £955-1,060 million. The largest part of the capital employed above the RAV relates to working capital requirements, with the remainder being risk capital for other potential losses under the framework. KPMG provided an illustrative cost of remunerating the capital employed based on overall company WACC. It suggested that we could expect an overall return of between £55-61 million. This indicates a funding gap of £36-£39 million.

   Of the approximately £1 billion capital requirement, KPMG estimates the risk capital to be £285 million.[177] As a cross-check, this is less than the £330 million equity capital invested in us when we were legally separated from NGET.

2. For our second risk-based approach, we have continued to work alongside KPMG to further develop our risk analysis, using CAPM. CAPM is based on a return to compensate for non-diversifiable or systematic risk. The report considers the relative concentration of systematic risk compared to the network companies, and explains why we are subject to higher levels of systematic

[175] KPMG report (December 2019) 'Remuneration requirement & financeability' is included as Appendix C to Annex 5 of this Business Plan

[176] Return on capital employed

[177] KPMG report (December 2019)

risk under conditions where the regulator is very disciplined (i.e. cost disallowances are unlikely) and the regime is unambitious. A more ambitious regime introduces greater systematic risk, driving a requirement for higher levels of additional remuneration. The advantage of this approach is that it relates the additional remuneration to the factors driving a potential risk of loss, and puts a value on creating a more ambitious framework. The KPMG analysis indicates that in a less ambitious framework additional returns could be around £20 million. However, in the ambitious regulatory regime that our customers and stakeholders want us to deliver, the additional remuneration could be in the range of £30-35 million.

#### 9.5.1.4. Margin benchmarks

Margin benchmarks are relevant because they demonstrate the returns that are typically expected in competitive industries performing similar activities or subject to similar risks. Competitive pressures are acknowledged to reduce margins, so benchmarks are an efficient outcome. The presence of margins in competitive markets reflects at least two things:

- investors require a return for the risks they face
- companies that do not earn positive returns for performing activities and services are not sustainable in the long run.

We have used two approaches in our review of margin benchmarks.

1. Our October draft Business Plan assessed the benchmark returns for each of the three roles we undertake.
    - For the industry revenue management role, we used an independent report from Oxera, which estimates an appropriate margin on external costs by drawing on two pieces of analysis: a benchmark analysis against comparator companies that undertake financial intermediation activities; and regulatory precedents, more specifically the regulatory parameters following the SONI / CMA determination, the relevant price control parameters for EirGrid, and the final determination for SEMO.[178] In its determination of additional revenue in the SONI case, the CMA noted that "the value of revenue cannot be precisely determined but should not be zero". Oxera suggested a margin on external revenues of 35 basis points (0.35 per cent).
    - For the market and industry services role, we used KPMG's benchmark analysis of 72 comparator companies in the professional and commercial services industry, as set out in its report published alongside our July consultation response.[179] This indicated an EBIT margin of 11 per cent.
    - For the operating and balancing role, we used KPMG's benchmark margin, based on the London Stock Exchange forecast operating margin adjusted to remove our RAV return. This suggested a comparable operating margin of 13.9 per cent.
    - While we have used relevant comparators, we have used our judgement across these methods to suggest reasonable returns. For example, for the revenue management role, SONI has a 0.5 per cent margin on external costs. While SONI is our closest comparator, it is not perfect, so we cross-checked with private sector benchmarks. These indicated a range, within which we have proposed a reduced position of 0.35 per cent.

If we apply the above assumptions, this suggests a funding gap compared to the RAV*WACC funding model of £32-36 million.

2. We considered a range of overall EBIT margins, drawing these from the following sources:
    - Moody's minimum required EBIT margin to achieve an investment grade credit rating for similar asset-light companies, based on its rating methodologies, would be in the range of 10-15 per cent.
    - In the UK, some regulated companies have had allowed revenues set with reference to allowed profit margins. Like us, these companies are typically asset-light, and a margin-based approach has been used to determine appropriate levels of return. In this case we reference Ofgem's determination for Smart Data Communications Company (DCC), where allowed margins were 12 per cent.
    - KPMG's analysis is based on two comparable sectors: industrial and commercial services and software and IT services. These were chosen as they have similar financial and business characteristics to us. Analysis suggests that the market benchmark range would be 10-13 per cent.

If we consider a range of overall company EBIT margins based on all the above sources, the margin range would be 10-15 per cent. This would suggest the minimum viable margin is £13 million, with the high end of the range being £26 million.

[178] SEMO – Single Electricity Market Operator, which operates a single wholesale market for Ireland and Northern Ireland.

[179] https://www.nationalgrideso.com/document/147601/download

#### 9.5.1.5. Conclusion

Our approach to quantifying an appropriate level of additional remuneration uses three key points of triangulation and looks at different approaches in each of these points. The ranges of possible outcomes are shown in the figure below.

| Point of triangulation | Method | Range (£m) per annum | |
|---|---|---|---|
| Regulatory precedent | Applying SONI principles | 34 | 34 |
| Risk | Return on risk capital | 36 | 39 |
| | Risk framework (CAPM) | 20 | 35 |
| Margin benchmarks | Benchmarked margins by role | 32 | 36 |
| | Overall 10-15 per cent EBIT margin | 13 | 26 |

*Figure 53: Additional remuneration approaches*

Our analysis highlights a broad range of outcomes. Deciding on a suitable level of additional remuneration may be a matter of judgement, but we consider in principle that it should not be zero. The minimum level to support a financeable proposition would be at least £13 million per annum, but evidence suggests it could be as high as £39 million.

A margin on controllable totex could provide remuneration for the asymmetric risks of potential cost disallowance and help to encourage innovation and additional activities for the benefit of consumers. While it could be argued that this ex ante approach does not, in itself, avoid risk aversion, the fact that allowances are reset every two years would do so, as we would know that additional enduring value-adding activities would be covered by a margin in subsequent allowance determinations.

Separately, margins could be applied to the different revenue streams to reflect the revenue management role. A uniform rate could be applied to give a simple, transparent approach, or different rates could be applied to each revenue stream to reflect the relative risks and activities involved. As with a margin on totex, we propose a fixed financial amount calibrated on a biannual basis.

In both cases, allowances could be set ex ante to remove any suggestion that we are incentivised to increase costs or revenues purely to increase the remuneration provided.

Consideration must be given to creating the right balance between risk and remuneration. A regulatory framework that encourages us to take measured risks will drive the ambitious culture needed to unlock greater benefits for consumers.

## 9.6. Our impact on consumer bills

Our price control framework splits our expenditure (totex) between what is paid for by consumers over time (slow money), and what is paid for immediately (fast money), as well as how and when allowances for tax, return and other costs may be recovered from consumers.

Below, we set out our estimated total internal expenditure across the RIIO-2 period and associated internal revenue using Ofgem's proposed parameters.

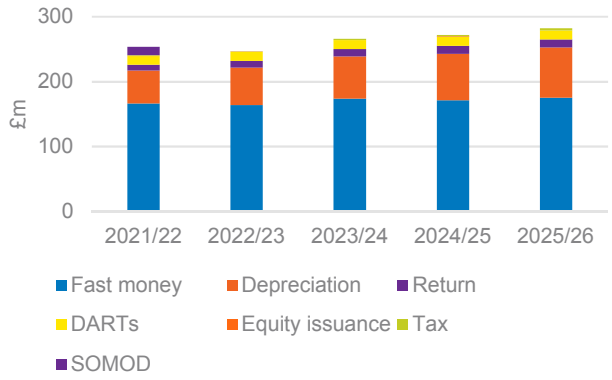



*Figure 54: ESO controllable revenues in 2018/19 prices*

We have used a simple top-down approach, aligned with the methodology used by Ofgem,[180] to calculate our impact on the average household bill. This follows a four-step process:

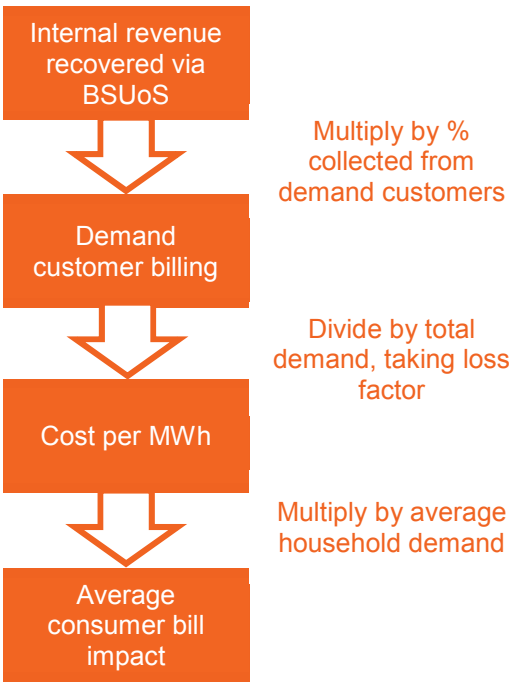



*Figure 55 – Process to calculate impact on bills*

[180] Understand your gas and electricity bills (Ofgem 2019) available at https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits and www.ofgem.gov.uk/consumers/household-gas-and-electricity-guide/understand-your-gas-and-electricity-bills

All our internal costs collected via BSUoS charges are included in our assessment of the consumer bill. Of this, 50 per cent is assumed to be recovered from demand customers in line with current billing protocols, with these revenue levels allocated across total demand to provide a cost per MWh. Both total system demand and average household demand are assumed constant across the RIIO-2 period. The average household demand of 3,100 KWh has been used in line with Ofgem's latest data. This is under consultation to reduce to 2,900 KWh, which would reduce the impact on consumer bills.

We estimate that the average Great British household will pay £1.80 per year on average for our services during the first two years of RIIO-2 (2018/19 prices) under Ofgem's working assumptions. This equates to around 0.3 per cent of the total electricity bill of £612 and less than 0.2 per cent of the dual fuel bill.

We want our framework to encourage us to take appropriate risks on behalf of industry and consumers: to be ambitious, innovative and facilitate the transition to a zero carbon energy system. The addition of 11p to 28p on consumer bills to cover the range of additional remuneration we have identified supports these aims, creating an environment which helps unlock these wider benefits. This would increase the consumer bill to £1.91-£2.08.

Although our contribution to the average bill increases across the RIIO-2 period, feedback from stakeholders indicates general support to increase our costs to achieve better industry outcomes and support the challenging energy system transformation ahead.

**Ultimately, both the funding and incentives of the framework need to be designed coherently reflective of the asset-light nature of the business. We note that ESO internal operating costs are negligible in comparison to the benefits of the services provided to stakeholders and consumers.**
**Trade Association**

Efficiency is also important, and we want to get the balance right. As set out in chapter 3 – Assumptions underpinning our plan, each of the cost areas in our Business Plan has been tested for efficiency, either through cross-sector benchmarking, cost-benefit analysis or by applying an efficiency target. We are therefore confident that we will start RIIO-2 at the efficiency frontier. Several stakeholders recognise that, while our proportion of the average customer bill is increasing, it still represents a very small portion of the total and reflects the significant ambition they wish us to pursue:

**The ESO performs a crucial role within the energy system and its actions and expenditure influence much greater sums of industry costs. This means it is a far greater risk to consumers that the price control framework for the ESO does not provide adequate incentives to pursue initiatives that may realise value, compared to the ESO being overcompensated.**
**Generator**

## 9.7. Other financial policies

### 9.7.1. Pensions

Our Business Plan fully reflects Ofgem's pensions methodology, as set out in its consultation documents and in line with the RIIO-2 Sector Specific Methodology Decision Finance Annex.[181]

We are a participating employer of the National Grid Electricity Group of the Electricity Supply Pension Scheme (NGEG), which is a defined benefit scheme.

Ofgem will continue to review network operators' pensions scheme deficit costs triennially as part of the Pensions Deficit Allocation Methodology (PDAM), which runs parallel to (but outside of) the RIIO Price Control process. Our Business Plan reflects our best estimate based on the PDAM methodology and latest formal triennial valuation (March 2016) and known market movements.

| £m 2018/19 prices | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|
| Deficit costs | 11.7 | 11.7 | 11.7 | 11.8 | 11.8 |
| Incremental deficit costs | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Scheme admin and PPF levy | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 |
| Ongoing service | 8.9 | 8.8 | 9.1 | 8.8 | 8.4 |

*Figure 56: Employer contributions for pension schemes*

Incremental deficit costs that relate to pensionable service after 31 March 2012 are also recalculated triennially as part of the PDAM process. These incremental deficit costs are included in totex.

Pension scheme administration costs and Pension Protection Fund (PPF) levy costs have also been reflected in our Business Plan totex. Administration costs are essential to ensure effective management of the schemes and the protection of members.

[181] https://www.ofgem.gov.uk/publications-and-updates/riio-2-sector-specific-methodology-decision

Our defined benefit pensions scheme closed to new members in 2006. Contribution rates for future service accruals are expected to increase from today's levels due to the aging of active members and future forecast market conditions. However, the number of contributing employees is expected to decline, offsetting this increase.

| | 2021/22 | 2022/23 | Rate reset 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|
| [redacted] | | | | | |
| YouPlan | 13.7% | 13.7% | 13.8% | 13.8% | 13.8% |

*Figure 57: Annual employer contribution rates*

Further detail and explanation of pension costs can be found in Annex 5.

## 9.7.2. Corporation tax

Ofgem continues to consider potential alternative mechanisms for tax allowances for RIIO-2. Its BPFM calculates tax allowances based on the estimated tax costs of a notional, efficient company, consistent with RIIO-1, so we have prepared our Business Plan on that basis.

While we understand that policy decisions have not yet been made over the RIIO-2 treatment of tax allowances, we anticipate the retention of the tax trigger mechanisms in RIIO-1 to adjust allowances for changes in the prevailing rate of tax and other major changes impacting tax liabilities, to ensure that both consumers and we are protected from changes outside of our control. The Ofgem BPFM for us does not currently contain this functionality. Removing these protections could have a significant impact on our tax performance in RIIO-2, with the risk disproportionately sitting with us, given the current rate of corporation tax and the uncertain political environment. We therefore suggest that the tax trigger mechanisms included in RIIO-1 are retained in RIIO-2.

We can show high levels of profit volatility – partly driven by our industry revenue management role – with these timing differences flowing through accounting revenues. This could see actual tax charges varying significantly in line with these timing differences.

Ofgem is considering three options for the calculation of a tax allowance as a proxy for efficient corporation tax costs. One is the double-lock. We do not believe this is appropriate for us due to the potential volatility in taxable profit as highlighted above; it would leave us inappropriately underfunded for tax.

Ofgem is seeking greater company disclosure on tax matters. The National Grid group is considering the tax disclosures in its published accounts in light of external benchmarks on tax disclosures such as the Fair Tax Mark. The group currently goes beyond the statutory required level of UK tax disclosures; however, the group is evaluating whether it can make further improvements to its tax disclosures and the relative merits of obtaining approval of such disclosures from a third party.

## 9.7.3. Other finance items

Other finance items are covered in Annex 5 to this Business Plan, including non-totex pass-through costs, treatment of our property RAV transfer and real price effects.

# 10. Technology underpinning our ambition

## 10.1. Introduction

In this chapter, we set out why technology is inseparable from our ambition and how our information technology (IT) strategy is deeply embedded within our organisational strategy.

We show our vision for IT and how our technology will need to change to support our ambition and the wider energy transition. We describe how we are evolving our capability as an innovative, service-delivery organisation underpinned by technology. We set out our investment proposals and how they have been tested with delivery and benchmarking organisations.

As a technology and service-delivery company at the heart of the energy industry, we invest in, and maintain, critical IT infrastructure for Great Britain's economy. We continue to innovate to anticipate and respond to new demands on technology as decarbonisation, decentralisation and digitalisation drive significant change across the energy sector.

Our core architecture and systems provide security-ringfenced, highly available and reliable services that support system operation and competitive open markets. Critical National Infrastructure (CNI) systems provide dual-redundant (multiple backups), high-availability services across multiple data centres and control rooms, with contingency solutions to make sure the lights stay on around the clock. These systems analyse millions of data points a day across Great Britain's transmission system. For example, we process 20,000 transmission network data points each second to inform our Balancing Mechanism system activities.

Our technologies support registration, forecasting and modelling capabilities to schedule supply, hours ahead of real time. This enables our real-time systems to dynamically meet demand, on a second by second basis, by instructing balancing services to increase or decrease power through our highly resilient, Black Start-compliant communication networks. Post-event services provide market transparency, settlements and regulatory reporting to stakeholders across Great Britain and continental Europe.

The changing energy landscape is transforming how consumers and other parties interact. Technologies such as machine learning and artificial intelligence (AI) will unlock the rich insight that is inherent in our data. Visualisation of the whole energy network, generation mix, weather events, and network constraints will create a real-time picture to inform decision-making and maximise transparency.

**ERSG supports our technology proposals.**

"ERSG has previously provided a great deal of challenge on the proposed IT strategy, particularly how the ESO creates a culture that can deliver such vast change, and how it brings the expertise it needs in-house in short timescales. A lot of work has been done with ERSG in this area and we feel it is much improved.

Clarification was provided on IT projects and resulting intellectual property, and that this would be owned by the ESO rather than at National Grid group level. ERSG feels it's important that the consumer benefits from the intellectual property that they pay for."

With the energy transformation comes greater system complexity, vast growth in the volume of data, and an expectation from external stakeholders for our data and insights to be shared. Cyber threats associated with the energy sector have been growing in terms of their sophistication and frequency. The threat of an attack on critical infrastructure is becoming an ever-increasing reality.

### 10.1.1. IT as a shared service

IT is a service provided across all National Grid group companies. The ESO leadership team owns the ESO IT strategy and investment plan, and ESO-specific IT investment is delivered by IT resources who are dedicated to ESO projects. General business IT projects, such as infrastructure or cyber security projects, are delivered by a central IT function.

Of our proposed £257 million average annual investment in RIIO-2, £159 million will be spent on shared IT. £78 million represents our spending on ESO-specific IT investments, with a further £33 million being invested in shared IT infrastructure and cyber security and £48 million on IT running costs.

This chapter can be read in conjunction with Annex 4 – Technology investment report, where we detail the investment lines, as well as shared investments made by National Grid group IT. Annex 8 – Shared services provides detailed information on the methodology used to allocate IT costs to the ESO.

## 10.2. Vision for our IT

Our technologies must enable a market where anyone can participate, regardless of their generation type or the maturity of their in-house systems and technical capability. We will advance our use and integration of technologies to enable the running of a carbon free network. And we will support access for an even wider range of generation, demand and service providers. We must do all of this while ensuring safe, reliable system operation and managing our risks appropriately.

Through our IS Change Forum, we received feedback that a greater level of technological integration is required. This echoes our ambition to use proven technologies and methodologies to transform traditional models of doing business within the energy sector.

Utilities are in the early stages of digitalisation (see figure 58: The progression of digital maturity). Leaders are moving to achieve increased back-office automation, data-driven decision making and increased customer insights through analysis of customer journeys. Digital will become foundational to participation in the marketplace and is likely to open many further opportunities across our value chain.

**National Grid ESO's processes and systems were designed for human-speed, but these both need to mature to match the speed of new energy technologies.**
**Andy Hadland, Chief Development Officer, Arenko Group**

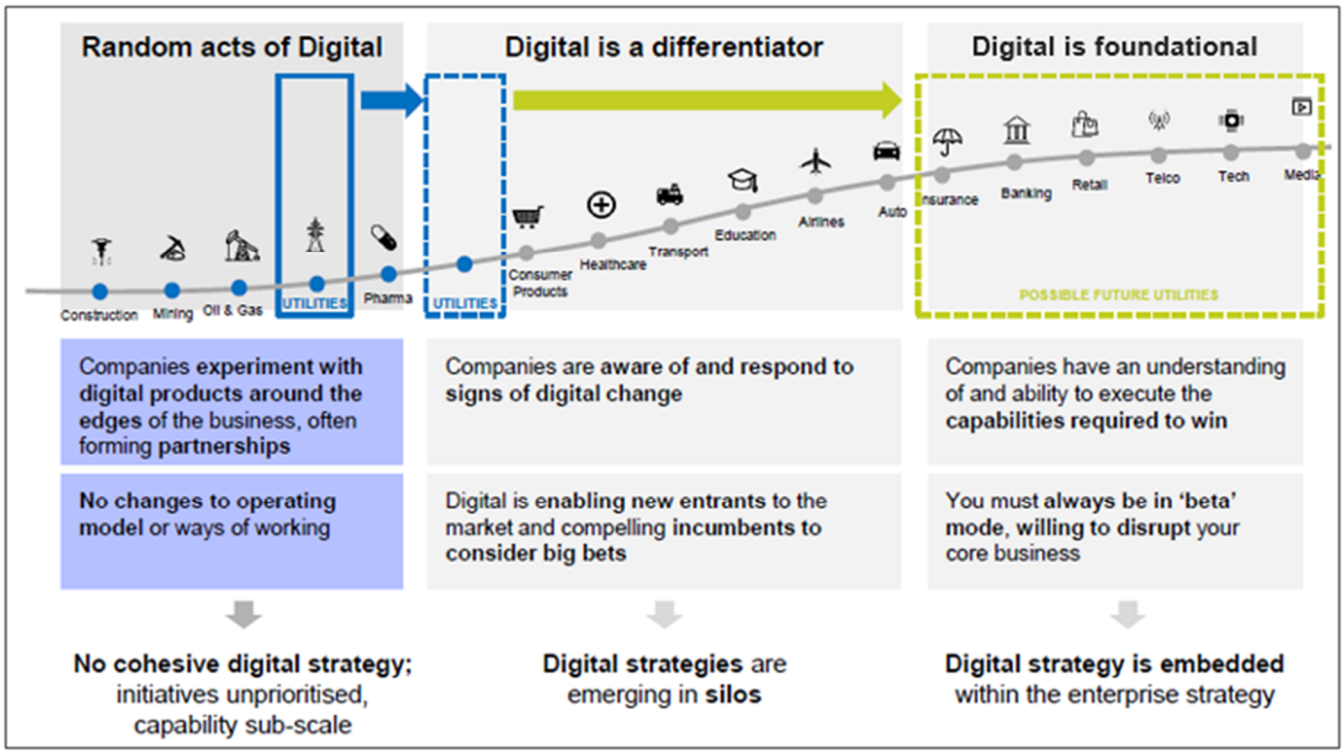



*Figure 58: The progression of digital maturity*

To achieve our digital ambitions, we need to think beyond the application of technology and consider our culture and ways of working. Capturing meaningful value from digital is more than just the application of digital tools as shown in figure 59: The enablers that will make our digital approach successful.

| Enabler | Why this is important |
|---|---|
|  Technical design | • Business capabilities are often underpinned by high-quality, easily-accessible data, and efficient core IT platforms.<br>• A critical focus is to invest in data (consistency, accuracy, and timely access) where it is a pre-requisite to success. |
|  Operating model | • We are targeting efficient delivery of our ambitions by concentrating capability into delivery centres.<br>• These serve to bring the right capabilities together with a common purpose to deliver at pace. |
|  Governance | • Our new governance model will see us move from disconnected digital solutions to strict prioritisation of digital applications that hold a clear value case.<br>• Combined with iterative delivery methodologies, we will see value released incrementally in line with stakeholder priorities. |
|  People capability and culture | • It is critical for us to build the right technical skills and bring them together with business expertise in dedicated delivery teams.<br>• This will become a core capability over time and we need to start advancing our capability now.<br>• Culture is typically the biggest challenge to successful digital transformation and we are supporting and promoting leaders in the organisation who are change drivers.<br>• This is explored further in chapter 14 – People, culture and capability. |

*Figure 59: The enablers that will make our digital approach successful*

# 10.3. Technical design underpinning our ambition

In this section, we show how we will bring together applications as components of a modular, platform-based architecture. This architecture allows us to invest in building blocks, such as a data platform that can be re-used and extended to meet the use cases of each ambition.

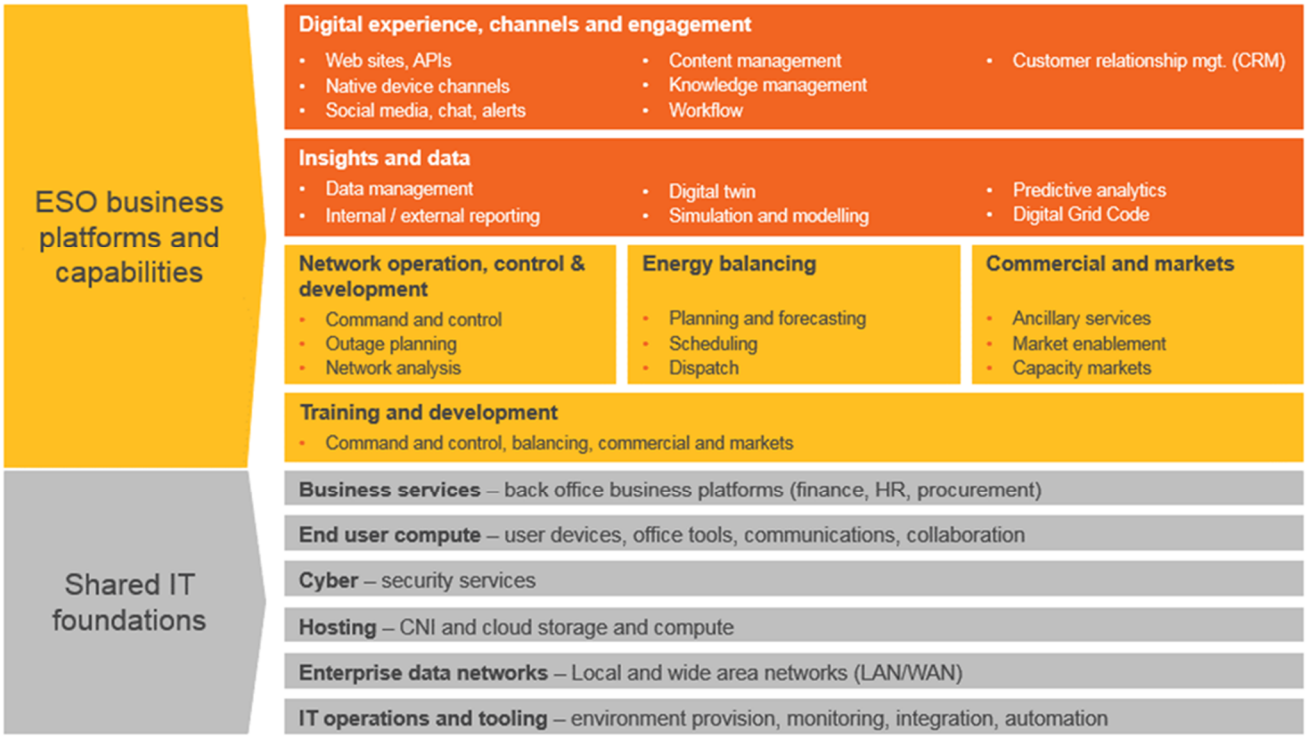



*Figure 60: Our target landscape*

## 10.3.1. Our target landscape

We have developed our existing application landscape over time to ensure the safe, reliable operation of a traditional generation and demand model for electricity. This involved the adoption of proven information technology to enable the management and operation of the electricity system.

As changing demands on the generation landscape accelerated, additional application solutions were implemented, IT solution packages extended, and greater analytic capability introduced. These capabilities have allowed us to continue to operate the system. However, the drivers for change across the wider energy and electricity landscape developed at different rates. Without an agreed, wider strategic vision, this led to the creation of capability and data in silos. These solutions are effective and addressed internal and external needs. However, looking ahead, it is important to ensure a more holistic approach

If we continue to evolve our IT solutions in the same way, it means our costs and delivery timescales will increase significantly as the complexity and maintenance of siloed solutions grows. Innovative IT technology, new service and consumption models, and changing business markets, create an opportunity to transform the IT landscape. We will move from specific applications for each capability, to a platform-based architecture that can support multiple capabilities, making maximum use of their efficiencies.

As an example, across our IT landscape there are multiple applications for modelling different generation types and further applications for analysis and reporting. They use different datasets across the business process, which can be consolidated onto common platforms using a consistent source of data.

## 10.3.2. Platform architecture

Our approach will be to consolidate these multiple applications and capabilities onto standard platforms. Creating these platforms will lay the foundations that move us away from interdependent systems and enable consistent adoption of digital initiatives (see figure 60 Our target landscape)

A platform approach will change the building blocks of our architecture, and also change the methods in which we implement change. This will make us more agile and flexible in adapting to market changes. We will introduce multiple platforms, including a digital engagement platform, insights and data platform, integration platform, and engineering services platform (including network operation, control and development; energy balancing; and commercial and markets).

Within our platforms, we will embed modelling and simulation using digital twin and artificial intelligence technologies. The platforms will be designed to grow in line with customer priorities. We will use cloud computing and on-premise[182] services to achieve this.

Digital twin technology is defined in Theme 1 as: Offline replicas of our digital control centre IT estate with live data feeds that we can use to simulate both markets and the operation of the Great Britain transmission system. It can be used as a testing and/or pre-production environment to validate the benefits and impacts of changes to the market and physical network. It will use AI to run multiple, complex scenarios in a real-time training and simulation environment.

In parallel to transitioning to the future platforms, we must continue to provide at least the same level of service as today. This includes lifecycle upgrades and feature enhancement for near-term requirements.

Our first step will be to develop platform designs and a delivery plan. The designs will support bespoke in-house and standardised off-the-shelf solutions. To support growth, we will design, build and deploy standard components that can be combined to create flexible solutions that deliver change by reconfiguration.

Future market demand, changes in the codes used to govern and operate the markets, and an expectation of greater flexibility in solutions present an opportunity for a holistic approach to the delivery of market systems.

Our approach to delivery will be underpinned by platforms that enable modelling of problems and simulation of operation. We conducted market analysis of similar problem solving, for example visiting a Formula 1 racing manufacturer, to further develop this approach. This forms the use cases for digital technology proposed in Theme 1. The outputs will be used to build, deploy and operate future capabilities on our newly formed platforms.

The delivery of business capability through a platform-aligned architecture (see figure 61 The platform architecture) provides benefits over our current IT landscape. It creates opportunities for operational cost reductions (licence, skills scope, infrastructure); development and delivery improvement (reuse, simplified integration, testing efficiencies); and strategic business alignment and enterprise capability reuse (cloud platforms, enterprise customer platforms, business support services). This approach enables us to deliver customer priorities more efficiently.

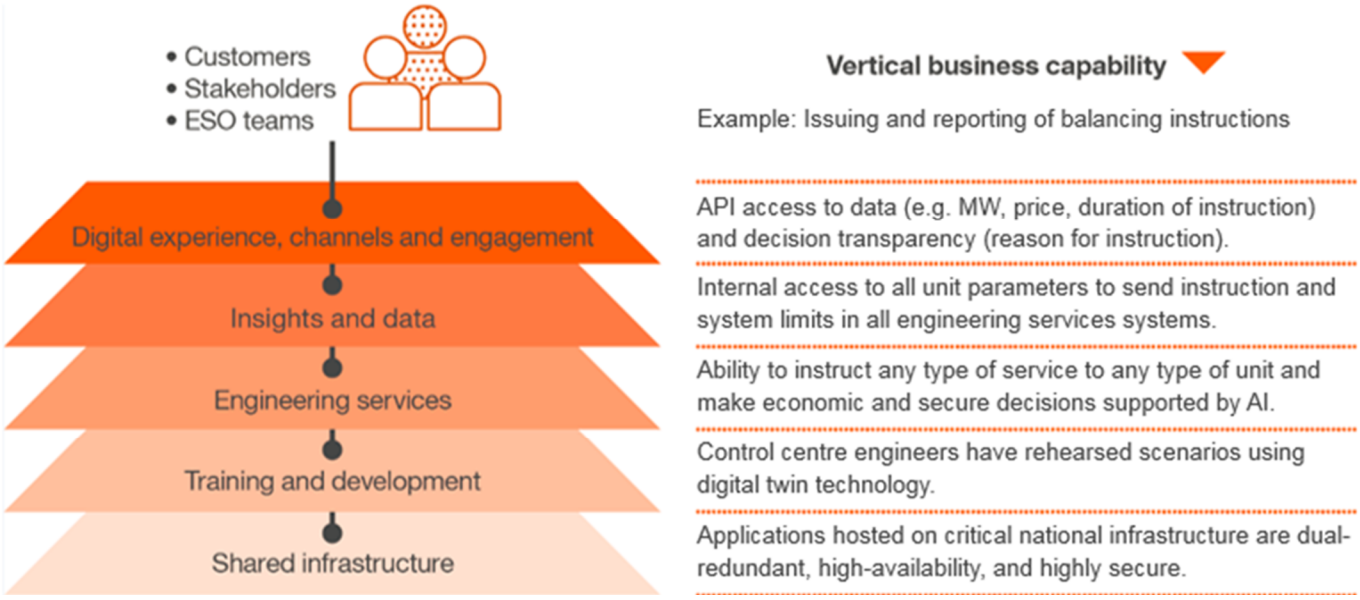



*Figure 61: The platform architecture*

[182] On-premise are in-house platforms, solutions and systems to support CNI.

# 10.4. Total IT investment to deliver our Business Plan

This section provides transparency of all IT investments. The IT investments proposed in this Business Plan have been developed as part of a five-year roadmap. Many of the investments run beyond the two-year business planning cycle. The five-year roadmap proposals and cost tables show how some investments starting in 2021 assume an ongoing commitment into years 2023 and beyond.

IT investment is comprised of three components:

- ESO-specific investments that directly support the outputs in this plan. These include both capex and opex expenditure.
- Shared investments in cyber security, IT infrastructure, and business services, made by National Grid group IT on behalf of the ESO, and allocated based on the universal cost allocation methodology (UCAM). These include both capex and opex expenditure. For more details on the UCAM, see section 10.5 and Annex 8 – Shared services.
- IT running costs. These are opex investments to provide operational IT services for the ESO. This number also includes the increases to the base value following investment in technology change These are allocated based on the UCAM.

More detail about the individual investments can be found in Annex 4 – Technology investment report.

Annex 1 – Supporting information, table 4, shows IT investments split by ESO-specific and shared, and by transformational and ongoing.

## 10.4.1. IT totex investment

This table shows the ESO total IT investment (capex and opex, both ESO-specific and ESO share of group) over the two-year business planning cycle and five-year RIIO-2 period.

Section 10.7 - RIIO-2 investment benchmarking outlines how we have tested these costs for efficiency. There is more information later in this chapter on the specific IT cost benchmarking we have undertaken.

| £million | RIIO-1 | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 | Total |
|---|---|---|---|---|---|---|---|
| **ESO-specific investm'ts** | | 76.5 | 80.3 | 92.4 | 82.4 | 75.8 | 407.3 |
| **Shared investm'ts** | | 40.1 | 25.9 | 20.8 | 20.4 | 18.5 | 125.5 |
| **IT running costs** | | 47.1 | 49.6 | 53.7 | 59.6 | 64.2 | 274.2 |
| **Total** | 96.5 | 163.6 | 155.7 | 166.9 | 162.3 | 158.4 | 807.0 |
| **2-yr/5-yr total** | | | 319.3 | | | | 807.0 |

Note: the table does not include £2 million IT capex that is delivered directly by the ESO. These costs are included in Annex 1 – Supporting information table 4.

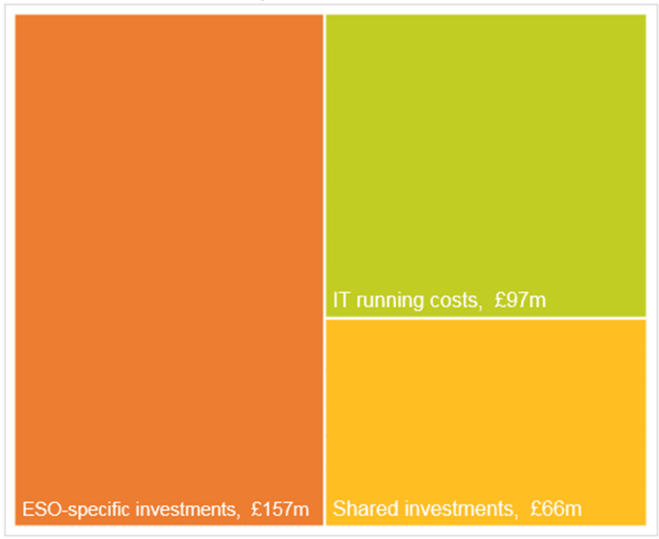



*Figure 62: £319.3 million IT totex investment for first two years of RIIO-2 (18/19 pricing)*

The Head of IT for the ESO is accountable for the delivery of technology change and services affecting the ESO. This role is a member of the ESO leadership team (as well as the UK IT leadership team) and exists directly in support of the ESO.

The ESO specific investments will be delivered by a dedicated team supporting the Head of IT for the ESO. This team has responsibility to define and deliver change on behalf of the ESO and will engage with the wider National Grid group IT function to support this activity (see Our IT operating model below and chapter 14. People, culture and capability, section 14.3.3. Dedicated IT resources within a shared service model).

Shared investments will be delivered by our National Grid Group plc IT function on behalf of the ESO and the wider group. Such investment is delivered in collaboration with the ESO IT team – with all shared projects being reviewed and approved at the ESO Investment Committee to ensure a holistic view across the full IT delivery portfolio.

### 10.4.2. IT capex investment

This table shows the IT capex investment over the two-year business planning cycle and five-year RIIO-2 period. It relates to investment in technology change that can be capitalised (e.g. development, testing and hardware).

| £ million | RIIO-1 | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 | Total |
|---|---|---|---|---|---|---|---|
| **ESO-specific investments** | 41.3 | 57.9 | 64.5 | 75.3 | 68.3 | 61.3 | 327.3 |
| **Shared investments** | 15.4 | 34.3 | 19.5 | 16.0 | 15.4 | 13.4 | 98.4 |
| **IT running costs** | - | - | - | - | - | - | - |
| **Total** | | 92.1 | 84.0 | 91.3 | 83.7 | 74.7 | 425.7 |
| **2-yr/5-yr total** | 56.7 | | 176.1 | | | | 425.7 |

### 10.4.3. IT opex investment

This table shows the IT opex investment over the two-year business planning cycle and five-year RIIO-2 period. This investment relates to investment in technology change that cannot be capitalised (e.g. scoping, training and subscription licensing). Additionally, it includes the day-to-day, ongoing operational costs (e.g. support and maintenance).

| £m | RIIO-1 | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 | Total |
|---|---|---|---|---|---|---|---|
| **ESO-specific investments** | | 18.6 | 15.8 | 17.1 | 14.1 | 14.5 | 80.0 |
| **Shared investments** | | 5.8 | 6.4 | 4.8 | 5.0 | 5.1 | 27.1 |
| **IT running costs** | | 47.1 | 49.6 | 53.7 | 59.6 | 64.2 | 274.2 |
| **Total** | 39.7 | 71.5 | 71.8 | 75.6 | 78.6 | 83.8 | 381.3 |
| **2-yr/5-yr total** | | | 143.3 | | | | 381.3 |

### 10.4.4. ESO-specific investment by theme (totex)

Table shows the total ESO-specific IT investment (transformational and ongoing) that underpins our ambition.

| £ million | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 | Total |
|---|---|---|---|---|---|---|
| **Theme 1** | 27.7 | 41.7 | 52.8 | 47.1 | 38.8 | 208.2 |
| **Theme 2** | 32.0 | 20.7 | 19.7 | 17.4 | 19.1 | 108.9 |
| **Theme 3** | 3.8 | 3.8 | 4.0 | 2.0 | 1.5 | 15.1 |
| **Theme 4** | 10.8 | 12.0 | 14.1 | 14.8 | 16.4 | 68.1 |
| **Open data** | 2.1 | 2.1 | 1.8 | 1.1 | - | 7.0 |
| **Total** | 76.5 | 80.3 | 92.4 | 82.4 | 75.8 | 407.3 |
| **2-yr/5-yr total** | | 156.7 | | | | 407.3 |

## 10.5. Shared investments supporting the ESO

Shared investments are made centrally within National Grid group IT. We engage National Grid group IT to deliver the underpinning IT environment that provides us with efficient, scalable, reliable IT services. This provides the economies of scale for procurement and unlocks access to global support providers.

IT investments are allocated to the ESO and the other entities within National Grid group using a process that reflects usage and the specific drivers of cost for that entity.

This share is based on the UCAM agreed with Ofgem and updated annually. Under this model, for example, end user-related costs are allocated based on headcount. Other allocation methods include taking a view of project activity as it relates to a specific organisation. For more details see chapter 12 – People, culture and capability and Annex 8 – Shared services. Assumptions for RIIO-2 are based on our forecast position at the end of 2020/21 based on the above allocation methodology, with incremental maintenance costs and efficiency assumptions then overlaid for the RIIO-2 period.

### 10.5.1. Cyber security

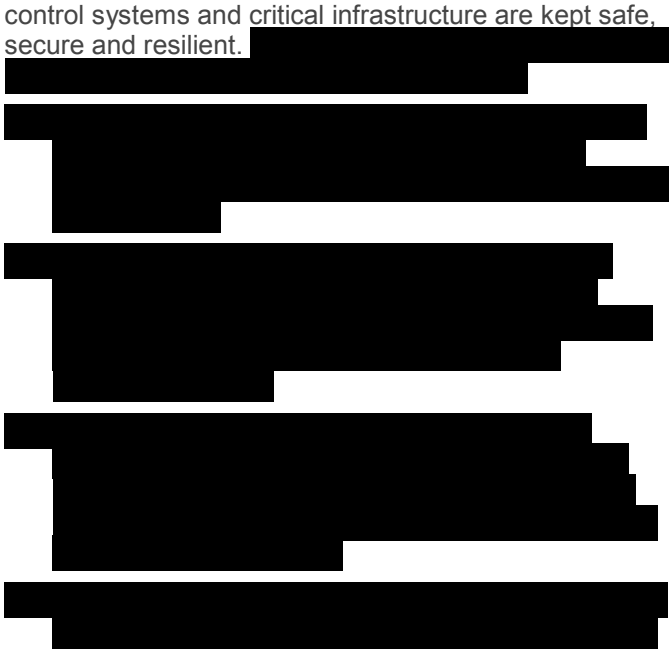
Due to the sensitivity of our cyber resilience plans, we detail our cyber investments in Annex 9 - Business IT security plan. The plan outlines our approach managing the external threat landscape, shows key risks impacting our continued safe operation, and summarises our preferred investment programme to secure our system environments. We are unable to share detail of the investments in this report and this section provides a summary of that proposal.

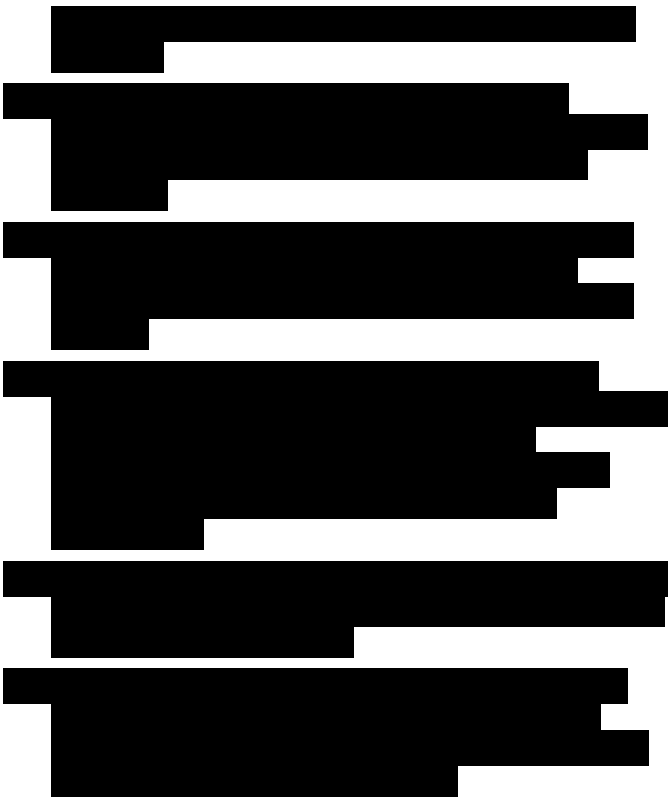
The cyber security threats faced in our CNI and ESO environments are becoming increasingly sophisticated and prevalent. New business activities, such as the planned expansion of the Great Britain energy market, reduction in entry level to the Balancing Mechanism and introduction of pan-European ancillary services, all significantly increase the cyber security threat.

As we introduce new technologies, our exposure to cyber-attacks expands through the increased connection to external systems. Previously, our energy networks operated primarily as a closed system, where any concern fell on internal devices, systems and infrastructure. This is now transforming into a decentralised and interconnected mesh of systems, devices and partners, which all play an integral role in the operation of the energy network across the industry. Our solutions and capabilities to tackle threats need to grow and adapt to handle this complexity.

These threats are particularly significant in the Control Centre. As an example, any disruption to communications between the Control Centre and generators, or a loss of visibility of the status of the network, could have a significant impact on the electricity system.

As these threats continue to evolve, it is vital that our control systems and critical infrastructure are kept safe, secure and resilient.





Investments to refresh legacy assets and infrastructure will be important in building a strong foundation for continued investments in new cyber-security capability. Such investments will be carried out with scalability and interoperability in mind. This will create a sustainable model for cyber security that aligns with business objectives and cyber-security goals during the price control period.

Our continued alignment with best practice and standards, as defined in the National Institute of Standards and Technology Cyber Security Framework (NIST CSF), allows us to identify and manage risk through a comprehensive range of security controls and measures. Ongoing engagement with UK National Cyber Security Centre (NCSC), Centre for the Protection of National Infrastructure (CPNI) and the Department for Business, Energy and Industrial Strategy (BEIS) will be central to the protection of our systems.

These capabilities will also be aligned with new regulations, such as the EU Directive on the security of network and information systems (NIS Directive[183]). We will continue to work with the NIS Competent Authority (comprising Ofgem and BEIS) to help shape our investment plans, identifying the most effective and efficient way to meet them.

### 10.5.2. Shared infrastructure

Shared infrastructure includes end user computing, hosting, enterprise data network, and IT operations and tooling.

IT infrastructure underpins the ESO business, delivering a safe, secure and reliable operating environment for

[183] https://ec.europa.eu/digital-single-market/en/network-and-information-security-nis-directive

our customers. It must be future proofed to support the rapid pace of change in the utility industry. National Grid group IT provides the delivery, management and maintenance of all shared IT infrastructure services. This ensures efficient delivery and value for money through the economies of scale that the group provides.

These technologies are the foundation for cyber security and are key to enabling our ongoing digital transformation, including improved quality and customer experience.

At the start of RIIO-1, we responded to the challenge to reassess our IT asset health policies by extending the technical life of our IT infrastructure, accepting higher levels of controlled risk while maintaining levels of availability.

By 2018/19 our employees fed back that IT was becoming a significant blocker to effectiveness, affecting the service, value, and quality levels given to our customers. Over the same period, the escalating threat of cyber-attack on our IT systems meant that we had to look again at how we managed our infrastructure so that we could proactively monitor and remediate cyber threats.

We revised our IT asset health policies, which have been reviewed by Gartner – a recognised IT benchmarking organisation – who confirmed the policies in place are in line with industry practice.

We have invested to ensure our workforce has the tools to stay productive, enable lower operating costs and maintain effective cyber security and controls in our business support services.

Our IT investment portfolio for the RIIO-2 period continues the work we have begun in RIIO-1 to bring our IT infrastructure assets in line with asset health policies, so our people have the right tools and equipment to work effectively, respond to the growing cyber threat, enable us to share data securely and effectively, and to promote cross sector collaboration.

### 10.5.3. IT to enable Business Services

Our business support functions provide services such as property management, HR and finance to all the National Grid plc businesses. They help with the delivery of our core activities, for example by procuring materials, helping us to find and retain our people, and managing our property estate. Our support functions also perform key business activities such as financial control, health and safety and legal compliance.

Each of these functions are dependent on modern, high-quality IT tools and services to ensure high-class delivery while remaining efficient.

National Grid group IT makes investments on behalf of these business service functions to maintain the asset health and ensure availability of cost-effective IT solutions. This enables the business service functions to operate in an efficient and affordable model and provide value for money.

During RIIO-1, we invested in our SAP platform. This SAP solution will need to be refreshed at the end of RIIO-2 to maintain the asset health of the platform.

Investment in compliance and controls over the RIIO-2 period ensures we remain compliant with all appropriate regulation and legislation.

## 10.6. How we will support the transformation

### 10.6.1. Our IT operating model

Our IT organisation is undergoing a significant transformation to prepare for the demands of the future, in terms of capability and the methods and approaches used to provide value for our customers and stakeholders.

Historically, our IT organisation has been reactive to business demand and held a greater bias towards the use of suppliers across key phases of delivery. While this approach was successful for our RIIO-1 ambitions we continue to evolve our operating model based on lessons learned and the greater levels of change we expect in RIIO-2. This includes: engagement, technical design sourcing approach, commercial focus, delivery approach, and delivery capability (see Annex 4 – Technology investment report, section 15. Appendix D: Lessons learned).

Our Head of IT for the ESO, who has end-to-end accountability for delivering our IT strategy, will lead this change on behalf of the ESO. The delivery team will engage the wider National Grid group IT organisation to deliver products and services. This provides a greater level of focus on our requirements, while balancing risk, responsibilities and obligations to our customers and stakeholders.

Figure 63 below sets out the key features of the operating model:

The ESO IT leadership team, led by our Head of IT for the ESO provides thought leadership and guidance into the short and long-term business and technology plans. They are responsible for:

- Working with the ESO leadership team to define the ESO IT strategy
- Delivering the ESO IT strategy and investment plan.
- Managing financial budgets for their portfolio.
- Contributing to the leadership, strategy, operation, and performance of the ESO business.
- Programme delivery and production operations.


*Figure 63: The key features of the operating model*

## Responsibilities of our dedicated ESO IT team

Ensuring value

- Represent IT within the ESO to challenge expectations of scope, quality, time, business case, and priority.
- Represent ESO within National Grid group IT to challenge solution design, implementation approach, resource model, timeline, cost, and quality.
- Support the ESO design authority to consult on customer value priorities and process.
- Ensure partner frameworks encourage competition and provide access to innovative technology and ways of working (see Sourcing approach within section 10.6.2).
- Ensure integration and maintenance costs remain efficient through a common enterprise architecture (see 10.3 Technical design underpinning our ambition).

Strategic analysis and consultancy

- Provide guidance to deliver the ESO long-term business and technology plans. Build relationships with other utility companies and create opportunities for knowledge sharing.
- Proactively identify opportunities for existing IT solutions to drive business value for the ESO.
- Own the ESO strategic business plan and facilitate regular updates with business on strategy, roadmap progress and operational metrics.
- Develop and maintain the multi-year technology and process vision, together with the implementation strategy.

Planning and governance

- Manage the ESO IT investment plan and prioritisation process.
- Support the IT investment sanctioning process across the direct and indirect portfolios. Figure 65 illustrates the investment governance process.
- Develop the capabilities and skills of the ESO IT team to ensure the required skills are available to deliver against commitments.

Portfolio and performance management

- Manage investments including determination of high-level future funding needs.
- Provide transparency of ESO IT operating costs and identify efficiencies.
- Represent the ESO IT function in delivering insightful and intuitive IT performance metrics.
- Manage ESO IT consumption (e.g. end user computing and application rationalisation).
- Manage operational metrics to ensure appropriate action plans are in place to drive improved operational performance.
- Identify opportunities to increase ESO IT value proposition and act on key pain points.
- Provide escalation management.

Programme management

- Be accountable for ESO IT solution delivery with direct responsibility for programme/project management activities, partnering with ESO sponsors and delivery teams.
- Manage time, budget, and quality of IT deliverables to meet business value expectations.
- Manage IT delivery governance and reporting.


*Figure 64: Investment governance structure*

## 10.6.2. Delivery approach

Our approach to delivery will involve creating a transformation programme that will link our strategy and ambition with implementation. This will provide alignment and transparency across our business and delivery teams.

Further detail as to how these phases will apply can be found in Annex 4 – Technology investment report, section 13, Appendix B: High-level capability roadmaps

The programme will follow a three-stage approach, consisting of an enabling, transforming and sustaining phases (see figure 65 The transformation programme delivery approach)

**Enabling phase:** we will lay the foundations for the programme by creating our digital market engagement, data and integration platforms. We will use these to progressively develop our core engineering services platforms.

**Transforming phase:** we will develop the engineering services platforms that will enable significant growth and transformation across our core energy balancing, network operations and control, and commercial platforms. We will continue to maintain resilience and compliance across our existing systems and services while transitioning to our new platform-based architecture.

The programme will apply delivery methods such as Scaled Agile Framework (SAFe)[184], and Agile Scrum so business value can be achieved faster, and with higher degrees of predictability and quality. The programme will build a common platform-based architecture across all systems allowing for greater modularity and ease of integration. It will use multi-functional teams with a greater bias towards in-house skills, creating release teams that will enable continuous delivery and release solutions as required. This is particularly relevant for our market and regulatory reporting systems where regular releases will support the pace of change stakeholders are seeking.

[184] https://www.scaledagile.com/enterprise-solutions/what-is-safe/

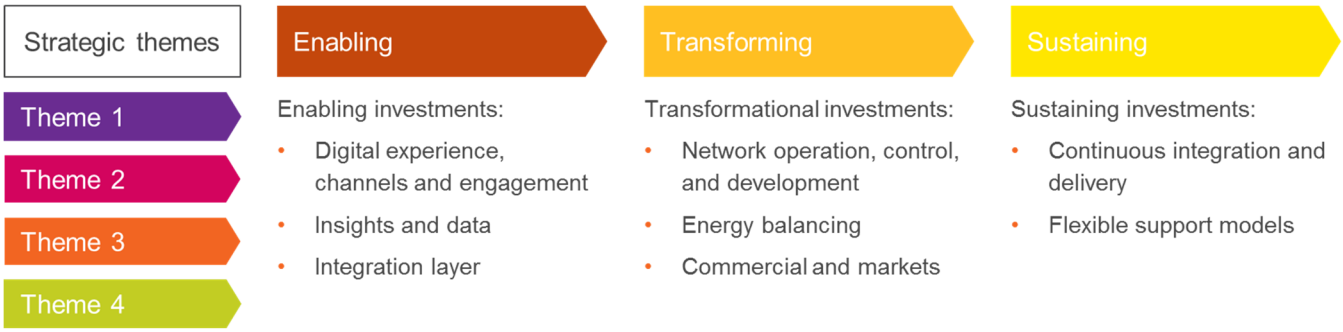



*Figure 65: The transformation programme delivery approach*

We will take a prototyping-based approach to the development of these platforms, where early releases can be ready for external testing to gain early feedback on new functionality. This will allow us to be more responsive in the development lifecycle.

The introduction of a design authority (see figure 66: The relationship between engagement, development, operations and feedback) will allow us to consult and engage on the experience of interacting with us. It will also encourage input into key design, development and testing phases of our solutions development.

Feedback from our stakeholders at our IS Change Forum, trade-association round tables and RIIO-2 workshops tells us that this is a positive step forward. Market participants have told us they want to understand and have transparency of the decision-making logic behind our systems. They also spoke positively about their experiences with the development of the Platform for Ancillary Services (PAS) system.

**Sustaining phase:** we will transition our platforms and systems into operation, using methods such as continuous integration and continuous delivery. This is important for applications that will undergo significant change during their operational service life, such as our energy balancing and commercial and markets platforms.

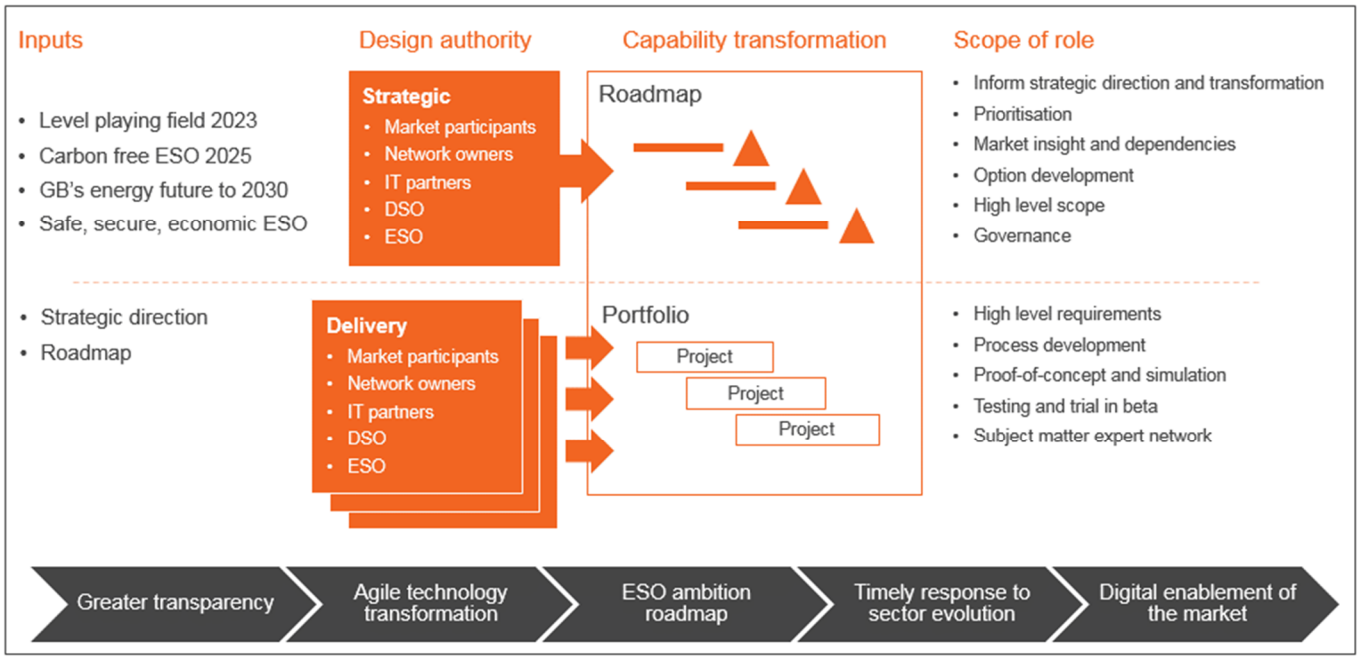



*Figure 66: The relationship between engagement, development, operations and feedback*

## Sourcing approach

We have implemented an application development and maintenance (ADAM) framework through a competitive tender process. This framework provides a broad range of application services, from custom built applications to software as a service (SaaS) and digital applications development.

This market tested framework allows us to use the buying power of the wider National Grid group and is structured to create competitive tension between the partners of the framework. It provides the option to conduct service provision on a time and material basis, fixed-price, or combination of the two. We also expect to engage suppliers using a risk / reward model, ensuring delivery risks are shared appropriately. We do not expect to outsource in full any direct technology investments. We plan to augment our teams with our framework suppliers. There are shared services at a group level that we may outsource. Examples include end-user devices such as laptop and print provision.

We offshore supporting capabilities across our project delivery and ongoing support activities. This encompasses capabilities such as development, testing, third line support.

## Technology transition from RIIO-1 to RIIO-2

We expect to build on our RIIO-1 investments (where applicable) to support the development of our future architecture. In 2020/21, we will develop platform strategies to ensure we understand the components needed for delivery in 2021/22.

Furthermore, we are building the IT delivery capability to support our future platform-based architecture. Work in this area has started; our solution development team are transitioning to a new structure and recruiting staff to develop this model. The changes required in other supporting functions are underway and will be developed over the course of 2019/20 and 2020/21.

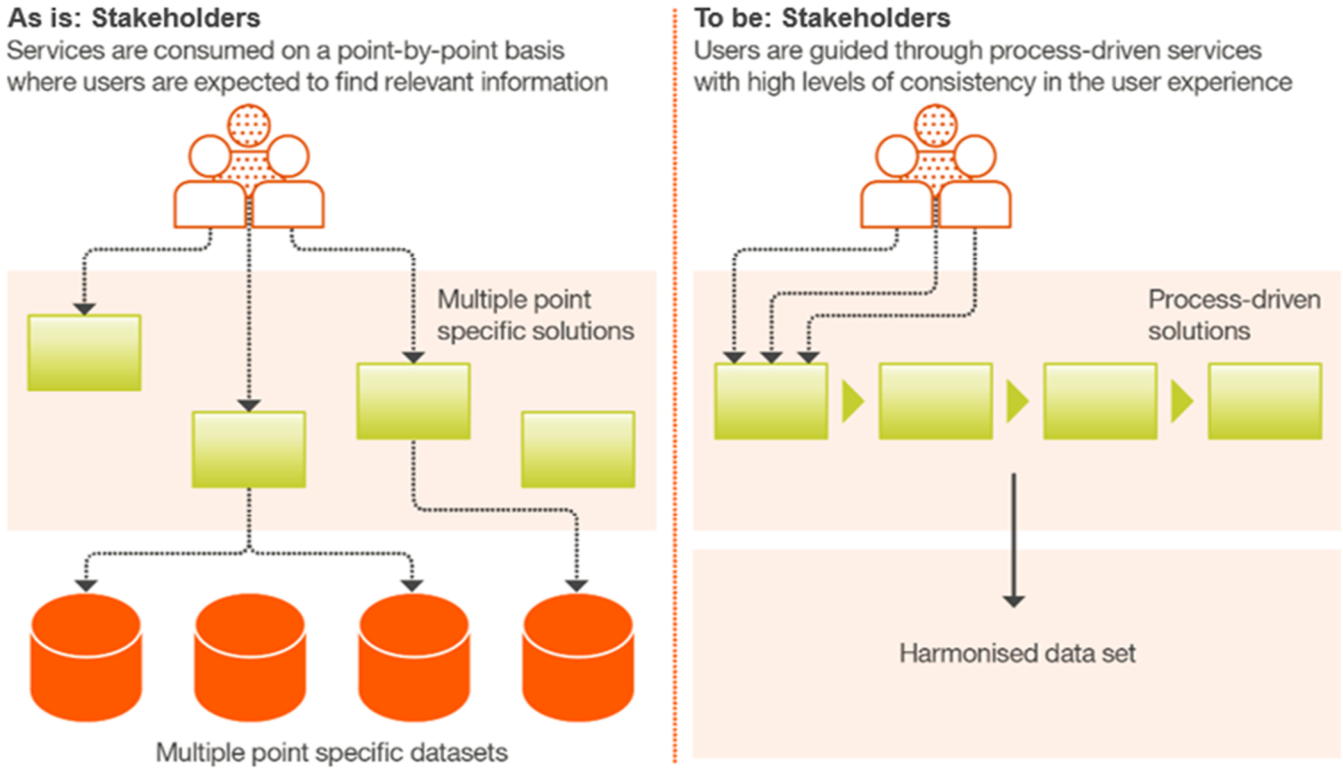



*Figure 67: The as-is and to-be architectural approaches*

### 10.6.3. Metrics

We have heard from stakeholders that they desire greater visibility of our IT delivery to support their own technology roadmaps. We believe that our proposal for a design authority, in combination with our regular reporting processes, will provide the transparency they are seeking. Regular (potentially quarterly or bi-annual) communications will provide insight into deliverables, timelines, technical impact and progress. Further information can be found in Annex 7 – Metrics and measuring performance.

### 10.6.4. Architecture approach

Stakeholders access our applications on a point-by-point[185] basis, and we rely on users self-navigating through the content. As we transition towards the future environment, the user journey will be enhanced. They will be guided through a more intuitive process, with higher levels of consistency in the user experience (see figure 68).

The underlying architecture will be migrated in two stages. The first will establish the base level platforms with a leading use case. The second stage will be to build on that platform, migrating other use cases before eventually retiring the old, legacy applications. This will run in parallel with existing applications. This modular approach will allow us to release functionality quickly, and gain feedback and learnings.

This drives a high level of dependency between our investments which is shown in Annex 4 – Technology investment report, section 16, Appendix E: Investment dependencies.

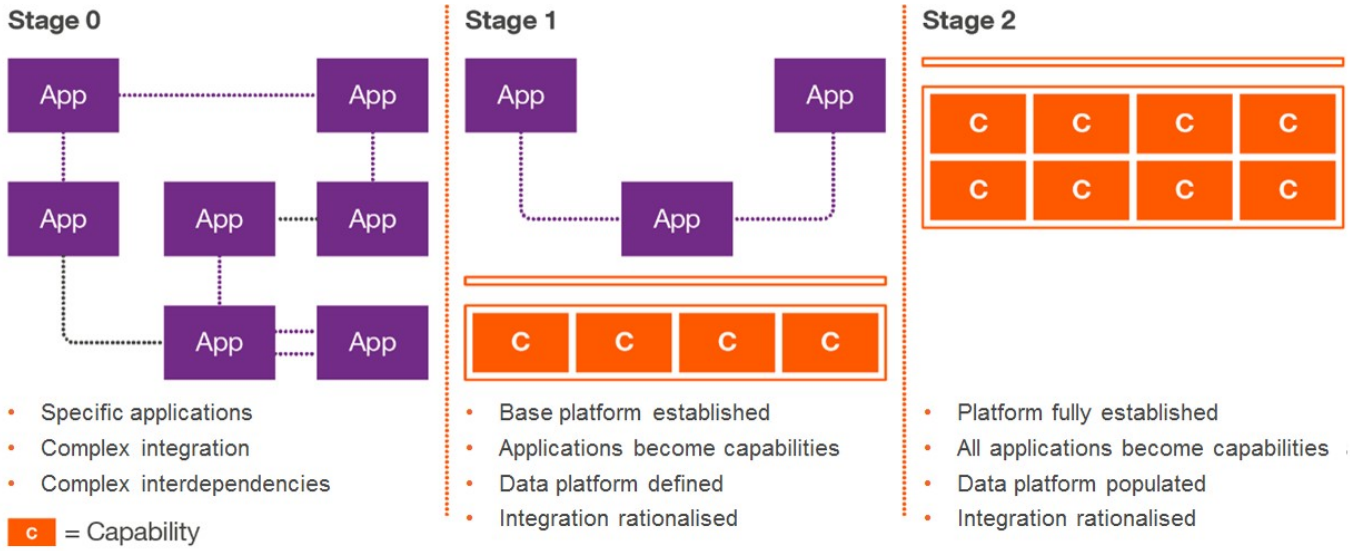



*Figure 68: The approach to architectural transition*

[185] This refers to the fragmented sections where our information can be found. For example, stakeholders will need to go to one space for ancillary services and then another for connections. We want to join up the experience so there is a more seamless flow through the services we offer.

# 10.7. RIIO-2 Investment benchmarking

Investments, and their associated benefits, are summarised by activity in each of the Theme chapters. To ensure that the IT component of those investments is realistic, efficient, and comparable to our peers, we have carried out independent benchmarking of each investment.

A full benchmark report is available in Annex 4 – Technology investment report, section 18, Appendix G: Gartner benchmark report.

## 10.7.1. Basis for investment calculation

The cross-functional nature of technology means that, in many instances, we will be able to meet multiple ambitions through the establishment and re-use of technology platforms. This approach requires investment in a flexible base technology, with incremental funding for each associated use-case.

We have mapped our ambitions and generated logical investments, each with a high-level scope. This has been used to define the requisite IT capabilities and identify any gap between our existing offering and the target architecture. You can find out more about this work in Annex 4 -Technology investment report.

With this understanding, we have engaged Gartner, a technology benchmarking organisation, as well as our application development and maintenance partners (Capgemini, IBM, TCS and Wipro) for high-level estimations. This, combined with our own intellectual property from comparable projects and cross-functional technology teams, has led us to the proposed investment profile.

Our major components of investment are shown below in figure 69. These percentages are based on the anticipated technology solutions. As investments enter detailed scoping, these proportions are likely to change as the solution and implementation methodology is refined in response to market options and to provide the best value for money for customers.

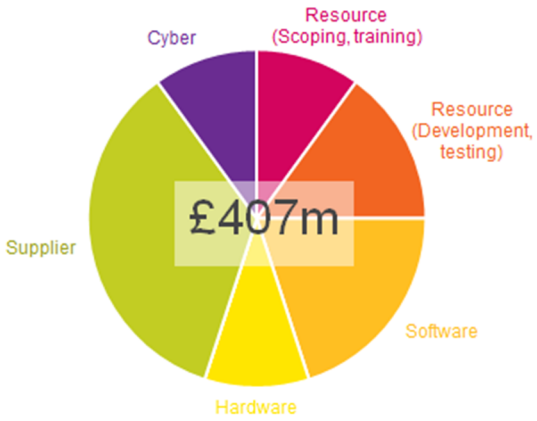



*Figure 69: Breakdown of key components of the ESO-specific five year totex investment*

## 10.7.2. Industry benchmarking of investments

### Independent technology benchmarking

In preparing this Business Plan we have continuously engaged Gartner to assess our approach and estimations as they evolved. Gartner also benchmarked the costs of supporting and maintaining our IT systems. It compared our costs for each of the key activities that IT performs (e.g. application support, networks, storage, end user computing) with the costs in their database of other companies, on a workload basis (i.e. number of applications, number of services, number of users).

Across the investment portfolio, several approaches are taken to benchmarking the individual investment proposals. Gartner takes comparative data and conducts a verification of what is planned in the future, based on what we know today.

For example, where we have planned an asset refresh, Gartner has a clear and tangible starting point. It knows the technology to be refreshed, the scale and scope is usually clear, and it has accurate data on the component costs of an upgrade (hardware, software, people costs) based on today's prices. Similarly, for a new application, Gartner can estimate the size of this based on a large database of project implementations. It can benchmark against known comparable projects, normalised for the actual estimated size of our requirement. In both instances, known costs to deliver are used and normalised for scope. Using a combination of historical trend data and research analysts predicting future trends, Gartner can model a future cost and provide the benchmark. While this is an estimate, the materiality[186] of this part is typically very small.

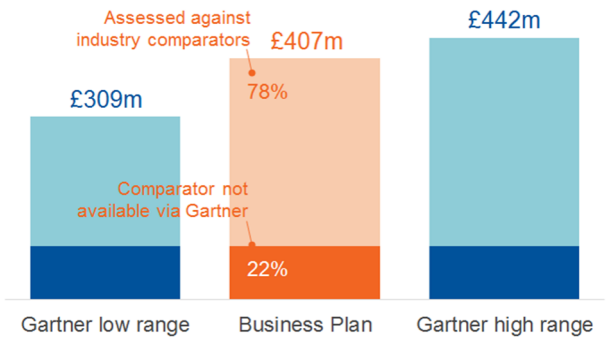



*Figure 70: Total ESO specific IT investments (£ million) over the RIIO-2 period and the alignment between our investments and Gartner benchmarking*

Gartner can provide benchmarking for systems that are common across multiple organisations (finance, HR and others). Within the ESO, there are systems or activities that are niche to our industry and, in some cases, to our organisation and market, such as our Regional Development Programme activities. These cannot easily be benchmarked by Gartner. In this instance, Gartner passes through our estimates, as they are the most accurate values available. This accounts for 22 per cent of the investment value.

Where technologies and systems are common, industry benchmarking was performed against 78 per cent of the investment value. They found that the mix of investment areas, the individual project costs and our costs on project teams were all in line with their expectations, formed from their knowledge of IT investments made by other utility companies.

We also engaged Hackett, a recognised business benchmarking organisation, who, on a cost per end user basis, found our IT infrastructure costs to be higher than those of similar sized organisations. These higher cost values are justified given our dependence on IT systems to operate and monitor the electricity transmission network, which is independent of the number of IT users in our organisation.

Gartner's more detailed analysis found that, after adjusting for levels of workload (number of servers, volume of storage, scale of local area network (LAN) provision), our IT costs are in line with peers while delivering higher levels of system availability. In some areas, such as our wider area network (WAN) and servers, our costs were best in class efficiency defined by Gartner as between the peer average and 25th per centile levels.

In other areas, Gartner found we spend more than our peers on maintaining our networks (LAN) and in supporting end user applications. The proposed shared investment plan for RIIO-2 will support us in achieving best in class efficiency across our IT costs, as well as improving cyber security and will bring our IT costs to upper quartile efficiency by the end of the RIIO-2 period.

### Application development and maintenance partners

Our ADAM framework with Capgemini, IBM, TCS and Wipro provides IT services, such as application development and maintenance services. These partners have invaluable delivery experience and are familiar with our operating environment. They have provided insight into our architectural approach, drawing on experience with other clients and technology providers.

Our partners have reviewed the requirements across each of the Themes and have provided their outline estimates for design, development and implementation. These estimates were benchmarked across industry by Gartner and used to inform our investment plan.

## 10.8. Engagement

Engagement and collaboration are critical to our success. In line with our overall stakeholder engagement approach, we will continue to consult broadly on our IT strategy during the RIIO-2 period. This includes:

- **Strategy and approach**: we will continue to engage with governing bodies, RIIO stakeholder groups, the IS Change Forum, through bilateral meetings and consultancies to make sure our strategic direction and approach are sound.
- **Transformation delivery**: based on positive industry feedback, we will introduce a design authority. This will see industry stakeholders providing their input across the analysis and design phases of our change initiatives. It will also allow us to gain regular, market-tested feedback from customers and stakeholders as we progress through our development lifecycle. This will ensure we can be responsive to change.

[186] This is the difference between their estimates and what happens in reality.

- **Technology disruptors and innovators**: engaging with technology-centric organisations, which have disrupted their marketplaces, will give us insight into opportunities and new ways of working within the energy sector.
- **Non-utility industry leaders**: drawing on examples from large data processors (e.g. banking), simulation and modelling experts (e.g. Formula 1), and engagement specialists (e.g. media) will provide us with best-practice methods to inform our approach.
- **Parallel regulated industries**: engaging with international utilities, air traffic control and transport organisations will provide context-specific examples to inform our approach.
- **Technology partners and benchmark organisations**: we regularly engage with our framework technology partners and benchmark organisations for technology selection, solution design, cost comparators, and delivery approaches.

### Stakeholder views

Through our engagement programme, particularly for Themes 1 and 2, we have received feedback from stakeholders on our approach to developing and implementing IT capability. Generally, stakeholders (particularly service providers) have said that this is something we need to improve. A service provider at a trade association meeting told us that no service providers have had a good experience so far and asked us what we are going to do differently. They told us that we need to learn from our previous projects to ensure transparency around our processes and to deliver in a more agile way. Service providers also asked that we develop clear roadmaps and ensure we communicate the new systems that they will need to interface with in the future.

Stakeholders acknowledged that IT development can take a long time and that there can be implementation issues. By the time changes are delivered, the context has sometimes moved on, which means a modular approach to IT delivery is more pragmatic. This was echoed by feedback at our IS Change Forum, where service providers liked the more agile approach that we propose. Similarly, at our stakeholder engagement event on 11 April 2019, stakeholders asked us to avoid ‘big bang’ IT projects as they often fail, both within the energy sector and elsewhere.

**… the agile development approach worked well … and we got a better system as a result.**

**Generator/ supplier, trade association meeting**

We received wide stakeholder support when we tested our proposal in Theme 1 for using a cross-industry design authority to implement new control capabilities. At our IS Change Forum, all those we spoke to support this proposal for capability development and implementation. We received expressions of interest to be part of the cross-industry design authority from two market participants. We also identified two opportunities for further IT-focused engagement – one on adoption of artificial intelligence, the other was the idea of an IT ‘hackathon’, to include energy and non-energy industries.

# 11.Innovation at all levels of our business

Innovation plays a crucial role in helping us address the challenges from a rapidly changing energy system. Stakeholders from across the industry have highlighted that innovation will make a significant contribution to helping the UK meet its target of net zero emissions by 2050. Following on from RIIO-1, innovation continues to be at the core of our operating model. It is a key enabler for delivering our Business Plan, driving efficiency, and helping us to lead the transition to a low carbon energy system. Innovation allows us to experiment and find viable, diverse solutions to uncertain future challenges; faster and more cost-effectively than would otherwise be possible.

Our innovation function works to foster and embed a culture of innovation in the business, while ensuring we stay focused on solving issues affecting the industry as well as our priority challenges. In this chapter, we present our innovation approach and methodology, along with areas where we will embed our learnings from RIIO-1 and further innovate in RIIO-2.

The innovation projects we launched in RIIO-1 will deliver savings for consumers. For example:

- Our Samuel Inertia Element project[187] (SIM) aimed to reduce balancing costs associated with inaccuracies in estimating inertia. We have successfully completed a public procurement process to provide inertia-monitoring services. It is estimated that this will provide up to a 15 per cent improvement in the accuracy of rate of change of frequency measurement. This will deliver savings of between £6 million and £10 million for consumers every year.
- The Optimisation of Energy Forecasting[188] project explored whether the way we predict the output from solar photovoltaics could be improved, using machine learning techniques and much larger, historical datasets. One approach to machine learning, called random forest, was very effective at reducing forecast error by as much as ten per cent. These findings will help improve the way we plan for balancing actions, taking into account the variable nature of solar generation, and reduce the cost of these for consumers.
- Our Vector Shift initial performance assessment[189] set out to explore vector-shift settings used for protecting distribution-connected customers from loss of mains supply. The project concluded that the vector-shift method was less effective than measuring the rate of change of frequency and resulted in a Distribution Code modification (DC0079) to prohibit the use of vector shift as a loss-of-mains protection technique. The DC0079 workgroup is investigating whether the new requirement can be retrospectively applied to existing generators connected to the distribution networks. Estimated savings from these changes are around £240 million net present value by 2024, which will result in lower bills for consumers.

For more information on these and other ESO innovation projects, please see: https://www.nationalgrideso.com/innovation/projects/network-innovation-allowance-nia.

**ERSG supports our innovation proposals.**

"There has been an attempt to react to feedback, but more improvements could be made. More information is required on the consultation and engagement with academia, which is an important part of innovation. Market collaboration should also play a larger part in innovation.

It is important that the ESO does not feel constrained in innovation by the funding model and risk of cost disallowance."

## 11.1. Innovation in the ESO

Innovation, as one of the central pillars of RIIO, is about establishing a safe, collaborative space in which to explore higher-risk technologies and ways of working. It is about developing novel solutions to specific, medium to long-term problems, identifying new methods to unlock additional consumer value and better preparing for the future.

### Innovation timescales

In the following pages, we concentrate on longer-term innovation that yields improvements over a mid-to-long term timeframe, often with benefits realised only much further in the future, on average more than four years ahead. This covers solutions that may not have been tested in a commercial environment – which require further development, or fundamental adjustments, to ensure safe implementation at the end of the testing cycle. Due to the high-risk nature of innovation a dedicated funding mechanism is needed. This is also to recognise that on some occasions innovation projects are unsuccessful as they do not deliver the expected energy system improvements or consumer benefits.

In chapters 4 to 7 of this Business Plan, we highlight where shorter-term innovation activities are contributing to our proposals. This is also summarised at the end of this chapter.

[187] https://www.smarternetworks.org/project/nia_nget0192
[188] https://www.smarternetworks.org/project/nia_ngso0015
[189] http://www.smarternetworks.org/project/NIA_NGET0052

We use two criteria to determine where innovation-stimulus funding can be most effective:

- **Time: does the idea deliver value in the future (ideally within four to eight years)?** We believe that innovation-stimulus funding is best targeted at delivering higher risk solutions that need more time to properly develop and be tested. If a solution is more mature, and is closer to our ongoing activities, it should be funded through ongoing budgets. Solutions can, and have been, implemented quickly where results from innovation projects have proven immediately viable to be rolled-out into the business. However, we must aim for the four-to-eight-year timeframe (see figure below) so we can focus on the future system challenges anticipated by our *Innovation Strategy*[190].

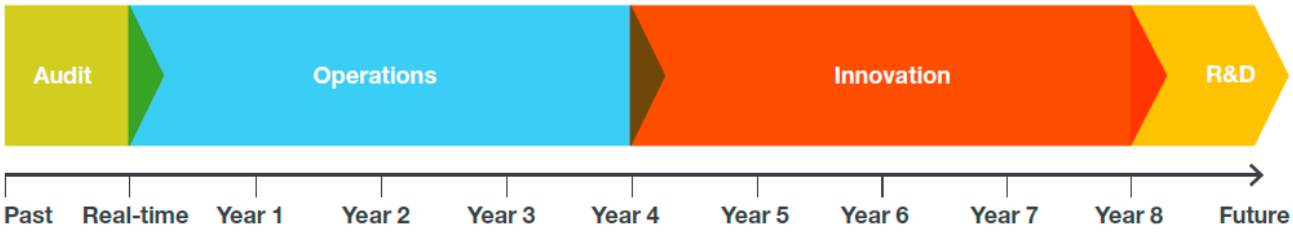



*Figure 71: The innovation timeframe*

- **Maturity: how well developed is the solution to the problem?**
  We tend to tackle projects in the later stages of research and development (R&D), rather than very early stage ideas. They are usually solutions with a low-to-medium Technology Readiness Level (TRL)[191], and we aim to progress these towards implementation-ready solutions (high TRL). We prioritise stimulus spending on more disruptive solutions that, if successful, could deliver step-change improvements and larger, system-wide benefits. Projects that only deliver small, incremental improvements in our day-to-day operations should be financed through our core funding. This focus on low-to-medium TRL activities further justifies why many of the benefits from innovation will only be realised much further into the future. These higher-risk, unproven ideas take longer to develop to an implementation-ready (but potentially more disruptive) solution, and are where innovation stimulus is truly needed most.

Our innovation portfolio will continue to have a balance of research, development and demonstration projects, which we will develop and undertake in collaboration with partners such as academics, consultants, manufacturers and network licensees. We will continue to innovate through a mix of activities in the Business Plan – and via ring-fenced innovation-stimulus funding.

Through the RIIO-2 period, we will deliver an even wider range of innovation projects, covering late-stage research and development activities, up to real-world trials and implementation-ready solutions. The type of innovation project will determine the funding accessed, whether that is innovation stimulus, or funding through the Business Plan. Examples of potential innovations, identified against each of the Theme chapters, are detailed in section 11.4.

We believe that a ring-fenced stimulus for more disruptive, higher-risk, or longer-term innovation will ensure a healthy pipeline of future projects. It will enable us to respond to new energy-system challenges as they appear, and to better understand or test solutions, using new technologies, knowledge and business models.

### 11.1.1. Innovation methodology

We continue to refresh our innovation process, working with stakeholders to incorporate their feedback. Several stakeholders including network companies, service providers and technology providers amongst others commented on the high number of innovation projects underway. As a result we have focused the available funding and resources on larger, higher-impact projects, which are aligned with our *Innovation Strategy*[192]. The strategy prioritises expected consumer benefits, and provides clear roadmaps towards implementation of solutions into our ongoing activities.

Our project portfolio will continue to be driven by the following three fundamental and proven pillars of SO innovation, shaped by some of the best practice[193] and innovation principles[194] adopted by industry leaders across sectors:

[190] https://www.nationalgrideso.com/innovation/strategy
[191] Technology Readiness Level (TRL), as defined in Ofgem's NIA Governance Document v.3 https://www.ofgem.gov.uk/system/files/docs/2017/07/final_elec_nia_gov_doc_v3_0.pdf

[193] Principles For Creating A Good Corporate Innovation Process: https://www.forbes.com/sites/tendayiviki/2018/03/26/six-principles-corporate-innovation-process/#45260da044f4
[194] Fail Fast concept: https://whatis.techtarget.com/definition/fail-fasts Agile Principles to Drive Innovation in Large Organizations: https://www.productplan.com/how-to-drive-innovation-in-large-organizations/

- **A robust and systematic innovation process**[195]**.** This is designed to quickly and efficiently assess each project proposal. It ensures that consumer benefits are at the heart of our approval criteria and costs are efficiently managed. It also ensures that we are aware of – and have a plan to mitigate – potential risks associated with each project.
- **A collaborative Open Innovation approach**. This has been especially effective in exposing us to the industry's latest solutions and technologies. We will continue to hold Open Innovation events to involve academia and the wider industry in the development of our projects, as well as other open calls for ideas and solutions. By doing so, we will make sure we take full advantage of today's vibrant start-up scene, while giving everyone an opportunity to tackle some of Great Britain's priority energy challenges.
- **An annual refreshed *Innovation Strategy***. By producing a strategy and updating it each year, we ensure our innovation efforts remain relevant to the ESO's activities and the wider system's challenges. All our innovation projects must have a clear link to at least one of the priority challenges outlined in our strategy (our 2019/20 priorities are set out in figure 73). Our top-down and bottom-up process to produce these innovation priorities enables us to align with major energy-system trends, our ambition as the ESO, and specific challenges identified from within the business areas (see below). Engagement with stakeholders allows us to test our innovation strategy and, by following this process each year, we gain feedback to further refine our priorities and identify new opportunities to collaborate with our stakeholders.

Ongoing conversations with Ofgem have highlighted that developing and publishing our Innovation Strategic priorities, and mapping our project portfolio against these priorities, is an example of best practice. This extends to requesting that all network organisations be required to publish a common strategy with overarching themes, making sure to map out their portfolios against the priority themes.

**ESO's open innovation day provided a fantastic opportunity for us to approach many key stakeholders in one place. We found there an open approach, constructive challenges, a collaborative mindset and a great launch pad for Project RecorDER**

**Service provider**

**Open Innovation Events**

These are focused one to two-day events where teams consisting of ESO experts, network partners and third parties work together to develop innovation project ideas into pitch-ready proposals for innovation funding. We start with an open call for project ideas to solve some of the priority challenges set out in our strategy. Third parties submit brief ideas, which are circulated amongst our experts who shorlist these to around ten specific proposals The shortlised ideas will be brought forward to the event. On the day/s of the Open Innovation event teams work collaboratively on project ideas to ensure these are fit for purpose and aim to deliver the most consumer benefits, the ideas are finally pitched to a panel of judges where the best are awarded conditional funding and developed into full innovation projects.

[195] Download the *Innovate with the SO* document too find more on how we work: https://www.nationalgrideso.com/innovation/get-involved

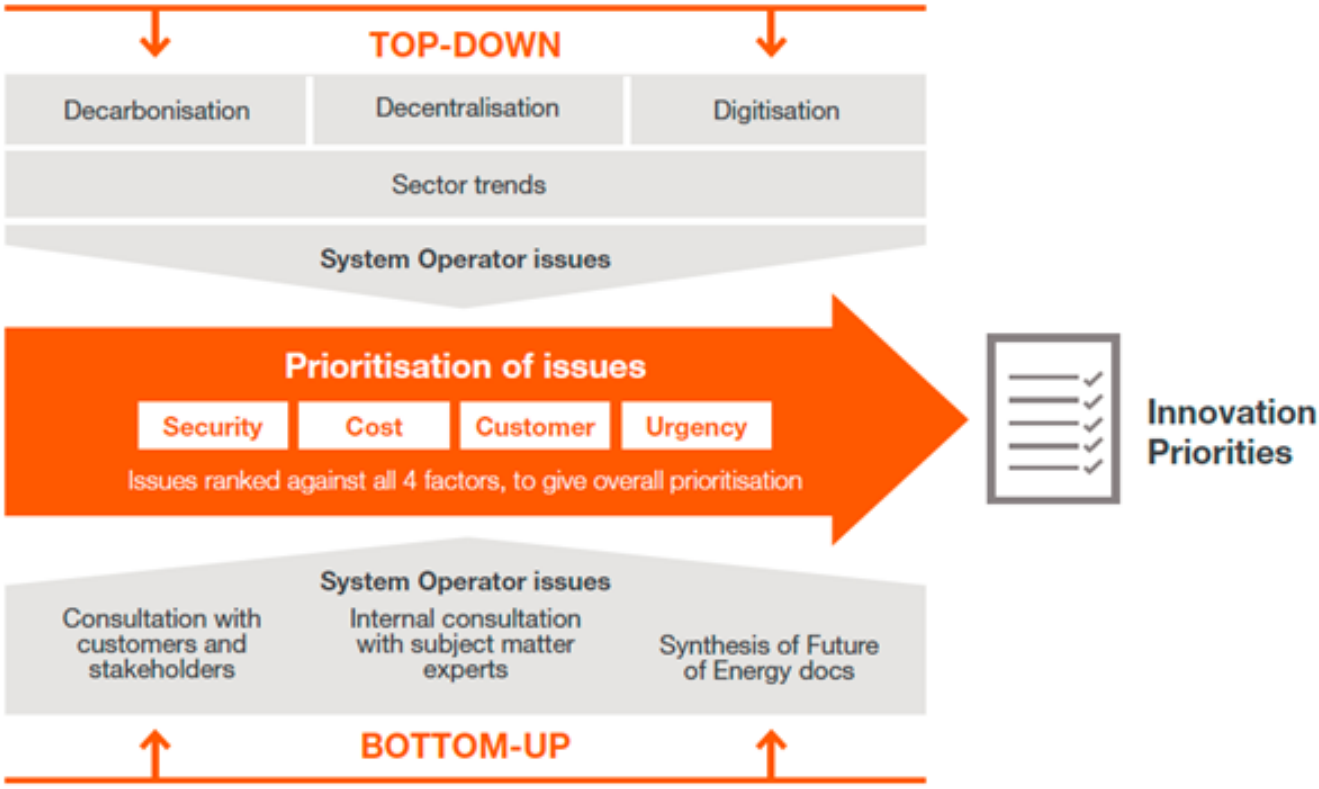



*Figure 72: ESO Innovation Strategy priorities process*[196]

External audits of our regulatory reporting have included positive feedback on our approach to innovation. A recent successful ISO 9001 audit commented that our Innovation processes are “using clearly defined and established governance procedures” and “demonstrated a sound approach utilising the (portfolio management) system to provide visibility and control of project progress”.

By adopting an ‘open innovation’ approach that involves ESO colleagues and third parties, we use different tools, channels and events to scope out potential solutions. We use a number of channels to ensure we work closely with stakeholders and these include:

- Customer visits to understand their issues and explore ways to address them
- Themed “hackathons” and other dynamic events, including with stakeholders, that explore creative approaches to difficult problems
- Online engagement through social media
- Calls for third-party proposals (e.g. Network Innovation Competition (NIC) project ideas)
- Contribution through collaborative working groups (e.g. Energy Networks Association, Eurelectric, ENTSO-E and ENTSO-G)
- Engaging leading individuals and organisations in the sector, collaborating and sharing knowledge with network companies in Great Britain and around the world.

[196] https://www.nationalgrideso.com/innovation/strategy

| | Priority | Fuel |
|---|---|---|
| 01 | System stability | Electricity |
| 02 | Whole Electricity System | Electricity |
| 03 | Future markets | Electricity & Gas |
| 04 | Digital transformation | Electricity & Gas |
| 05 | Whole Energy System | Electricity & Gas |
| 06 | Whole Gas System | Gas |
| 07 | Long-term behavioural change in supply and demand | Electricity & Gas |
| 08 | Constraint management | Electricity & Gas |
| 09 | New types of gas | Gas |
| 10 | System restoration | Electricity |

*Figure 73. 2019-20 SO Innovation Strategy Priorities*[197]

## 11.1.2. Investing in innovation in RIIO-2

The ESO's funding in RIIO-2 will be set ex ante, with efficient costs being passed through to consumers. We believe there is a strong case for dedicated innovation funding within this model as it supports a continued focus on and investment in our longer-term vision and higher-risk innovation projects. It will give our innovation partners (both internally and externally) confidence that they are allowed to fail (necessary element of a successful innovation mechanism) and that funding will not be disallowed as a result.

### Investments in innovation over RIIO-1

Over £11 million of Network Innovation Allowance (NIA) funding has been allocated to ESO innovation projects since 2013. The maximum allowance (approximately £3.4 million) was used in 2018/19 and the same is expected for 2019/20 (approximately £3.2 million). Figure 74 sets out the ESO NIA spend each year since 2013/14. These figures are the result of over 40 different projects in over six years, working with partners across industry and academia. More than 80 per cent of this funding has been spent outside the ESO to research, develop and demonstrate novel solutions to benefit consumers and the wider energy system. These projects have improved our knowledge of the future challenges facing the electricity system, identified new challenges, helped us modify our internal processes, how we design markets, and provided new learnings to enhance the forecasts and insights we deliver for stakeholders.

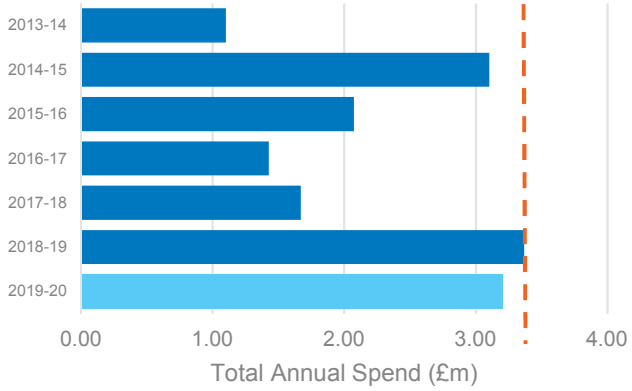



*Figure 74 ESO NIA spend since 2013/14*

We have learned from the experience of operating the NIA in RIIO-1 and would like to highlight two key challenges we have experienced in RIIO-1:

- The current level of funding for the legally separate ESO (capped at around £3.4 million in the past three years of RIIO-1, due to legacy funding arrangements) is not sufficient given the scale and scope of the challenges facing the energy system and the ambitious outputs our stakeholders want us to deliver. We reached the full capacity of our allowances in 2018/19 and are forecast to do so again in 2019/20. The limit of our funds meant, for example, we were unable to support the evaluation phase of the Department for Business, Energy and Industrial Strategy (BEIS) Flexibility Exchange demonstration (FleX)[198] competition this year, despite demands for us to do so.

[197] https://www.nationalgrideso.com/innovation/strategy

[198] https://www.gov.uk/government/publications/flexibility-exchange-demonstration-projects-flex-competition We will participate in the later stages of the process when a much smaller number of bids are being evaluated.

- The NIA is set up as an annual budget and unspent budget cannot be carried forward from one year to the next. This has resulted in an undue focus on ensuring that innovation projects fall within a specific timeline, rather than on delivering value most efficiently, which could be addressed by a multi-year approach (potentially with the majority of innovation spending occurring in a short window of time within the RIIO-2 period).

We therefore propose an increased level of innovation funding, with more flexible access to this funding over the RIIO-2 period. More details are given below.

As our role transforms within an energy system that is itself transforming, we have a greater role to play in facilitating innovation for the industry. This includes more partnerships to take into account changes to distribution system operation. In 2018 our Open Innovation event received more than 140 ideas and proposals, and in 2019 we received 87. These were from universities as well as start-ups, small and medium-sized enterprises and larger industrial organisations. As a comparison, the ENA's 2019 call for ideas for a joint NIC proposal received 46 submissions in total. As we are unique within the energy industry, we tend to get a higher level of interest from potential innovation partners than individual TOs or DNOs; if a DNO or a TO were to decline to fund a project, applicants could re-pitch their ideas to another DNO or TO. £14 million of NIA funding is split between three TOs each year, a further £28 million is split among nine different DNOs, but there is only one ESO to innovate for the industry.

The Flexibility Exchange (FleX) demonstration competition was established this year by BEIS, which we were asked to support. This provided us with an opportunity to show how we could work with the energy industry and their innovation efforts. The original BEIS guidance to participants was to engage with the ESO, which resulted in numerous flexibility platform providers contacting us and wanting to partner with us. However, we did not have the funds to engage with all of them. As a result, BEIS had to change the terms of the competition such that the ESO would only be involved in the final stages. With more funding we could have played a greater part and worked with all the participants.

We have looked at a range of other businesses to understand what an appropriate level of innovation funding could be for the ESO. The number of start-ups with innovative ideas we can work with, or potential solutions that we can test, is constantly increasing. According to the Beauhurst database of fast-growing companies, in the past five years UK start-up investment has increased from around £4 billion a year to over £9 billion. The scope and scale of our innovation funding needs to increase to take full advantage of this increasing opportunity to work with new talent, in a rapidly developing start up and technology landscape.

In addition, a review of transmission system operator (TSO) standards shows a greater push into R&D and innovation. [redacted]

Similarly, other energy and electricity businesses in the UK invest in R&D and innovation on a yearly basis with budgets set at anything from one per cent of sales (for larger, asset-intensive oil and gas businesses) to up to nine per cent of revenue spend for lighter service and technology firms[200].

**We therefore propose a £10 million annual innovation allowance for the ESO, available as an allowance over the length of the RIIO-2 period.**

We would continue to contribute a proportion of costs from our core budget, as is the current requirement for NIA; the level of contribution and the mechanism for how this will work in practice under a pass-through model will need to be agreed.

Based on stakeholder feedback on the level of our innovation funding in RIIO-2, we believe this figure reflects fair value when considering the benefits which ESO-led innovation can deliver for consumers. We are undertaking larger, more impactful innovation projects which aim to solve the increasingly complex challenges faced by the Great Britain energy system. Increased funding reflects the significant benefits we can achieve in delivering our ambitions and will help us support even more third party innovation into the future.

The increased funding level would allow ESO to support innovation across the industry, delivering the best outcome and benefits for our consumers. This would increase the number of solutions that can be implemented into ongoing activities.

Allowing funds to be used flexibly throughout the price control would create more certainty in investment, and better planning to allocate spending more efficiently across time periods. This includes with third parties on larger, higher-impact projects.

We propose to invest in activities against each of the priorities identified in our Innovation Strategy, with highest spending allocated to the higher priority challenges, which would be refreshed according to how successful our efforts would be. Using a weighted approach to allocating funding against each electricity priority, an example allocation could see approximately £11 million invested in innovation for System Stability (currently the top priority challenge) over a five-year price control period, tapering down to £1.4 million invested in the lowest priority challenge over the same period (system restoration). This is illustrated in the figure below and is shown before internal, portfolio management and other costs (e.g. dissemination events) are deducted.

[redacted]

[200] Source: PwC 100 UK businesses ranked by R&D – not public document, available to subscribers.

| ESO innovation priority | Investment split (%) | Total RIIO-2 stimulus (over 5 years) | Theme allocation |
|---|---|---|---|
| System stability | **22%** | **£11m** | **1** (100%) |
| Whole electricity system | **19%** | **£10m** | **4** (100%) |
| Future markets | **17%** | **£8m** | **2** (100%) |
| Long-term behavioral change in supply and demand | **14%** | **£7m** | **1** (100%) |
| Digital transformation | **11%** | **£6m** | **1** (50%) and **2** (50%) |
| Whole energy system | **8%** | **£4m** | **4** (100%) |
| Constraint management | **6%** | **£3m** | **1** (50%) and **3** (50%) |
| System restoration | **3%** | **£1m** | **1** (100%) |

*Figure 75: Example innovation stimulus spending over RIIO-2 (if aligned to current ESO innovation priorities)*

The figure above illustrates how the proposed innovation stimulus would be spent according to the priorities set out in our current Innovation Strategy. As this strategy is refreshed each year, the allocation of funding will change to align with the evolving energy system challenges and respective need for innovation investment for solving these in the most effective and efficient way.

As our priorities for innovation shift over RIIO-2, based on our annual refresh of our innovation strategy, so will the investment allocation against these priorities change. We believe that flexibility is absolutely essential in allowing us to always focus our investment and efforts on the most critical issues, which is why we propose a mechanism for communicating any changes with Ofgem as part of our annual strategy refresh process. This will allow us to engage more closely with Ofgem on our SO Innovation Strategy and ensure absolute transparency on the reasons for our Innovation priorities to change, along with the associated spending to be re-mapped against these priorities each year. This will help achieve a balance between providing visibility and assurance on how innovation stimulus is spent over the RIIO-2 period to deliver consumer benefits, and maintaining an agile, flexible innovation stimulus which can address the evolving challenges our energy system faces in the energy transition. This will allow us to reflect constant updates to the priority of challenges, based on new learnings and new solutions delivered from past or ongoing innovation activities each year, making sure that funding is always being used in the most impactful way to solve system challenges and deliver benefits for consumers Innovation stimulus is best used when invested in unplanned innovation activities over the price control, outside the usual business investment process, and to support third party innovation. This makes it difficult to estimate the expected benefits from the RIIO-2 innovation stimulus. However, our CBA process (used when deciding investments and developing new projects), ensures all ESO innovation activities are expected to produce sufficiently high consumer benefits from the investment (including non-financial benefits for the whole system). Ongoing CBA assessments ensure that any activities no longer expected to deliver expected benefits can be terminated early (i.e. fail-fast) to ensure funding can be reallocated to more beneficial investments.

The figure below illustrates how funding would be allocated across Themes 1 to 4, based on our existing strategic innovation priorities. How this stimulus will be allocated against each Theme will continue to be developed through a combination of a top down approach (as an articulation of the wider business and ENA industry strategy) and as a result of stakeholder engagement (including consumer group feedback), in our strategy refresh process each year.

| Theme | Example Allocation (over 5yrs) |
|---|---|
| 1 | £23.5 million |
| 2 | £11 million |
| 3 | £1.5 million |
| 4 | £14 million |

As we developed our learnings from existing innovation projects, new challenges become apparent, which we did not anticipate at the beginning of RIIO-1. For example, the scale of solar generation uptake, and the resulting impact on networks was not forecast at the start of RIIO-1. As innovation projects have developed our understanding of this challenge (and potential opportunities) we have increasingly looked at funding new solutions to address this (e.g. Vehicle to Grid and smart charging technologies, new EV demand forecasts). As the rate of change in the energy landscape becomes more rapid, additional innovation funding will help us develop our understanding of new challenges, and the solutions to address these.

We recognise that projects that are the direct result of innovation funding would not be eligible for an incentive reward. However, the current proposals for the incentive scheme offer an opportunity to recognise where the results of innovation have been successfully rolled out into business as usual. Where innovation enables us to make progress against our long-term plans, this would have a greater evaluative focus (such as incentives for markets and networks activities), and where it feeds into short-term measurable improvements, this would have a higher focus on metrics (such as incentives for balancing).

Towards the end of RIIO-2, consideration would need to be given to how continuity can be ensured across the price-control periods, so projects continue to be funded and deliver benefits across price-control boundaries.

We support Ofgem's decision for a continuation of a large, competitive funding pot similar to the NIC in RIIO-2.

In addition to a dedicated ESO innovation stimulus, we will look to access other forms of innovation funding during RIIO-2, including from the Natural Environment Research Council (NERC), Innovate UK, BEIS and other public competitions. Accessing other funding sources will help us increase the number of innovation projects we undertake with partners and optimise the use of any network-innovation stimulus, which will help us deliver even greater consumer benefits from the funding available. New external funding sources could also allow us to work with more diverse suppliers and project partners, who may otherwise be deterred by, or unable to meet, the terms of NIA funding.

### 11.1.3. Realising benefits from innovation

ESO-led innovation projects often do not result in direct benefits for us. Value from innovation is realised across the energy system and ultimately by consumers. Examples include an NIA-funded project, which resulted in the creation of PV-live[201], a solar energy forecasting platform which is available for free and has become an industry standard used by network companies, energy suppliers, consultancies and government agencies. Better forecasting by the market, as a result of this tool, has delivered balancing cost savings for consumers. It has also brought savings for the whole industry, by reducing the need to develop individual forecasting tools. Our innovation includes improvements to markets, policies and codes, and the creation of better forecasting platforms, more accurate models and more efficient control tools. It has also enabled other network companies' innovations, and created better strategic direction and knowledge for the industry based on research and development.

There is no one-size-fits-all process for implementing ESO innovation projects. This is due to the diversity of our activities, the type of output that is being produced, the maturity of a solution and the area of our business it will be realised in. Therefore, at the beginning of each project's development proposals are reviewed by the teams who will ultimately be responsible for implementing the solution. A clear plan and outline of what that handover and transition to business as usual will look like is detailed and considered as part of the cost benefit analysis. The resourcing and capability of the team responsible for implementing the outputs is considered and plans are then put in place and reviewed throughout the project's life to ensure these remain appropriate and any benefits are realised in the future.

In order to track and report on the benefits arising from our innovation projects, we propose to follow the same mechanisms set out in the ENA benefits reporting framework[202]. Given our asset-light nature however, we will differ in some respects.

We track and monitor benefits from innovation projects to ensure that benefits remain net positive and that a sufficiently high level of consumer value will be realised. To be approved, a project must meet a minimum threshold for consumer benefits as part of a robust cost-benefit analysis. In RIIO-2, we will develop and deploy a benefit-tracking framework that will help us identify and monitor both financial and non-financial benefits. This includes assessing expected reductions in consumer costs i.e, lower Balancing Services Use of System (BSUoS) charges on bills, reduced environmental damage, improvements in safety, reliability and, service quality.

This approach also informs how we could mitigate future energy challenges, or better understand these and reduce the risk from implementing new solutions. Expected benefits will be quantified whenever possible during the project-development phase, and monitored once the solution has been successfully implemented into business as usual activities. Where benefits are difficult to quantify, we will assess or benchmark our performance against the other network licensees to ensure sufficient value is being realised for consumers.

As our criteria for innovation expects value to be delivered within four to eight years, it is too soon for us to be able to see clear results from most implemented solutions from RIIO-1. We continue to monitor project outputs, so we can better forecast the expected value

[201] https://www.solar.sheffield.ac.uk/pvlive/

[202] http://www.energynetworks.org/electricity/futures/network-innovation/network-innovation.html.

they will deliver. Many of the projects we have funded through NIA are lower TRL (for example, late-stage research), so they will improve our understanding, help us avoid unviable solutions, and identify the correct roadmaps for industry to take to address specific challenges on behalf of consumers. Value is gained from de-risking future work, advancing the results being developed, and avoiding unnecessary costs from pursuing unviable solutions.

## 11.2. Building our innovation capability

In line with our innovation funding proposals, our innovation team will be further strengthened and restructured. This will enable us to better plan and respond more effectively to opportunities, use innovation funding even more effectively, and reprioritise our strategic challenges as new ones arise. Our preferred option is to retain a dedicated innovation team in RIIO-2, which will keep our focus on an overarching system strategy and further enhance our innovation capability across the ESO.

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 0.4 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| FTEs[203] | 6 | 9 | 9 | 9 | 9 | 9 |

Our innovation team was established in its current form in 2017. Our model features:

- A central innovation team with increased focus on cost-benefit analysis and stakeholder engagement. Stakeholder feedback has highlighted the need to focus resources on broader industry engagement. This will unlock our open innovation ambitions, allowing us to share internal knowledge, while leveraging industry insights and ingenuity. This team will also ensure more detailed and wider dissemination of the content generated by our projects, increasing the number of our external events such as Open Innovation days or SOHacks.
- Continued portfolio governance[204] and project management, along with new, dedicated innovation business partners embedded in the business. This will drive the growth of our innovation culture, streamline the discovery of new ideas from our internal teams, and help to connect external ideas from our stakeholders with the right subject matter experts within the ESO. Having embedded innovation leads will also help ensure that innovative solutions are successfully deployed into ongoing activities. They will achieve this by staying close to our business operations, and by providing a clear link between ongoing and planned innovation activities and the teams responsible for implementing them.

We will continue to operate an efficient, matrix team structure[205] that does not monopolise innovation for the entire business, but instead governs activities that are delivered from our various business lines from a central team. We refer to this structure as Business Partnering; where Innovation Leads within each business department report to a central innovation team for the innovation activities, while remaining under direct management of their original teams for all other activities. This ensures close links between the business departments with the subject-matter experts and the innovation function, helping to further embed innovation culture.

The central innovation team will continue to govern the funding (including our innovation process; see the section on our innovation methodology above), have full ownership of our annual *Innovation Strategy*, be responsible for ensuring an open innovation approach with stakeholders, and manage the portfolio in a cost-efficient way. Having a central team in place frees the project teams from many of the administrative responsibilities that are essential to running successful innovation projects – such as contract negotiations, completing CBAs, regulatory reporting and organising stakeholder-engagement events. It allows them, and innovators within our partner organisations, to use their time more effectively and focus on innovation activities that add the most value.

We will embed an innovation culture throughout the ESO and extend our external engagements to ensure we deliver our strategic priorities and, through collaboration, maximise benefits for consumers and energy industry stakeholders

The innovation team will liaise between the subject-matter experts and stakeholders to source new project ideas, ensure learnings are disseminated, and help implement successful solutions into the business. Projects will continue to be carefully planned, with steps taken to ensure successful outputs are effectively implemented into ongoing activities. This will include better coordination with our IT function to ensure sufficient resources are available for implementation. The team will also ensure there is committed buy-in from the relevant teams and senior management, to

[203] Opex and FTE numbers are the average for the ESO since legal separation (years 2020 & 2021), which reflects the current ESO business. Capex figures are the average over the eight years of RIIO-1.

[204] Compliant with Ofgem's NIA governance document - https://www.ofgem.gov.uk/system/files/docs/2017/07/final_elec_nia_gov_doc_v3_0.pdf

[205] Matrix team structure: https://www.pmi.org/learning/library/matrix-organization-structure-reason-evolution-1837

successfully realise benefits from our innovation projects.

### 11.2.1. Establishing an innovation culture

Our *Innovation Strategy* will be fully aligned to our ambitious goals. It will clearly demonstrate where innovation links to achieving these goals and continue to focus on where it can deliver the most benefits to consumers and other stakeholders.

Our senior leadership team is committed to innovation. This is embedded in their personal objectives, ensuring there is continuing support for innovation activities cascaded throughout the teams. This will ensure innovation remains a key focus within the ESO, with the required internal resources assigned to running projects and implementing the successful solutions.

We will maintain the profile of innovation across the ESO by showcasing our activities and encouraging more people to think innovatively. This will include internal events such as Hackathons, which have proven successful in taking employees out of their daily routine and helping them think about solving challenges in a collaborative, agile and innovative way. We run these at least twice each year, where diverse teams taken from across the business work for two days to identify and define project ideas which could solve our priority challenges. As well as creating new proposals for our Innovation projects pipeline, these events expose employees to new ways of approaching problem solving (e.g. Design Thinking), and get them collaborating across subject areas, to achieve cross-pollination of ideas within the ESO and externally.

We will continue to embed our innovation approach by sourcing dedicated project leads from across the ESO. These resources are required to dedicate a portion, sometimes all, of their time to innovation activities for the duration of that project. They are supported by the central innovation team and so apply the same disciplines which they in turn can share with their teams. This results in more ideas from those teams and even more of their colleagues wishing to lead their own innovation projects, ensuring a sustainable source of resources to lead innovation projects within the ESO.

For more information on how our culture will change, please see chapter 14 – People, culture and capability.

### 11.2.2. Engaging and securing third-party participation

We will challenge and expand our own views on innovation, and our strategic priorities, by increasing our engagement with stakeholders. This means we are concerned with challenges affecting our customers and stakeholders, as well as the electricity and gas systems, all the way through to broader societal challenges. To achieve this, we need to draw on the expertise and skills of a wide range of organisations, building on the engagement we carry out. This will include gathering feedback through webinars and workshops, participating in cross-industry forums and events, and holding bilateral meetings with small, medium and large enterprises across all sectors, including transport, utilities, digital technology and environmental charities as well as academics.

Our ambition is to fully embrace an open innovation approach and to further accelerate innovation for the whole energy system, not just the ESO. This will be achieved by organising more open innovation days, to provide access to our subject matter experts for stakeholders seeking to develop new solutions. We will welcome ideas that go beyond addressing our own challenges, thus embracing our role at the heart of Great Britain's energy system and leveraging our full potential to create the system of tomorrow.

Along with establishing more open innovation days, we will extend our calls for new project bids to solve our priority challenges. This will give third parties more opportunity to work with ESO subject matter experts and develop innovation projects collaboratively. These activities will continue in parallel with internal innovation events, which are designed to promote creative thinking and build a strong culture of innovation within the ESO. Third parties (including academia, consultancies, manufacturers and other suppliers) will be invited to join these internal events more regularly. This will ensure that proposed activities are most relevant to customers and stakeholders, and will strengthen the potential for future collaboration.

We will also work with other network organisations through the ENA and other external engagement opportunities. This will include dissemination and collaboration activities, such as ENA working groups, industry forums and the collaboration portal[206]. By doing this, we will ensure other licensees are aware of our innovation activities, share any relevant learnings and provide suitable feedback on any new proposals.

Each year we are involved in numerous external events and workgroups to ensure we have continued contact with partners in industry and our other stakeholders set out in the table below.

| Event | Description | Schedule |
|---|---|---|
| Open Innovation Event | Collaborative opportunity for suppliers and industry partners to work with ESO experts over two days to develop new innovation project proposals | at least 1 per year |
| Strategy Refresh | Open call for feedback on our Innovation Strategy, including a | Q1 each year |

[206] ENA Network Innovation Collaboration Portal: https://www.nicollaborationportal.org/

| | | |
|---|---|---|
| | webinar and bilateral engagement | |
| LCNI Conference | Network innovation conference; showcase for all NIA and NIC activities, engaging with wider industry | Q3 each year |
| NIC Project Open Call | Open call for new NIC project ideas | Q4 each year |
| Other ESO Stakeholder Events | Innovation represented at external ESO Events, to gather feedback and disseminate learnings, including; Power Responsive, Operational Forum, FES launch | Throughout each year |
| Other forums for collaboration and stakeholder engagement | ENA R&D Managers Group, TO/SO Collaboration Group, Ofgem workshops, ENTSO-E workgroups, Electricity Innovation Forum | Throughout each year |

In addition to these opportunities, we continue to seek new ways to engage with our stakeholders. Better engagement allows us to more accurately reflect their views and respond faster to feedback, allowing us to further improve our innovation activities and processes going forward. This also creates more opportunities for us to help third parties with their own innovations, via contributing funds, resources, data or endorsement (e.g. Letters of Support).

**As a company which holds innovation as a core value, it was great to see such a wide range of new ideas on the Innovation Day. The day highlighted how National Grid [SO] are very open to trying new things and working with non-traditional service providers like ourselves. It's a fantastic opportunity to investigate what flexibility the water industry can bring, and the support received from the project sponsor and National Grid's Innovation team has been really helpful in getting our ideas off the ground.**
**Utility Company**

### 11.2.3. Stakeholder views

Engagement with a wide variety of stakeholders has been extremely useful in developing our innovation approach. Stakeholder feedback from trade associations, academics and technology providers has led us to develop and deliver a more focused and clear innovation strategy, consisting of more distinct and well-defined challenges. For example, our stakeholders wanted to better understand the different types of 'whole system' issues we were facing. This resulted in a breakdown of our whole system challenge into three separate priorities[207] – whole energy system, whole electricity system and whole gas system.

As part of our *Innovation Strategy* publication, we shared our process on how we decide which priority challenges to focus innovation projects on, and how stakeholders can work with us to explore new solutions to these. Our strategy will continue to be refreshed each year, following engagement with stakeholders, to ensure the priorities are fit for purpose, and reflect current industry understanding of energy-system challenges.

Stakeholders have consistently expressed the wish to have more clarity around which benefits we pursue – and how we realise them. As a result, we have made our CBA and innovation process public and will aim to constantly update our website to show the progress on each of our projects. As stated previously, it is our ambition to develop and deploy a comprehensive consumer-benefit tracking tool, to more effectively report benefits back to our stakeholders.

Through events such as our innovation days[208], we have seen a large number of requests from external parties to get involved in ESO innovation, with over 140 ideas submitted ahead of the first ever event and 87 this year. We will aim to run similar events more frequently throughout the year. This will give third parties more opportunities to work with us in solving our priority challenges through innovation projects.

We received feedback from a number of stakeholders which included government, suppliers and service providers about our lack of visibility. They also found it confusing to distinguish between the many different publications and activities that are ongoing within ESO. We have been leveraging other stakeholder-engagement platforms, such as Power Responsive, to reach out to a wider audience and ensure as many stakeholders as possible are aware of our innovation activities.

[207] See *Innovation Strategy* priorities in section 13.1.1, Innovation methodology, and in full document: https://www.nationalgrideso.com/document/106786/download

[208] 2019 Open Innovation Day: https://www.nationalgrideso.com/innovation/news-and-events/open-innovation-event

At the April 2019 RIIO-2 workshop, we gathered feedback from a wide range of stakeholders from across sectors on their priorities for ESO innovation.

Stakeholders told us they would like even better communication and engagement on our activities throughout the year, to enable them to better understand our current and future priorities, and how we can work with them. To address this, we will focus on better external engagement throughout the remainder of RIIO-1. We will ensure we have a team resource focused on external communications, and continue this into RIIO-2, with more innovation events designed to engage stakeholders and help them partner with us on projects.

Stakeholders also told us they want us to continually improve our ongoing activities, as well as looking at 'big I' (larger, more disruptive) innovations. We have ensured that ongoing innovation is reflected in the Business Plan. This is captured in each Theme chapter and summarised below. This allows innovation stimulus to focus on the 'big I' activities.

As a result of our central role in the electricity system, stakeholders believe we should be helping to lead collaboration across the industry, as well as progressing innovation projects that solve industry problems. Through our strategy refresh process, we are taking this feedback on board. We will use stakeholder engagement to continue to ensure our priorities for innovation reflect whole system challenges, which the ESO is ideally placed to tackle.

Most stakeholders agreed that we should retain an innovation stimulus, but there were mixed views around how innovation should be funded (e.g. through BSUoS). We also believe a ring-fenced stimulus is necessary to encourage higher-risk innovation. We will make sure innovation is funded in the most appropriate way, ensuring consumers are not overpaying and that any stimulus doesn't conflict with other ESO incentives or funding structures.

As with other proposals in our Business Plan, stakeholders, including ERSG, highlighted the importance of working with other companies across the industry and with academia. Increasing our collaboration with external parties has been a priority in the lead up to RIIO-2 and will continue to be during the RIIO-2 period. We will continue to engage with industry and other stakeholders to ensure we are providing the appropriate information and opportunities to encourage third-party participation.

## 11.3. Embedding innovation from RIIO-1

By the start of RIIO-2, we aim to have proven the viability of several innovations from RIIO-1 which will be implemented into the business. Examples of current innovation projects that could become ongoing activities during RIIO-2 include the following:

- RecorDER[209]

This project aims to develop and deploy a full-scale, blockchain-based asset register for flexible energy resources. This NIA-funded development and pilot demonstration project is being delivered as a collaboration between ourselves, SP Energy Networks, UK Power Networks and Electron. If successful, we will plan to implement the asset register during RIIO-2. This will realise system-wide benefits, including whole system visibility, easier asset trading, enhanced data management and dynamic asset registration, while also testing the viability of blockchain transactions.

- Frequency Response Auction Trial[210]

The aim of this trial is to test the hypothesis that closer to real-time procurement of frequency response will lower overall procurement costs, by increasing liquidity and transparency in the market – and delivering a stable market price for the relevant products. This NIA-funded project, developed in collaboration with EPEX Spot, and which will be supported and participated in by dozens of customers, is due to end in early 2021. If successful, this too will be implemented into our ongoing activities during the RIIO-2 period. Our conservative estimate of consumer benefits from this project is £360,000 a year, in the form of lower bills.

## 11.4. Ongoing innovation in RIIO-2

Innovation is embedded throughout this Business Plan. Within each Theme chapter, we have highlighted where our proposals have built on past innovations, and where we expect to further innovate to deliver benefits to consumers.

Below, we summarise the activities we have classified as ongoing or business as usual innovation for each of the Themes. These are the higher TRL activities funded through the Business Plan and some of these follow on from innovation already completed during RIIO-1, such as NIA and NIC projects. Where additional innovation projects could assist in delivering these Themes (lower TRL activities which are difficult to define at this stage), we have classified these as areas we may want to draw on ring-fenced innovation funding in RIIO-2. This funding will ensure we can research and develop possible new solutions, and address upcoming challenges as they arise.

[209] https://www.smarternetworks.org/project/NIA_NGSO0018

[210] https://www.smarternetworks.org/project/nia_ngso0017

## Theme 1 – Ensure reliable, secure system operation to deliver electricity when consumers need it

### Business as usual innovation

- Designing and building the new balancing and control capabilities in an agile, adaptable fashion enabled by digital twin technology.
- Developing situational awareness, new markets and services for the whole electricity system, not just transmission.
- Developing online and offline system modelling and forecasting tools to enhance decision-making, using new, advanced probabilistic techniques which are being developed by industry and academia.

### Areas we may want to draw on ring-fenced innovation funding in RIIO-2

- Bringing artificial intelligence, machine learning and automation into the Control Centre processes. Given the changing energy landscape, it is unclear exactly what tools and systems – which may not exist presently – machine learning could be applied to. Therefore, this is an area where we need to be agile and respond to new opportunities as they appear (where ring-fenced funding is better utilised).

## Theme 2 – Transforming participation in smart and sustainable markets

### Business as usual innovation

- Underpinning an integrated ESO platform will be a single, industry-wide asset registration process for all ESO markets. Assets will be registered at component level on a single register.
- Enhancing our modelling capability will put our Capacity Market analysis at the forefront of modelling techniques. As a result, we will be leading the world in security of supply technical modelling.
- During the RIIO-1 period, we have introduced innovative approaches to engaging more widely with market participants, as demonstrated though Charging Futures. As we embed these lessons into the wider business, we will continue to seek new approaches over the RIIO-2 period that enable us to transform the code processes effectively.
- Implementing a digital, whole system Grid Code, supported by artificial intelligence to better signpost and improve the users' experience, will be the first of its kind in Great Britain's electricity industry. We will capture lessons, which can be shared with the wider industry to improve the experience for all codes.
- During the RIIO-2 period, we will continue to work closely with stakeholders, such as service providers and DNOs, to innovate and convert operability pilot projects into new markets. We will utilise our sandbox environment to develop learning and test enduring solutions for new markets.

### Areas we may want to draw on ring-fenced innovation funding in RIIO-2

- The sandbox will enable innovation, so we will potentially draw on ring-fenced innovation funds, where appropriate, to test novel solutions to complex challenges. For example, system stability in ultra-low inertia scenarios.

## Theme 3 – Unlocking consumer value through competition

### Business as usual innovation

- We are currently exploring new modelling techniques, such as probabilistic modelling, to better identify the right level of investment needed on the networks. During RIIO2, we will build on this further to enhance these techniques, in particular to better reflect the interactions between different network issues.
- With increasing volume of analysis that needs to be completed, in shorter periods of time, we are currently undertaking an innovation project to test the tools we require. Subject to this being successful, we will implement these voltage assessment tools early in RIIO-2.
- During RIIO2, we will establish how we can best utilise our network-planning expertise to support interactions across different vectors.

## Theme 4 – Driving towards a sustainable, whole energy future

### Business as usual innovation

- We worked on the ENA Open Networks Project, alongside other network organisations. We will be taking the learnings from this project to establish deeper ways of working with DNOs at the start of RIIO-2. This will ensure consumer benefit is maximised in access planning across the transmission-distribution interface.
- We will deliver broader analysis and industry engagement to inform energy policy development. Our ability to lead in this area is built on data-driven analysis, including data from innovation projects. One example is our NIA project on electric vehicles (EVs) charging behaviour, which allowed a step change in our modelling of electricity demand from EVs. Another is our self-funded carbon-intensity forecasting project, which used machine learning and automation to provide more accurate forecasts, which we publish continuously, enabling others to make more informed choices.
- We are developing a pathway for zero carbon, whole system operability and beyond. Our work to develop the capability to operate a zero carbon electricity system will use the learning from our Enhanced Frequency Capability Control (EFCC) and Power Potential innovation projects – and potentially our recently funded Black Start from Distributed Energy Resources (DER) project.

### Areas we may want to draw on ring-fenced innovation funding in RIIO-2

- During RIIO-2, we will continue to innovate to take advantage of the opportunities presented by new technologies, such as automation and machine learning, to fill gaps in capability (ie, zero carbon operability) and to prepare for RIIO-3. We believe that this innovation will increasingly take a whole energy system view, particularly given the increasing penetration of EVs and the decarbonisation of heat. We will work with a broad range of stakeholders to further develop the whole energy system.

# 12. Leveraging value from shared functions

## 12.1. Model overview

We use business support services that are shared across all the National Grid group businesses under a single function for several key support services. These include information technology (IT), property, human resources (HR), procurement, corporate affairs, legal and finance. This shared services model means each National Grid group business benefits from economies of scale and use of expertise in each area, as well as taking a proportion of the costs for each function. This creates efficiencies for each National Grid group business, as it costs less than each business having its own functions. The shared service costs in this section have been benchmarked for efficiency. They include £4 million 'catch up' efficiency, where we have made adjustments to our forecast costs based on benchmarking results. Furthermore, they include a one per cent efficiency stretch target to ensure we keep pace with the efficiency frontier in RIIO-2.

Each National Grid group business pays a fair share of the costs of these functions, through the use of the unified cost allocation methodology (UCAM) approach agreed with Ofgem. Cost allocations are reviewed annually to make sure these are fair, robust and have not been affected by changes to business activities. These allocations are submitted to Ofgem every year as part of the regulatory reporting pack (RRP) process, which includes a description of any allocation methodologies that have changed, and why. Annex 8 – Shared Services, provides more details.

**1%**
**Annual efficiency savings on our shared service costs**

The principles of the UCAM process are a simple, consistent and transparent method to allocate costs by maximising direct attribution of costs where possible and then using agreed drivers for costs not directly attributable (for example, headcount of the relevant companies). The annual review of allocation drivers ensures that the drivers remain robust and allows changes required from any business activities or structures that have changed.

Through the legal separation process it was agreed with Ofgem that this model would continue. Across these services, our share of costs will be on average £20 million in the first two years of RIIO-2. This does not include shared IT costs, which are discussed in chapter 10 – Technology underpinning our ambition.

Benchmarking shows that our forecast costs for RIIO-2 are equivalent to the most efficient companies, after adjusting for the costs of being a regulated network and the additional security measures we take to protect our operations from threat. Being a regulated network increases our costs through the need to perform regulatory cost and output reporting in addition to the statutory reporting performed by most companies, and the fact that we are required to undertake additional compliance activities. Benchmarking helps us to know how the overall National Grid group business support costs compare with those of similar size companies. This, along with the annual review of allocation methodologies, ensures that this model continues to provide us with efficient services as part of this arrangement.

A number of business support areas have undergone restructuring in RIIO-1 to ensure they are providing services for efficient costs. Details of this, including comparisons to benchmarking are provided in the following pages.

There are three main components in the shared service model: shared service business partner, shared service non business partner, and group functions. These reflect the degree of interaction and how embedded each service is in the ESO business. Key functions – Finance, Human Resources, Corporate Affairs, Legal and IT – are highly embedded, using a dedicated business partner model compared with Group Functions (for example, tax and treasury) that have a low degree of regular interaction.

**Where the shared services model is used, the ESO must demonstrate that costs have been appropriately benchmarked.**
**ESO RIIO-2 Stakeholder Group**

## Shared services support model


*Figure 76: Shared services support model*

Within the ESO leadership team, lead business partners are accountable for the delivery of shared services. This includes IT, and we have provided more details on our approach to IT in chapter 10 – Technology underpinning our ambition. All members of the leadership team are responsible for setting strategy, driving performance, and managing ESO-specific resources.

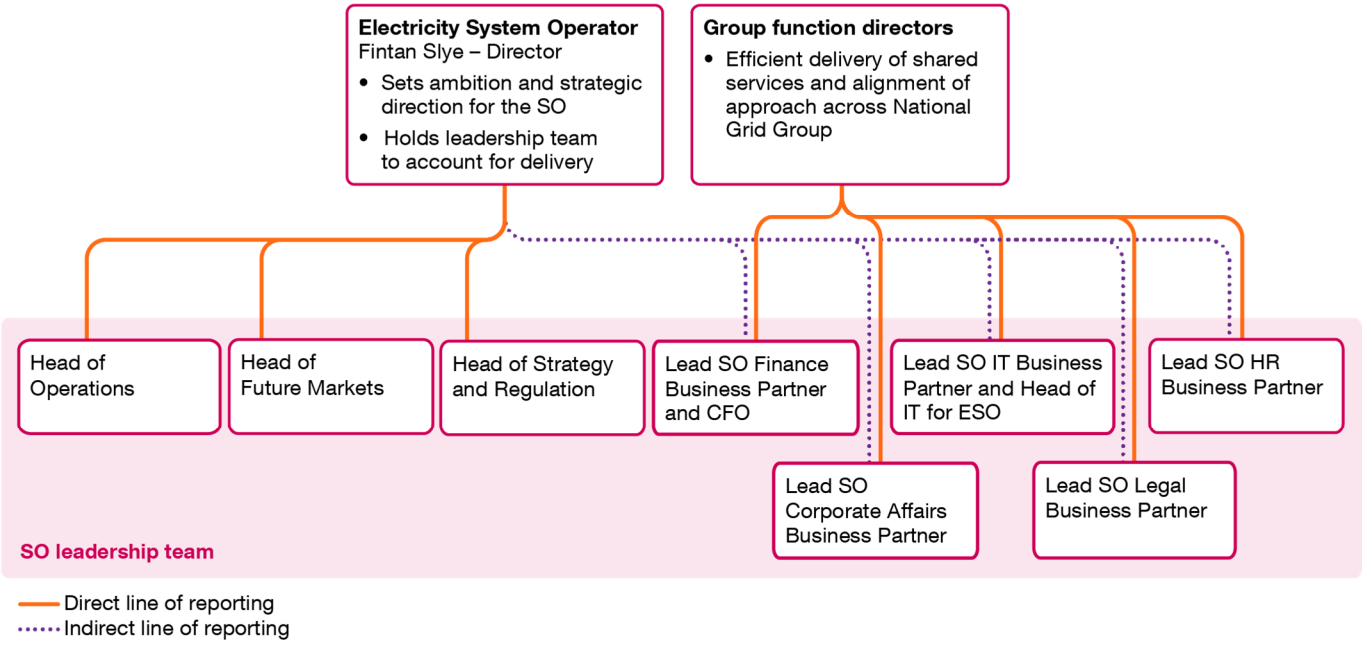



*Figure 77: ESO leadership team and lead business partners.*
*Orange line indicates direct reporting line.*
*CFO = Chief Financial Officer*

### Our approach to benchmarking of business support shared services

National Grid group asked The Hackett Group[211] to compare the costs of business support shared service functions with those of similar-sized companies. Hackett was provided with the costs of shared services supporting the electricity transmission, gas transmission and electricity system operator businesses[212]. Using Ofgem's business support function definitions, Hackett identified comparable activity categories within their database. Hackett was asked to compare the costs to as many non-regulated companies from the group Ofgem had used for business support benchmarking for which Hackett had current data. 19 companies from across multiple sectors formed the comparison group. Hackett performed the comparison to a peer group using a single metric for each business support area, such as costs as a percentage of revenue, or cost per full-time equivalent (FTE). Although this is a simplistic approach that averages out key differences (for example, how embedded IT is into an organisation's operations), it provides a reasonable foundation to start analysing and adjusting for more complex areas of the business support costs.

Where Hackett identified differences between National Grid group costs and those of the comparison group, they were asked to perform more detailed comparisons on an activity-by-activity basis so National Grid group could understand what explained the differences. For IT costs, Gartner was engaged to perform this further analysis, comparing costs for each of the key activities (e.g. application support, networks, storage, end-user computing) with those of other companies in their database, adjusting for workload (i.e. number of applications, number of services, number of users). More information is provided in chapter 10 – Technology underpinning our ambition.

The table below summarises our costs for shared services. This is broken down by area later in this chapter.

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 1.7 | 2.3 | 4.3 | 2.3 | 2.7 | 2.7 |
| Opex [213] | 22.1 | 16.4 | 16.4 | 16.5 | 16.7 | 16.7 |

## 12.1.1. Property

Our property function is responsible for:

- making sure our offices and other properties are in good condition and safe for our people to work in.
- managing the services to run our buildings, such as security, cleaning and catering.
- providing recycling services and using sustainable materials and energy.

The National Grid group property function has undergone changes through the RIIO-1 period to increase its efficiency. This has included rationalisation, adoption of smart workspaces and sharing of core estate. The key services are provided by outsource providers, including catering, maintenance and security, which can provide the services at a lower cost to National Grid group. Property has been able to achieve efficiencies totalling £3 million across the National Grid group portfolio, which we have benefited from through lower allocations than would otherwise have been the case.

### ESO property costs in RIIO-2, £m

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Property capex | 1.7 | 2.3 | 4.3 | 2.3 | 2.7 | 2.7 |
| Property management opex | 7.0 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 |

Our share of National Grid group property costs is based on our use of National Grid sites, primarily in Wokingham where the Electricity National Control Centre is located, and National Grid's UK head office in Warwick where our Faraday House site is located. Our Wokingham site falls under the government's definition of Critical National Infrastructure and the property management costs include maintaining the physical security of this site.

When the ESO separated from National Grid Electricity Transmission, a portion of National Grid's Warwick head office was separated to house the ESO. The costs in RIIO-2 reflect this change, including the provision of separate building services to the ESO such as reception, security and catering. Our proposal includes a small cost to reflect our intention to create an ESO corporate presence in London that is separate from National Grid group's London office.

National Grid group allocates property opex specifically by site to the part of the business that is using the property. Shared properties are allocated based on usage, and overheads are then shared based on overall use of the property portfolio.

The benchmarking study showed that the costs we spend on property management are comparable to the top 25 per cent most efficient companies of the comparator group (upper quartile efficiency). This is after adjusting for our additional Critical National Infrastructure-related activities (e.g. operating our gas

[211] The Hackett Group is a global business benchmarking organisation.
[212] 2020/21 costs

[213] Opex numbers are the average for the ESO since legal separation (years 2020 & 2021), which reflects the current ESO business. Capex figures are the average over the eight years of RIIO-1.

and electricity control centres on a 24-hour basis, and the enhanced physical security measures needed to protect our sites).

Property capex reflects spend forecast in RIIO-2 on ESO related properties. This is primarily spending on the Wokingham Control Centre and our share of capex required for the portion of National Grid UK's Warwick head office that houses the ESO. The spike in 2022/23 relates to additional work required in Wokingham during that year.

## 12.1.2. Human resources (HR)

Our HR function helps our businesses attract and recruit the best people to work with us. It also ensures that our people reflect the diversity of the society we operate in. It provides training to make sure our workforce has the right skills and capability to deliver our roles and activities, and sets out how we support and reward our people so they feel valued, engaged and want to keep working with us. Chapter 14, People, culture and capability provides more information on our plans in this area, and how we will continue to ensure we have the right people, skills and leadership to deliver our ambition in RIIO-2.

During RIIO-1 our costs increased in HR to cover additional demand for services including resourcing, business partnering and learning that were required to support the business, including work required for the significant change agenda. Following the support given to the business with its Performance Excellence (PEx) change programme, HR has started work to increase its own efficiency prior to the start of the RIIO-2 period. This is by streamlining HR activity, focusing on activities that add value and adopting new digital technology and platforms including the rollout of a new HR system. Efficiencies are already being realised with the ambition to reach upper quartile efficiency by the start of the RIIO-2 period reflected in our proposed costs.

The proposed annual costs also include an additional £0.4 million per annum for critical power system engineering roles across the ESO. This is part of our planning to secure workforce resilience which is an important objective for ESO in RIIO-2. In the National Grid group HR function, the costs also include around £2 million of employee benefit costs across the various businesses. These are business costs but within our organisational structure are managed by HR.

### ESO HR costs in RIIO-2, £m

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 2.1 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |

The Hackett Group looked at the overall cost of National Grid group's HR function, relative to the number of people in our organisation. Our proposed costs are lower than peer median but higher than peer upper quartile. We know we have to work harder in the energy sector to create an inclusive working environment, and our HR function supports these actions.

Adjusting for the critical roles and employee benefits, HR costs were in line with Hackett's world class cost of function (i.e. companies which are upper quartile efficient and effective in their operations), consistent with the additional focus we place on inclusion and diversity activities that drive cost over and above more transactional-focussed functions.

HR costs are allocated across the National Grid group, based mainly on headcount, which reflects the size of each team in generating requirements from HR. There are some costs for the ESO that are allocated specifically and senior HR management costs are shared reflecting the focus across the different parts of the National Grid group. The ESO HR costs, excluding the £0.4 million per year of additional critical roles, is flat compared to the RIIO-1 average. This reflects an increased allocation of cost to the ESO based on our forecast headcount offset by the share of efficiencies.

## 12.1.3. Procurement

The procurement function helps our businesses negotiate and manage our contracts for goods and services. It also makes sure we comply with the laws on how we buy goods and services.

Investment has been made in National Grid group procurement to support efficiencies and cost reductions throughout the business through enhanced supplier management and management of tender processes. This has included the creation of a global procurement organisation across the National Grid group to take further advantages of economies of scale and expertise.

### ESO procurement costs in RIIO-2, £m

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |

The Hackett Group benchmarking study indicates that our procurement costs are in line with the upper quartile of their comparator group, demonstrating efficient spend in this area.

In line with the UCAM, procurement costs are mainly allocated using a four-point measure that considers various business factors (revenue, operating profit, assets and headcount). This is a recognised and established measure which reflects a fair allocation of costs across the National Grid group where a single measure might not be appropriate. Some separately identifiable costs are allocated specifically reflecting the area of the business they relate to.

The investments we will make in RIIO-2 relate to:

- Source-to-contract: this area of investment relates to the upgrades and refresh of systems that are required to enable maximum leverage and

management of procurement spend on goods and services. Capabilities include contract management, to provide easy access and real-time alerts to vendor performance; supplier relationship management, to track vendor interactions and drive consistency in how we interact with suppliers; and benefits management, to accurately capture and track value from strategic contracts and category management activities.

- Procure-to-pay: this area of investment relates to the upgrades and refresh of systems required to enable the integration of the purchasing function with the accounts payable function. Capabilities include supply management, purchase requisition, purchase order, receiving, invoice reconciliation and accounts payable.

### 12.1.4. Finance

Our finance function manages processes to record and report the costs, assets and other financial transactions of our businesses. It supports the Director of the ESO in his duty to ensure proper management by auditing key processes in the business, and manages our regulatory obligations, such as reporting our cost performance.

Finance has been a key part of the National Grid group change programme to reduce costs and improve efficiency. This has resulted in savings across the group from several activities across finance, including streamlining activities, outsourcing and reviewing the organisational structure to ensure processes are carried out efficiently in the right teams.

**ESO finance function costs in RIIO-2, £m**

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 7.7 | 3.2 | 3.2 | 3.2 | 3.4 | 3.4 |

In RIIO-1, there were some one-off costs which accounted for the higher average cost. For example:

- New Sarbanes-Oxley requirements (additional controls around financial information that companies who are listed in the US must comply with) meant additional work in this area. In readiness for this change in approach, the National Grid group conducted its own review of controls, resulting in a more robust control environment.
- The legal separation of the ESO required extra activity to set up the new ESO financial structures.
- The RIIO-1 costs also include the ESO's share of National Grid group regulation costs. These have not been allocated to the ESO since legal separation, as we now have our own regulation team.

Chapter 10 provides more detail on the shared infrastructure that underpins our financial systems, and the investments we propose to make in RIIO-2.

The Hackett Group benchmarking study indicates that the National Grid group finance costs are lower than peer median companies but higher than upper quartile efficiency. This reflects the additional focus on strong financial controls and are part of the group's Sarbanes-Oxley requirements. They also provide the strong level of assurance and governance required of a regulated business.

Finance costs are also mainly allocated also using the four-point measure considering various business factors (revenue, operating profit, assets and headcount) for the shared teams. Specific finance teams that support each part of the National Grid group business are allocated specifically, including for example the finance business partner teams.

## 12.2. Other shared service costs

We also pay for a share of these National Grid group services:

- corporate functions
- health, safety and environment team costs
- insurance
- other shared service capex

Corporate functions have improved their efficiency over the RIIO-1 period resulting in a £1.3 million annual saving on our RIIO-1 costs in RIIO-2. This has included the creation of a global communications team to support best practice and synergies across the group. This supplements the dedicated team supporting the ESO following legal separation. The change and strategy teams have also undergone restructuring to create a more agile team for change and project management to provide synergies across the National Grid group. Corporate functions were also affected by the sale of the gas distribution business and have created efficiencies to make sure fixed costs (e.g. legal and management teams) were not burdened on the remaining businesses in the National Grid group.

Insurance costs increased in some areas, including increased costs to protect for cyber security but this has been partly offset by premium savings and enhanced market conditions.

## ESO share of other shared service costs in RIIO-2, £m

| £m<br><br>opex | **RIIO-1 average** | **2021/22** | **2022/23** | **2023/24** | **2024/25** | **2025/26** |
|---|---|---|---|---|---|---|
| Corporate functions | 4.0 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| Health, safety and environment | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Insurance | 0.6 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 |

The National Grid group is seen as a key public institution and faces greater scrutiny from the public than typical companies. Our corporate affairs and communications functions play a vital part in discharging that role. These costs also reflect the increased governance and legal costs associated with the regulated environment we operate in. This includes a separate governance process for the ESO including the ESO Board that was created post legal separation, which we have delivered without an overall increase in corporate functions costs.

Corporate functions costs are also mainly allocated using the four-point measure considering various business factors (revenue, operating profit, assets and headcount) for the shared teams. Some costs that support each part of the National Grid group business are allocated specifically or using drivers that reflect the time and resource allocated to each part of the National Grid group.

Insurance is provided through our licenced captive insurance company[214]. Periodically, external consultants review the premiums considered achievable in the market for our risks, and compares these against premiums charged by our captive. This was last completed in 2019 and showed significant savings of over 30 per cent in our proposed premiums over RIIO-2 using our captive which the ESO will benefit from over the period.

Insurance costs are allocated specifically for premiums which are directly attributable to the ESO. An allocation of management costs is based on the four-point measure considering various business factors (revenue, operating profit, assets and headcount).

Heath, safety and environment costs reflect spending to ensure the wellbeing of our employees, the communities we work in and other stakeholders are considered in our policies and objectives. The proposed costs reflect the allocation from the National Grid group for spend in this area.

[214] A captive insurance company is one that is wholly owned and controlled by its insureds; its primary purpose is to insure the risks of its owners.

# 13. Driving focus on customers and stakeholders

## 13.1. Overview

Delivering against our plan for and with our customers and stakeholders will be vital to a successful RIIO-2 period. To help us in this aim we are evolving our stakeholder strategy for the RIIO-2 period. We also have a number of cross-cutting teams who support the outputs and services we deliver, both in relation to our customers and stakeholders and more broadly: Those teams include;

- Customer and Stakeholder
- ESO Regulation
- Business Change
- Assurance

Our proposed spend on these teams in RIIO-2 is around £30 million over five years.

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 4.5 | 7.7 | 6.3 | 5.6 | 5.6 | 5.5 |
| FTE[215] | 55 | 54 | 54 | 54 | 54 | 54 |

### 13.1.1. Our stakeholder strategy in RIIO-2

Our stakeholder strategy will build on our work during RIIO-1, including the engagement carried out in developing this Business Plan. Our ambition for RIIO-2 is to deliver an excellent experience and add value to our stakeholders[216]. We have stated in our ESO Mission that success by 2025 includes the ESO being a trusted partner. This means:

- **Building trust:** using solid expertise, delivering on our promises, building an improved understanding of our impact on stakeholder activities and objectives, and demonstrating our position as a neutral system operator.
- **Building partnerships:** to deliver projects, to lead the debate, to jointly solve problems and build value, and to set up the energy transition for success.

We will demonstrate that we are providing greater value for our stakeholders by making sure we have:

- a consistent approach to involving stakeholders in our business;
- stakeholder inclusive Business Plans and involvement in decision making; and
- an evolving approach as stakeholder expectations grow and evolve.

We will deliver this ambition through six work streams:

| Building an improved understanding of stakeholders | Improving the experience we provide | Measuring our progress |
|---|---|---|
| 1. Our insights and feedback strategy – a more holistic approach to continual feedback and data analysis, alongside improved stakeholder identification and segmentation to recognise their requirements and tailor our approach accordingly. This will also cover hard-to-reach groups and end-user consumers.<br>2. Our engagement and communications approach – ensuring that interactions become more regular, more collaborative and less "tell", plus we make them more tailored to the relevant audiences. | 3. Our culture and capabilities – develop a culture agreement, undertake a gap analysis and targeted improvement activities to ensure we drive stakeholder focus in all our activities, processes and business planning. This will be reflected in the way we reward and recognise our leaders and our staff.<br>4. Our digital technology – improving our stakeholders' digital experience.<br>5. Our customer journeys – Improving journeys through our processes; through mapping and optimisation exercises. | 6. Our performance data and metrics – developing a suite of key performance indicators (KPIs), including more leading indicators and cultural measures. These will be used to gather evidence against stretching targets and be benchmarked against best in class customer experience providers. We will also include evidence of where we have acted on stakeholder feedback. |

[215] Opex and FTE numbers are the average for the ESO since legal separation (years 2020 & 2021), which reflects the current ESO business. Capex figures are the average over the eight years of RIIO-1.

[216] For the purpose of this strategy we use the term stakeholder to refer to customers, stakeholders and consumers

Our approach to stakeholder engagement has recently been reviewed as part of our legal separation programme. This has included an external assessment and best practice identification (by Capgemini) alongside a review of stakeholder feedback during RIIO-1. This has helped us to identify the areas described above for future improvement as an important part of delivering our stakeholder ambition. We will continue to benchmark our approach through the RIIO-2 period through:

- regular reviews of best practice across the energy sector and beyond by the SO Customer & Stakeholder team
- using data and feedback from stakeholders to identify improvements they would like us to make
- ensuring our stakeholder engagement is recognised as upper quartile against external benchmarks through the AA1000SES health check.

We recognise that delivery of this ambition will require demonstrable and explicit leadership commitment. In addition to performance objectives and associated reward, there will be a governance structure through the ESO leadership team. This will be called the ESO Customer and Stakeholder Experience Board and it will be chaired by Fintan Slye, Director of the UK System Operator. It will:

- Set our Customer and Stakeholder Experience ambition and agree the strategy to get us there.
- Be accountable for customer and stakeholder performance, measured and monitored through agreed KPIs such as results of satisfaction surveys, metrics and incentives reporting. Also encourage challenge, potentially through the evolved ESO RIIO-2 Stakeholder Group (ERSG).
- Monitor delivery of plans against the agreed strategy.
- Approve the customer and stakeholder engagement plan.
- Approve the culture agreement and drive cultural change.
- Review recommendations relating to capability assessments and upskilling, and support delivery of this within teams.
- Review and escalate risks, issues or blockers.
- Share best practice and celebrate successes.

## 13.2. Customer and stakeholder team

The customer and stakeholder team provides strategic ownership and direction for our customers and stakeholders. We use the term customers to refer to industry participants who pay us money, such as use of system charges for the transmission network. We define stakeholders as people or organisations with any interest in, or influence over, what we do.

The team is responsible for our customer and stakeholder strategy. Activities include supporting implementation of the strategy across the business in a consistent and coordinated way; supporting teams to deliver the strategic goals by providing best practice advice, expert guidance, toolkits, training and upskilling; and monitoring engagement activities. This includes providing regular updates on customer and stakeholder feedback and performance, and supplying insight and improvements to ensure continual optimisation.

This team is also the owner of the customer relationship management (CRM) IT system. This system will provide a critical function in understanding what our customers and stakeholders require, both now and in the future, so we can develop our strategy.

There is a growing requirement for this team to consider our role in engaging and supporting end consumers in the energy transition. This is a relatively new focal point for us, and growth in this area will require a substantially different approach and skillset to those we have previously used.

### 13.2.1. What will this team look like in RIIO-2?

To support our RIIO-2 proposals, the team will increasingly become a more insight-driven and strategic function. It will work across the ESO to provide a consistent stakeholder and customer experience, overseeing the governance, engagement and measurement of this. We will also step up our role in representing and championing the consumer experience, in line with our mission.

The table below shows what we will deliver for customers and stakeholders in RIIO-2.

| | |
|---|---|
| **For customers** | • Ensure we offer an excellent customer experience, aiming to get it right first time across every touchpoint and service. This will include, for example, improved query management and data sharing, as well as better communication and engagement. We will also ensure that customers are increasingly involved in identifying and planning for changes to our processes and activities early in the development stages.<br>• Develop trusted partnerships with our customers.<br>• Understanding our customers' business models better, so we can better understand our impact upon them and help customers to be future ready. This will include educating and guiding them on how to take advantage of the energy transition. |
| **For stakeholders** | • The team will be responsible for making sure we are supporting stakeholders in driving the energy transition. It will use meetings and other touchpoints to ensure we are providing a balanced and knowledgeable voice to the relevant debates, lending expertise where appropriate and using our published insights and analysis.<br>• We will facilitate conversations with stakeholders, enabling a collaborative relationship through meetings and forums.<br>• The team will also make sure we are seen as a consumer champion by stakeholders, so we can be relied upon to provide the consumer perspective in all appropriate conversations. |

In addition to this, we propose stepping up our role in relation to end-consumer engagement. There is a need to support consumers through the energy transition, to help them take advantage of the opportunities it may bring, as well as to consider their own priorities and value drivers. Because of our unique position as a balanced and neutral ESO, we are well placed to take on this role. We will develop our presence as a balanced and neutral partner to consumers, becoming a consumer champion across the energy markets and providing data and marketing to enable behaviour change around energy use. This work is likely to be a long-term journey, particularly as progress on decarbonisation of heat and transport begins to impact more directly upon greater numbers of consumers. More information on our consumer engagement proposition is in the figure below.

### Salesforce CRM system

The Salesforce CRM system has been introduced across the ESO over 2018 and 2019. The majority of users have now been trained, and we are in the process of increasing adoption of the tool. This includes using this tool for logging and managing contacts, events, queries, complaints, resolutions, as well as feedback and insights. As we move forward into the RIIO-2 period, we will continue to refine our approach, using this tool in a variety of ways to better manage customer and stakeholder relationships through improved understanding, shared insight, analytics and reporting, and better processes. For example we will be introducing a new ESO connections process using the Salesforce platform. We will also seek to integrate CRM with other insight and data platforms that will enable us to better tailor our engagement approach to different groups and individuals.

| Consumer Engagement Proposition | |
|---|---|
| **We empower understanding of the energy transformation** | We will initially seek to partner with key suppliers and consumer groups to provide education support around energy use and the future of energy. Further along this journey we would seek to work closely with others in the energy industry, not least the DNOs, as the impacts and opportunities both nationally and regionally become clearer. |
| **We drive decarbonisation** | We will also help to drive the decarbonisation agenda at the local consumer level through provision of data and analytics, pushing decarbonisation messages through our various communications and publications and encouraging behaviour change around energy use. |
| **We champion the consumer** | We will measure and consider consumer value in everything we do, and in our interactions across the energy industry and beyond. |

*Figure 78: Our consumer engagement proposition*

Our intention during the RIIO-2 period is to partner with consumer organisations to raise awareness of future challenges and the need for consumers to change, as well as our role in supporting them and the wider industry through this process. This work will develop and evolve over the period as we build greater understanding of consumer value drivers and the likely extent and timings of the impacts of the energy transition, as set out below.

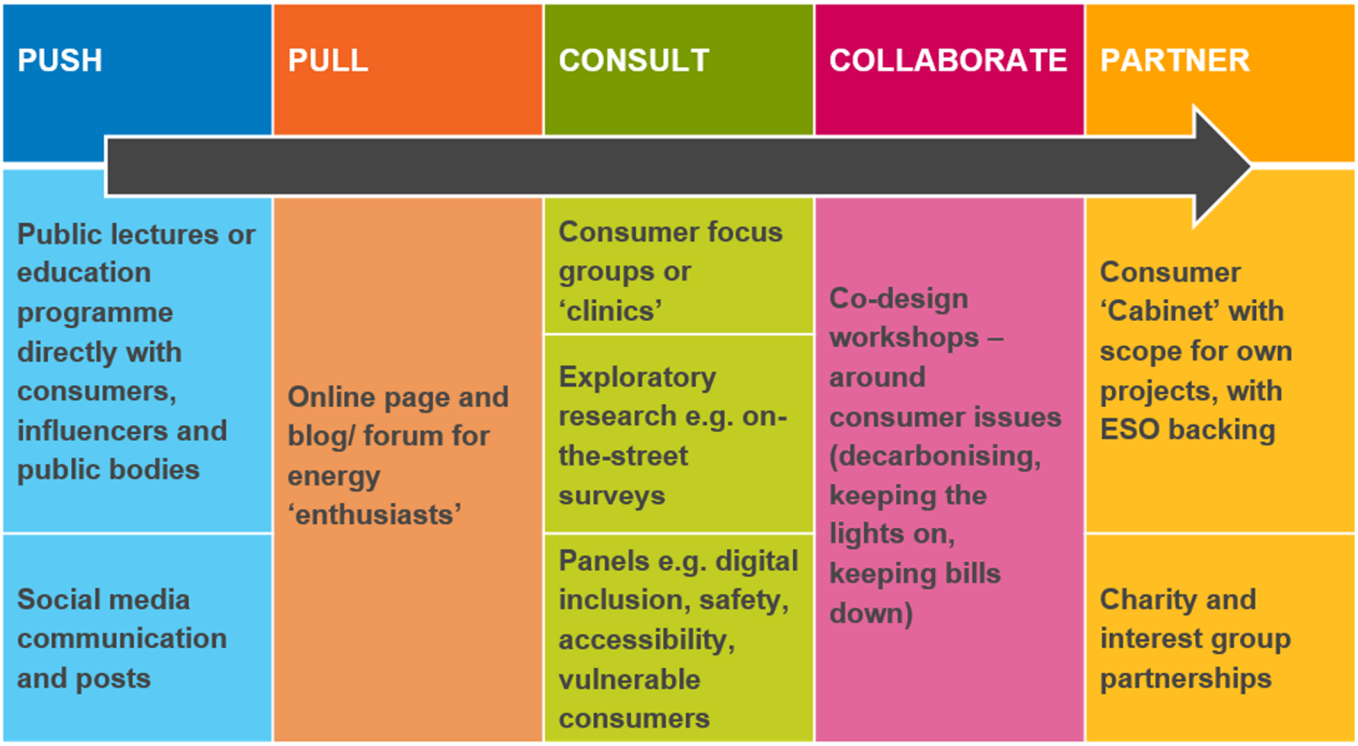



*Figure 79: Evolution of our consumer engagement role*

Delivery of this programme of work will be carried out by four new FTE within the customer and stakeholder team. There will be an additional requirement for funding for consultancy support and marketing and communications activity.

### 13.2.2. Costs

**ESO customer and stakeholder team costs in RIIO-2**

| £m | RIIO-1 average * | 2021/ 22 | 2022/ 23 | 2023/ 24 | 2024/ 25 | 2025/ 26 |
|---|---|---|---|---|---|---|
| Capex | 0.2 | 0 | 0 | 0 | 0 | 0 |
| Opex | 0.6 | 1.6 | 1.6 | 1.6 | 1.5 | 1.5 |
| FTEs | 9 | 13 | 13 | 13 | 13 | 13 |

*The lower RIIO-1 average cost reflects the fact that the team was set up in 2019-20 and has since been growing its activity in order to deliver our proposed expanded role in RIIO-2.

### 13.2.3. Stakeholder views

On being a consumer advocate, a consumer-interest body questioned how we might interact with consumer-advice organisations in this space, citing that other consumer organisations have different specialisms. A generator thought that we should consider direct engagement with consumers, but that it was not a priority. A consultant, meanwhile, was not sure whether we could be a consumer advocate without talking to consumers directly and building a level of trust.

We agree that it is difficult to become a consumer advocate without engaging directly with consumers but also acknowledge that we need to build capability in this area. Hence we propose to create a small team to start to build a relationship with consumers and we will work with consumer organisations as we develop our approach.

### 13.2.4. Measuring performance

#### 13.2.4.1. Performance metrics

**Metric 17 – Customer and stakeholder satisfaction**

**13.2.5.** We will supplement our assessment of our performance by undertaking customer and stakeholder surveys to ask how they would rate the experience provided by ESO colleagues. By doing this we will be able to understand how well each of our activities are meeting the needs of our stakeholders. Conscious of "survey fatigue" we will schedule these around key outputs and look to minimise burden on those we are seeking feedback from. Our baseline will be based on average survey scores taken for the last three years of the RIIO-1 period (i.e. 2018-19; 2019-20 and 2020-21 periods). As these scores are yet to be achieved, we will publish our final baseline and target scores during our first 2021-22 ESO performance report.

## 13.3. ESO regulation

ESO regulation is a new team, formed when we became legally separate from National Grid Electricity Transmission. It is responsible for supporting the ESO on all regulatory matters. This includes providing advice and guidance on regulatory issues and risks, as well as management of the NGESO licence and supporting all licence amendments. The team is accountable for all formal regulatory reporting under the price control arrangements and all regulatory engagement and reporting for our incentives scheme. It also supports the business on regulatory policy matters, including external consultation responses.

### 13.3.1. What will this team look like in RIIO-2?

The ESO regulation team will be fully accountable for all routine regulatory reporting and management of our incentives scheme under the new price control. At present, the nature of that reporting remains uncertain, because our new regulatory framework, including its incentive scheme, is yet to be finalised. The costs below reflect our assumptions about the resources needed to manage the proposed areas of:

- a shorter business-planning cycle, with a well-justified Business Plan required every two years
- ex ante[217] and ex post[218] reporting obligations
- incentive setting and reporting on a two-year cycle.

In addition, we hope to continue with an evolved version of the ESO RIIO-2 Stakeholder Group beyond development of this RIIO-2 Business Plan. We are currently exploring the potential remit with the Chair and members.

**ESO regulation team costs in RIIO-2, £m**

| £m | RIIO-1 average | 2021/ 22 | 2022/ 23 | 2023/ 24 | 2024/ 25 | 2025/ 26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 2.0 | 2.3 | 2.0 | 2.0 | 1.9 | 1.9 |
| FTEs | 19 | 19 | 19 | 19 | 19 | 19 |

We have held costs steady over the RIIO-2 period, with a slight cost increase in 2021-22 to reflect additional support required to embed our new funding model. Our staffing assumptions are based on the anticipated workload for two-year budget and incentive cycles and reflect the resources that have been required in RIIO-1 to manage our incentive scheme, regulatory reporting and RIIO-2 preparation.

[217] Based on forecasts rather than actual results.

[218] Based on actual results rather than forecasts.

## 13.4. Business change

The business change team is responsible for the identification, prioritisation, planning and delivery of business change programmes in the ESO. The team ensures all change programmes, projects and initiatives have robust business cases and trackable benefits. Activities include programme governance and assurance, change portfolio management and reporting, and delivery of business change programmes.

The team coordinates the business planning and prioritisation process across the SO. Activities include shaping a portfolio of changes to deliver ESO objectives and targets, performing business change impact assessments, managing the change pipeline, and assigning and managing resources. As a result of efficiency initiatives in RIIO-1, the business change team was moved to a hub and spoke model, with a smaller presence in the ESO linked to a central UK change hub. This provides a more flexible model that allows the business to leverage best practice and access a pool of change management professionals for deployment into prioritised programmes in ESO.

### 13.4.1. What will this team look like in RIIO-2?

To support our RIIO-2 outputs, the team will enhance our business planning and prioritisation process with increased focus on stakeholder, customer and consumer benefit. The team will plan and deliver key transformational and business change initiatives to enable the realisation of our RIIO-2 ambition. The reduction in FTEs from RIIO-1 to RIIO-2 reflects the move to the hub and spoke operating model as described above. Furthermore, the RIIO-1 costs include additional allowances for delivering the legal separation of the ESO.

We will undertake a programme of work to plan and deliver the key transformational and business change initiatives and the supporting culture and capability change needed to realise our RIIO-2 ambition. This programme will be responsible for ensuring the successful delivery of the activities proposed within our Business Plan.

This programme will be resourced from within our business change team, it will coordinate representatives from each of the Themes, HR, Finance and IT and will not require any permanent headcount increase. To support the delivery of the required change within each of the Themes we are proposing to create a central task force comprising seconded Theme representatives from across the ESO. These representatives will be responsible for ensuring the successful delivery of the change activities for their areas. They will engage with the local teams to ensure that the delivery is owned locally and processes are effective for both the teams who undertake them and stakeholders who interact with them.

The programme will be managed by a programme board that will bring together the delivery team and subject-matter experts who have developed the RIIO-2 proposals for the Business Plan, the ESO change team and IT. Our proposals and the stakeholder feedback we have received make clear that IT delivery is vital to ensure successful delivery of our ambitions. The inclusion of representatives from IT should ensure that delivery of our IT solutions is timely and fit for purpose. All three teams will work closely together during the last year of RIIO-1 to carry out further delivery planning of the activities and starting the delivery on items that will need to be undertaken immediately to ensure that they are delivered in the timescales proposed within the Business Plan. This programme board will also interact with the design authority to ensure that proposals and activities are fit for purpose both for stakeholders and the ESO, the design authority will also provide input to changes to scope and cost to ensure that the most effective solution is being delivered at the right cost.

When representatives from across the ESO are seconded into the task force we may on occasion provide backfill resource for the teams they have come from. To accommodate this, we have included the costs for short-term backfill requirements, most likely through contingent resource, to ensure that we maintain our high standard of delivery while delivering the change. We have calculated this to equate to £0.4 million in both the first and second years of RIIO-2. We will revisit these costs and make proposals for years three to five in our next Business Plan.

To support our lean core delivery team on certain projects or deliverables we will require short-term access to specialist capabilities which we may source externally. We anticipate in that this support will cost £1.2 million the first year of RIIO-2 with an additional £0.2 million in the second year. Again, we propose to review these costs after the first two years of RIIO-2 to agree the best approach for years three to five.

In order to ensure the organisation is ready and able to deliver we will put in place our RIIO-2 programme delivery team in January 2020 which will start to take delivery responsibility from the RIIO-2 development team during the next financial year and will specifically focus on the preparation for delivery in RIIO-2. This activity will be resourced in the first instance from within the ESO change and RIIO-2 development teams.

Our preparation will start by creating detailed and prioritised delivery plans that understand what delivery activities need to be undertaken ahead of April 2021 in order to meet our proposed RIIO-2 delivery timelines. We will need to ensure that this activity also has enough flexibility to respond to and reflect any changes to our Business Plan arising through draft and final determinations.

As identified in Theme 1 we will have already established our design authority in RIIO-1 and this will be a key interface for the delivery programme team as we establish greater detail on our IT deliveries during the last year of RIIO-1. We will operate closely with the design authority as we are preparing for the delivery of

RIIO-2 to ensure that our approach is aligned to the needs of stakeholders.

As part of this preparation programme we will also be building on the work identified within chapter 14 – People, culture and capability to prioritise the key capabilities that we need to bring into the ESO and scoping our approaches to recruitment as appropriate. For specialist capabilities we envisage running specific recruitment campaigns to enable us to upskill the organisation quickly and effectively. Once we have a greater clarity on our RIIO-2 requirements from the draft and final determinations we will begin recruitment to be ready for the start of RIIO-2.

**ESO's Business Change team costs in RIIO-2, £m**

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 0.9 | 2.5 | 1.5 | 0.9 | 0.8 | 0.8 |
| FTEs | 16 | 8 | 8 | 8 | 8 | 8 |

### 13.5.1. What will this team look like in RIIO-2?

The insight and independence that ESO Assurance brings provides an invaluable safeguard across our complex and changing operating environment. In our RIIO-2 Business Plan, we have provided for some small growth in ESO assurance. This is being driven by our ambitious commitments, increasingly demanding stakeholder expectations and a demand for specialist experience, alongside the need to attract the right calibre of core internal auditors into our in-house assurance team. Our costs also include around £200,000 annual legal and professional fees for external audits, data system and safety licences.

**ESO's assurance team costs in RIIO-2, £m**

| £m | RIIO-1 average | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |
|---|---|---|---|---|---|---|
| Capex | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Opex | 1.0 | 1.3 | 1.3 | 1.3 | 1.2 | 1.2 |
| FTEs | 11 | 14 | 14 | 14 | 14 | 14 |

## 13.5. Assurance

The ESO Assurance team embeds frameworks and tools and builds capability that assures we are managing risk and meeting our obligations every day. This includes delivery of independent, risk-based assurance activities across the ESO.

There are four teams in ESO Assurance covering risk, safety, audit, and data and compliance. Their role is to inform, protect and strengthen every aspect of our business; from people to performance, systems to strategy, business plans to business resilience.

# 14. People, culture and capability

## 14.1. Five-year strategy: our people ambition

As a service organisation, our most important resources are undoubtedly our people. Operating the system of the future and delivering our ambition and goals for 2025 successfully will require us to have the right people and capabilities in place to help us deliver this successfully. Our success at delivering is built on our sustained ability to attract, retain, train, motivate and engage our people. Therefore, to deliver the full commitments of our RIIO-2 Business Plan, we require a resilient, agile, capable and diverse workforce.

We will develop and extend our position as being a customer service and asset-light organisation today, to a more technology- and data-led ESO tomorrow. Given the pace with which the energy industry and our role at the heart of it will change, our people will need to be comfortable working with ambiguity and in a rapidly changing environment.

Power system engineering will remain at the core of our organisation, however advanced analytics and data management skills will be increasingly important and will require a significant shift in capability similar to other industries. Alongside these, customer-focused, stakeholder and commercial capabilities will remain critical.

Furthermore, we recognise the increasing importance of IT delivery capability to enable us to achieve our ambitions. As we work with industry to deliver IT systems infrastructure necessary to enable the energy transition, we will ensure we equip our teams with the right skills to drive projects in an agile, iterative manner, realising value as soon as possible

Our proactive strategic workforce planning, has meant that we can identify any emerging future workforce and capability gaps and risks and mitigate against them. We will be implementing a blended sourcing strategy to fill the gaps. This means we will continue to 'grow our own' workforce for our critical roles through our successful trainee intake; this builds a pipeline of resource and future capability. This will be supplemented by, external direct hires to help fill new and specialist roles as required. In doing so we will look to recruit a diverse workforce representing the industry we operate in.

We will continue to invest in training our existing workforce and building capability as identified through employee development plans and capability diagnostics.

Today, we have a strong engaged workforce to leverage going into RIIO-2. In order to achieve our ambitious Business Plan, we need to transform our business and take our employees along this change journey by continuing to adapt our ESO organisational culture. We are looking to make a number of key behavioural shifts, for example, leading by empowering, embracing an enterprise and collaborative mindset, operating with agility and flexibility and balanced risk taking and speedier decision making. These shifts are supported by our stakeholders and will be reflected and reinforced across all elements of our operating model to ensure everything including leadership tone, governance, processes and systems support our desired end-state culture.

In order to turn ideas into action, to deliver our vision and ambitious Business Plan, we will attract, develop and enable the next generation of climate change leaders. We will look for people to join us to work on "the job that can't wait".

**ERSG supports our People, culture and capability proposals.**

"The chapter shows the company's understanding of current culture vs. where they need to get to. Could still add additional detail on change management aspects."

### 14.1.1. Stakeholder feedback

Through our conversations with a wide range of stakeholders, talking with trade union representatives and feedback from our ESO RIIO-2 stakeholder group, we were asked for additional detail on:

- our existing and future capabilities requirements
- our organisational culture today and how it needs to evolve to support our Business Plan
- how we will source the required people and capabilities
- how we are confident in the deliverability of the RIIO-2 plan.

In this chapter, we have provided as much detail as is feasible and proportionate, noting that allocations of teams to Themes is an estimation. It is important to understand that Themes do not exist in isolation. The key to success lies in people collaborating and working across Themes.

Where we have not been able to respond to stakeholder feedback, explanations have been captured in Annex 3 - Stakeholder report.

### 14.1.2. People and capability trends

Our workforce is made up of four different generations, which brings great diversity of thought and requires targeted management to ensure different needs are met. To appeal to different employees, we must review our people value proposition, especially in areas such as onboarding, employee development and retention to ensure we overcome the challenges of the future. Today employees have a greater choice of jobs, career fields and employers than ever before.

The major trends which may affect the ESO include:

- The rapid pace of change and technological advancement means that it is often difficult to predict the future skills required. The pace will not be slowing, so we need to accelerate deployment of our existing capabilities yet remain alert and pivot quickly in response to new requirements.
- Despite steady improvements in our higher education systems, the competition for science, technology, engineering and maths (STEM)-qualified workers is ever increasing. New technology further drives this demand across all sectors.
- The 'gig economy' is growing. Organisations will be increasing their interactions with independent workers for short-term employment engagements.

We want to make sure we can source and maintain a capable workforce to deliver the requirements in this Business Plan. We will:

- refine our people value proposition so we remain an attractive employer
- increase collaboration and communication with education providers
- consider what type of contract is most suitable for which roles and required skills.

## 14.2. Our people profile

### 14.2.1. The 2020/21 workforce: our starting point

We forecast that by the end of March 2021, we will have a workforce of approximately 620 full-time equivalent (FTE) employees. The average age of our workforce is 40. This means that by the end of the RIIO-2 period, we estimate that five per cent of our current workforce will reach retirement age (including six per cent of all our engineers). Combined with our historic attrition rates, we anticipate a people turnover of 18 per cent by 2026.

In line with our workforce trends, we applied the following age band attrition rates:

| Age band | Attrition |
|---|---|
| 20-29 | 9.5% |
| 30-39 | 7.9% |
| 40-49 | 1.4% |
| 50-59 | 1.1% |
| 60-69 | 0.0% |

Looking at the FTE profile requirements for the Business Plan against the current workforce (adjusted with forecasted retirement and attrition rates for the RIIO-2 period), we anticipate a recruitment gap as shown in the figure below.

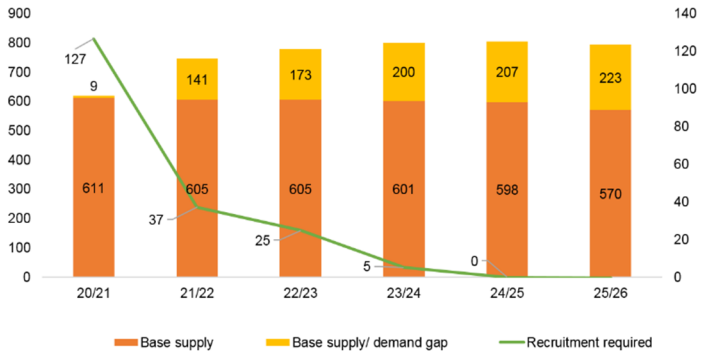



*Figure 80: Anticipated people demand and supply profile*

## 14.2.2. Our estimated future people profile

- We recognise that to deliver the Business Plan, the balance of people and skills will have to change. Over half of the additional FTEs required for 2021 will be roles working on: EU codes engagement, transforming balancing markets, market platform related activities, data stewardship for the open data platform, policy-related activities and system operation innovation. Throughout the RIIO-2 period, we will also be increasing our resources in our control room and those involved in the transforming the code modification process.

Below is an overview of the range of FTEs (approx.) allocated to each Theme and cross-cutting area. Many roles will be working across Themes.

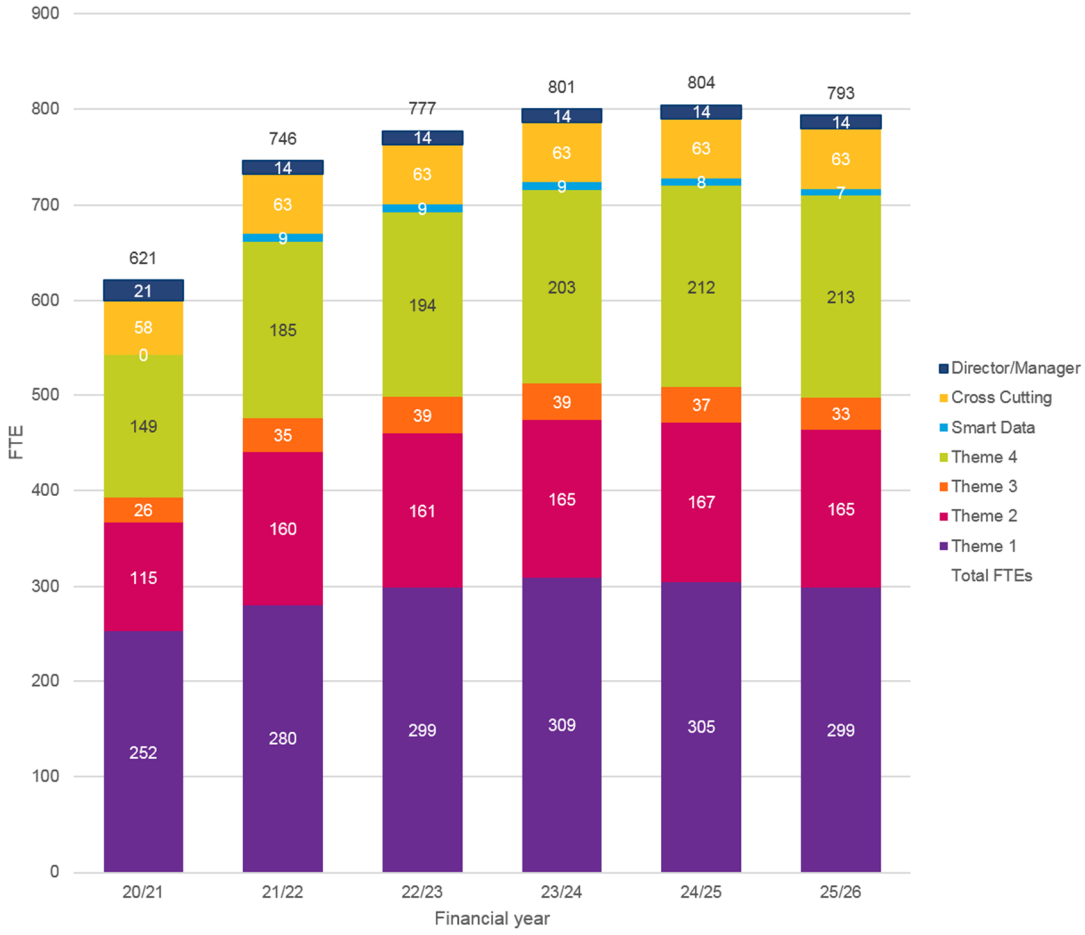



*Figure 81: Estimated people profile by Theme*

Due to the peak increase in 2021/22, there will need to be a strong recruitment drive ahead of the commencement of the RIIO-2 period.

The tables below provides an overview of activities employees will focus on in each Theme and the key capabilities required. More detail on the capability shift is provided in section 14.3.

## Theme 1 Reliable, secure system operation:

As we transition to a low carbon energy system, the control engineers of the future will have to extend their current power system engineering skills to include expertise in data analytics and technology. This will allow them to better understand the performance of the system and make best use of the significant increase in data from those connecting to and using it. This will transform our system balancing and decision-making capabilities, and ensure we continue to make the right decisions in a highly complex energy environment.

### Areas of focus:

- expand and transform our Control Centre architecture and systems
- transform training and simulation
- system restoration.

### Key capabilities required (not exhaustive list):

- power system engineering
- data management
- advanced analytics to increase situational awareness
- customer- and stakeholder-facing capabilities.

## Theme 2 Transforming participation in smart and sustainable markets:

We will design the future markets, codes and charging arrangements that embrace industry advancements and maximise benefits to consumers.

### Areas of focus:

- build the future balancing service and wholesale markets
- transform access to the capacity market
- develop code and charging arrangements that are fit for the future.

### Key capabilities required (not exhaustive list):

- customer- and stakeholder-facing capabilities
- innovation with a commercial mindset
- economic analysis and modelling
- data analytics and predictive analytics using machine learning
- IT project sponsorship and delivery.

## Theme 3 Unlocking consumer value through competition:

We will continuously build on our successful *Network Options Assessment* approach to facilitate competition across all dimensions.

### Areas of focus:

- embed the Network Development roadmap enhancements
- extend and enhance the *Network Options Assessment* approach
- undertake, with industry, a review of the Security and Quality of Supply Standard (SQSS)
- support Ofgem to develop its thinking on competitively appointed transmission owners.

### Key capabilities required (not exhaustive list):

- economic analysis
- data management and analysis, programming capabilities
- customer- and stakeholder-facing capabilities.

## Theme 4 Driving towards a sustainable whole energy future:

We will increase strategic insights in the policy space to support the development of a smart, flexible energy system. This will include a clean-heat strategy and a pathway for ensuring the operability of a zero carbon electricity system.

### Areas of focus:

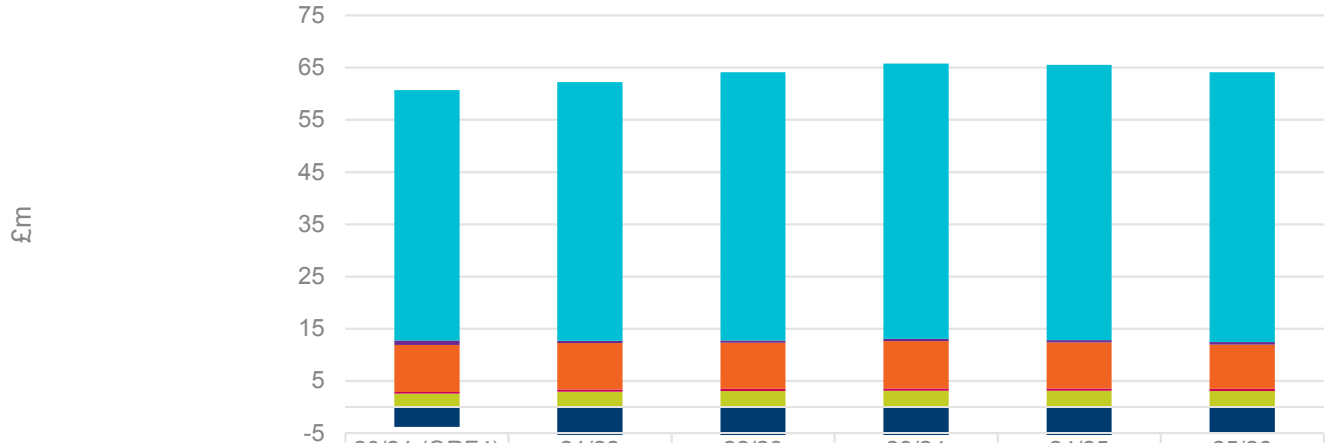
- leading the debate on decarbonisation of the Great Britain energy industry
- working more closely with Distribution Network Operators (DNOs) and Transmission Owners (TOs) to streamline the connection process
- defining a pathway for zero carbon, whole system operability
- developing a whole system approach to accessing electricity networks.

### Key capabilities required (not an exhaustive list):

- economic analysis and modelling
- data management and analysis
- customer- and stakeholder-facing capabilities
- leading the debate.

### 14.2.3. People costs

Below are our expected people costs in RIIO-2, in alignment with the current estimated FTE profile. We will continue to undertake measures that make sure our staff costs provide value for consumers while remaining an attractive employer.




| | 20/21 (QRF4) | 21/22 | 22/23 | 23/24 | 24/25 | 25/26 |
|---|---|---|---|---|---|---|
| Salary Costs, NI, Shares | 47.9 | 49.5 | 51.3 | 52.7 | 52.7 | 51.7 |
| Overtime | 0.9 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Pension | 9.0 | 8.9 | 8.8 | 9.1 | 8.8 | 8.4 |
| Training | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Other people costs | 2.58 | 2.93 | 3.02 | 3.10 | 3.10 | 3.06 |
| CAPEX* | (3.8) | (5.4) | (5.5) | (6.3) | (5.6) | (4.9) |
| Total OPEX | 60.65 | 62.19 | 64.09 | 65.74 | 65.53 | 64.11 |

*Figure 82: Key people costs. These costs are one element of the total business opex, the costs only relate to staff cost (e.g salary, training etc).*

* People capex = timesheeting to capex project delivery.

## 14.3. Our capabilities

In many ways, we will be undertaking the same activities as today, but requiring new skills to tackle new challenges. For example, power system engineering will remain core, while we need to strengthen capabilities in data analytics, commerciality, IT delivery and leading the debate to meet new system operation and market demands. With accelerating change, increasing uncertainty, ambiguity and cross-industry dependency, our future workforce will require a more blended capability profile.

### 14.3.1. Capabilities to deliver current activities

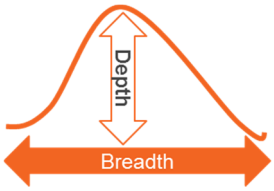
Two-thirds of our current workforce is comprised of engineering capabilities (mostly electrical network control engineering) and commerciality (mostly commercial operations, market development and energy trading).

We have also been increasing our strategic, customer and data capabilities during the RIIO-1 period to develop our role as a legally separate ESO in a fast-changing, consumer-driven energy industry.

The capabilities we have today will continue to be important, but they will need to evolve while we develop new capabilities detailed in the next section.

### 14.3.2. Our future capabilities

System operation of the future will become more complex, inter-dependent and ambiguous. As a result, our employees will require both a breadth and depth of capability in terms of skills, knowledge and experience. This is particularly true for the key capabilities needed across the ESO: power system engineering, data and analytics, commerciality, IT delivery and leading the debate.




- **Depth** - Primary capabilities at advanced or expert level
- **Breadth** - Mixture of secondary capabilities at foundational or skilled level

*Figure 83: Capability model*

We have described below why it is important for us to focus our attention on these five organisational capabilities. We considered what does that capability look like in the context of the ESO, and the shift in people skills required to achieve it.

| **Capability** | **Power systems engineering** |
|---|---|
| **Why** it is important | To meet the increasing complexity of managing system operability and the new challenges presented by rapid decentralisation, technological development and changing system dynamics. |
| **What** it means for the ESO | Core power system engineer capabilities will remain essential, both in terms of planning ahead of time and managing the electricity system in real-time.<br>Power system engineers (PSEs) of the future will have to be increasingly data literate and situationally aware as available data grows in volume, variety, velocity and veracity. They will be required to understand what this data tells us about the behaviour of the power system and its users, so that they can take actions that are cognisant of the impact on the whole electricity system and beyond.<br>The ability to engage stakeholders and collaborate with others will become more relevant, to work with not only the DNOs to manage networks across voltage levels, but also with policy makers and multi-vector players to understand broader impacts and maximise consumer benefit.<br>This capability will be increasingly competitive to source within the industry, as the development of distribution system operation will also drive demand for PSEs. |

| **Capability** | **Data and analytics** |
|---|---|
| **Why** it is important | To use data to provide the rapid and automated predictive insights required, providing value for system operation and market participants. |
| **What** it means for the ESO | This capability includes data science, analysis, modelling and programming capabilities, working with machine learning algorithms and artificial intelligence, knowledge of statistics and neural networks.<br>This capability will enable us to improve our use of data throughout the timescales in which we operate. Closer to real time, we will be better able to develop forecasting models for generation and demand (such as our recent machine learning innovations for Solar PV forecasts).<br>We will be able to derive greater insights into system behaviour and use this to support the development and use of our balancing services to meet those operational needs. Further, we will be able to deploy these capabilities to support and improve our longer-term insights through our *Future Energy Scenarios*, *Network Options Assessment* and system operability analysis. We will consider creating a central resource/centre of expertise to develop and share best practice, but it will be important to also have these capabilities embedded within certain teams.<br>This capability will be required to successfully drive innovation in system operation.<br>We recognise this is a scarce and highly sought-after skill. You can find more detail on how we will source it in section 14.4. |

| Capability | Commerciality |
|---|---|
| **Why** it is important | To understand and optimise commercial agreements and market solutions, driving value for consumers while meeting complex operational needs. |
| **What** it means for the ESO | Commerciality will need to be augmented so the needs of the power system can continue to be sourced through competitive processes. This capability will include:<br>• understanding of commercial frameworks and markets<br>• ability to balance requirements, e.g. of stakeholders, consumers and shareholders<br>• negotiation skills to find the lowest sustainable cost solutions to operability and network development challenges, where competitive procurement mechanisms might not be feasible.<br>This will cover, for example, the need to develop commercial terms for new balancing services and design new markets to meet emerging requirements, while broadening the access to existing services so that they can accommodate many new, smaller providers likely to require closer-to-real-time procurement (such as through auction processes).<br>It will also cover the assessment of a range of ways to meet network development requirements, e.g. by comparing traditional asset build to other more service-based solutions from those that connect to networks. This activity will increase in both scale and scope during the RIIO-2 period. |

| Capability | Leading the debate |
|---|---|
| **Why** it is important | To enable the energy transition through facilitating industry collaboration, taking a distinctive and leading voice, proactively engaging with stakeholders to progress conversations on key topics and support decisions across industry and policy, in the best interests of consumers. |
| **What** it means for the ESO | Our people will need to employ subject matter and content expertise, demonstrating strategic thinking across the energy landscape, to articulate the wider energy market needs, to be able to persuade and influence stakeholders. This includes:<br>• having a clear understanding of the regulatory environment, energy markets (including trends and drivers beyond the implications of the Future Energy Scenarios), the wider business context of industry participants, and so the impact of decisions on them can be better understood<br>• being able to effectively communicate the need for change and influence stakeholders and take them on a journey<br>• having the strategic capability to see the bigger picture with an ability to translate this into robust deliverables and plans to drive delivery<br>We are creating roles that are fully dedicated to leading the debate activities. |

| Capability | IT delivery |
|---|---|
| **Why** it is important | This enables digitalisation, one of the key precursors of a more flexible, smart and sustainable network. During the RIIO-2 period, we will invest in our systems and digital capabilities, necessary to ensure continued efficient system operation to drive value for our stakeholders and consumers. |
| **What** it means for the ESO | As referenced in the chapter 10 – Technology underpinning our ambition, to move to a world of 'digital as a differentiator', we will need to strengthen our IT delivery capability across the ESO.<br>For our people, this means being able to<br>• interface with large IT transformation programmes, translate business requirements into IT technical requirements and vice versa<br>• deliver projects iteratively, incrementally, to high standards of quality, on time and within budget that meet the high levels of complexity, operational need and level of dependency across the industry<br>For our IT function, this means building the technical depth and leadership capabilities to enable us to execute on our focus of being a technical thought leader. To achieve this, we are creating |

a stronger bias towards in-house capability. More detail on how we will source it is in section 14.4 3.

We will also increase the cyber awareness of all ESO employees, who will not only be compliant but vigilant about potential cyber threats and social engineering.

Our IT transformation programme will apply the Scaled Agile Framework (SAFe) [219] and Agile scrum and we will need to ensure our leaders are equipped to work in this environment.

This capability, especially, will require a culture shift towards more agility, flexibility, and ability to absorb change, to be sustainably embedded.

We provide more detail on our IT capability later in this chapter.

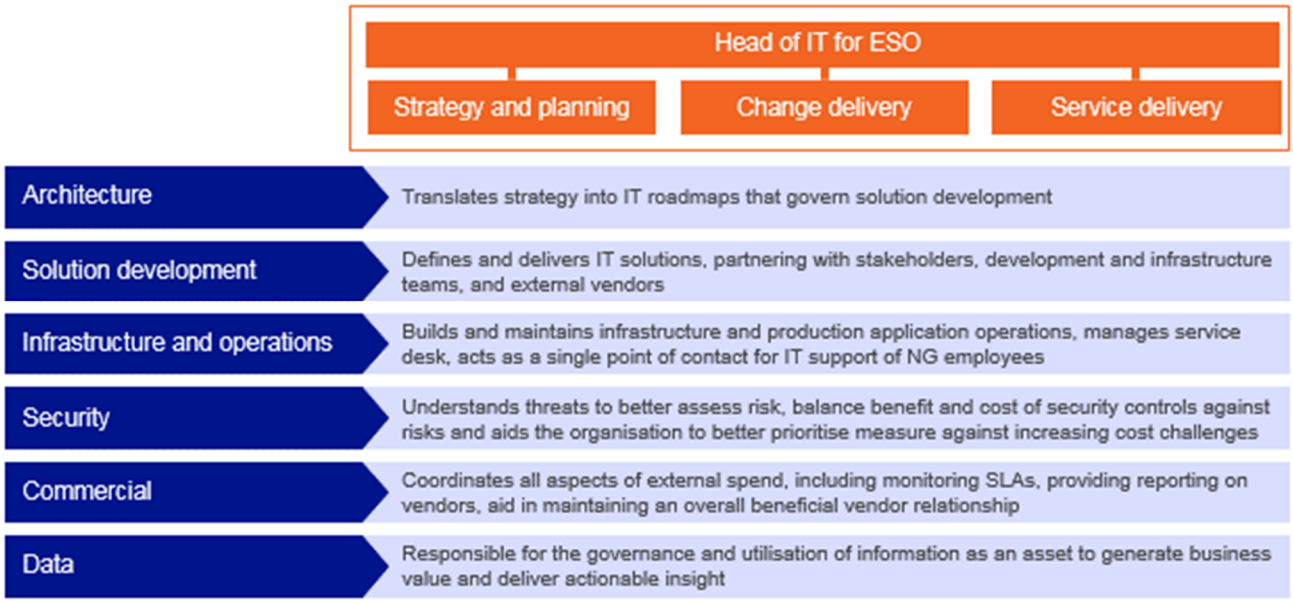
*Figure 84: IT shared services provided by National Grid group IT*

We will also need to enhance our existing capabilities;

- **Innovation:** Our leaders will need to have innovation hard wired into their everyday activities. The innovation team will continue to be the specialists, enabling us to pursue necessary projects that have the potential to disrupt and create a step change towards reaching the net zero target by 2050.
- **Change Management**: Given the level of change occurring across the energy landscape and within the ESO during the RIIO-2 period, the capability needed from our leaders and senior staff members will be to lead, enable and empower our people through periods of uncertainty.
- **Stakeholder engagement**: Given the increasing inter-dependency within the energy system, the ability to create long-term sustainable partnerships with stakeholders, use a systematic approach to proactively engage and collaborate with them and become a trusted partner will become progressively more important.
- **Economic analysis**: Our SMEs will be required to balance their focus on power system analysis with the economic performance of the system, so consumer benefit is maximised.
- **Leadership:** We will be empowering and enabling our leaders to set direction and the tone that reinforces our culture. We will continue to invest in our leadership development over the RIIO-2 period.

### 14.3.3. Dedicated IT resources within a shared service model

As covered in chapter 10 – Technology underpinning our ambition, the dedicated ESO IT team will use the National Grid group IT function for IT products and services as required. By centralising common capabilities, such as end user computing (laptop and desktop services, email, etc) and application support services, we benefit from the economies of scale that the group offers and avoid duplication of resource and solutions.

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[219] https://www.scaledagileframework.com/

Stakeholders have questioned how we can provide confidence in large-scale technology delivery with no direct reporting line between the ESO leadership and the IT function. The feedback focused on whether the requisite levels of control could be exercised to ensure successful delivery.

We believe this concern is mitigated through the structure we introduced in August 2018 that provides a dedicated ESO IT team which focuses on strategy and planning, change delivery and service delivery. This team is dedicated to the ESO, led by the Head of IT for the ESO. This model allows the ESO IT team to focus on specific ESO requirements which are different to those of the wider National Grid group. It also allows the ESO IT team to scale quickly and efficiently through the broader National Grid group IT function.

The Head of IT for the ESO has direct control over a team that is responsible for strategic engagement and planning, change delivery, and service delivery. This team draws on resource from the wider National Grid group. This resource is dedicated to the ESO where there is a high dependence e.g. critical national infrastructure, or leveraged where the requirement is more generic. This is set out in the figures below.

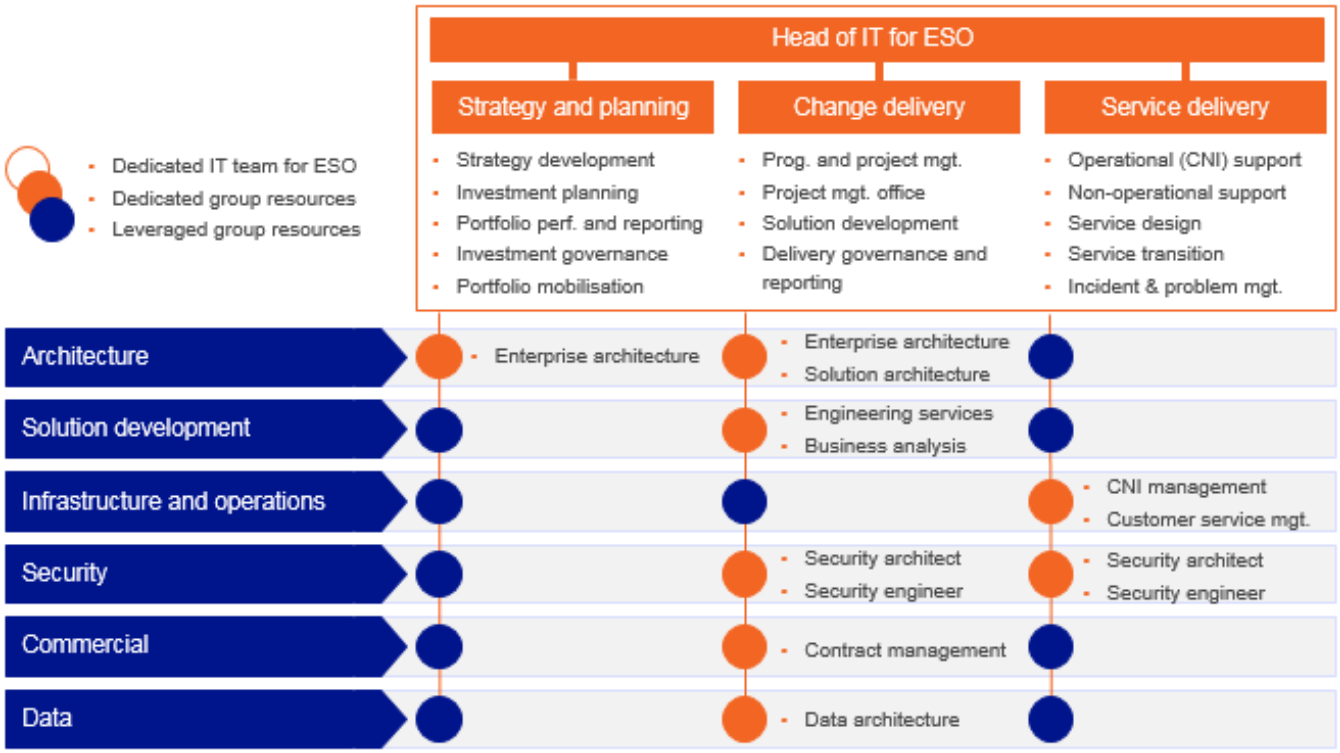


*Figure 85: IT resources that are dedicated to ESO and where services will be drawn from the wider National Grid group.*

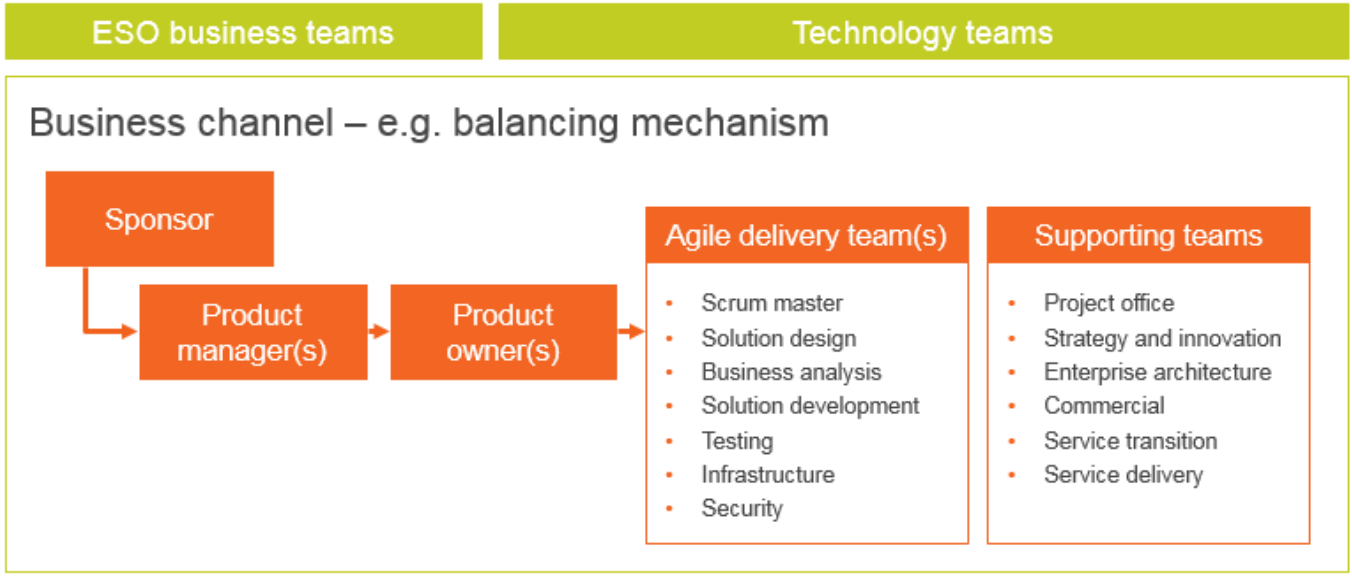


*Figure 86: An example agile delivery team for a business channel*

We are committed to building the technical depth and leadership capabilities to enable us to execute on our focus of being a technical thought leader. We have a programme committing our IT teams to a minimum of 40 hours of training per person per annum.

### Technology capabilities

To enable the ESO to achieve the ambitions that drive value for our stakeholders and consumers, scalable, agile IT delivery teams are fundamental in the successful implementation of technology solutions. The following roles are being developed in addition to our current capability to enable our transformation towards agile delivery, as illustrated in the figure above.

*Scrum Masters* – we utilise a large base of project managers across the delivery of our projects and programmes. As we have transitioned to a greater use of agile, we have invested in the role of scrum master. This is a facilitation role that coordinates the sharing of information across the agile development team. It is a transition from the traditional project manager role, as it acts as a servant leader, promoting team communities and shared decision making. In conjunction with the agile coach we are accelerating our transition towards an agile delivery culture.

*Agile Coach* – we are investing in agile coaches across the IT portfolio, to accelerate our cultural and process transformation. This role is necessary, particularly in the medium term (18-24 months) to ensure we embed the techniques and discipline of agile in the DNA of our delivery portfolio. This role will also allow us to train our teams and new joiners in an efficient and effective manner.

*Product Owners* – as our adoption of agile increases we are upskilling our business subject-matter experts to become product owners. This role transforms the traditional role of business lead to become more active in the development of products and services. The product owner operates as a dedicated delivery role, providing the vision, priority and interface between IT and the business across projects and programmes. This role is critical to ensure our delivery initiatives continuously align to the needs of our customers and stakeholders.

*Product Managers* – we are extending the role of our IT strategy analysts to manage and oversee the full lifecycle of IT products and services. This role will ensure there is integrity between the strategic ambition, delivery and service life of our products and will ensure it maintains the interests of our internal and external customers and stakeholders as requirements and capabilities mature.

## 14.4. How we will attract and retain our talent

We have identified gaps in capability and capacity and are confident we can fill both with a blended sourcing strategy, using our unique people value proposition.

### 14.4.1. People value proposition

Our mission is to enable the transformation to a sustainable energy system and ensure the delivery of reliable, affordable energy for all consumers. This provides an exciting employee proposition, which helps us attract and retain new talent. Our employees have a strong purpose as they can anchor their contribution to the energy transformation at such an exciting time.

Our people value proposition is focused around:

- **Our purpose** – being at the heart of the energy transition and driving real change within the industry.
- **Our development opportunities** – continuing to invest in our people, in line with our ‘grow your own’ and STEM strategy.
- **Our inclusive and diverse environment** – welcoming diverse talent and diversity of thought in an inclusive environment representing the communities we serve.

- **Our strong focus on health and well-being** – looking after our people so they can perform to the best of their abilities and deliver outcomes for consumers.

### Sourcing an inclusive and diverse workforce

Our workforce will be representative of the communities we serve in all aspects of diversity.

- Increased diversity will make employees feel included. This improves wellbeing and enables us to deliver better outcomes for our customers and stakeholders when we better reflect communities internally.
- Being a socially-responsible employer, inclusion and diversity are important to us because by being diverse we amplify the range of ideas and innovation that our people can generate as well as enabling our people to thrive in a culture that represents the communities we serve.

The National Grid group has seen positive progress in inclusion and diversity (I&D). Our workforce demographics are becoming more diverse, and we have been recognised externally as leaders in this area – with our inclusion in The Times Top 50 Employers for Women.

Some 31 per cent of the workforce in the ESO are female, and 24.6 per cent of the workforce are black and minority ethnic (BAME). There is still more to do. Our ambition is to achieve greater gender parity in recruitment for engineering roles through growing and broadening the potential candidate pool, attracting females to apply for our engineering/STEM roles, demonstrating inclusive recruitment and onboarding processes, and retaining and developing our female talent. The strategic drivers to meet our I&D ambition are to:

- continue to build on our success to-date, evidenced by increased external recognition and our gender and BAME diversity progress.
- seek to attract diverse talent by being visible and appealing to a variety of potential employees.
- offer equal opportunities for everyone at ESO to develop and advance throughout the organisation.
- continue to work on inclusive leadership to raise awareness of our own biases, and seek out and consider different views and perspectives to inform better decision-making.

### Focus on health and wellbeing

We have three aims in this space:

- A workforce where healthy, engaged and supportive employees can succeed and thrive, including with the demands of shift and operational working.
- A culture that enables everyone to perform to the best of their abilities, knowing they are well cared for and can talk openly about their health and wellbeing.
- Recognition as an employer that champions employee wellbeing and this enables us to attract and retain the best talent around.

## 14.4.2. Pay and reward strategy

The ESO has a pay-for-performance philosophy. Our objective is to have a pay and reward strategy that is fair, competitive, sustainable and ensures the right value for consumers.

Senior management pay and reward is linked to achievement of personal objectives and the ESO performance scorecard. The set of personal objectives will include achievement of the commitments in the Business Plan. Furthermore, their bonus has five measures; one relates specifically to ESO incentive performance and another relates to customer satisfaction.

We carry out market benchmarking to make sure our compensation and benefits programmes remain competitive. Our aim is to be at the market median position in relation to our comparator group. The last review, conducted in 2018, showed that total cash remuneration is in line with median pay for a comparator of 130 entities in the utilities, oil and gas, and chemical sectors, with an average comparison ratio of 101 per cent.

We also benchmark individual role salaries annually and have established pay mechanisms to increase salaries where required, to close any capability gaps that we face, such as for specialist roles included on the government's Shortage Occupation List. Our assumptions for real pay growth during the RIIO-2 period are based on historic experience and external evidence. They will be refined as we receive more economic data. We work with the trade unions and employees to make sure we balance the requirement for cost efficiency with motivating employees, so the skills we require are available into the RIIO-2 period.


*Figure 87: Sourcing strategies*

We are continually looking to grow our own talent in core STEM areas through our higher apprenticeship and graduate programmes. To support the transformation of our organisation, we will supplement this approach by hiring new talent from the external market to fill gaps for emergent, scarce or urgently needed skills. Some of our core roles have a scarce talent pool and are recognised on the shortage occupation list in the UK. Where required we make use of the General Work Visa (Tier 2).

In addition, to maintain flexibility and manage peaks and troughs in our workload, we will continue to supplement our core workforce with contingent labour through dedicated managed service providers.

## 14.4.3. 'Grow your own' talent

Given the shortage of STEM talent, we aim to:

- attract talent by further enhancing our reputation as an award-winning engineering organisation, having top-quality entry programmes, and ensuring our engineers are professionally accredited.
- grow the UK talent pool in STEM, so we have a quality pipeline that we can recruit from. For example, via key partnerships with industry bodies such as the Royal Academy of Engineering and Energy and Utility Skills.

Internships, apprentices, undergraduates and graduates are at the heart of our ambitions, which is why the National Grid group has been committed to investing in the futures of new talent for over 40 years. Higher apprenticeship schemes have worked for us in successfully providing a pipeline of 'grow your own' talent to our power system engineer roles. Furthermore, our graduate scheme has provided a pipeline for both engineering and non-technical and commercial routes. Our 18-month graduate scheme is accredited by the IMechE, IGEM and IET.

We will continue to adapt our current new talent schemes to better reflect the skills we need for the future. For example, we have increased our intake to the higher apprentice and graduate scheme from 2021 to help mitigate our forecasted attrition. In order to retain our technical and STEM talent, we will consider creating new technical career and development paths.

### Sourcing the power system engineer pipeline

As we manage the fundamental changes to operating the network and markets over the next decade, the capability of our people and engineers to manage and respond to changing operational challenges and environment will be vital.

Our STEM strategy will help source the power system engineers of the future, but it will not be enough to deliver the requirements under Theme 1. Hence, we propose an enhanced training strategy for system operation, as outlined below:

- In the short term, sponsoring dissertations and developing modules for existing courses related to system operation.
- In the longer term, if there is appetite, developing a more tailored course in electricity system operation.
- We will look at adapting our current higher apprenticeship scheme within the National Grid Academy to make sure it continues to meet our future needs.

We will:

- shorten and enhance initial Control Centre job training and authorisation through online courses and e-learning
- enhance our existing facilities for off-line event simulation and team scenario training, using digital twin technology to conduct a wider range of realistic "what-if" exercises
- secure the exercises and team training necessary to maintain robust operational Control Centre response to changing network conditions.

This initiative will:

- provide fulfilling development for our people that supports improved staff retention
- create a pool of talented people with the skills for the future, reducing our exposure to attrition
- provide expertise of value across the electricity industry.

### Sourcing IT capability

For IT capability, we are identifying roles that should be in-house, rather than delivered by partner suppliers. We are building an internal skill base that supports business engagement, intellectual property development, strategy, and architecture. Where greater depth or breadth of technical knowledge is required, we will draw upon a close partner network of suppliers.

We will develop a resource-acquisition approach to secure in-demand skillsets covering data, information, and digital toolsets and platforms. We will also create career pathways that develop staff and build a strong base of skills, knowledge and experience within the team. We will support this with the practices, processes and culture that enable our IT function to operate as an innovative thought leader.

We anticipate that, in response to the ambitions of the business and increased stakeholder expectations, the volume and availability of business subject matter experts to integrate with delivery teams will increase. This will also support strategic value. The anticipated resource requirements have been embedded in the Theme chapters and cost profile for IT.

We will draw on global IT delivery teams to provide consistent platforms, such as customer relationship management (CRM). This will allow us to use the economies of scale that come from being a multinational organisation. We will also minimise our dependency on specific vendors and utilise our commercial frameworks and engagements with technology suppliers and partners.

### Sourcing data scientists

Data scientists are in high demand. As this is a scarce skill in the market, we will consider various sourcing options. As well as upskilling our own employees and partnering to source niche capability with academia, we will consider using specialist recruitment providers who will not only supply the resource, but will also provide training and development while the resources are assigned to us. As competition for these skills increases, we will consider technical career paths for certain roles to help retain them.

## 14.5. Our culture

The right organisational culture is a key enabler to ensure organisational success.

To attract, recruit and retain talent in our organisation through the RIIO-2 period, we will have to adapt our existing organisational culture. A strong organisational culture allows us to live our core values, enhances employee engagement and has a positive impact on performance and our employees' wellbeing.

Given the business challenges we and industry face over the coming years, change management provides the process, tools and techniques to manage our people through the period to achieve our business outcomes. We will develop and upskill our people in the tools and techniques they will need to use to enable the culture change required to deliver our ambitions.

Leaders will need to challenge the status quo constructively and apply understanding of change behaviours and requirements to engage their teams as we transition to new systems and processes.

We are seeking to make a number of key behavioural shifts which will allow us to build on our existing culture. This will enable us to make the shift required to support the achievement of our RIIO-2 ambitions. Our stakeholders have been consulted on this proposal throughout our transformational activity engagement and have provided feedback which we have incorporated where relevant throughout the Business Plan. More information on the feedback we received and how we have incorporated it in our proposals is set out in Annex 3 - Stakeholder report. Additionally, in order to build and embed our desired culture, we will need to make sure it is reflected and reinforced across all elements of our ESO business operating model, including leadership tone, governance, processes and systems.

### 14.5.1. Our culture today

The ESO today has a distinct organisational culture. Within the RIIO-1 period, we have embraced our values of "do the right thing" and "finding a better way". "Do the right thing" pulls together our foundational values of keeping each other and the public safe; complying with all the relevant rules, regulation, and policies, respecting our colleagues, customers and communities, and saying what we think and challenging constructively. "'Find a better way" challenges us to focus on performance and continuous improvement. These aspects underpin our culture and we are keen to build on them.

We are proud to have a strong engaged workforce today. Since 2016 our employee engagement survey results average at 72 per cent, with 76 per cent of our employees indicating they are proud to work with us and 77 per cent feeling aligned with our company's goals.

We need to build on these strong foundations internally and with the wider industry so we can deliver our Business Plan and provide maximum benefits for Great Britain's energy consumers.

### 14.5.2. Our culture tomorrow – The shift

Given the rate of change and our pivotal role in supporting Great Britain to embrace new energy sources and achieving its decarbonisation targets, we need to enhance our culture to support the transformation required.

To enable successful delivery of the Business Plan, we are proposing the following behavioural shifts:

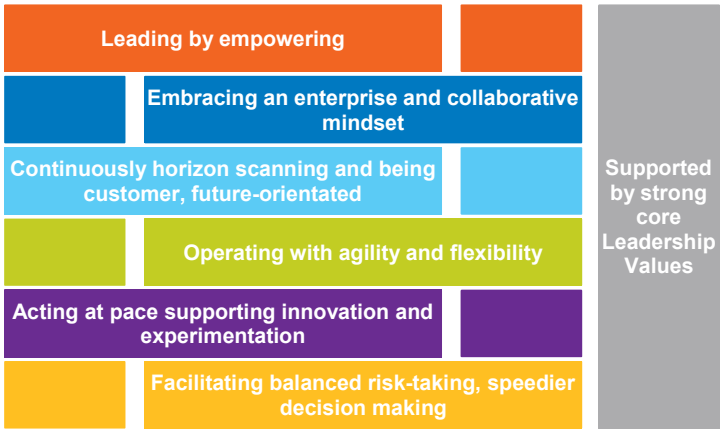


*Figure 88: Behavioural shifts*

Our culture needs to continue to be supported by strong core leadership values to drive collaboration, create the future, take bold and brave actions, tell compelling stories which inspire belief, and lead with influence and presence.

Our desired culture-shift will enable us to operate with agility and realise our ambitions. To achieve this, we need to reinforce our desired culture across all areas of our operating model (i.e. people, process and technology). Figure 90 demonstrates the spectrum of change across an organisation's operating model dimensions. We are working internally and consulting with our stakeholder groups on where we need to be across these dimensions, so we can achieve our RIIO-2 ambitions.

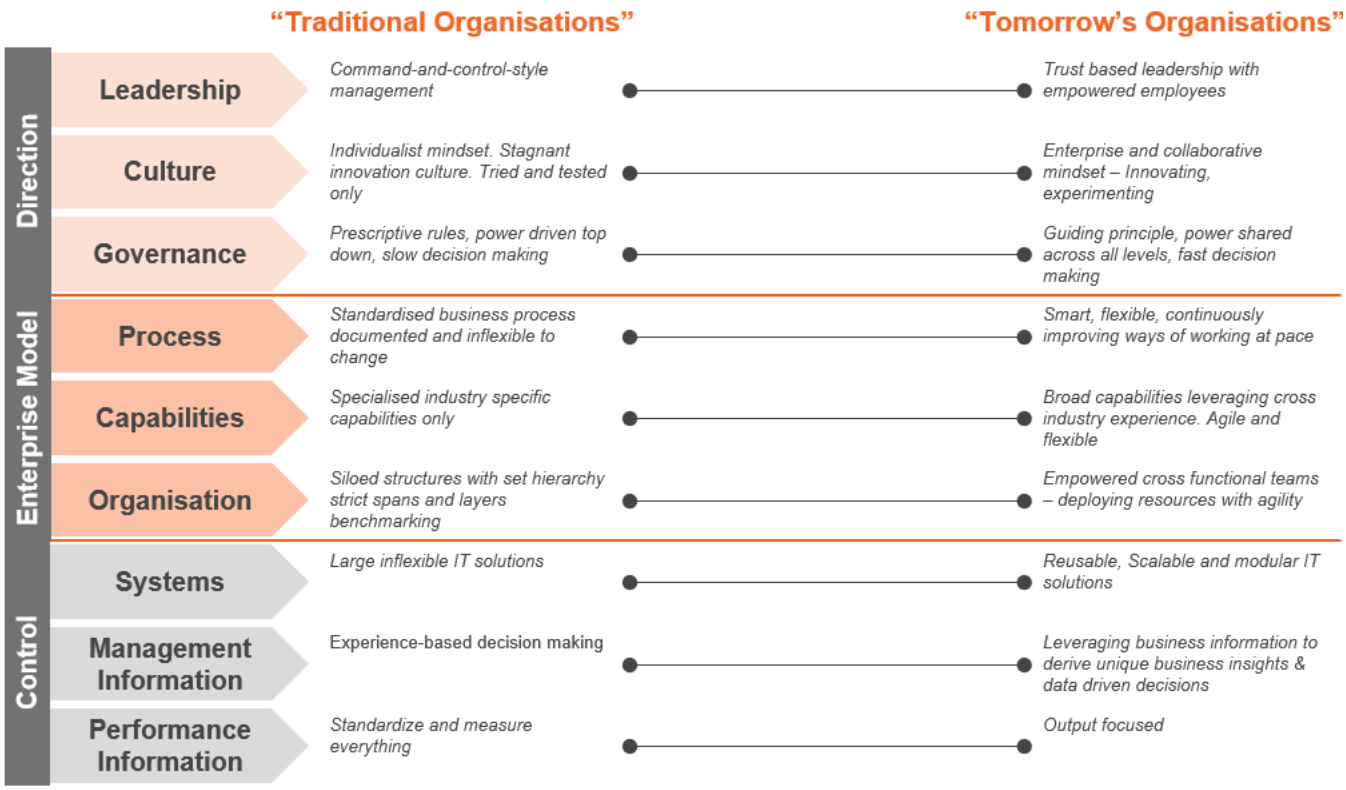


*Figure 89: Spectrum of change across an organisation's operating model dimensions*

Over the next few months, we will finalise the design of our desired culture and behavioural shifts required to help us to achieve our ambitions. During the RIIO-2 period, we will seek to put in place the changes required through a targeted, proportionate transformation programme that moves us towards our goal.

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