The ESO Digitalisation Strategy and Action Plan

December 2021

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Foreword

Our mission as the Electricity System Operator (ESO) is to enable the transition to a sustainable energy system and deliver safe, reliable, affordable energy for all consumers.

As the United Nations climate change conference, COP26, made very clear – the need to decarbonise the world's energy systems has never been greater. The ESO has a unique opportunity in shaping the way we use and consume energy for generations to come.

We have committed to be able to operate a zero-carbon system by 2025, which supports the UK's plan to achieve net zero greenhouse gas emissions by 2050. This is an exciting and challenging time for the energy sector as we all work together towards a decarbonised and decentralised energy system.

We will reduce our reliance on traditional energy sources and move to a more inclusive energy system with hundreds of connected generation, storage, and consumption assets. Over 600,000 heat pumps could be installed per year by 2028; and with all new cars and vans required to be zero emissions from 2035, the number of electric vehicles connected to the energy network will soar.

Pivotal to the successful delivery of these initiatives is ensuring we have a robust digitalisation strategy and action plan that outlines our approach and details a roadmap of how we will deliver to plan. The ESO's digital transformation is not just an enabler, but a core component of our transition as we progress on our journey to reach zero carbon operability.

Digitalisation and data will underpin the transition to net zero through better monitoring and management of the system, improved sharing of large quantities of high-quality data and the analytics this enables, as well as the developing customer-centric digital capabilities.

We're excited and proud of the role we are playing in the decarbonisation of the energy system to help mitigate climate change and the opportunity to bring about greater value for consumers through digitalisation.

Norma Dove-Edwin
ESO Chief Information Officer

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1. Document purpose

1.1. This document sets out our approach to digitalisation to deliver benefits for our stakeholders. It shares our understanding of stakeholder needs, the customer experience journey they have with us, and the products and services we provide to meet those needs.

1.2. Part one is our digitalisation strategy. Section 3 sets out a vision for future digitalisation – the 'what', and section 4 shows our tactics – the 'how'. We have also highlighted where we support the recommendations of the Energy Data Taskforce[1] (EDTF) and align with the Government Digital Service standard[2].

1.3. Part two of this document is our digitalisation action plan which shows our progress towards achieving the vision in our digitalisation strategy.

Part one – digitalisation strategy

2. Introduction

2.1. The environment in which we operate is undergoing a level of disruption as electricity generation is decentralised and decarbonised. Our customers need us to digitalise data and processes as we head towards a democratised marketplace that is more accessible to more people. Our independent role in the electricity industry requires us to be increasingly transparent in all our activities.

2.2. Our mission is to enable the transformation to a sustainable energy system and ensure the delivery of reliable, affordable energy for all consumers. Success in 2025 looks like:

2.2.1. An electricity system that can operate carbon free.

2.2.2. A whole system strategy that supports net zero by 2050.

2.2.3. Competition everywhere.

2.2.4. The ESO is a trusted partner.

2.3. We have an ambitious five-year business plan[3] that is supported by our stakeholders. To achieve this, and provide the value and experience our customers desire, we need to become more digital in the way we design, develop, and provide the products and services articulated in our business plan.

2.4. We have aligned with Ofgem's definitions of digitalisation[4] where our digitalisation strategy is the strategic approach taken to digitalise our products and services. We will use technologies to change our ways of working and provide new value-creating opportunities. This is the process of becoming a digital business.

2.5. Our Bridging the Gap to Net Zero[5] programme has allowed us to take a closer look at what is required to reach the UK's 2050 net zero target. From this we have identified several key topics:

2.5.1. Increased data availability and digitalisation of our systems will be fundamental to enable markets and technology to manage our energy peaks and troughs.

2.5.2. The technology to help manage these peaks and troughs is available now but it needs to be both smart and deployed at scale to be effective.

2.5.3. Our electricity markets need reforming, whether they are for short term trading or longer-term contracts, to provide the flexibility required to balance our energy system more effectively.

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[1] EDTF Recommendations – https://es.catapult.org.uk/reports/energy-data-taskforce-report/
[2] Government Digital service standard – https://www.gov.uk/service-manual/service-standard
[3] See our December 2019 Business Plan – https://www.nationalgrideso.com/our-strategy/riio/riio2-business-plan
[4] Definitions taken from Ofgem's Digitalisation Strategy and Action Plan, Supporting Information v1, p.8
[5] Read more about Bridging the Gap on our website – https://www.nationalgrideso.com/document/187761/download

2.6. Harnessing digital technology will enhance our operations, whether that is ensuring reliable, secure system operation to deliver electricity when consumers need it; transforming participation in smart and sustainable markets; unlocking consumer value through competition; or driving towards a sustainable, whole energy future.

2.7. Our digital organisation is about having a fanatical focus on people – their needs, wants, desires, expectations, and experiences. It will no longer be acceptable to deliver technology solutions that just do the job, or to provide solutions that users find difficult, clunky, or stressful to use.

2.8. Digital means that we will review and reimagine our processes, products, services, and the way we get things done. We will do this without constraint and without the bias of our predetermined assumptions to really understand the needs, wants, and expectations of the people we serve and the future scenarios we might encounter.

2.9. In response to Ofgem's seven Digitalisation Strategy and Action Plan (DSAP) principles, the EDTF's recommendations, and the Government's Digital Services (GDS) standards we have structured our DSAP around three elements: the digital mindset, product model, and agile delivery (See Figure 1). These are summarised in section 3 where we define 'what' we will achieve in our digital strategy. Section 4 provides our tactics as to 'how' we will active this. Our action plan (see Part two) lists the detailed activities, deliverables, milestones, and technology investments delivering the products and services that will realise our DSAP and EDTF recommendations.

2.10. While not explicitly referenced in this document, increasing our digitisation capability comes with a requisite increase in our cyber security response to ensure ongoing reliable and safe operation. We continue to invest in our cyber security proficiency and are working with all key stakeholders and competent authorities including Ofgem, the National Cyber Security Centre (NCSC), and the Department for Business, Energy, and Industrial Strategy (BEIS).
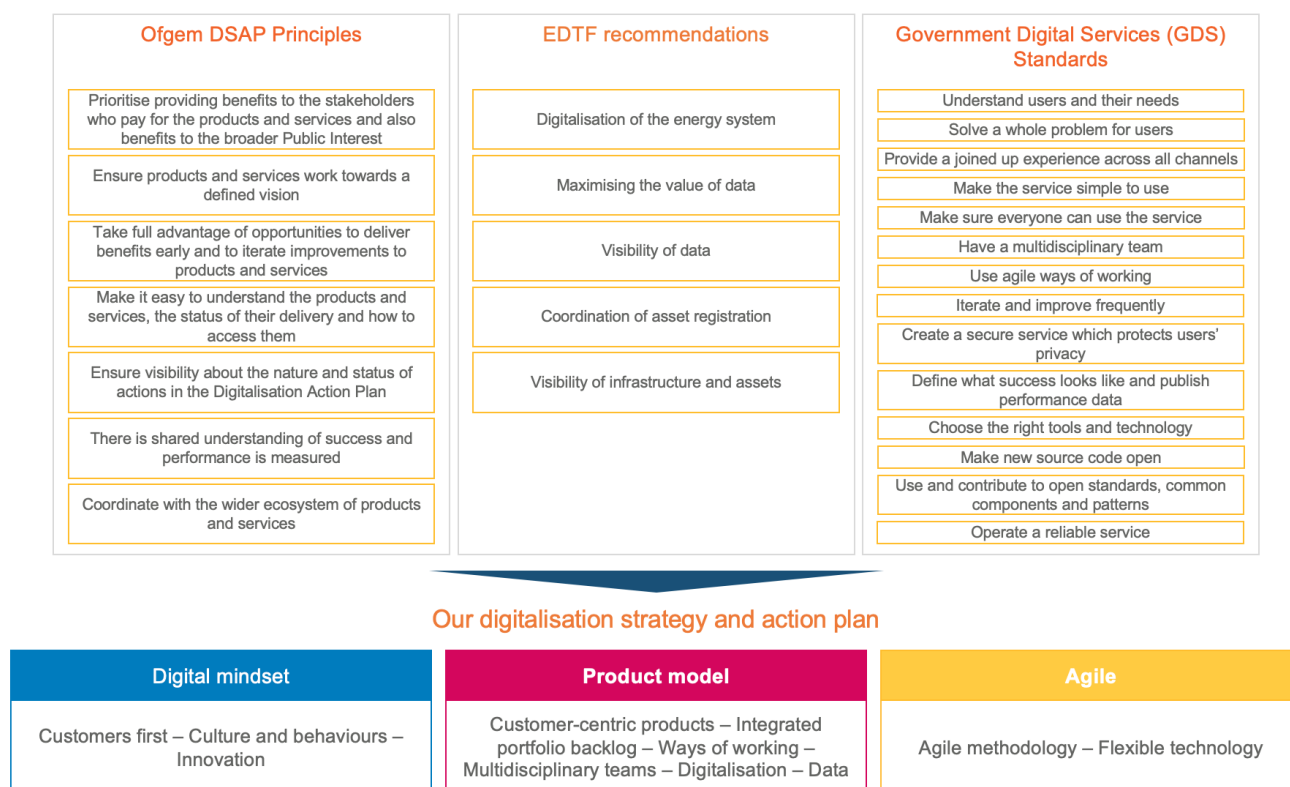
Ofgem DSAP Principles	EDTF recommendations	Government Digital Services (GDS) Standards
Prioritise providing benefits to the stakeholders who pay for the products and services and also benefits to the broader Public Interest	Digitalisation of the energy system	Understand users and their needs
		Solve a whole problem for users
Ensure products and services work towards a defined vision	Maximising the value of data	Provide a joined up experience across all channels
		Make the service simple to use
Take full advantage of opportunities to deliver benefits early and to iterate improvements to products and services	Visibility of data	Make sure everyone can use the service
		Have a multidisciplinary team
Make it easy to understand the products and services, the status of their delivery and how to access them	Coordination of asset registration	Use agile ways of working
		Iterate and improve frequently
Ensure visibility about the nature and status of actions in the Digitalisation Action Plan	Visibility of infrastructure and assets	Create a secure service which protects users' privacy
		Define what success looks like and publish performance data
There is shared understanding of success and performance is measured		Choose the right tools and technology
		Make new source code open
Coordinate with the wider ecosystem of products and services		Use and contribute to open standards, common components and patterns
		Operate a reliable service

Our digitalisation strategy and action plan

Digital mindset	Product model	Agile
Customers first – Culture and behaviours – Innovation	Customer-centric products – Integrated portfolio backlog – Ways of working – Multidisciplinary teams – Digitalisation – Data	Agile methodology – Flexible technology

Figure 1 – Our DSAP is informed by Ofgem's principles, GDS Standards and supports the EDTF recommendations.

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3. Our strategy – the 'what?'

3.1.   As outlined above, our digital ways of working consist of three elements: a digital mindset, product model, and agile delivery methods (see Figure 1). We expect these changes to be fully embedded by 2025.

The digital mindset

3.2.   We will generate a people first mindset and put our customers, clients, stakeholders, suppliers, workforce, and users first in designing our end-to-end processes and technology solutions. Putting people first will enable us to think about what people really want to create value in the form of new products and services, or to create new user experiences, in the form of different more effective ways of doing things.

3.3.   Our customers tell us that the experience of participation in energy markets it too complex, there is no step-by-step guidance for how to participate, information is diffuse, rules and frameworks are ambiguous requiring interpretation and discussion, and they don't know who to talk to.

3.4.   They need a more seamless experience when interacting with the ESO – friction free with minimal clicks to get what they need. Engaging with the ESO will become more intuitive and user friendly through the provision of a consistent and personalised user experience including access to information, data, codes, connections, and market participation. We want to make it fluent, easy, and actively engaging to take part in the energy market.

3.5.   Customers want processes to be automated, data to be machine readable, collected once and reused. They want an engaging experience with high levels of automation. This helps them to be more efficient, to be more proactive, and provide the value that consumers need.

3.6.   We will better understand the customer journey and the required products/services. Our vision is for this to be a co-creative process where together we will better understand their needs and improve the experience.

3.7.   We will use external best practice through the Technology Advisory Council (TAC) [6], our vendor partnerships, and strategic influence from organisations like HM Government, BEIS, Ofgem, the Climate Change Committee, and the Energy Networks Association.

3.8.   The TAC was launched in December 2020 with an independent Chair. Engagement from all members is extremely high and we are benefiting from the experience, skills, and contacts of the Council members. The TAC supports us in various ways including:

   3.8.1.   Helping set the strategic direction of the ESO transformation journey in systems (including process and technology) development.

   3.8.2.   Providing stakeholder input into the ESO transformation, ensuring the changes we make reflect wider market needs.

   3.8.3.   Bringing transparency around our decision making and helping the ESO communicate change externally in the appropriate manner. This will help stakeholders plan their own IT system changes, including those that will interface with the ESO.

   3.8.4.   Ensuring accountability from the ESO for delivering on its promises and proactively communicating changes.

   3.8.5.   Allowing us to consult and engage on the experience of interacting with the ESO and invite input into key design, development, and testing phases of our solutions development. It also provides transparency of the decision-making logic behind our systems.

3.9.   On 3 September 2021 we tested our approach to culture, product model, and agile delivery with the TAC. We received valuable insight and affirmation of the importance of customer centricity, one-team approach, empowerment, and leadership. We are working to integrate this feedback into our next change increment.

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[6] The terms of reference and minutes for the technology advisory council can be found on our website here
https://www.nationalgrideso.com/who-we-are/stakeholder-groups/technology-advisory-council/documents

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3.10. In addition, suppliers from our application development and maintenance framework (ADAM) and general management consultancy framework (GMC) advise and provide insight from other sectors and introduce innovative solutions.

3.11. We continue to develop and nurture a culture of 'we're all in this together' based on shared risk, accountability, ownership and, importantly, success. This is built on a foundation of true empowerment of teams, creating a bias for decision making and action across all levels.

3.12. Embedding innovation in our daily operations embodies the spirit of the aggregation of incremental gains – small changes made daily which, over time, create significant benefits.

Product model – customer-centric and data driven

3.13. Using the principles behind design thinking (see Figure 5), we will develop customer-centric products and services that are built with the user in mind. Integrating our customers into the design and development of products allows us to develop a greater understanding of what they need and creates the 'golden thread' from customer to engineer. This insight helps us to offer better solutions, and when combined with agile delivery methods, allows us to deliver value incrementally at speed and scale.

3.14. In Part two – digitalisation action plan, we list the specific activities, deliverables, milestones, and technology investments that will deliver the customer-centric products. These have been tested extensively with stakeholders, are all detailed in our RIIO-2 business plan and will be tracked and reported on a quarterly basis as part of our incentives reporting.

3.15. Our ambition is to be fully data enabled, demonstrating the policy of 'presumed open' and making data available to facilitate new and efficient markets, zero-carbon system operation, innovation, and unlock further value for our customers and stakeholders. This includes closer coordination with stakeholders to increase the volume, accuracy, timeliness, and types of data.

Agile delivery

3.16. We will use proven technologies and methodologies to transform traditional models of doing business within the energy sector. We will bring together applications as components of a modular, platform-based architecture. Creating these platforms will lay the foundations that enable consistent adoption of digital initiatives. We will introduce multiple platforms, including a digital engagement platform, insights and data platform, integration platform, and engineering services platforms (including network operation, control, and development; energy balancing; and commercial and markets).

3.17. Within our platforms, we will embed modelling and simulation using digital twin (see Figure 8 – A digital view of the energy system) and artificial intelligence technologies. The platforms will be designed to grow in line with customer priorities. We will use cloud computing and on-premise services to achieve this.

3.18. We will change the methods in which we implement change to make us more agile and flexible in adapting to market changes. We launch sprints that are short, two- to four-week activities, after which, we review and feedback – 'Is this what you want?', 'Is this what you are after?'. If we're not meeting the customer need, we will iterate, continuously improving until we delight our customers.

4. Our tactics – the 'how?'

Digital mindset – customers first

4.1. Our customers and stakeholders (see Figure 2) span the electricity industry from generation to consumption. We balance Great Britain's electricity system and ensure that, whatever the generation mix, electricity is always there when it's needed[7].
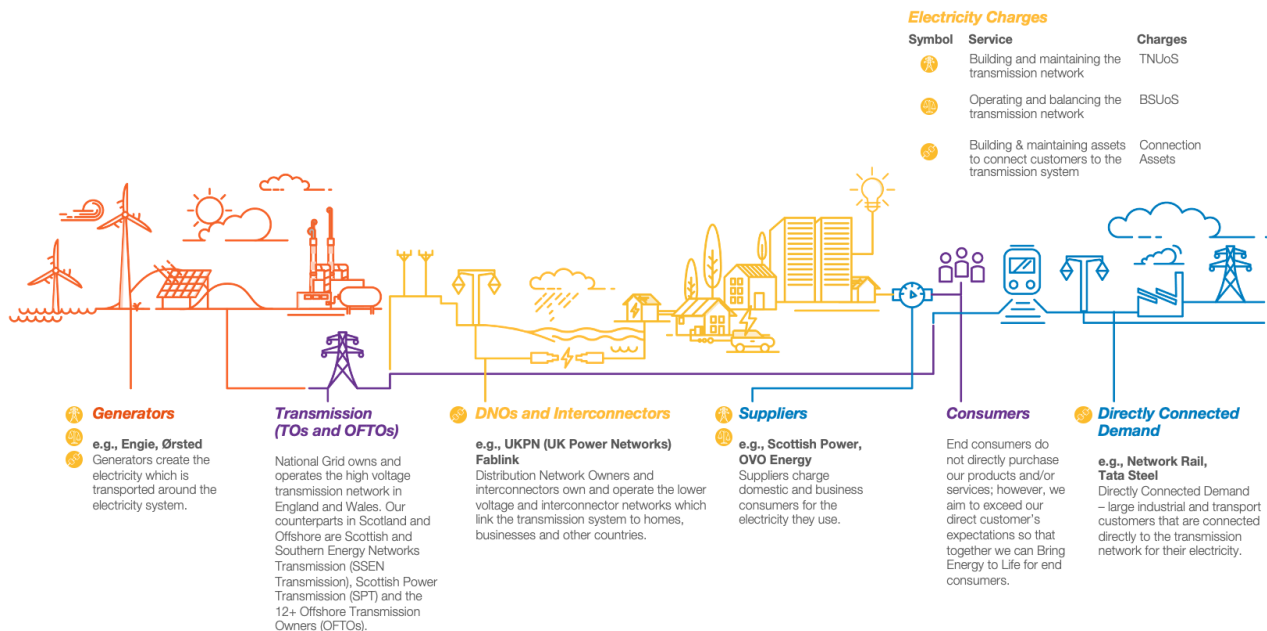

Electricity Charges

Symbol	Service	Charges
	Building and maintaining the transmission network	TNUoS
	Operating and balancing the transmission network	BSUoS
	Building & maintaining assets to connect customers to the transmission system	Connection Assets

Generators

e.g., Engie, Ørsted
Generators create the electricity which is transported around the electricity system.

Transmission (TOs and OFTOs)

National Grid owns and operates the high voltage transmission network in England and Wales. Our counterparts in Scotland and Offshore are Scottish and Southern Energy Networks Transmission (SSEN Transmission), Scottish Power Transmission (SPT) and the 12+ Offshore Transmission Owners (OFTOs).

DNOs and Interconnectors

e.g., UKPN (UK Power Networks) Fablink
Distribution Network Owners and interconnectors own and operate the lower voltage and interconnector networks which link the transmission system to homes, businesses and other countries.

Suppliers

e.g., Scottish Power, OVO Energy
Suppliers charge domestic and business consumers for the electricity they use.

Consumers

End consumers do not directly purchase our products and/or services; however, we aim to exceed our direct customer's expectations so that together we can Bring Energy to Life for end consumers.

Directly Connected Demand

e.g., Network Rail, Tata Steel
Directly Connected Demand – large industrial and transport customers that are connected directly to the transmission network for their electricity.

Figure 2 – Customers and stakeholders explained

4.2. We will build technology solutions that people – internal and external to the ESO – want to use and that get the job done. Solutions that maximise productivity and increase wellbeing.

4.3. Digital technologies are a piece of technology where the user's interaction or experience with the technology is paramount. Users don't care, and nor should they, about the actual underling code or system – they want a personalised, friction-free, seamless start-to-finish experience that delivers the right outcome to them. Equally, our organisational structure will not be visible in the product/service as we increase interdepartmental collaboration through multidisciplinary teams.

4.4. It is important for us to provide digitalised products and services in an inclusive way. We intend that digitalisation of our products and services should not become a barrier to any of our stakeholders.

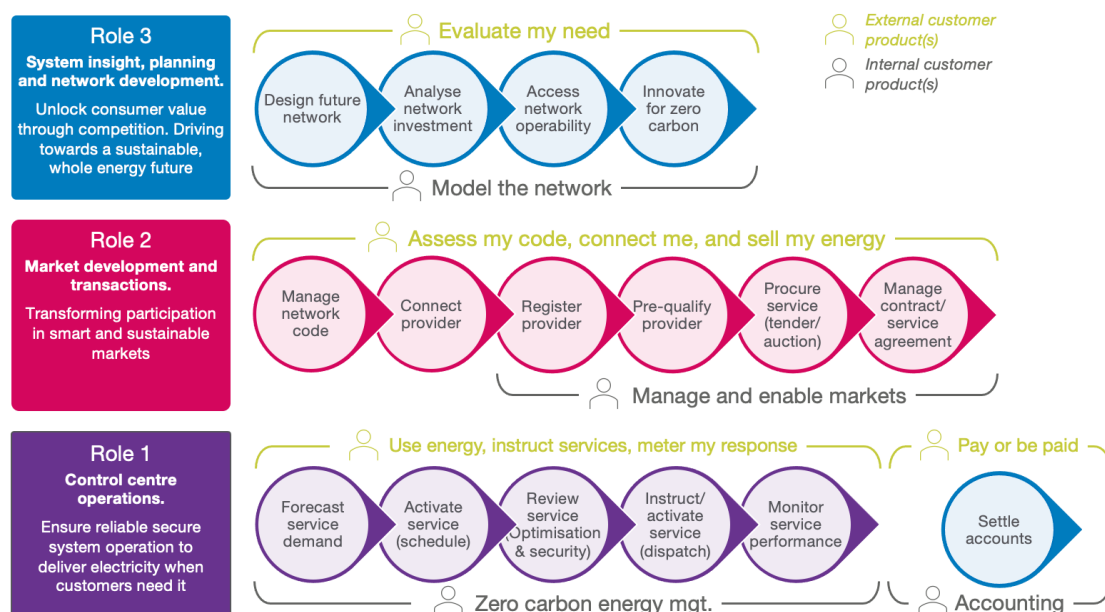[7] Read more about what we do on our website https://www.nationalgrideso.com/who-we-are/what-we-do

Figure 3 – A high-level example customer journey

4.5. Core to this is the customer journey, which helps us to understand the needs of our customers (see Figure 3 for an example). A more apt name is the customer experience journey as it is a map of how and what people experience when they interact with ESO to achieve their outcome. The usability of our systems for both internal and external users is critical for our success and is a key design principle for our products.

4.6. During 2021/22, we will have mapped our personas and customer experience journeys to better understand the needs of our customers. We will achieve this through three methods. The first is our digital transformation programme where we will map our high-level, end-to-end customer experience journeys. This is complemented by a parallel activity of our digital engagement platform development,[8] which details elements of those journeys to a greater depth and begins to realise the journey as a seamless experience in the supporting technologies. Our customer team will develop any journeys not captured by the former activities. This will then become a process of continuous improvement.

4.7. This 'customer first' mindset within the ESO is demonstrated in the case study detailing the process of improving the user experience of our control room engineers within the enhanced balancing capability (**Error! Reference source not found.**).

Case study

Showcasing a customer first mindset within the ESO
Enhanced balancing capability (investment 180)

As we implement balancing capabilities that support zero carbon operation, this programme showcases the customer first mindset within the ESO. The balancing programme multidisciplinary team piloted the digital and product model ways of working, co-creating with the control room customers to map our the experience journey of balancing the network.

The programme demonstrates a clear focus on design thinking, best evidenced by the process of improving the user experience of our control room engineers. Solutions were co-created with our engineers and included persona mapping, pain-point identification, and the creation of an end-to-end storyboard that overlayed customer journeys of both a 'good day' and 'bad day'.

These activities were key to producing epics and features that focused on the outcomes that are most important for our control room engineers and ensured that solutions were created with them and not for them.

Figure 4 – Enhanced balancing: demonstrating a customer first mindset

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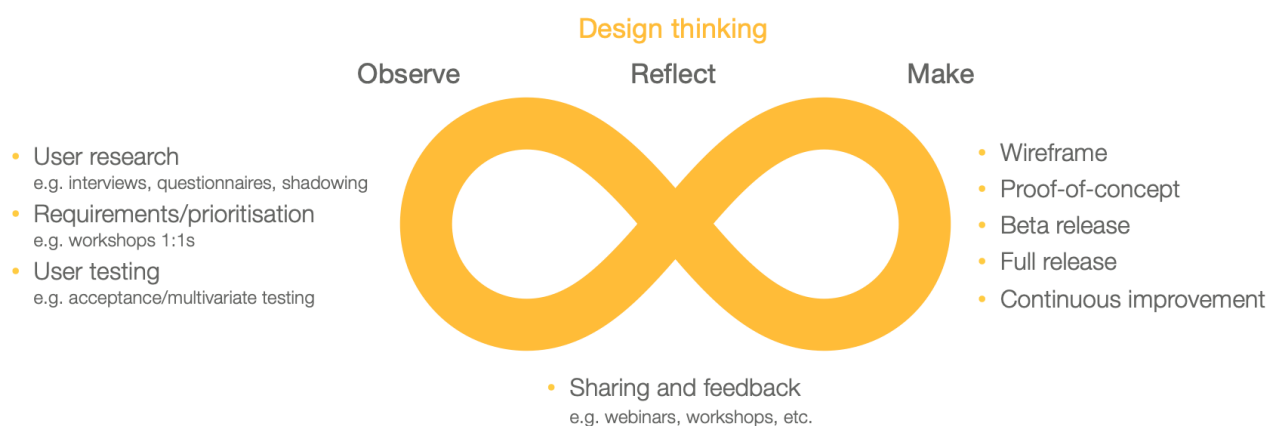[8] For more detail about our digital engagement platform, see investment '250 – digital engagement platform' in Annex 4 of our December 2019 Business Plan https://www.nationalgrideso.com/document/158071/download

Design thinking

Observe   Reflect   Make

- User research
  e.g. interviews, questionnaires, shadowing
- Requirements/prioritisation
  e.g. workshops 1:1s
- User testing
  e.g. acceptance/multivariate testing

- Wireframe
- Proof-of-concept
- Beta release
- Full release
- Continuous improvement

- Sharing and feedback
  e.g. webinars, workshops, etc.

Figure 5 – Customer engagement and design thinking approach used within our digital engagement platform development

4.8. We carry out regular customer surveys using online tools to capture immediate feedback following events and key milestones. We also run a biannual customer satisfaction survey to gather feedback on our Role commitments and general performance. We look for themes to turn these insights into actions that deliver customer value. We will publish this insight and action in 'you said/we did' documents. From 2021 in line with our license obligations, we have now begun reporting on our bi-annual independent survey scores and feedback against our three Roles as part of our incentives reporting.

4.9. Our digital engagement platform is also one of the leading programmes to integrate the customer into the development lifecycle through interviews, questionnaires, and workshops. We then share this insight more broadly through webinars to access further feedback. A summary of that process is shown in Figure 5 above. This is a model that we will embed in all digital delivery. A more detailed explanation to the digital engagement platform can be seen in the case study below (see Figure 6).

Case study

Demonstrating an external customer first mindset
Digital engagement platform (investment 250)

This investment brings a single point of access into our solutions, providing a joined up experience, and making it easy to do business with the ESO. Engaging with us will become more intuitive and user-friendly through a consistent and personalised interface which includes access to our data, digitalised Grid Code, connections hub, market participation, and planning and outage data.

The user's experience is paramount and our focus on customer research means we have co-developed a list of key user needs. These user needs will inform the iterative design and development, ensuring that the user can engage and interact with the ESO, not just consume static information.

Our vision is that through the sharing of data and insight on platforms such as this, we can be a catalyst for driving the quality of information and debate that will hasten our progression towards zero carbon operation.

Figure 6 – Digital engagement platform: demonstrating a customer first mindset

Digital mindset – culture and behaviours

4.10. Culture is a critical enabler of the digital mindset and fundamental to our success. There are characteristics of our culture that we want to encourage. Developing the right capabilities and skills in our workforce alongside a supporting culture and behaviours will foster a proactive, innovative, and collaborative operating environment.

4.11. Enabling cultural principles are:

4.11.1. Open, transparent, and inclusive – so people can see what we're doing and be part of it.

4.11.2. Shared purpose and vision to give clarity and focus.

4.11.3. Empowered teams with defined roles and accountability that reflects and supports the way in which we create value.

4.11.4. Quick, efficient, and continuous decision making.

4.11.5. Coaching style leadership incentivised on purpose or mission.

4.11.6. Learning culture with a continual rapid iteration of thinking, doing, and learning to innovate and operate in an flexible and adaptable way.

4.11.7. Ask 'Why?' – create an inquisitive organisation that is connected to outcomes.

4.12. As part of our ongoing Ways of Working transformation and supported by our engagement with the Katzenbach Centre[9], we conducted a culture baseline survey designed to highlight our organisational strengths, as well as identify challenges for ongoing focus and continuous improvement. This work conducted in Q2 2021/22, helped us to align on culture aspirations, and prioritise critical behaviours that will drive greater alignment between our culture, operating model, and ongoing technology strategy.

Case study

We have a supportive and collaborative culture
Developing our cultural priorities and attributes for continuous improvement and success

Working with the Katzenbach Centre we conducted a culture survey across our ESO technology and business operations (TechOps) community that highlighted our relative strengths and challenges. The cultural baseline surveys emphasised a highly purpose driven, supportive and respectful culture.

The challenges from the survey allowed us to define our strategic priorities that focus on customer care, collaboration, and operational excellence. These are underpinned by the five TechOps mindset attributes.

Subsequently, a series of transformational initiatives have been launched across the TechOps community to foster collaboration and empower individuals in their decision making.

The introduction of a RAPID* decision making framework has been instrumental in helping to define clear roles and responsibilities and create a strong sense of accountability.

RAPID (Recommend, Agree, Decided, Input, Perform)

Our cultural priorities and attributes for success

Figure 7 – We have a supportive and collaborative culture

4.13. We are constantly considering how our approach to decision making, motivators, commitments, mindset, and our structure all contribute to our culture. Our first culture change sprint in 2021/22 aims to increase collaboration and empowerment and we see the cultural transition being fully embedded over the RIIO-2 period.

4.14. One of the ways we are encouraging internal collaboration across teams, is by establishing communities of practice (CoP). Two examples are the data management/ advanced analytics (modelling) CoP and the Business Analyst CoP. Through these forums, we share best practices, educate and upskill others, and provide *ad hoc* project support. In the following months, we plan to set up several other CoPs for product management, scrum masters, architects, DevOps etc.

Digital mindset – innovation

"As we evolve and transition to a greener future, we'll need to respond to a range of future challenges. And how we innovate and adapt the energy system will require a range of tools, which is where the Virtual Energy System comes in - a shared, digital national asset to help optimise the route to net zero,"

Fintan Slye *(Executive Director, ESO)*

4.15. The Virtual Energy System is one of the ultimate aspirations listed in the ESO's 2021 innovation strategy[10] and digital transformation and data will be key to enabling it. On a day-today basis,

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[9] https://www.strategyand.pwc.com/gx/en/insights/katzenbach-center.html
[10] Read our full innovation strategy on our website https://www.nationalgrideso.com/innovation/strategy

technology will underpin the vision, whether that be through the building of operational digital twins, or the creation of scheduling and forecasting tools that will utilise artificial intelligence and machine learning (see Figure 8).

Case study

A digital view of the energy system
Virtual energy system (innovation)

Our goal is to build a 'digital twin' of the UK power system and energy markets which can validate the benefits and impacts of changes to the market and physical network.

Our Virtual Energy System will utilise machine learning to run multiple, complex scenarios in a real-time training and simulation environment. This will inform the way we develop our new balancing and control tools, which will then be built offline in a modular and agile way. In a cultural shift, we will move away from large tools and IT systems, where the algorithms, data and control centre user interface sit together, to smaller tools that only house the system algorithms, with data sitting on the central data and analytics platform. This benefits energy consumers, by making it easier for us to upgrade tools in the future and respond faster to change.

Our use of digital twin technology is aligned to the vision for the UK national digital twin (NDT). We are actively engaging with stakeholders, such as via the Centre for Digital Built Britain Digital Twin Hub4. We envisage our Virtual Energy System as a 'federation' of organisations and educational institutions developing digital twins, sharing APIs and data across an entire network. Working in collaboration, we seek to develop a home-powering system from the bottom up and this could bring significant benefits for system operation. For example, connecting a digital twin of our electricity system balancing tools to those that model electric vehicles (EVs) could help us better understand the challenges and opportunities from the future increase in EV uptake.

This will be a large programme of work, researching and testing different elements before starting to pull together the enduring system.

Figure 8 – A digital view of the energy system

4.16. Innovation is not limited to the investments listed in the 2021 innovation strategy. At the ESO, innovation also comes in the form of asking questions like 'is my customer happy?', 'how can I make this better?', or 'how can I improve on my previous best?'. In these marginal gains we will improve our products and services, and the way we deliver them.

Product model – customer centric products and services with integrated backlog

4.17. A product delivers a distinct offering that is valued by customers and is managed as a distinct unit across its lifecycle. It might be made up of many applications or components but to the user it is a single product.

4.18. We have chosen to align our products to the customer journey rather than a technology platform or business capability. This enables us to focus on the product as a whole and the value and benefits it delivers to customers as opposed to individual or groups of components or features delivered through a project.

4.19. Products can exist within products as part of a product family meaning our product model will be a hierarchy. This will ensure that the sub-products integrate within the product family and that the user's experience is same across all products and is simple, seamless and friction free.

4.20. For example, a potential example of a product could be the balancing product (see Role 1) that enables engineers to visualise and manage the entire network at an appropriate level of detail. This product is made of other sub-products (like forecasting, scheduling, and dispatch) and multiple applications which come together to form a single solution that meets the engineer's needs. Figure 9 provide examples of potential customer centric products that are being explored by the TechOps community.

4.21. Each product and service will have a prioritised backlog of functionality and features with closely managed dependencies.

4.22. The cross-cutting activities including innovation, customer and stakeholders, regulation, assurance, and business change, will either be part of a product within our key product areas or have standalone products that suit their needs.
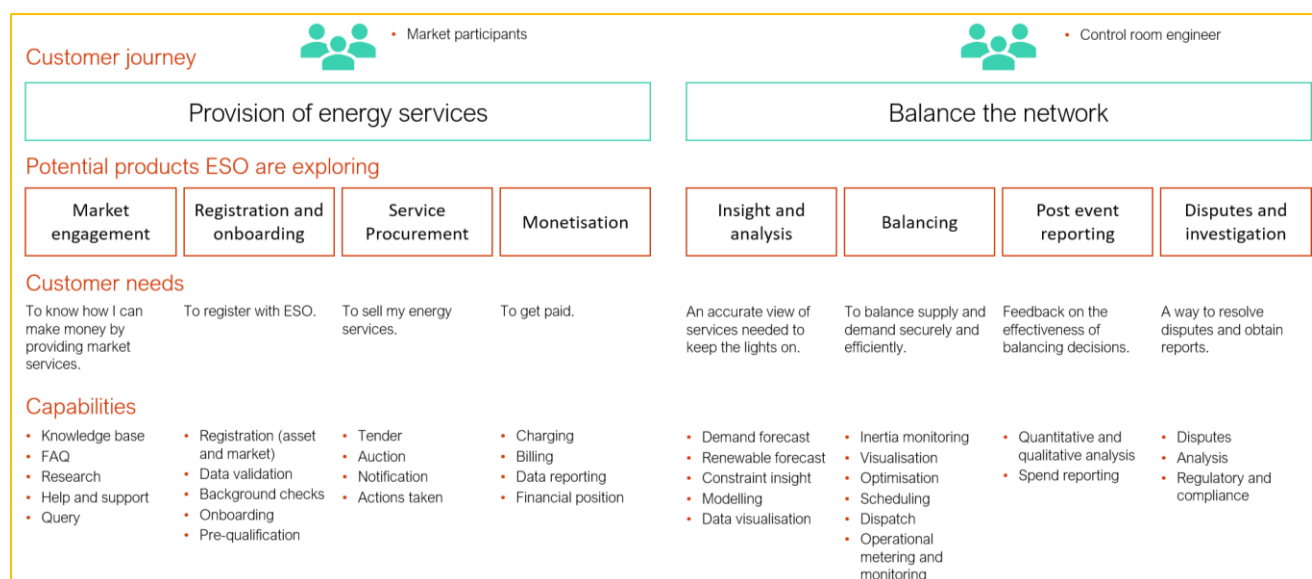
Figure 9 – Potential examples of customer-centric products that ESO are currently exploring

4.23. Our Business Plan is structured by roles/themes, activities and deliverables that define the measures of success. In October 2020, we developed a comprehensive delivery schedule that breaks down our ambition into activities, deliverables, and milestones (see Figure 10 below).

Figure 10 – Excerpt from our updated ESO RIIO-2 delivery schedule (9 October 2020)

4.24. In our digitalisation action plan, we show the relevant activities and deliverables from the ESO RIIO-2 delivery schedule. Each deliverable has detailed 2021/22 and 2022/23 milestones, success criteria, and outcomes.

4.25. The ESO RIIO-2 delivery schedule shows the related technology investments. This includes the scope, architectural approach, deliverables, timelines, work breakdown structure, risks, and resourcing. These are detailed in our December 2019 business plan: Annex 4 – Technology investment report[11] and our ESO RIIO-2 consultation response – Technology investment detail parts 1-3.

4.26. We are tracking progress against detailed milestones, deliverables, and activities. This is published on our website quarterly starting from July 2021 and aligns with our incentive reporting[12].

Product model – ways of working

4.27. We will partner and collaborate with our customers and truly include them in the product development lifecycle. As we bring together our own team to operate with a one-team mindset, we will be able to

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[11] See our December 2019 RIIO-2 business plan: Annex 4 – technology investment report here
https://www.nationalgrideso.com/document/158071/download
[12] See our website 'How we're performing under RIIO-2' https://www.nationalgrideso.com/our-strategy/riio/how-were-performing-under-riio-2

innovate faster and reduce the time between an initial idea and a product launch, thereby enhancing the customer experience.

4.28. We are moving to a product approach and away from a project approach (see Figure 11), where possible, in how we govern and manage business initiatives.
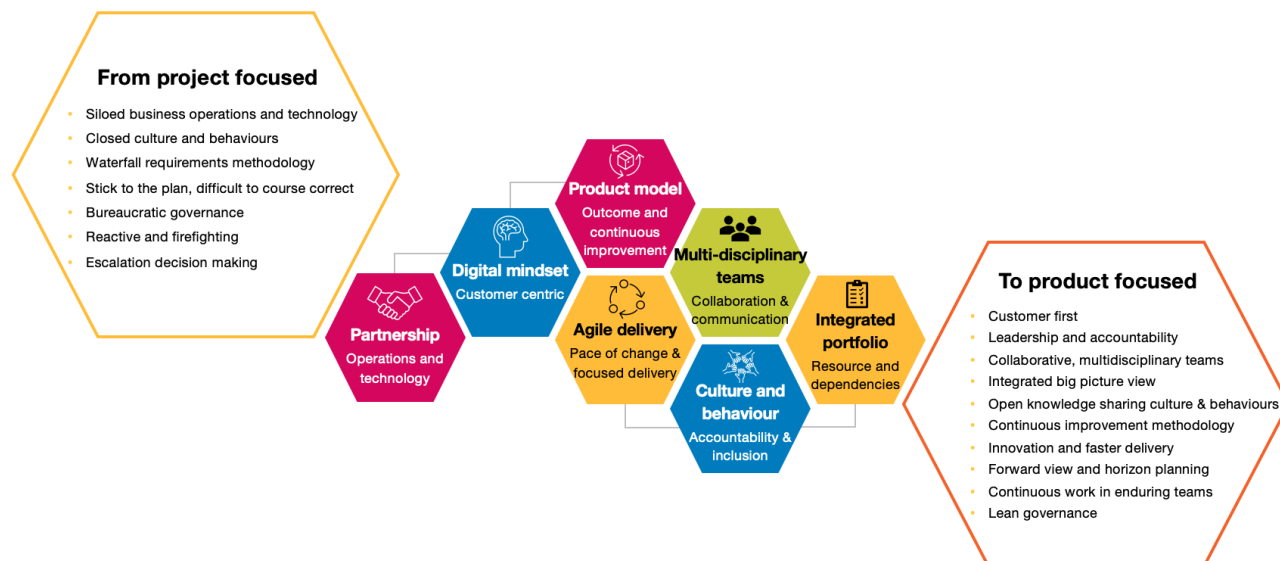

From project focused
- Siloed business operations and technology
- Closed culture and behaviours
- Waterfall requirements methodology
- Stick to the plan, difficult to course correct
- Bureaucratic governance
- Reactive and firefighting
- Escalation decision making

Partnership Operations and technology

Digital mindset Customer centric

Product model Outcome and continuous improvement

Multi-disciplinary teams Collaboration & communication

Agile delivery Pace of change & focused delivery

Integrated portfolio Resource and dependencies

Culture and behaviour Accountability & inclusion

To product focused
- Customer first
- Leadership and accountability
- Collaborative, multidisciplinary teams
- Integrated big picture view
- Open knowledge sharing culture & behaviours
- Continuous improvement methodology
- Innovation and faster delivery
- Forward view and horizon planning
- Continuous work in enduring teams
- Lean governance

Figure 11 – What we are going to do differently, from project to product focus.

4.29. Products are people centric and developed with a holistic view to people's needs and expectations and are long term endeavours that are continuously improved. Projects tend to be one off endeavours with a narrow view, a set scope, a start/end date, and a defined goal, where change is not easily accommodated.

4.30. Our transition from a project to product focused model will be phased (see Figure 12), as we evolve our capabilities, establish multidisciplinary teams, and incrementally add new products to cover our key end-to-end customer journeys.
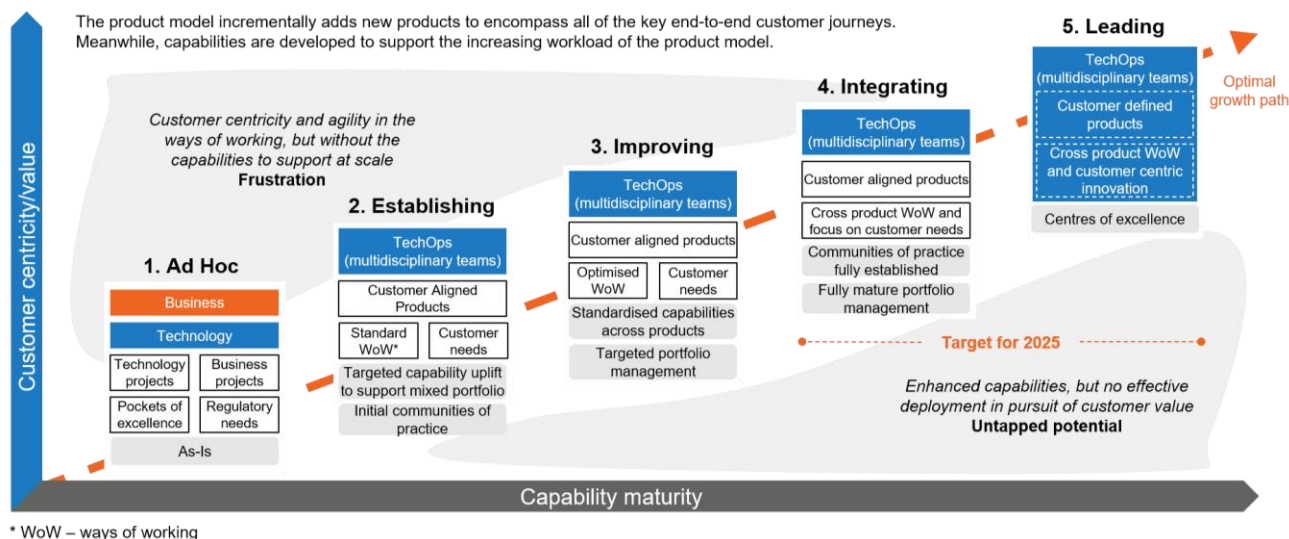
Figure 12 – Our phased approach to increasing our product model maturity.

4.31. We are developing our product management capabilities – the practice of having individual, long-standing teams dedicated to the development, enhancement, and support of products that deliver value for end users.

4.32. We will implement new ways of working with early adopters. These early adopters will trial the operating model, providing valuable feedback and lessons learnt, before it is rolled out across the teams (see Figure 12). There will be an engagement plan to take people along the journey form awareness to empowerment.

4.33. For one such pilot programme we have understood customer needs through user research and customer journeys. We are working on creating a set of standard products and iteratively refining them as we deliver via show and tell. We will then create standard scalable products – all contributing to build and refine the product roadmap.

4.34. A critical component of the new ways of working is the partnership between technology and operations (TechOps), building collaborative teams focused on outcomes. We will come together as equal partners in enduring, multidisciplinary teams to deliver this.

Product model – multidisciplinary teams

4.35. We will create cross-functional teams that foster collaboration and inclusion. Involving the relevant people connects the users to the people that design, develop and support the products and services. This leads to a higher quality outcome.

4.36. Individual sprint teams are purposefully built with ESO leadership and supported by high-calibre people from cross-functional teams. An example is shown in Figure 13 below. The team composition will vary depending on the product context. For example, in a data product, we would also include data engineers and/or machine learning engineers.

4.37. We will draw on deep technical competencies from our own teams and those of our framework partners and niche suppliers. This will allow a core/flex model, increasing our own competencies while allowing flexibility for scale or niche skills.

4.38. We will move to a model where development, security, and IT operations (DevSecOps) are integrated in the multidisciplinary teams to give high performance and throughput.

4.39. We are mapping existing roles across ESO IT to align with a new way of working that is structured to deliver products.
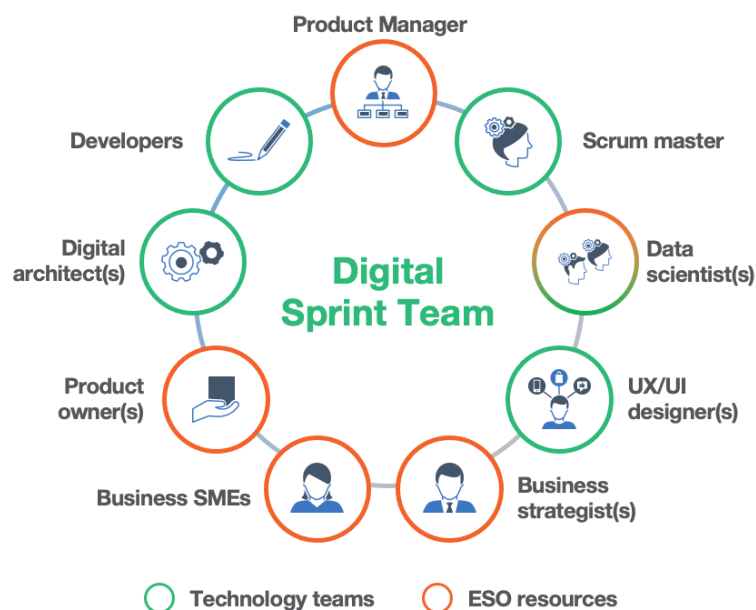

Figure 13 – Example multidisciplinary team

Product model – digitalisation

4.40. To fully embrace a digital culture, there are two key prerequisites – digitisation of data rather than analogue storage, and digitalisation to optimise processes through increasing levels of automation. This means removing paper, reducing manual processes, removing duplication, and making data transparent. We will use automation and workflow tools in combination with machine learning and artificial intelligence to optimise processes and procedures for our teams and for customers.

4.41. Examples includes energy forecasting, system operation and network planning to enable secure and efficient operation of the electricity system and markets.

4.42. As with customer centric products, digitalisation will be achieved through the technology investments that support our business plan ambition.

4.43. An important investment is '250 Digital engagement platform' as this will enable a single point of access for all ESO data and services, including the markets, connections, digitalised Grid Code management, and data and analytics platform. It sits at the heart of our vision for digital capability across all our themes, providing a common engagement experience for stakeholders.

Product model – data

4.44. Data is fundamental to digitalisation. We will set targets, measure, monitor, and act to continuously improve our data. As we listen through data, we will better understand how our customers behave and under what conditions.

4.45. We anticipate vast growth in the volume of data, and an expectation from external stakeholders for our data and insights to be shared.

4.46. We will adopt the principle of 'presumed open' and make all our shareable data[13] available in an accessible format. Improving transparency is a key commitment within our RIIO-2 Business Plan 2021-2023. To support this, we will:

   4.46.1. Publish a transparency roadmap every six months setting out the projects we are working on to improve transparency[14].

   4.46.2. Share data publicly wherever we can. This will help our stakeholders hold us to account by publishing information on how we operate and perform and will increase transparency of the decisions we make and how we make them. Increasing access to data we hold will encourage analysis, understanding and innovation.

4.47. We will increase transparency in compliance with all relevant guidance and legislation including (and not limited to,) data protection laws, licence obligations around disclosure of System Operator Functions Information (SOFI), confidential or commercially sensitive data, and the Utilities Act 2000.

4.48. Data will help us make better decisions through consolidation of information, machine learning, and artificial intelligence. This extends beyond control centre operations (Role 1) into all aspects of the ESO, including market development (Role 2) and system insight, planning, and network development (Role 3).

4.49. Gathering customer insight into how people use our products and services is also vital for continuous product improvement.

4.50. We've already begun evolving our data-sharing platforms to meet the demands of today's more data-intensive energy ecosystem. We're in the early stages of this journey, and our first milestone is the development and rollout of a new pilot data portal to support our ambition to make our data easier to discover, understand and consume.

4.51. Our investment '220 Data and analytics platform'[15] is foundational work to unlock the value of the data we hold (see Figure 14). It will be the technology underpinning all our internal and external data management, pulling together data from a variety of sources, and ensuring there is only one source of the truth.

4.52. Through the consolidation of our data assets, this new capability will enable enhanced analytics and the generation of new insights and forecasting services, improving our overall operational efficiency, and maintaining balancing costs/security through enhanced real time decision making.

4.53. As we engage with stakeholders, we will understand their roles and how data can support them. Through a process of standardisation and classification, we will make it easier for stakeholders to find and understand data. We will support data sharing at a greater volume and frequency as desire for transparency and insight increases.

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[13] In accordance with Ofgem's open data triage process, defined on p.11 of 'Data best practice, supporting information' 25 May 2021.

[14] For more information visit our website 'Increasing the transparency of our operational decision making' here https://www.nationalgrideso.com/news/increasing-transparency-our-operational-decision-making

[15] See p.40 of our December 2019 RIIO-2 business plan: Annex 4 – technology investment report here https://www.nationalgrideso.com/document/158071/download

4.54. Cloud-based data management and analytics are now universal and essential for modern data analysis approaches and even more so for artificial intelligence implementations. This investment will evolve ESO's traditional data management and analytics to the cloud. It is indispensable for much of the RIIO-2 change programme, including unlocking the value of our digital twin technology investments and hosting data from the asset register which is fundamental for our Single Markets Platform.
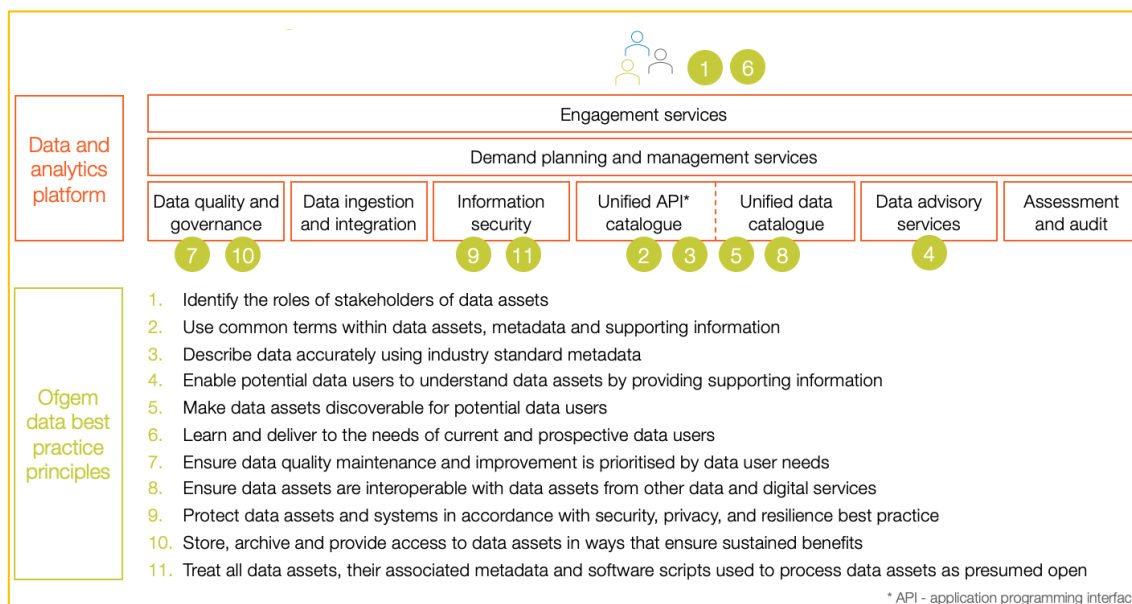

Figure 14 – Mapping between Ofgem's data best practice principles and our data and analytics platform approach.

Agile – agile methodology

4.55. We want to delight our customers through early and continuous delivery of value.

4.56. Agile and iterative development methodologies will enable us to cycle through the design thinking loop where we observe, reflect, and make. By integrating our customers into the design and development process, we can focus on high-value outcomes that meet the customers need (see Figure 15).

4.57. Using methodologies like SAFe[16] we will organise our delivery teams in value streams to focus on outcomes and people's experiences. Working in mixed discipline teams to achieve timeboxed (weeks not months or years) results that enable stakeholders to continuously test against the relevant outcomes, user experience, and course correct the solution as required.

4.58. As part of our digital transformation, we are drawing on expertise from our agile transformation office. This team are focused on the practical implementation of agile methodology include agile scrum ceremonies, backlog management and DevOps tools, and training.

4.59. We have conducted a delivery team agile maturity self-assessment to gauge the readiness of existing programmes to pivot to product focused model.

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[16] See the Scaled Agile Framework website for more detail https://www.scaledagileframework.com
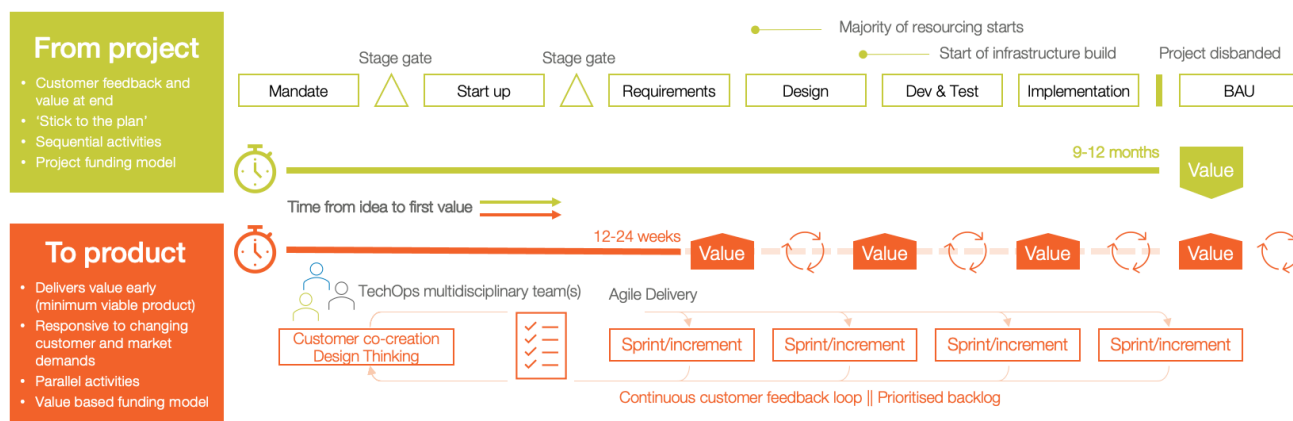
Figure 15 – From project to product. Prioritising the customer and delivering value sooner.

4.60. Our customer focussed product model will be delivered using iterative development methodologies (see Figure 16) and will combine elements of SAFe, Agile and Waterfall delivery frameworks.
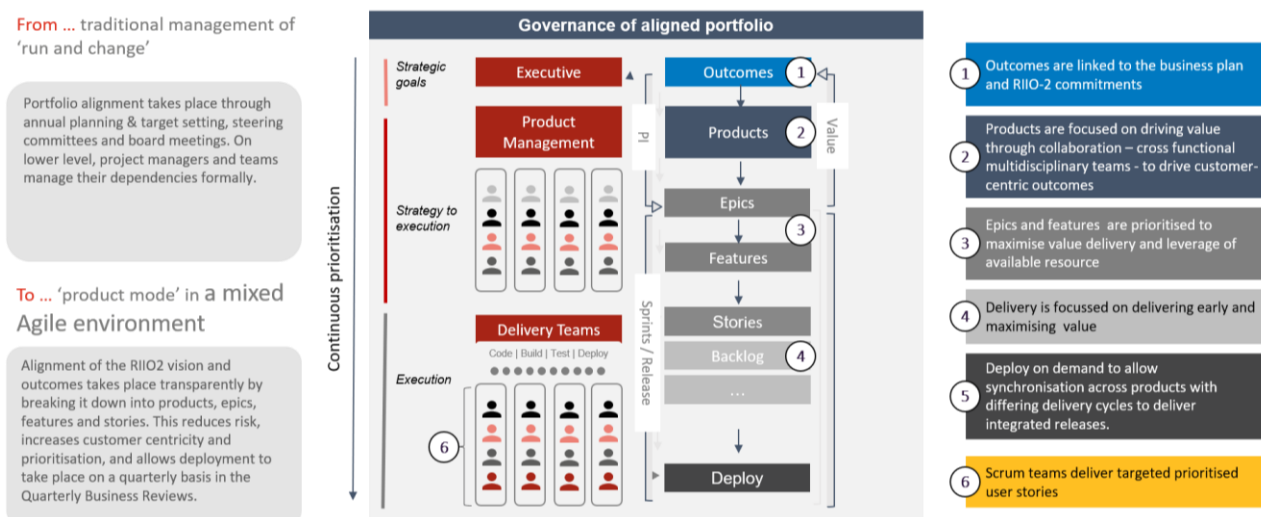

Figure 16 – Our customer focused product model will be delivered using iterative development methodologies.

Agile – flexible technology

4.61. We will use modern game-changing digital technologies, which are architected in modular way in to enable flexibility, i.e. we can upgrade or change parts of the solution more easily to meet changing needs. It provides opportunities for a simplified, consistent, and accessible customer experience.

4.62. We will build solutions that facilitate and expedite change (easier and faster). Using a modular architecture approach will enable flexibility for change and growth – modules can be replaced/upgraded for more modern technologies without impacting other modules – and modules can be reused across the ESO, eliminating duplication (interoperability by design).

4.63. Our approach will be to consolidate 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.

4.64. This allows multiple enabling capabilities (activities) to be hosted on the same platform and consumed by customers via a product. For example, the balancing solution will host forecasting, scheduling, and dispatch. These capabilities will be exposed to the end-user through the ENCC operator console product. The single markets platform will host registration, auction participation, and reporting – all exposed to the end-user through the single market platform product.

4.65. An insights and data platform 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 services to achieve this.

4.66. For openness of information and interaction, we will enable application programming interfaces (API) through our digital engagement platform.

4.67. Our non-CNI solution platforms will be hosted in the Azure cloud and CNI solution platforms will be hosted in the on premise CNI data centre. All shared IT infrastructure investments (e.g. data centre, networks, and identity access management) take into consideration the possible separation of the ESO from National Grid Group.

4.68. Rationalisation and decommission of legacy applications and technologies is a key focus for the following two to three years. On an enduring basis, we will dedicate a proportion of our capacity to removing the technical debt that is a normal part of technology evolution and change.

5. Digital leadership

5.1. The ESO leadership is fully committed to ensure senior ownership and the ESO Board accountability of our Digitalisation Strategy and Action Plan (see Figure 17). Across the Non-Executive Directors on the ESO Board there is significant experience in digitalisation and digital transformation[17].

5.2. In November 2020, we were joined by a CIO who brings a wealth of digital transformation experience. This role is part of the ESO executive team and takes accountability for digital transformation and technology delivery for the ESO.

5.3. In May 2021 we recruited a head of data who will create a hub and spoke model to integrate the data strategy with our day-to-day delivery. Projects and programmes draw from this central expertise and have established multidisciplinary teams who adopt agile practices to deliver customer-centric products incrementally.
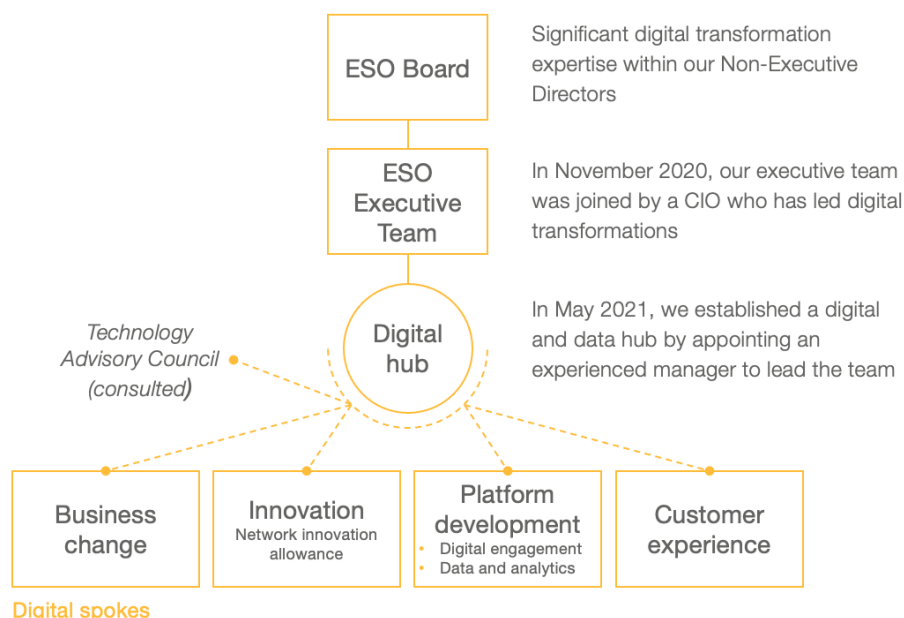

Figure 17 – We have established a digital transformation capability at all levels of the ESO

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[17] Meet our Board - https://www.nationalgrideso.com/who-we-are/meet-board

Part two – digitalisation action plan

6. Conceptualising our digitalisation strategy and tracking our delivery

6.1. Success in achieving our digitalisation strategy is closely linked to the successful delivery of our overarching Business Plan. To help conceptualise the relationship between these elements we have developed a 'Digitalisation matrix' (see Figure 19). This seeks to demonstrate how our investments, activities and deliverables are aligned to a primary ESO role, whilst also acknowledging that all investments, activities and deliverables will be cross-cutting to a degree, and collectively contribute to the ESO's overall digital transformation.

6.2. This seeks to illustrate how our transformation activities and associated investments will collectively support our ongoing transformation towards a sustainable energy system. Broken down across our three core ESO delivery roles (see Figure 18), we have highlighted how our change activities link back to improvements across our core business services.

6.3. Using the power of data is fundamental to our transformation, as will a cultural shift towards more digital ways of working and associated delivery structures. These two items are the foundation of our matrix, collectively underpinning our overall transformation journey across all business areas.

6.4. To provide visibility of our digital transformation progress, Figures 21-24 show a plan view of our transformation activities, deliverables, and milestones. We have updated our action plan to more readily demonstrate our ongoing delivery progress and successes to date.

6.5. We report against these activities, deliverables, milestones, and investments on a quarterly basis through the RIIO-2 deliverables tracker[18]. This tracker contains detail about each milestone, and these are linked back in our business plan to agreed performance measures that have been tested with stakeholders and regulatory bodies. The successful delivery of our DSAP is intrinsically linked to the successful delivery of our Business Plan.

6.6. Sections 7, 8, 9 and 10 outline our status updates of our activities and investments associated to each ESO role group. Section 10 outlines our status updates for those activities and investments which are cross cutting in nature covering all ESO role areas, and finally section 11 summarises our digital transformation (ways or working) delivery progress.
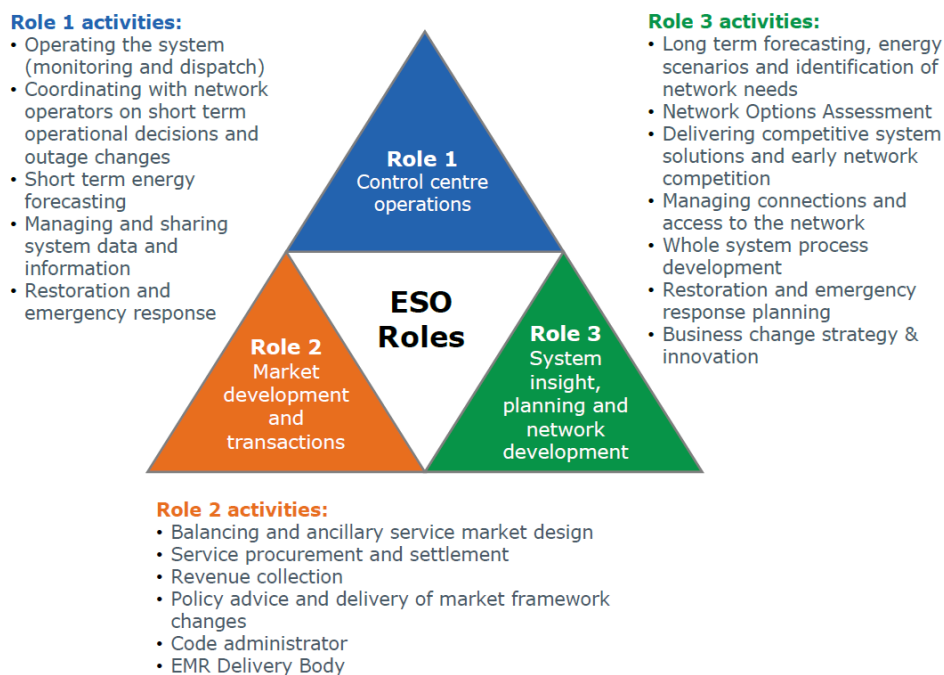

Role 1 activities:
- Operating the system (monitoring and dispatch)
- Coordinating with network operators on short term operational decisions and outage changes
- Short term energy forecasting
- Managing and sharing system data and information
- Restoration and emergency response

Role 3 activities:
- Long term forecasting, energy scenarios and identification of network needs
- Network Options Assessment
- Delivering competitive system solutions and early network competition
- Managing connections and access to the network
- Whole system process development
- Restoration and emergency response planning
- Business change strategy & innovation

Role 1 Control centre operations

ESO Roles

Role 2 Market development and transactions

Role 3 System insight, planning and network development

Role 2 activities:
- Balancing and ancillary service market design
- Service procurement and settlement
- Revenue collection
- Policy advice and delivery of market framework changes
- Code administrator
- EMR Delivery Body

Figure 18 – ESO Roles

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[18] Our deliverables tracker can be found here https://www.nationalgrideso.com/document/189141/download

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ESO's mission: to enable the transformation to a sustainable energy system and ensure delivery of reliable affordable energy for all consumers

Role	Role 1 Control Centre Operations	Role 2 Market Development & Transactions	Role 3 System Insight, Planning & Network Development
Services	• System operations • Network coordination • Short-term energy forecasting • System data & information management • Restoration & emergency response	• Balancing & ancillary service market design • Service procurement & settlement • Revenue collection • Policy advice & delivery • Code administrator • EMR Delivery Body	• Long-term forecasting • Network options assessment • Competitive system delivery & early network competition • Connection Management & Network Access • Whole system process development

Activities

Role 1	Role 2	Role 3
A1.1 Ongoing Activities D1.1.7 Detailed forecasts and analysis D1.1.8 Trading solutions for the Control Centre	**A4.4 Deliver a single, integrated platform for ESO Markets** D4.4.1 Market platform D4.4.2 Common standards	**A11.1 Refresh and integrate economic assessment tools to support future network modelling needs** D11.1 Improved investment analysis
		A11.2 Implement probabilistic modelling D11.2 Identification of network needs
A1.2 Enhanced Balancing Capability D1.2.1 Enhanced balancing tool D1.2.2 Develop inertia monitoring capabilities	**A5.3 Improve our security of supply modelling capability** D5.3 Enhanced modelling/data sets	**A13.1 Carry out analysis and scenario modelling on future energy demand and supply** D13.1 Future Energy Scenarios (FES)
		A13.2 Conduct mathematical, modelling & market research on local and wider geographic demand information D13.2 Energy demand models
A1.3 Transform Network Control D1.3.1 Situational awareness tool D1.3.2 Network modelling D1.3.3 Control Centre upgrades	**A6.5 Work with all stakeholders to create a fully digitalised, whole system Grid Code by 2025** D6.5 Digitalised grid code	**A14.4 Facilitate development of the customer connections hub** D14.4.1 Connections hub phase 1 D14.4.2 Connections hub phase 2
		A15.6 Transform our capability in modelling and data management D15.6.1 Phase 1 data mgt. scope D15.6.4 Data analytics platform D15.6.2 Grid Code modifications D15.6.5 Data platform extension D15.6.3 Phase 2 modelling scope D15.6.7 Outage planning

Investments

Role 1	Role 2	Role 3
110 Network control (situational awareness)	330 Digitalised grid code management	360 Offline network modelling
150 Operational awareness and decision support	400 Single markets platform	350 Planning and outage data exchange
180 Enhanced balancing capability	410 Ancillary services settlements refresh	380 Connections platform
260 Forecasting enhancements	420 Auction capability	
	250 Digital engagement platform	

Cross-cutting

A17 Transparency and Open Data D17.1 Open data portal with limited data sets D17.2 All published data in machine readable format	**Data** Open data unlocking zero carbon system operation and markets	**A1.4 Data and analytics platform** D1.4.1 Data and analytics platform **220 Data and analytics platform**

Digital Transformation (Ways of Working)

Figure 19 – ESO digitalisation matrix

6.7. Figure 20 below shows the high-level timeline for the IT investments that support our activities and deliverables. There is a many-to-many relationship between the activities outlined in Figure 19 and the enabling IT investments outlined in Figure 20. Given the importance of these enabling investments, we have provided a progress update in Tables 2, 4, 6 and 8, structured via the respective ESO roles that they enable (for mapping see 'Digitalisation matrix' Figure 19).
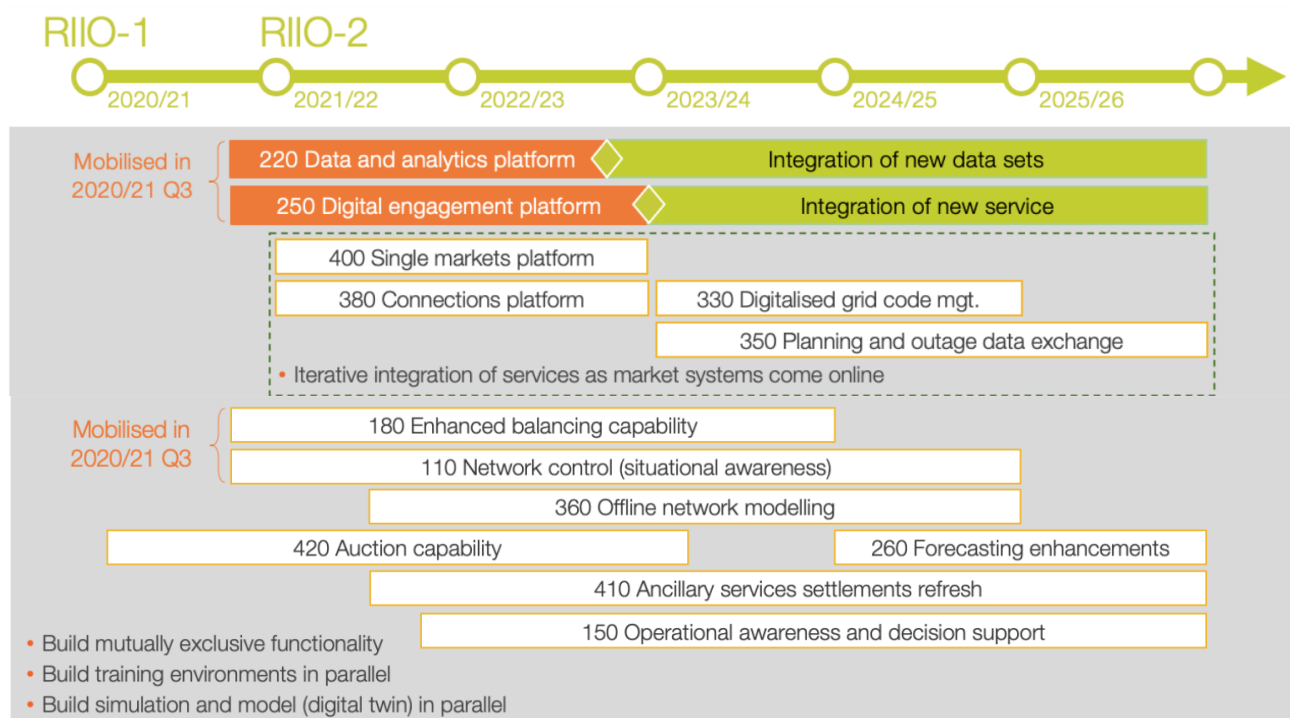
RIIO-1   RIIO-2

| 2020/21 | 2021/22 | 2022/23 | 2023/24 | 2024/25 | 2025/26 |

Mobilised in 2020/21 Q3
- 220 Data and analytics platform — Integration of new data sets
- 250 Digital engagement platform — Integration of new service
- 400 Single markets platform
- 380 Connections platform
- 330 Digitalised grid code mgt.
- 350 Planning and outage data exchange
- • Iterative integration of services as market systems come online

Mobilised in 2020/21 Q3
- 180 Enhanced balancing capability
- 110 Network control (situational awareness)
- 360 Offline network modelling
- 420 Auction capability
- 260 Forecasting enhancements
- 410 Ancillary services settlements refresh
- 150 Operational awareness and decision support

- • Build mutually exclusive functionality
- • Build training environments in parallel
- • Build simulation and model (digital twin) in parallel

Figure 20 – Technology investments supporting our digitalisation strategy

7. Role 1 activities, deliverables, and investments

Role 1 – Control Centre Operations

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.

Figure 21 below shows a plan view of our transformation activities, deliverables, and milestones corresponding to Role 1 – Control Centre Operations.
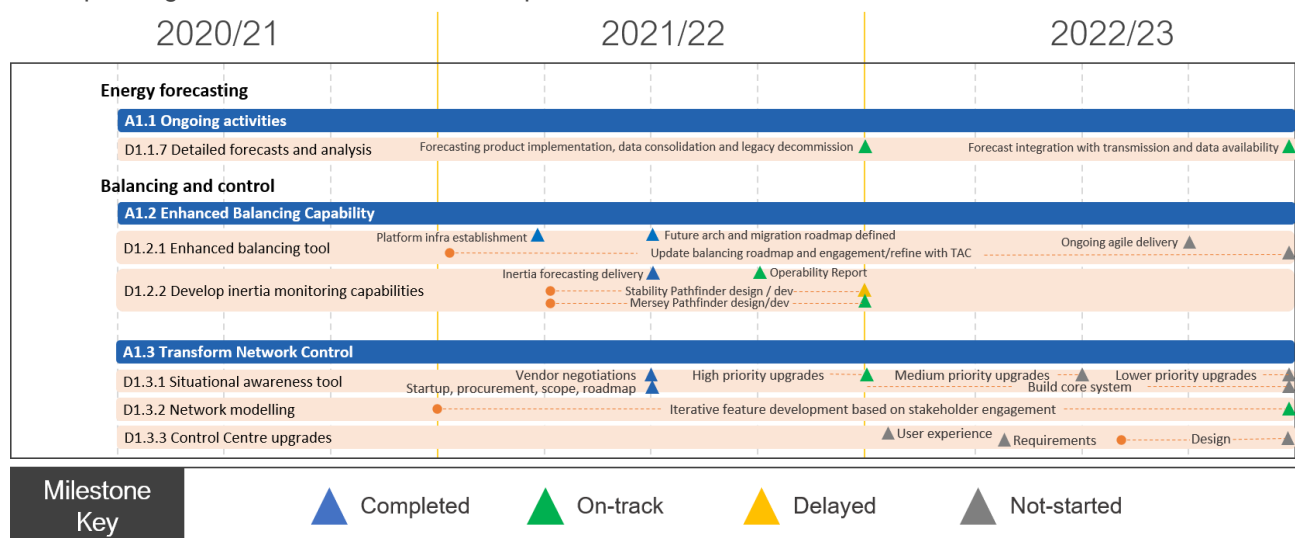

Figure 21 – Our Role 1 digitalisation strategy activities, deliverables, and associated delivery statuses

Role 1 activities and deliverables

Table 1 – Activities and deliverables that support Role 1 – Control Centre Operations.

Activity/Deliverable	Status	Update
A1.1. Ongoing activities		
D1.1.7 Detailed forecasts and analysis Produce and publish detailed forecasts and analysis, for both demand and generation, published at day-ahead and other timescales. Forecasts will be enhanced using detailed statistical and machine learning approaches. Provide data and insight to inform control centre decision making and performance review and integrate relevant IT projects into business as usual. Our forecasting enhancements will provide the control room with better quality, more frequent forecasts, allowing them to make better operational decisions. This helps minimise balancing costs and reduce carbon emissions. *See also section 7, Table 1 technology investment '260 Forecasting Enhancements'*	On track	We are on track for our 2021/22 implementation of forecasting products and sharing outputs from mature products externally where possible: • Implementation of core forecasting capability (demand, wind, and solar power generation forecasts at national and grid supply point levels) in our platform for energy forecasting. • Embed additional input data into internal forecasting processes – embedded generation metering data, weather data. • Build further on digital forecasting foundation to deliver improvement in large data processing, model training and forecast prediction time. Decommission existing legacy forecasting capability and system.
A1.2 Enhanced Balancing Capability		

Activity/Deliverable	Status	Update
D1.2.1 Enhanced balancing tool Enhanced balancing tool built and developed in a modular fashion that will incorporate machine learning and artificial intelligence. It will enable us to schedule and dispatch a greater number of market participants than today. *See also section 7, Table 1 technology investment '180 Enhanced balancing capability'*	On track	• We have started developing the foundational infrastructure and tools to support applications. • In Q3 2021 we will start to build a platform environment in which to create applications (collaboration space with servers, storage, and code development infrastructure).
A1.3 Transform Network Control		
D1.3.1 Situational awareness tool Develop and deliver new real-time situational awareness tool, so Control Centre engineers can better understand changing network limitations, leading to a more efficient risk-based operation of the system. Modules will integrate with the new Network Control tool to provide advanced situational awareness. *See also section 7, Table 1 technology investment '110 Network control'*	On track	• We have developed a vision and strategy for the network control management system. • We have developed requirements against this vision and strategy and are engaging with suppliers in a competitive procurement event. • This is due to be completed by the end of 2021/22. • Over the next six months we will develop our vison and requirements for future capabilities and prepare the data centres for initial deployment mid 2022/23.
D1.3.2 Network modelling Enhanced network modelling capabilities with online analysis of voltage and power flow profiles closer to real time. This deliverable outlines the potential modules that will be incorporated into the new Network Control tool (D1.3.1). *See also section 7, Table 1 technology investment '150 Operational awareness and decision support''*	On track	• We have completed workshops to define modules for situational awareness toolset. • Modules will be delivered as part of D1.3.1 Situational awareness tool.

Role 1 investments

Table 2 – Investments that support Role 1 – Control Centre Operations. Note: there is a many-to-many relationship between these enabling IT investments and the corresponding activities and deliverables above.

Technology investment	Status	Update
110 Network control (situational awareness) This investment will introduce new real-time situational awareness capability giving control centre operators a better understanding of changing network limitations, leading to a more efficient risk-based operation of the system. This capability will need new alarm management, modelling and visualisation tools. We will also deliver training simulation tools combined with artificial intelligence and digital twin technology relevant to this investment.	On track	• We are progressing with the competitive dialogue procurement process with short listed suppliers. Forecasted to complete March 2022. • We have agreed outline terms and conditions with our provider for new enhanced Managed Support Agreement.
150 Operational awareness and decision support This investment will enhance our network modelling capabilities by giving online analysis of voltage and power flow profiles closer to real-time. This will ensure the network is run securely and data exchanges with TOs and DNO/DSOs are timely and correctly assessed.	On track	• We are delivering 'Fault level analysis' and 'Look ahead forecasting' as part of this project. • These will deliver Network and Information Systems Directive (NISD) security alignment and improve the economical operation of the network, respectively.

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Technology investment	Status	Update
180 Enhanced balancing capability Our core balancing systems enable the real-time balancing of electricity supply and demand and are classed as critical national infrastructure (CNI). A major failure of these systems would result in widespread loss of supply, which would lead to economic and societal damage to the UK and put ESO's licence at risk. It is essential that we invest in our core balancing systems to manage the rapidly evolving electricity market. We will also deliver training simulation tools combined with artificial intelligence and digital twin technology relevant to this investment.	Delayed	The following milestone has been delayed: • Q2 2021-22 - Complete foundational infrastructure tooling work • The provision of foundation infrastructure milestone has been delayed due to procurement of technologies taking longer than planned. • We have revised this milestone to be completed in Q4 2021-22 and it is on track to be completed by end of March 2022. • The combination of a better understanding of the scope and the cost base has resulted in requiring a higher than planned budget being required than was envisaged at final determinations. • By the end of the blueprint phase in November 2021, we completed a detailed functional roadmap, end-to-end technology design, and a dispatch instruction module prototype in partnership with University of Strathclyde led by our control room engineers. • Core system development sprints have commenced from November 2021.
260 Forecasting enhancements Continuing with the investment made under RIIO-1, to enhance our mathematical forecasting models and refresh the forecasting system in line with our policies.	Delayed	• Release 1 – Integration of national demand forecasting models with consuming systems to deliver a circa 20% improvement in accuracy. • Planned for Q3 2021/22, delayed to Q4 due to integration testing issues. • Review of approach in progress to de-risk Release 1 and ensure delivery in FY21/22. • Strategic roadmap for integration into the Data and Analytics platform beyond Release 1 is also under development.

8. Role 2 activities, deliverables, and investments

Role 2 – Market Development and Transactions
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. 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.

Figure 22 below shows a plan view of our transformation activities, deliverables, and milestones corresponding to Role 2 – Market Development and Transactions.
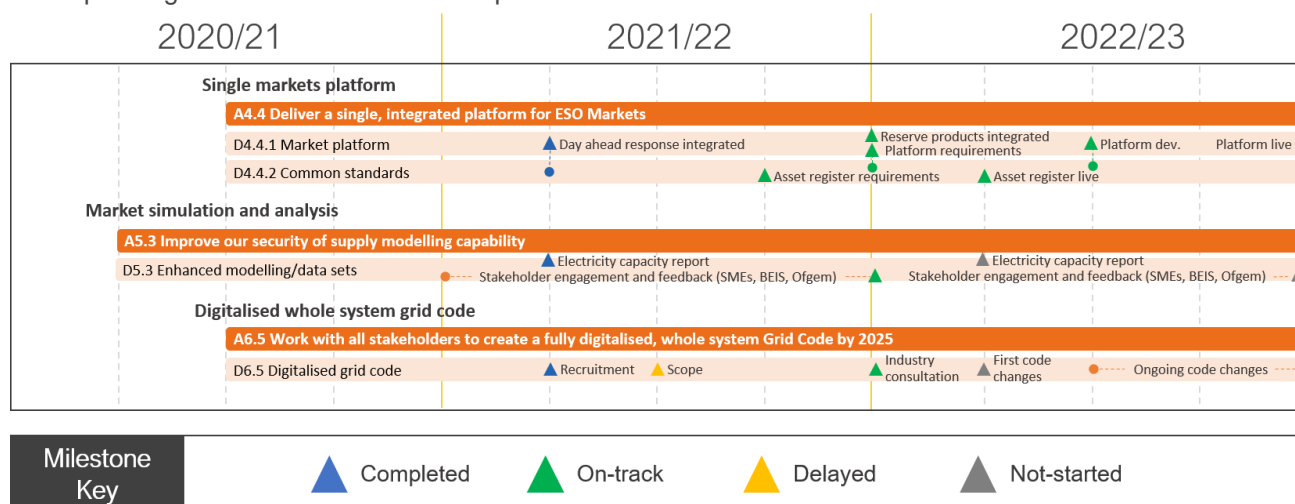
Figure 22 – Our Role 2 digitalisation strategy activities, deliverables, and associated delivery statuses

Role 2 activities and deliverables
Table 3 – Activities and deliverables that support Role 2 – Market Development and Transactions

A4.4 Deliver a single, integrated platform for ESO Markets		
D4.4.1 Market platform A market platform through which market participants will be able to participate in balancing and capacity markets. The markets platform will cover the end-to-end process for market participation including communications, data input and management, messaging, and validation. *See also section 8, Table 4 technology investment '400 Single markets platform'*	On track	The single market platform (SMP) will evolve over time. Different elements of functionality will be deployed for different markets and services at different times in a co-ordinated release train. Elements of the foundational single markets platform deployed and operational in Q1 2021/22 as part of the day ahead frequency response auction trial include: • Service providers have a single log-in for the auction platform and associated functionality. • Automatic loading of service provider registration information into the auction platform where users can view it. • Bids are submitted via the platform as opposed to spreadsheet or email.
D4.4.2 Common standards Common standards, including interoperable systems, a common data model and shared minimum specifications between the ESO and other flexibility platforms as well as at the distribution level. *See also section 8, Table 4 technology investment '400 Single markets platform'*	On track	• See D4.4.1 Markets platform.

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A5.3 Improve our security of supply modelling capability

D5.3 Enhanced modelling/data sets	On track	

D5.3 Enhanced modelling/data sets

Use of enhanced modelling and more granular data sets to improve security of supply modelling.

In a world of rapidly evolving energy systems, we will need to deploy the latest modelling techniques to ensure 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. This will ensure their contributions to security of supply remain appropriate and help to ensure the Great Britain reliability standard is met.

With growing interconnection across Europe and between Great Britain and other countries, our pan- European modelling needs to be able to better model different markets. We will improve our pan- European modelling in 2021 and 2022. This will include participation of interconnectors and/or European generators in the capacity market (CM).

It will require significant development of the model and data collection to model the interactions of future plant mixes within Europe. It will have to factor in the different operating regimes and security of supply standards across the various European capacity markets.

See also section 8, Table 4 technology investment '220 Data and analytics platform'

On track

- Our first milestone for Q1 2021/22 'Production of the Electricity Capacity Report' was submitted to BEIS on 28 May 2021.
- The report was considered Confidential EMR Information until it was published on 8 July 2021
- In line with the prioritisation agreed with the Panel of Technical Experts (PTE), BEIS and Ofgem enhancements will be made to our modelling.
- Following the production of the Electricity Capacity Report in Q1 2021/22 we will agree with the PTE, BEIS and Ofgem and begin to work through, the prioritised list of enhancements.

A6.5 Work with all stakeholders to create a fully digitalised, whole system Grid Code by 2025

D6.5 Digitalised grid code

The Grid code combines transmission and distribution codes in an IT system with AI-enabled navigation and document and workflow management tools.

See also section 8, Table 4 technology investment '330 Digitalised code management'

On track

- Engagement at Grid Code Development Forum (GCDF), Industry Technical Codes Group (ITCG – DNOs), Ofgem (technical Codes Representatives) and Major Energy Users Council undertaken to introduce the project.
- We will engage with DNO Code User, Trade Associations (FGG, ADE, Renewable UK) and Wider Industry (Birmingham University).
- The feedback that has been received to date has informed Consultation 1 that was published on 27 September 2021 and closed on 12 November 2021.
- Consultation 1 aims to gather views on the scope, objectives, and approach, and will guide the formation of an industry-led governance structure for the project.
- Further engagement or consultation will be developed and published by the project members and steering group (as informed by Consultation 1).
- We anticipate the plan will continue to evolve as we engage externally.

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Role 2 Investments

Table 4 – Investments that support Role 2 – Market Development and Transactions. Note: there is a many-to-many relationship between these enabling IT investments and the corresponding activities and deliverables above.

330 Digitalised grid code management Investment to transform the stakeholder experience of the code management process through artificial intelligence enabled navigation, and document and workflow management tools.	Pre mandate	• We have started the pre-project discovery phase. • We will define technology investment timelines in D6.5 (see Table 3).
400 Single markets platform The single markets platform will provide a full end-to-end customer journey allowing market participants to access the data relating to how to become a provider (obligations, sign up, test, application progression), contract tender (see contracts status and manage contracts), unit management (see what units are registered for, see and change aggregation configurations), dispatch (access instructions), performance monitoring (see how units behaved under instructions), payment. This will include all ancillary service products plus EMR and CfD. This investment includes a market sandbox to enable faster and more efficient trial of new products through the ability to integrate with the core systems.	On track	• Following a successful enablement (start-up) phase where the strategic vision, scope and choice of technology was defined, we are now in the design and development phase of the programme. • Initial functionality focused on onboarding (registration and pre-qualification) will be delivered during February 2022 in support of the new day-ahead response markets. • Industry is engaged and regularly involved in co-creation through three weekly 'show and listen' working group sessions. • Future release roadmap is being refined to deliver ongoing functionality improvements and integrate additional balancing service products.
410 Ancillary services settlements refresh Replacement of, and ongoing investment in, the ancillary services settlement system, to manage the increased number of market participants and increasing rates of change.	On track	• We combined the product roadmap with Charging and Billing Asset Health to gain efficiencies by integrating services into new platform. • Release 1 and 2 are inflight and will be delivered in Q1/2 2022. • We updated the product roadmap outlining all releases to 2023.
420 Auction capability We will invest in common auction capability and apply economies of scale for more efficient action-based procurement activities. This capability will be expandable to all types of auctions and allow for appropriate running frequency: EMR, CfD, reserve, response, reserve and response, reactive power. Where possible, efficiency benefits from auctions will also be implemented in tender- based service procurements.	On track	• The project is in the process of completing a full tendering process to identify a vendor and supporting technology to provide the enduring auction capability. • Following a pre-qualification exercise (PQQ), an RFP (Request for Proposal) has been issued to short-listed vendors. RFP evaluations will be complete by mid-Jan, with vendor selection taking place in March 2022. • A delivery phase with the selected vendor will then begin, aiming to deliver the enduring auction capability by December 2022.

9. Role 3 activities, deliverables, and investments

Role 3 – System Insight, Planning and Network Development
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 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.

Figure 23 below shows a plan view of our transformation activities, deliverables, and milestones corresponding to Role 3 – System Insight, Planning and Network Development.
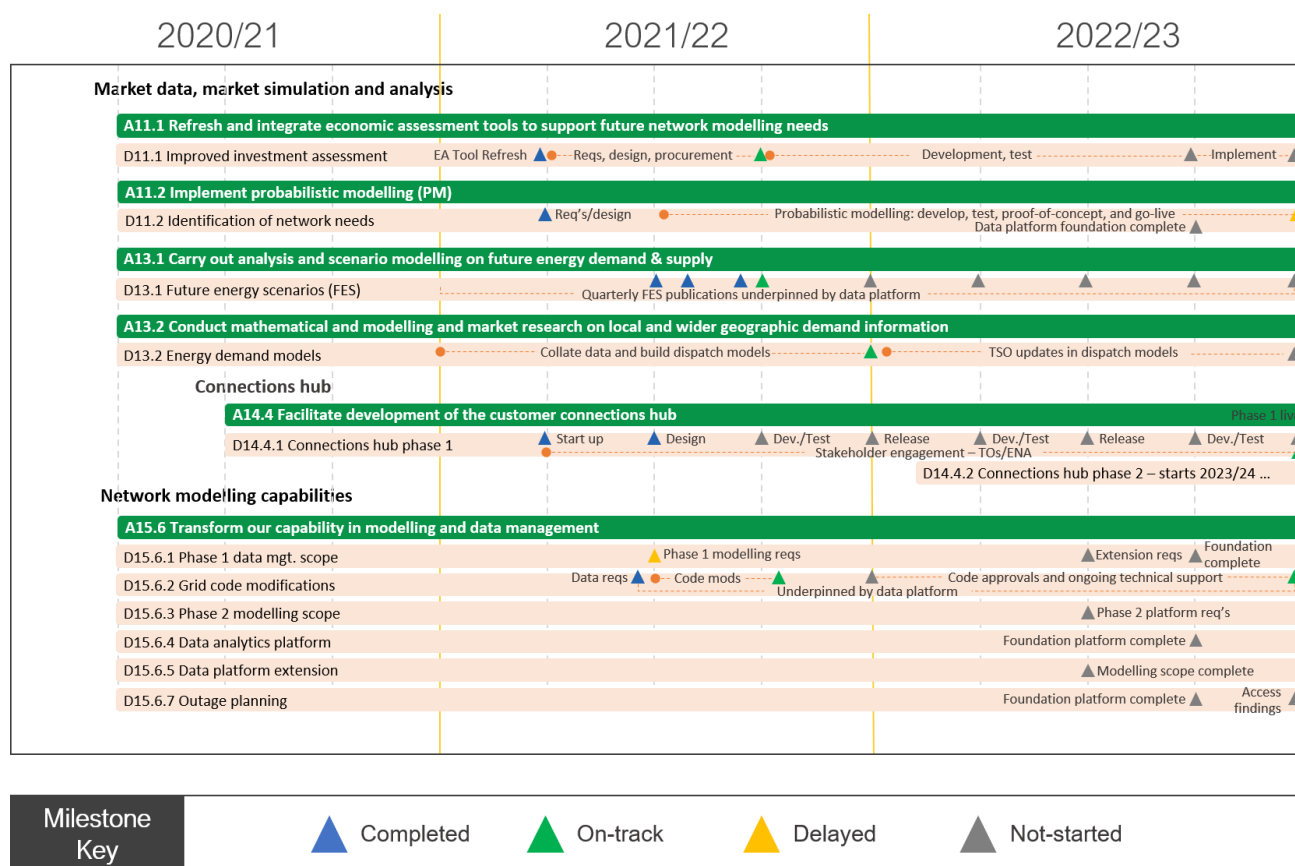

Figure 23 – Our Role 3 digitalisation strategy activities, deliverables, and associated delivery statuses

Role 3 activities and deliverables

Table 5 – Activities and deliverables that support Role 3 – System Insight, Planning and Network Development

A11.1 Refresh and integrate economic assessment tools to support future network modelling needs		
D11.1 Improved investment analysis Improved identification of when is the most economical time to invest and the most efficient solution.	On track	• We have started bilateral discussions with suppliers. • Requirements for the future Economic Assessment tool are being gathered and assessed against the current and potential solutions before any tender exercise takes place.

A11.2 Implement probabilistic modelling

D11.2 Identification of network needs Improved identification of network needs.	On track	• We have started to capture requirements for the design of probabilistic modelling • A proof-of-concept tool is in place and being used alongside network analysis for NOA to demonstrate capability for further integration

A13.1 Carry out analysis and scenario modelling on future energy demand and supply

D13.1 Future Energy Scenarios (FES) Published Future Energy Scenarios (FES), Winter Outlook and Review, Summer Outlook, and other regular external commentary such as blogs from ESO employees on our website. *See also section 10, Table 8 technology investment '220 Data and analytics platform'*	On track	• FES launch took place as scheduled week commencing 12 July 21 and was delivered via a series of virtual sessions across the week. • Documents and associated publications were uploaded to the ESO website in line with the launch. • Stakeholder feedback is critical to the development of the FES. The Call for Evidence was published on the ESO website on 8 September 2021 and promoted via the FES Newsletter and on social media. We are in the process of determining topic areas and questions we will take to our stakeholder base through a mixture of channels and methods. • Regular meetings are ongoing. We are also using the Network Forum to discuss and shape some of our regional FES thinking and development as the meetings cover a range of whole energy stakeholders across gas and electricity. • The stakeholder engagement that the SFD reports on is underway in line with the established FES process.

A13.2 Conduct mathematical, modelling and market research on local and wider geographic demand information

D13.2 Energy demand models Created pan-European and country level electricity and energy demand models. *See also section 10, Table 8 technology investment '220 Data and analytics platform'*	On track	• We are on track to deliver our commitment within Q4 2021. • This will ensure that we have two new European scenarios out to 2050 that can be included within our pan-European market dispatch model, as used in FES and NOA. • Both new scenarios are compatible with the EU's new net zero targets and therefore represent a more accurate forecast for our interconnected markets than the data they replace.

A14.4 Facilitate development of the customer connections hub

D14.4.1 Connections hub phase 1	On track	
Implement first phase of the ESO connections hub, including online account management and integration with other network organisation websites. *See also section 9, Table 6 technology investment '380 Connections portal'*		• We have commenced project start up and are engaging with the Transmission Owners around portal proposals. • We have held workshop sessions with DNOs to obtain feedback that will provide insight on what needs and requirements which must be included in the design assumptions to enable the key areas for customer to be included. • The project is now at design stage; we are still on track for delivery by April 2022. • Further sessions to be arranged with Customers to share draft portal and obtain feedback functionality started during Q2 2021.
D14.4.2 Connections hub phase 2	Not started	
Phase 2 of the connections hub concluded. *See also section 9, Table 6 technology investment '380 Connections portal'*		• We will start this activity in 2023/24.
A15.6 Transform our capability in modelling and data management		
D15.6.1 Phase 1 data mgt. scope	Delayed	
Phase 1 data management scoping complete to feed into data and analytics platform (see D1.4.1) – modelling and data expertise will be used to scope planning data requirements for the data and analytics platform *See also section 10, Table 8 technology investment '220 Data and analytics platform'*		• This activity depends on D1.4.1 Data and analytics platform Phase 1 modelling scope, which is still ongoing to establish the approach.
D15.6.2 Grid Code modifications	On track	
Further Grid Code mods (arising, for example, from O/N 2020 work programme, discussions with industry participants and/or in response to Ofgem's Call for Evidence on Distributed Generation visibility) *See also section 10, Table 8 technology investment '220 Data and analytics platform'*		• We have completed the data requirement assessment. • We are currently progressing through the working group stage.
D15.6.3 Phase 2 modelling scope	n/a	
Phase 2 modelling scoping complete to feed into data and analytics platform extension *See also section 10, Table 8 technology investment '220 Data and analytics platform'*		• See D1.4.1 Data and analytics platform.
D15.6.4 Data analytics platform	n/a	
Data analytics platform foundation in place *See also section 10, Table 8 technology investment '220 Data and analytics platform'*		• See D1.4.1 Data and analytics platform.
D15.6.5 Data platform extension	n/a	
Data platform extension complete (please see deliverable D1.4.1 for further details) – once the data and analytics platform foundation is complete, an extension will be developed as new tools are delivered. *See also section 10, Table 8 technology investment '220 Data and analytics platform'*		• See D1.4.1 Data and analytics platform.

D15.6.7 Outage planning Deeper Outage Planning go live in Offline Network Modelling – this will enable higher volumes of network data, regional models, and outage planning data to be exchanged, used, and shared by network companies. D15.6.7 Deeper Outage Planning go live in Offline Network Modelling enables higher volumes of network data, regional models, and outage planning data to be exchanged, used, and shared by network companies. *See also section 9, Table 6 technology investment '360 Offline network modelling'*	Not started	• Work on this deliverable is planned to start later in the BP1 period. • We are developing the outline process and once complete, will start this activity.
A17 Transparency and Open Data		
D17.1 Open data portal with limited data sets Open data portal with limited data sets (go live 2019) This deliverable refers to the foundational data portal acting as a proof of concept for the RIIO-2 data portal which will be powered by the Data and analytics platform and utilise the user interface of the Digital engagement platform. *See also section 10, Table 8 technology investment '220 Data and analytics platform'*	On track	• In 2019 we completed the foundational portal launch. • Enduring solution will be delivered by the data and analytics platform. • See D1.4.1 Data and analytics platform. • Data and analytics platform foundation requirements and design (Q2/3 2021/22). • Digital engagement platform requirements and design (Q2/4 2021/22).
D17.2 All published data in machine readable format All published ESO data in machine readable format. *See also section 10, Table 8 technology investment '250 Digital engagement platform'*	On track	• We achieved our Q2 2021/22 target for all ESO data to be published in a machine-readable format. • We are on track for releasing and automating further data sets.

Role 3 Investments

Table 6 – Investments that support Role 3 – System Insight, Planning and Network Development. Note: there is a many-to-many relationship between these enabling IT investments and the corresponding activities and deliverables above.

350 Planning and outage data exchange Enhancement of outage planning and data exchange systems to enable a whole system approach to access networks, manage significantly increased data volumes, and provide interactive stakeholder engagement.	On track	Project now fully mobilised, with three workstreams: • Agile delivery train to continuously improve the new electricity network access management system capability. • Discovery phase for deeper access planning with the Distribution Network Operators (DNO's). • Discovery phase to improve data flows in readiness for the Common Information Model (CIM) roll out.
360 Offline network modelling Transmission analysis is carried out from ten years ahead through to real-time and post event to help design and run the network as securely and economically as possible. The offline network modelling tools deliver the day-to-day analysis required to operate the transmission system in a safe and secure manner, as well as deliver the Electricity Ten Year Statement (ETYS) and ENTSO-E reporting	On track	• Delivery model being established to deliver enhanced network modelling capabilities, in parallel a cloud migration and software upgrade of the existing tool is in progress, completion planned for August 2022.
380 Connections platform We propose building a customer connections hub, providing a single point of contact for connections to electricity networks that will guide customers through the connection process. The hub will advise customers of capacity opportunities on both the distribution and transmission networks.	On track	• High-level scope and plan for the initial phase agreed, targeting a phase 1 delivery in March 2022. • Initial development Sprints in progress, customer feedback sessions planned to commence in January 2022.

![national**grid**ESO logo]

10.   Cross cutting activities, deliverables, and investments

ESO Data Strategy

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.

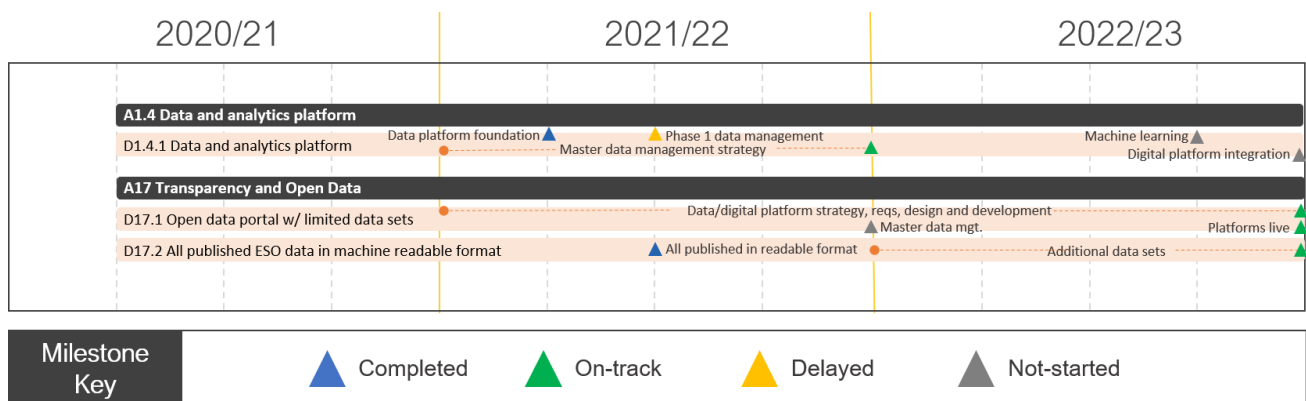Figure 24 shows a plan view of our transformation activities, deliverables, and milestones corresponding to Data.

Figure 24 – Our data strategy activities, deliverables, and associated delivery statuses

Cross cutting activities and deliverables

Table 7 – Cross cutting activities and deliverables

A1.4 Data and analytics platform		
D1.4.1 Data and analytics platform Creation of a data and analytics platform that will act as the foundation for our new Control Centre architecture. It will house all ESO internal data, including from the Control Centre systems, and allow users to access it in the timescales they need. External stakeholders will be able to access it through the data portal. *See also section 10, Table 8 technology investment '220 Data and analytics platform'*	Delayed	• The programme has experienced a delay in completing our detailed design and foundation cloud services implementation. • To addresses these issues, a new Lead Solution Architect has been onboarded. • Our industry partner is providing support around cloud remediation. • To support platform design, we have established lean agile squads, moving away from a programme focused model and run two proofs-of-concepts to validate capability. • In the next six months we will focus on (i) completing DAP solution design, (ii) enabling analytic services to support migration of critical models, and (iii) onboarding prioritised investments.

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Cross cutting investments

Table 8 – Cross cutting investments. Note: there is a many-to-many relationship between these enabling IT investments and the corresponding activities and deliverables above.

220 Data and analytics platform	Delayed	
This is foundational work to unlock the value of the data we hold. It will be the key technology underpinning all our internal and external data management, pulling together data from a variety of sources and ensuring there is only one source of the truth. This includes CNI and non-CNI data and analytics platforms as well as their associated integration platforms. Cloud-based data management and analytics are now universal and essential for modern data analysis approaches and even more so for artificial intelligence implementations. This investment will evolve ESO's traditional data management and analytics to the cloud. It is indispensable for much of the RIIO-2 change programme, including unlocking the value of our digital twin technology investments and hosting data from the asset register, fundamental for our single markets platform.		• We have completed documenting our strategy and technology project approach and mobilised our Project team, including 3rd party resources. • Our ESO data strategy and conceptual solution architecture has been documented but there has been a delay in completing our detailed design and foundation cloud services implementation. • An RFP to select a single implementation partner is in-flight, targeting selection within Q1 2022.
250 Digital engagement platform	On track	
This investment, mentioned in the chapter 8, Digitalisation and open data unlocking zero carbon system operation and markets, will enable a single point of access for all ESO data and services, including the markets, connections, digitalised Grid Code management and data and analytics platform. It sits at the heart of our vision for digital capability across all our themes, providing a common engagement experience for stakeholders.		• Following a successful enablement (start-up) phase where the strategic vision, scope and choice of technology was defined, we have now initiated procurement activities on three workstreams: • New Design System. • Customer Identity and Access Management (CIAM) – Pin Notice published – Delivery expected June 2022. • Digital Experience Platform (DxP) – to make the experience of engaging with the ESO more intuitive and user friendly by providing a personalised user interface with access to information, data and other services including markets, connections, and codes. Pre-qualification questionnaire (PQQ) issued 26 November. Competitive Dialogue will commence mid-January 22 (PQQ issued 26-Nov) with minimum viable product (MVP) anticipated December 2022.

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11. Digital transformation (Ways of Working)

11.1. We have established a digital transformation programme that will implement our digital approach to operations. Figure 25 shows our near-term roadmap. The first phase focused on understanding, definition, and early adoption. The next phases will be to scale our digital operations, before moving into a period of continuous improvement.

11.2. In the first phase we completed a series of activities to understand how we improve our emphasis on customer, and how we bring the customer into the heart of our product development. This included understanding the products and services they want, and how they want to interact with us.

11.3. We have now begun our second phase, adoption. The adoption phase supports the implementation of the product model blueprint.
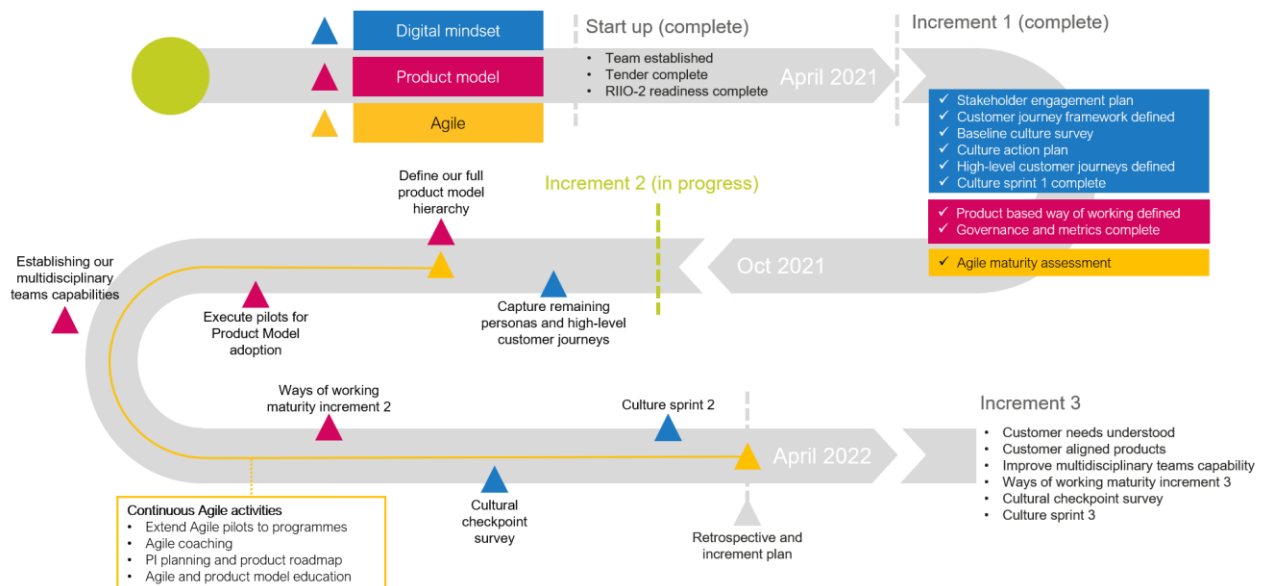

Figure 25 – Digital transformation (Ways of Working) roadmap

11.4. In parallel we have defined a customer journey framework. This allows us to consistently capture the needs and wants of our customers through personas and journey maps.

11.5. The product model allows us to organise our internal teams to deliver the needs of our customer through the formation of multidisciplinary teams who deliver our products through agile ways of working.

11.6. Our adoption phase will be a multiyear programme of change as we scale the product model, as we establish, improve, and integrate our new ways of working.