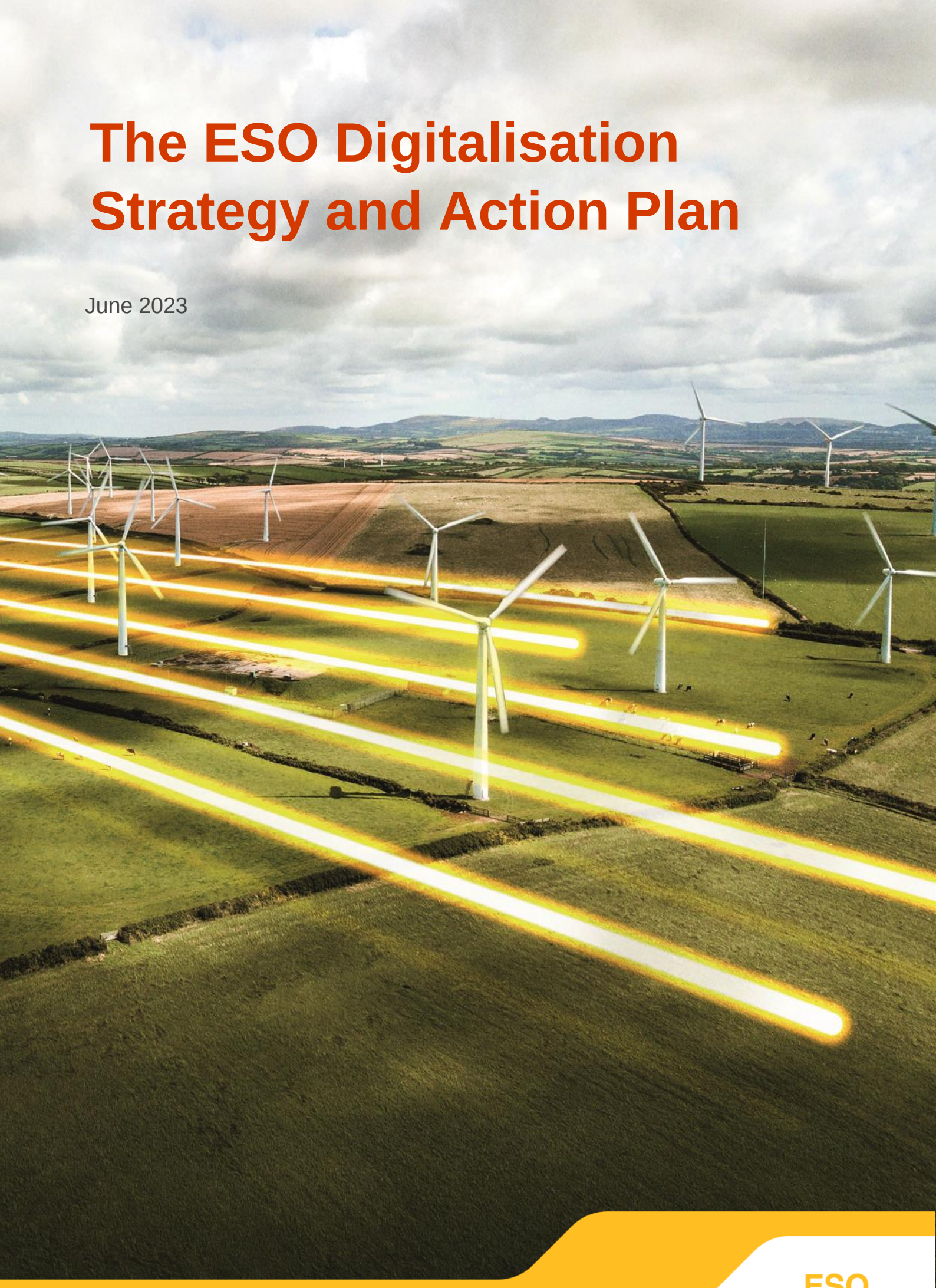
The ESO Digitalisation Strategy and Action Plan

June 2023



ESO

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Foreword

Our mission as the Electricity System Operator (ESO) is to drive the transformation to a fully decarbonised electricity system by 2035 which is reliable, affordable, and fair for all.

The ESO has a unique opportunity to shape the way we use and consume energy for generations to come. We have committed to being able to operate a zero-carbon system by 2025, which supports the UK's plan to achieve net zero greenhouse gas emissions by 2050. Our transformation to a Future System Operator (FSO) is set to build on the ESO's position at the heart of the energy industry, acting as an enabler for greater industry collaboration and alignment.

Digital, Data, and Technology drive our mission and underpin all our core activities and services. In the RIIO-2 period, we have shared an ambitious digital, data, and technology plan focused on driving consumer value, meeting net zero expectations, and building toward the Future System Operator. As we enter the RIIO-2 Business Plan 2 (BP2) period, we are excited by the opportunities to accelerate innovation, unlock value through data and continue to drive digitalisation across all our current and future roles.

Our current Digital strategy focuses on customer centricity, modern architecture transformation, data transparency and interoperability, and a shift in culture to digital ways of working. We are currently revising our digital strategy in line with our ambitions for FSO, reflecting the industry's transformational shifts, growth in technology options, and a strong need to drive data interoperability between participants.

Successful and sustainable delivery is based on our robust digitalisation strategy and action plan, which outlines our approach and details a roadmap of what we have successfully delivered during BP1 and what we plan to deliver during BP2.

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.

Shubhi Rajnish

ESO Chief Information Officer

Submission Overview

In our last update in December 2022, we advised that we had submitted our RIIO-2 Business Plan 2 (BP2) to Ofgem and were in the middle of the consultation on the Draft Determination. We are pleased to confirm that Ofgem has approved our ambitious technology investment plan, refined to drive our roadmap for the next two years.

We are excited to share that we have completed the Digitalisation Action plan deliverables identified for the Business Plan 1 (BP1) period. This document updates the status of the BP1 deliverables and provides the roadmap for the Digitalisation Action Plan for the BP2 period.

Our current Digital Strategy, published in December 2021, covered the whole period of RIIO-2 and still stands in terms of our ambition. We had planned to publish a revision to the Digital Strategy in June 2023, however, in conversations with our internal and external stakeholders, including the Technology Advisory Council (TAC), we received strong feedback and support to extend the strategic horizon to 2035 and to ensure that we include a future FSO view in the digital strategy.

We have started the work on this; however, as our ambitions for FSO are being finalised, and some of the roles are under consultation and still being refined, we have decided to defer the publication to a later date. We will continue to work with our stakeholders to ensure that the revised Digital Strategy and Action Plan is completed as early as possible within the regulatory timeframe.

We continue to deliver our BP2 plans and progress on building Future System Operator capabilities. We are excited about the opportunities that FSO offers in terms of creating and delivering consumer value and accelerating our net zero ambitions.

Digitalisation Action Plan

Conceptualising our digitalisation strategy and tracking our delivery

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 2). 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.

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 1), we have highlighted how our change activities link back to improvements across our core business services.

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.

To provide visibility of our digital transformation progress, Figures 3-8 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.

We report against these activities, deliverables, milestones, and investments on a quarterly basis through the RIIO-2 deliverables tracker1. 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.

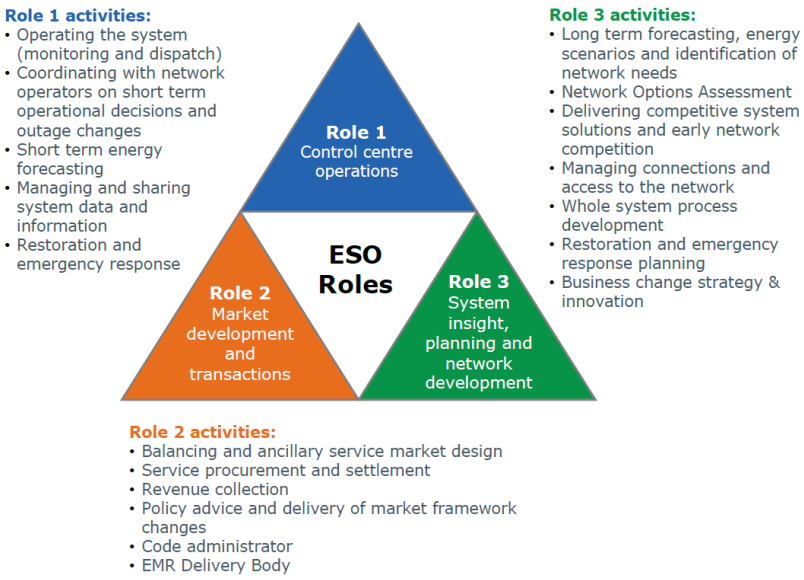

Figure 1 – ESO Roles Overview

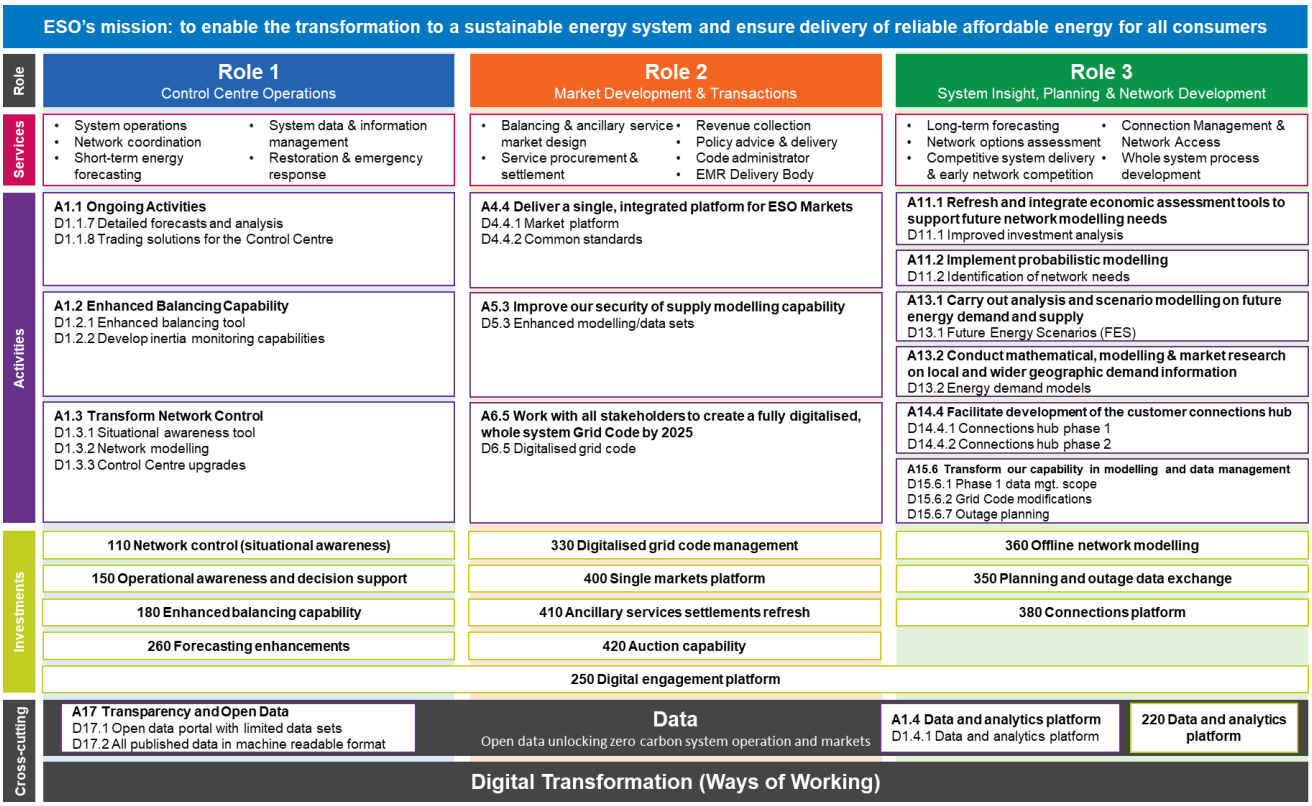

Figure 2 – ESO digitalisation matrix.

[1] Our deliverables tracker can be found here https://www.nationalgrideso.com/document/266141/download

Figures 3 to 8 below show the high-level timeline for digitalisation strategy activities, deliverables, and associated delivery statuses. Given the importance of activities and deliverables, we have also provided a progress update in Tables 3, 4, and 5.

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

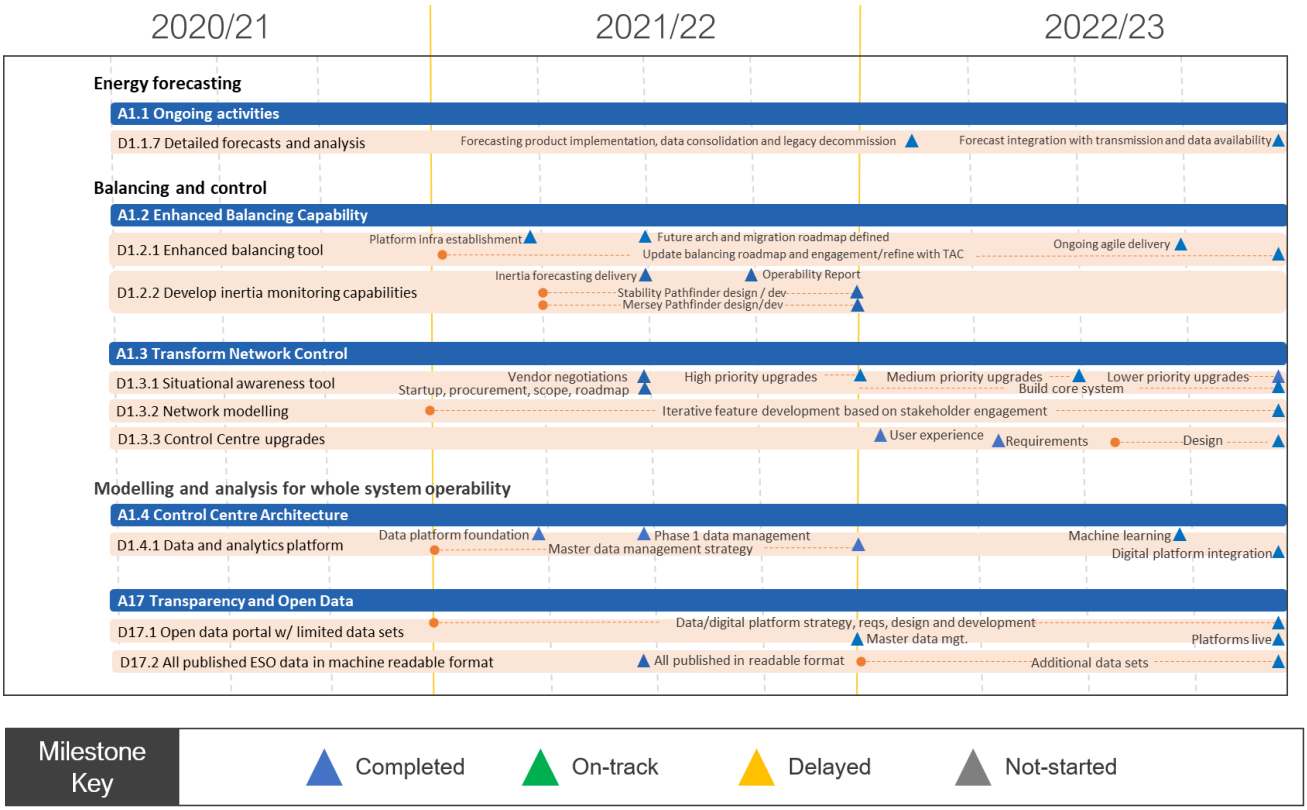

Figure 3 – Our Role 1 BP1 digitalisation strategy activities, deliverables, and associated delivery statuses. Data is as per the April 2023 Incentives Report.

Role 1 activities and deliverables

Table 1 – Activities and deliverables that support Role 1 – Control Centre Operations (as reflected in the April 2023 Incentives Report).

Activity/Deliverables	Related Investment	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.*	260 Forecasting Enhancements	Completed	• Forecasting Platform delivery is now re-prioritised to maximise consumer benefits through reducing technical debt by 1. Delivering PEF on ESO's strategic cloud platform 2. Integration with ESO's other strategic initiatives Data analytics platform (DAP) and Open Balancing platform (OBP) in BP2 • We will continue to maintain and improve (where possible) forecasting and performance improvements delivered in BP1 and adoption of product model and agile ways of working while we deliver additional features and benefits in BP2. • PEF is a continuous improvement project to develop and implement ESO's new forecasting capability. We have already developed and implemented national solar power generation, national demand and GSP net demand forecast products • We have now partially implemented this milestone (GSP Forecasts) , we aim to implement remaining GSP level forecasting product (PV & Wind) in FY24 • GSP demand machine learning model outputs are now consumed with in operational planning and decision-making timescales. Output from this model is estimated to be ~20% better than legacy energy forecasting system. • Model are re-training automatically at least 3 times a week to capture most recent demand patterns and provide accurate possible forecasts to transmission analysis study setups and real time decision making in control room. PEF products also use most recent and weather data inputs • During the next phases of the project and in BP2, we are adopting new way of working and start delivering forecasting as a product. We are exploring options to further enhance and implement newly developed forecasting products into operational use and share it with market (where possible)
A1.2 Enhanced Balancing Capability			

Activity/Deliverables	Related Investment	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.*	180 Enhancing balancing capability	Completed	• The programme is now in the Core Phase. • This is where we begin to build out the core of the new platform. • For the "build a platform environment" milestone, we are setting up the Development environment to begin building the new platform in February 2022. The "foundational infrastructure tooling work" deliverable also forms part of this activity, and has been re-planned to be delivered just ahead of the first go-live in 2023. • Updated roadmap has been shared with TAC as part of ongoing engagement
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.*	110 Network control	Completed	• Work on a Voltage Stability Analysis Tool (VSAT) is continuing and we have completed an upgrade to Industrial Defender Software. However some projects such as Fault Level Enhancements have been delayed due to other projects blocking build deployment paths. Delivery completed in March 2023. • Work has completed on a proof of concept for using SSD hard drives. Remediation work following security penetration tests has been completed. The enhancements to our Control Training Unit (CTU) are completed • Core system functions and environments have been scoped, final system design to be agreed with winning vendor. Work with data centres underway for initial deployment by mid 2022-23. • Roadmap updated to focus on breaking down silod working between the future balancing programme and the Data Analytics Platform plus stressing the role of data and its flow into the NCMS & other systems • Regular touch points with Data Analytics Platform team to ensure both programmes are aligned. RFI completed for CNI Central Data Repository to gather market intelligence for CNI specific needs • Base core system design complete, refinements now in progress to get richer user stories with specific examples from real-time operations
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).*	150 Operational awareness and decision support	Completed	• This is an ongoing activity with scoping being completed, we are now working with the vendors to ensure the Network Control Management System can deliver the functionality and integration levels required as per our requirements

Activity/Deliverables	Related Investment	Status	Update
D1.3.3 Control Centre interfaces *Upgraded Control Centre video walls and operator consoles, with a single interface giving an overall state of the power system. This will allow Control Centre engineers make better and quicker decisions.*	140 ENCC Operator Console	Completed	• A number of user workshops and engagements have taken place which has allowed us to develop the initial Epics and Capabilities. • User stories completed and reference and vendor site visit completed allowing the team to build out the operator console strategy
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*	220 Data and analytics platform	Completed	• Machine learning capability available in DAP (Dev) environment. ML requirements for both Balancing (OBP) and Forecasting (PEF) currently under review and will be released and delivered on a use-case basis. AiCOE team developing additional use-cases from across the wider ESO business functions • Agreed pilot data sets ingested onto DAP and DAP-connection to CKAN established. DEP connectivity to CKAN planned for Q1 2023-24 • Connection to Salesforce established (Dev) and awaiting Production-connection approval. Backlog engagements inflight, to manage the downstream consumption of SMP data. • Initial datasets (DNO Embedded Capacity Registers) ingested onto DAP. Ongoing engagement with RDP initiatives (including the Hartree Centre - STFC) to identify further data sources and consumption expectations
A17 Transparency & Open Data			
D17.1 Open data portal with limited data sets *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.*	220 Data and analytics platform	Completed	• MVP Platform released into the Production environment. Final tests completed and DAP launched in December 2022 • DEP went live in Q4 FY23. The Foundational release includes the new ESO web platform, enhanced navigation, advanced search and new architecture and templates for balancing services content. This release will make ESO content more accessible and discoverable for a wide range of stakeholders. This release also lays the foundations for enhanced features including an ESO account dashboard, integrated query management and personalisation. These features will be prioritised according to customer value and released with a regular cadence starting in Q1 FY24. • There are several elements to this deliverable. The DAP ingestion of data sets for publication on the CKAN data portal was delivered in Q4. This completed an initial integration providing a link from the ESO website (DEP) through to data sets hosted on DAP. The next step with DEP hosting the user interface and integrated across all ESO content and data across all ESO content and data search is on track for

Activity/Deliverables	Related Investment	Status	Update
			delivery in Q2 FY24. The final step will see all published data sets published on DEP and hosted on DAP in Q4 FY24. In parallel further enhancements to our data visualisation capability will be developed in this period.
D17.2 All published ESO data in machine readable format *All published ESO data in machine readable format.*	250 Digital engagement platform	Completed	• All suitable datasets are now in machine readable format. ESO are now publishing over ~100 datasets, many new datasets have been informed by engagement through the OTF. Digital Engagement Platform (DEP) on track to commence procurement activities for new platform. • Work underway to populate DAP with existing datasets, to facilitate visibility and publication via the DEP.

In the BP2 period we continue to deliver on our digitalisation priorities. Figure 4 shows an overview of our main BP2 transformation activities, deliverables, and milestones corresponding to Role 1 – Control Centre Operations.

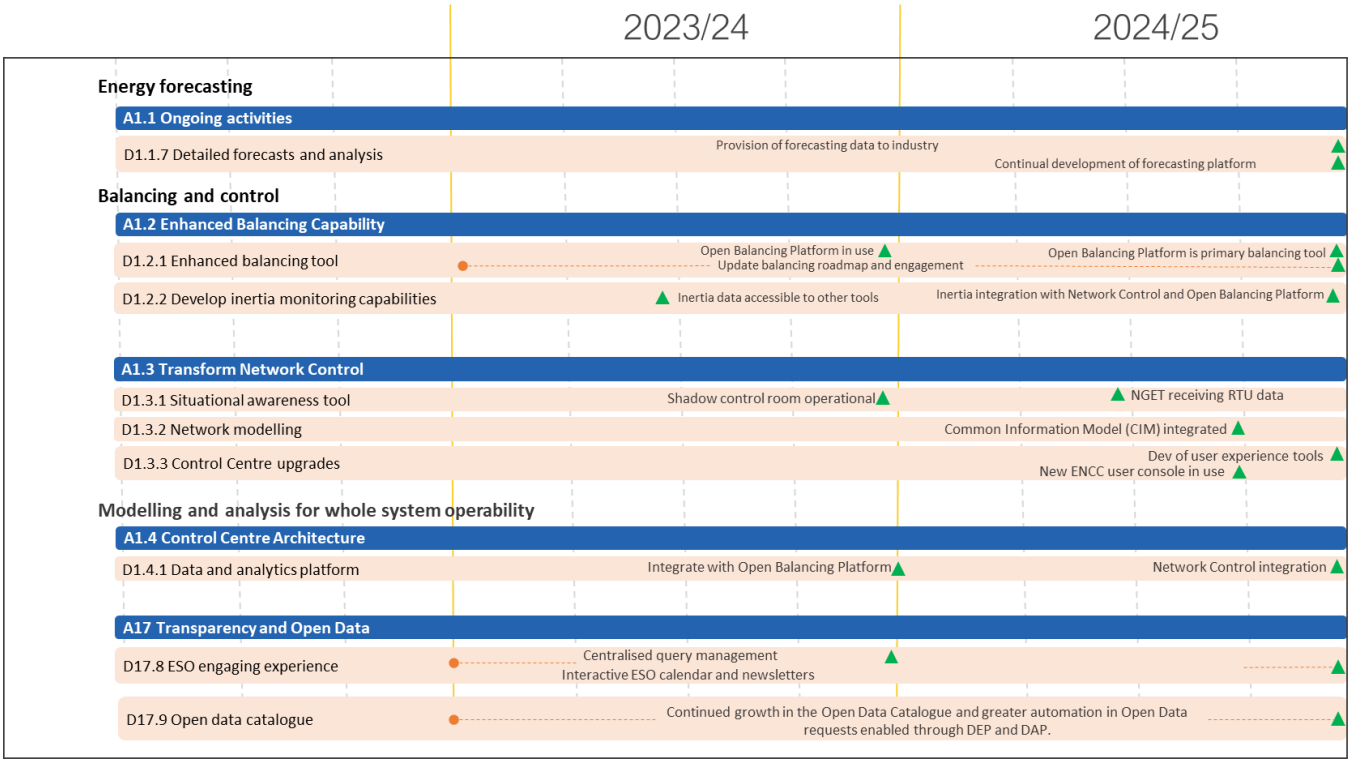

Figure 4 – Our Role 1 BP2 digitalisation strategy activities, deliverables, and associated delivery statuses. Data is as per the April 2023 Incentives Report.

Role 2 activities, deliverables, and investments

Role 2 – Market Development and Transactions

We will continue to drive delivery of efficient outcomes for consumers and remain 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 5 below shows a plan view of our transformation activities, deliverables, and milestones corresponding to Role 2 – Market Development and Transactions.

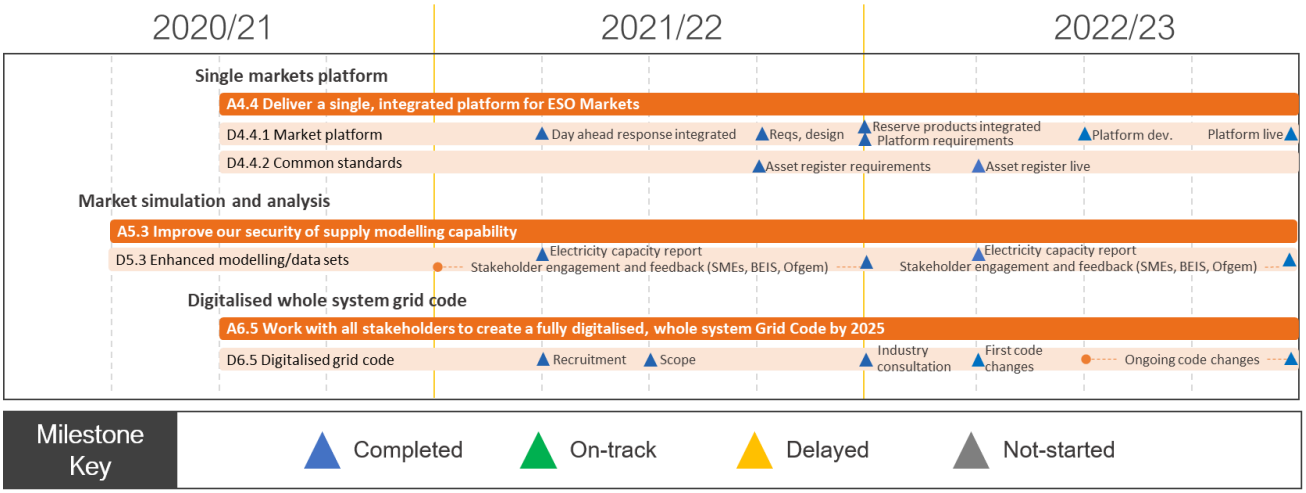

Figure 5 – Our Role 2 BP1 digitalisation strategy activities, deliverables, and associated delivery statuses. Data is as per the April 2023 Incentives Report.

Role 2 activities and deliverables

Table 2 – Activities and deliverables that support Role 2 – Market Development and Transactions (as reflected in the April 2023 Incentives Report).

Activity/Deliverables	Related Investment	Status	Update
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.*	400 Single markets platform	Completed	• 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. SMP first went live in February 2022 to support the onboarding process for new and enduring frequency response products. Since then a further 7 releases have taken place and we have actively developed a backlog of functionality that has been co-created and prioritised with our users. • Based on the backlog of requirements it is now expected that the procurement of all appropriate balancing services through SMP will extend into BP2 timescales. This will

Activity/Deliverables	Related Investment	Status	Update
			ensure that we are able to focus on the development of value adding functionality for new and existing Day Ahead markets over simply integrating all services. Our plan for BP2 is already well structured and is being communicated with our stakeholders.
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.*	400 Single markets platform	Completed	• See D4.4.1 Markets platform.
A5.3 Improve our security of supply modelling capability			
D5.3 Enhanced modelling/data sets *Use of enhanced modelling and more granular data sets to improve security of supply modelling.*	220 Data and analytics platform	Completed	• Development projects for 2022/23 were prioritised in Sep 2022 in line with our established process. Projects have now been completed and will be reported on in the 2023 Electricity Capacity Report expected to be published in July 2023, as per the well-established annual process.
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.*	330 Digitalised code management	Completed	• We have descoped significant changes to the codes as a result of the WSTC in BP1, therefore this objective will not be met but has been overtaken by other priorities. This is in line with stakeholder feedback and expectations and is being guided by input from the external WSTC steering group. • Next steps are for the steering group to develop and publish the project scope, objective and approach through the scoping documents. Due to the approach adopted by the steering group and the focus on digitalisation this will not lead to code modification proposals as first envisaged as part of the original plan. We will continue to work with stakeholders on the benefits of and timing for any Whole System Technical Code including engaging with Ofgem and DESNZ's Energy Code Reform programme, however, this milestone no longer appears valid due to this stakeholder led prioritisation activity.

In the BP2 period we continue to deliver on our digitalisation priorities. Figure 6 shows an overview of our main BP2 transformation activities, deliverables, and milestones corresponding to Role 2 – Market Development and Transactions.

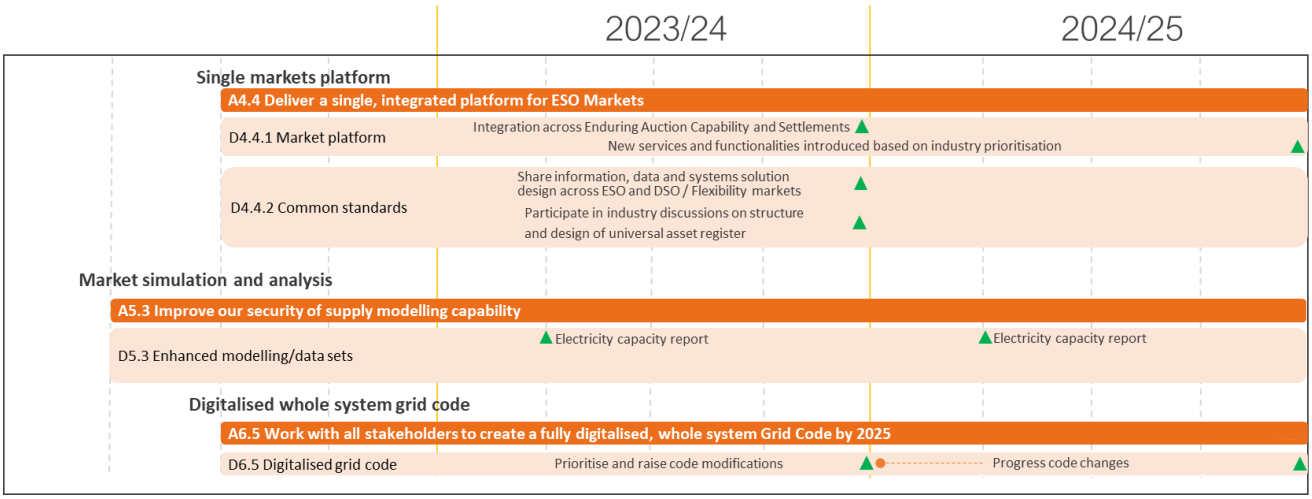

Figure 6 – Our Role 2 BP2 digitalisation strategy activities, deliverables, and associated delivery statuses. Data is as per the April 2023 Incentives Report.

Role 3 activities, deliverables, and investments

Role 3 – System Insight, Planning and Network Development

We will 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 7 below shows a plan view of our transformation activities, deliverables, and milestones corresponding to Role 3 – System Insight, Planning and Network Development.

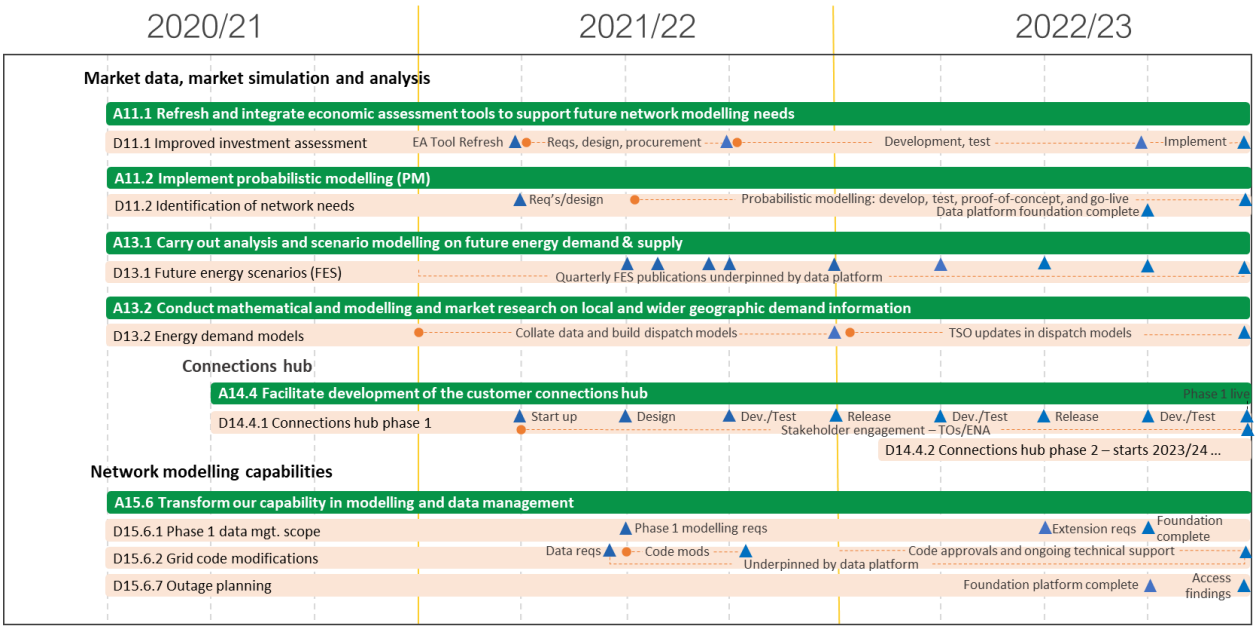

Figure 7 – Our Role 3 BP1 digitalisation strategy activities, deliverables, and associated delivery statuses. Data is as per the April 2023 Incentives Report.

Role 3 activities and deliverables

Table 3 – Activities and deliverables that support Role 3 – System Insight, Planning and Network Development (as reflected in the April 2023 Incentives Report).

Activity/Deliverables	Related Investment	Status	Update
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.*	390 NOA enhancements	Completed	• Implementation of new EA tool now in progress
A11.2 Implement probabilistic modelling			
D11.2 Identification of network needs *Improved identification of network needs.*	390 enhancements NOA	Completed	• We have reviewed our specific tool development requirements and interface with DAP, we now conclude that this tool development does not rely on the DAP and it will progress independent of the DAP. This tool will be developed with built-in functionality to interface with DAP in the future if it's needed. • We have developed, delivered, and tested the year-round probabilistic analysis tool (POUYA). We are now during warranty period. The solution relies on the Azure ML cloud platform enabling distributed optimization and multi-processing.
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.*	220 Data and analytics platform	Completed	• Network forum continues to meet regularly. • The FES Stakeholder Feedback document has been published and provided to Ofgem as per licence requirement
A13.2 Conduct mathematical, modelling and market research on local and wider geographic demand information			
D13.2 Energy demand models *Update pan-European and country level electricity and energy demand models*	220 Data and analytics platform	Completed	• We have developed two new European scenarios out to 2050 that are now 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.

Activity/Deliverables	Related Investment	Status	Update
A14.4 Facilitate development of the customer connections hub			
D14.4.1 Connections hub phase 1 *Implement first phase of the ESO connections hub, including online account management and integration with other network organisation websites*	380 Connections portal	Completed	• Workshop sessions have been held with customers and TOs to obtain insight on their needs and requirements, which has been factored into the design assumptions. During the design and development phase, we learned that the build of the new portal was more complex than originally anticipated, and reviewed its level of functionality to ensure that the final product will meet our customers' needs and expectations. • As planned, Phase 1 of the Portal was successfully released.
D14.4.2 Connections hub phase 2 *Phase 2 of the connections hub concluded.*	380 Connections portal	Not started	• This activity does not commence until BP2.
A15.6 Transform our capability in modelling and data management			
D15.6.1 Phase 1 data mgt. scope *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*	220 Data and analytics platform	Completed	• This activity depends on D1.4.1 Phase 1 modelling scope
D15.6.2 Grid Code modifications *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)*	220 Data and analytics platform	Completed	• Work depends on D15.8.1. • GC0139 (Enhanced Planning-Data Exchange to Facilitate Whole System Planning) is currently at Working Group stage
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.*	360 Offline network modelling	Completed	• Work on this deliverable is planned to start later in the BP2 period.

In the BP2 period we continue to deliver on our digitalisation priorities. Figure 8 shows an overview of our main BP2 transformation activities, deliverables, and milestones corresponding to Role 3 – System Insight, Planning and Network Development.

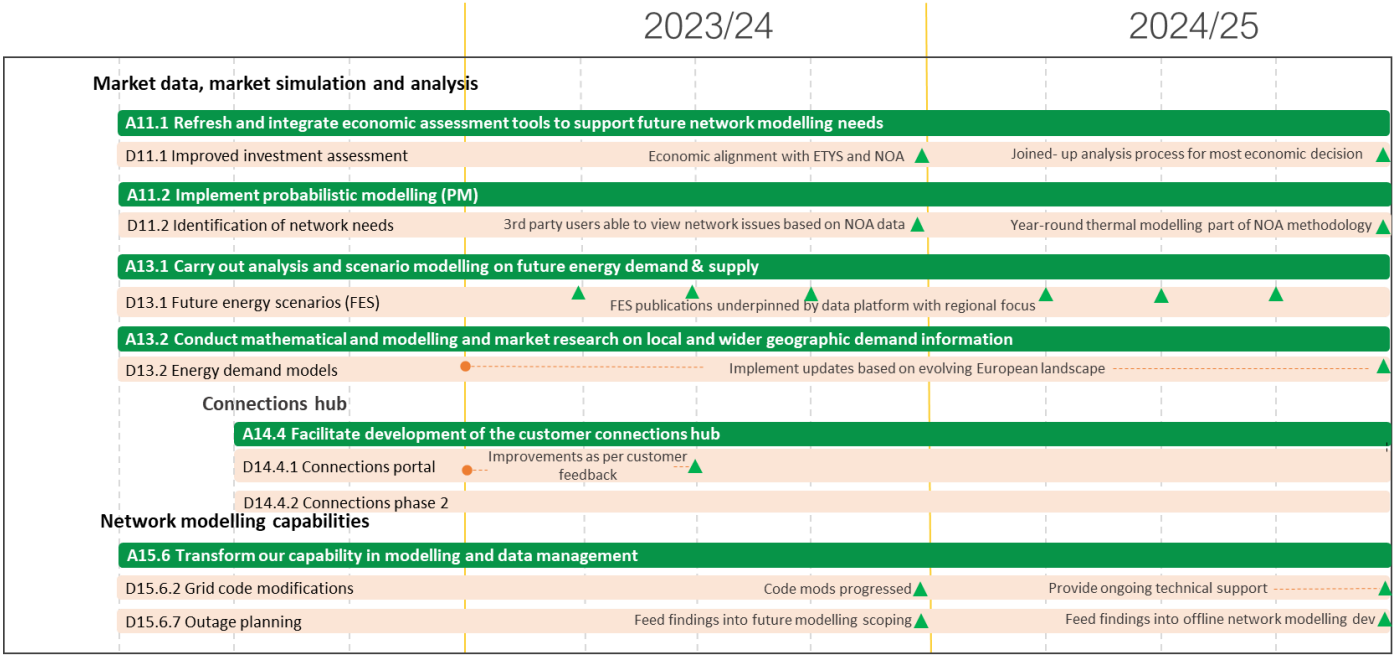

Figure 8 – Our Role 3 BP2 digitalisation strategy activities, deliverables, and associated delivery statuses. Data is as per the April 2023 Incentives Report.