ESB NETWORKS

Operational Systems Roadmap

NATIONAL NETWORK, LOCAL CONNECTIONS PROGRAMME

DOC-230921-GYT

Updated following consultation in Q4 2021

CONTENTS

1

Glossary

2 GLOSSARY

TERM	DEFINITIONS
ADMS	Advanced Distribution Management System (ADMS) is the software platform that supports the full suite of distribution management, optimisation, and control. An ADMS includes functions and algorithms that automate outage restoration, optimisation, and control of the distribution grid.
AMI	Advanced Metering Infrastructure (AMI) is an integrated system of smart meters, communications networks, and data management systems that enables two-way communication between utilities and customers.
ASM	Active System Management (ASM) refers to the ability to monitor and control distribution network assets, but also connected third party assets such as generators, storage, and controllable loads. ASM is the new operational capability built and delivered as part of the National Network, Local Connections Programme.
Curtailment/ Constraint/ Dispatch down	This is the deliberate reduction in output below what could have been produced.
DER	Distributed Energy Resources (DER) refers to generator, storage or controllable load which is connected to the distribution network.
DERMS	Distributed Energy Resource Management System (DERMS) is an end-to-end automatic control system which facilitates distribution system operators (DSO) manage their grids via real-time dispatch of distributed energy resources (DER) and other controllable grid assets. (DSO) manage their grids via real-time dispatch of distributed energy resources (DER) and other controllable grid assets.
DMS	Distribution Management System (DMS) is a collection of key applications designed to monitor and control the entire distribution network efficiently and reliably.
Flexibility Services	Flexibility services are used when a Distribution System Operator pays a third party to operate assets in a way that maintains power flow within network limits.
FLISR	Fault Location, Isolation, and Service Restoration (FLISR) is a distribution automation application that automatically restores the majority of customers impacted by a fault / outage on a feeder.
MMS	Market Management System (MMS) is a software platform which conducts procurement, bidding, tendering, DER selection of services required by the DSO. This platform also conducts verification and settlement of services provided by DERs.
OES	Operator of essential services. The entity should provide a service which is essential for the maintenance of critical societal and economic activities.
OMS	Outage Management System (OMS) is an application which allows control engineers respond to faults as well as plan and manage network outages.
OSP	Operational System Project (OSP) refers to the design and developments of systems, applications and processes which enables newly needed network operation capabilities of a Distribution System Operator.
SCADA	Supervisory Control and Data Acquisition (SCADA) provide operators and other control systems with real-time communication to substations and field devices.
SEAI	The Sustainable Energy Authority of Ireland is an Irish governmental body established to promote and aid in the development of sustainable energy in Ireland.

2

Overview

2 OVERVIEW

The core objective of the National Network, Local Connections Programme is to bring together changes in how we are generating electricity, and how we are using it, enabling all electricity customers and communities to play an active role in climate action, by using or storing renewable electricity when it is available to them locally. To be able to support this, ESB Networks' will need to invest in augmenting its control room technologies with the next generation of operational and market technologies.

In Q4, 2021 we consulted on the proposed Operational Systems Roadmap. Positive and constructive stakeholder feedback was received, with 16 items of feedback received from stakeholders on this document. All feedback was carefully reviewed and feedback which fell within its scope was considered in updating the proposed Operational Systems Roadmap which we are now adopting as the Operational Systems Delivery Roadmap.

The key themes arising in stakeholders' feedback were:

1. **Stakeholders agree that digitalisation, automation, and advanced technological integration are key components to the successful delivery of the programme**
2. **Stakeholders understand the importance of integration with DER management platforms and are seeking that options for this will continue to be explored throughout the programme.**
3. **Stakeholders are supportive of the alternative technological options for market management capability being explored.**

For more information on the detailed stakeholder feedback received and how it has been incorporated into the National Network, Local Connections Programme delivery plans, please refer to the Consultation Core Response Paper available on the National Network, Local Connections Programme website.

2 OVERVIEW

As set out in the National Network, Local Connections programme 2030 Power System Requirements (available here), the Irish energy system is undergoing enormous change. The Climate Action Plan sets out targets for renewable electricity, and the continued decarbonisation of the heat and transport sectors through electrification. The result is that there is large and growing number of decentralised renewable generators and storage competing for electrical capacity on the distribution system. The EU Clean Energy Package mandates changes to the role of the distribution system operator, including increasing use of market-based mechanisms to optimise the use of capacity on the distribution system, and measures to support the activities and market participation of active customers, energy communities and distributed renewables.

The National Network, Local Connections Programme will play a central part in achieving Ireland's Climate Action Plan targets. As the electrification of heat and transport and connection of renewable generation drives the need for electricity distribution system capacity, our ability to meet these demands at the right pace and cost will rely in part on ESB Networks using "flexibility" from demand or generation. The use of demand or generation flexibility as part of system management requires the DSO to have real-time and look-ahead analysis of the load flows and network state, and the ability to optimize that state using closed-loop SCADA control of utility assets and third party distributed energy resources (DER). To achieve this, the National Network, Local Connections Programme will require significant changes to ESB Networks' processes, skills, data, and technology.

To prepare to implement these changes, in late 2020 ESB Networks undertook an in-depth review of the current "as is" technological landscape. This review highlighted the systems that will need to be adapted, upgraded, or introduced to meet the technical requirements to introduce flexibility into system management.

Following this current state review, ESB Networks undertook a review of operational technologies available in the market and ongoing developments at other utilities. This was an essential step

to understanding what solutions are available to help manage distributed generation and deliver a more sustainable energy system with increased market participation from both commercial and domestic energy users. This paper sets out what was identified in relation to both network operational technology and market operational technology, and how it applies to ESB Networks' Operations Systems Roadmap.

ESB Networks will need to implement major new components including a Distribution Management System (DMS), a Distributed Energy Resource Management System (DERMS) and a Market Management System (MMS) to meet distribution system customers' needs, in line with the Climate Action Plan and the Clean Energy Package. New and enhanced capabilities such as unbalanced load flow, state estimation, congestion management and optimal load flow, as well as new protocols and interfaces, driving substantial investment in operational technology, will be required.

2 OVERVIEW

To achieve a fully functioning system capable of meeting the new demands, augmentation of existing functionality as well as procurement of new functionality may be required. Any system upgrade or new system implementation will follow a process of high-level design (HLD), detailed design (DD), build, test and deploy.

The technology required will be delivered through a multiyear plan involving two primary workstreams. The first workstream will focus on piloting new activities on the ground, supported by interim upgrades or adaptations of existing technologies. This will generate lessons learned which can be accounted for in the development of long term solutions. The second workstream will focus on the releases of new technologies into ESB Networks' operational control systems. As per the National Network, Local Connections Piloting Roadmap (link) the definition of up to 6 pilots in multiple locations running for approximately two years each commencing in 2022 is proposed. The deployment of new functionality will be broken down into 3 deployments running for approximately 6 years.

This document shares the outcome of the current state review, and the proposed future technology roadmap for operational system upgrades and deployments within ESB Networks relating to DERMS, DMS and MMS. The paper also details the associated operational and resourcing needs, licensing, and hardware requirements.

3

As-Is Operational Technology

The core of ESB Networks' current suite of operational technology consists of a supervisory control and data acquisition (SCADA) system and an operational management system (OMS). These two core operational systems are used together from each control room workstation in the National Distribution Control Centre (NDCC). SCADA is the gateway between the control room and network devices across the country. The two systems are integrated to allow for efficient operation of the system.

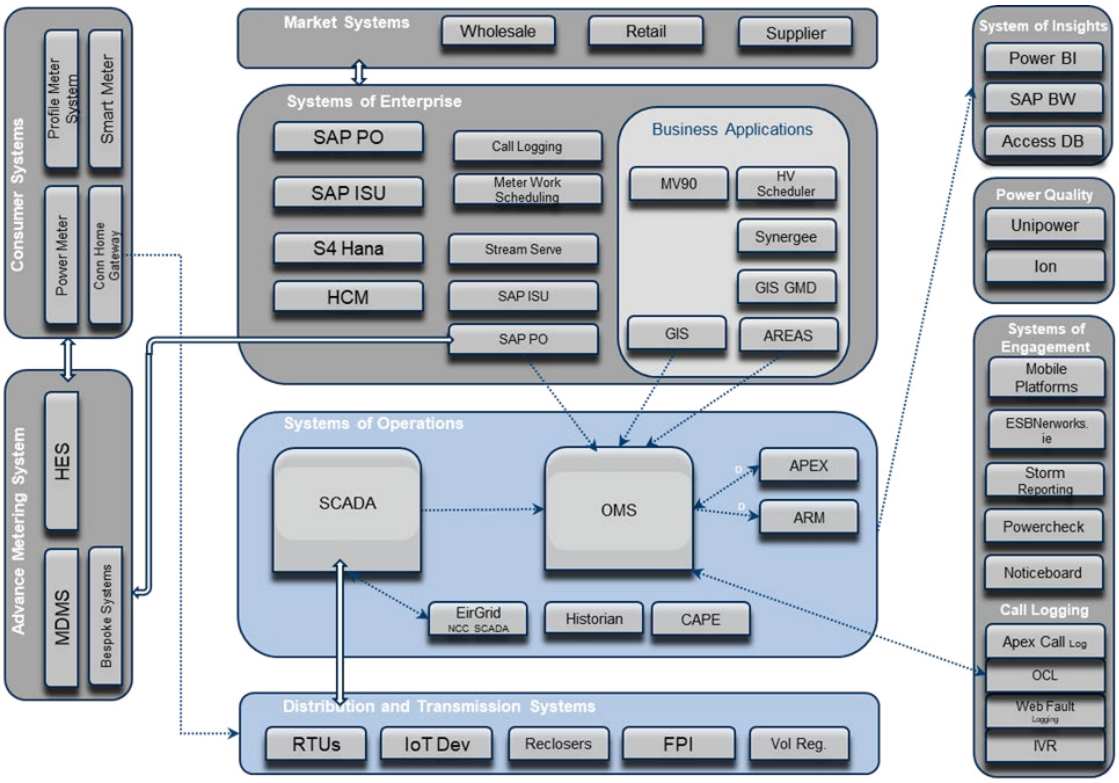
3 AS-IS OPERATIONAL TECHNOLOGY

The SCADA system provides a scalable system of communication front-end performing data acquisition from approximately 800 ESB Networks' substations using various protocols over serial communications and a growing number (currently 2,500+) of distribution automation devices, resulting in a total of about 500,000 points. This also includes secure links to the control system at Ireland's TSO, EirGrid. No other protocols beyond IEC 101/104 (particularly DER-specific protocols) are implemented, although some of the relevant protocols are available. The system is also used to provide other traditional SCADA capabilities such as visualisation, alarming, controls, tagging and an internal historian.

OMS currently serves as a network management system covering the processes of fault management, switching, planning and execution, for control room operators, dispatchers and 34 regional offices.

Several DMS applications have been developed and piloted in a proof-of-concept environment, as part of the National Network, Local Connections Programme but are not implemented in production. ESB Networks plans to implement capabilities such as unbalanced load flow, load forecasting and other basic optimisation capabilities.

HIGH-LEVEL ARCHITECTURE VIEW IN CURRENT STATE (ONLY THE SYSTEMS CONSIDERED FOR ADMS IMPLEMENTATION / REPLACEMENT)



4

Forecasted Operational Challenges

The electrification of heat and transport and further increasing the penetration of distributed renewable generation is central to meeting Ireland's national carbon emissions reduction targets. To support this, there is a need for ESB Networks to introduce new solutions to increase the capacity and reliability of the distribution system to meet the emerging needs that these resources create.

4 FORECASTED OPERATIONAL CHALLENGES

Examples of these challenges are as set out in the National Network, Local Connections 2030 Power System Requirements. An example of these challenges in practice arises of the expansion of the electric vehicle market in Ireland. It is anticipated that there will be more than 950,000 electric vehicles on Irish roads by 2030, resulting in high demand on the Irish network due to increased domestic and commercial charging.

Another example is the imbalance between renewable wind and solar generation and electricity demand in Ireland. Dispatch down of wind generation is increasingly commonplace representing a significant loss in both economic and electrical efficiency. Dispatch down is caused by congestion and excess generation during times of low demand that could potentially be offset by flexibility services in the future. This will increase with growing levels of microgeneration unless solutions are introduced to improve the balance at a local level.

ESB Networks' current operational technology does not have the functionality required to introduce these new operational and market solutions. As part of the National Network, Local Connections (NN,LC) Programme, the specific capabilities required have been identified, such as load flow modelling, state estimation, congestion management and optimisation, and a plan developed to deliver these technology requirements.

With these technologies in place, ESB Networks will be able to implement alternative solutions whereby active customers will play a role in climate action, by using and storing renewable electricity when it is available to them locally. This will require the creation of new flexibility markets, allowing customers who meet certain criteria (individually, aggregated or in communities) to engage in flexibility services via the use of batteries, renewable generation such as solar panels or heat pumps, and smart technologies.

5

Capabilities Required

To meet the new functional requirements arising, ESB Networks is planning the upgrade of both the network operational and market operational systems. This will involve investment in an advanced distribution management system (ADMS) – an operational platform that will allow ESB Networks to agilely extend and adapt distribution system management solutions. It will also involve the implementation of a flexible market management system that can incorporate complex market rules meeting regulatory and legislative requirements.

Both systems will need to be reliable, adaptable, and scalable to support ongoing changes on the electricity system over the coming decade and beyond.

5 CAPABILITIES REQUIRED

5.1 NETWORK OPERATION CAPABILITIES

To deliver the National Network, Local Connections Programme, ESB Networks will need to develop a series of new network operational capabilities. This will be achieved by augmenting the existing technology stack and/or by procuring and deploying new technologies.

ESB Networks will need to have the ability to operate, control and communicate with the increasing volume of renewable generators across the network. This may be achieved by using enhanced SCADA capabilities to manage an increased number of control points, including low voltage (LV) network and distributed energy resources (DERs). ESB Networks' control room operators will require enhanced and extended communication lines with distributed generators, third party DER aggregators, the TSO (EirGrid), and other systems.

System augmentation and the deployment of new technology will be required to allow ESB Networks forecast and manage the network load and voltage profile at a local level, including through dynamic network configuration, voltage regulation, reactive power management, and management of demand side response, storage, and generation. The DSO will need to perform complex network analysis and forecast assessments to maintain network security and capacity limits, including online power flow studies, state estimation and unbalanced three phase power flow optimisations. These capabilities will enable ESB Networks to actively monitor, manage, and coordinate electrical system parameters including dynamic response / protection, short circuit levels, etc.

These functions can be introduced by putting in place advanced applications available within an advanced distribution management system (ADMS). Implementing an ADMS involves ESB Networks extending its current OMS and SCADA capabilities to introduce DMS and DERMS applications.

5 CAPABILITIES REQUIRED

5.2 MARKET OPERATION CAPABILITIES

The Clean Energy Package requires the DSO to enable distributed generation, storage, demand side flexibility and allow active customers and communities participate in all organised markets. These include local flexibility markets, and participation in wholesale and ancillary service markets, without causing unsafe or insecure local conditions. ESB Networks needs to introduce a new set of capabilities to enable this. These capabilities include DER registration, ability to publish procurement events, and the ability to submit bids and select lowest cost providers. These technological capabilities can be met with the introduction of a market management system (MMS).

An MMS is a fully integrated software platform that will assist with the development and operation of a flexibility market. As set out in Section 6, a range of technological options to provide this functionality are available, including utility-owned software, software as a service, or platform as a service models. An MMS platform which is integrated with ESB Networks' ADMS can support the matching of renewable generators with local flexible demand or storage assets with the capability to absorb excess power to avoid dispatch down. This enables more wind or solar generation to be exported and consumed. The role of the MMS component is to determine flexibility pricing and provides market information to enable participants to trade distributed flexibility using a single platform.

MMS software can support registration, procurement and tendering of flexibility services and manage bidding and auctioning processes, all of which are required to support flexibility market operations. Once the bidding process is complete and the requisite information exchange and processing completed by the DSO ADMS, the MMS selects or nominates the relevant DERs for flexibility. The MMS can then verify and provide settlement for the services delivered by the DER provider. There is the potential for an MMS to also play a central role in facilitating distributed resources' participation in markets managed by the SEMO and the TSO, in a manner that avoids unsafe or insecure conditions.

6

Technology Solutions

ESB Networks has analyzed the functional fitness of the existing operational systems and the potential introduction of a future ADMS. The outcome of this analysis indicated that further enhancement of ESB Networks' operational technology may be implemented as part of the National Network, Local Connections Programme.

6 TECHNOLOGY SOLUTIONS

As part of this exercise, ESB Networks compiled documentation containing 2,000+ functional and technical requirements to deliver a clear and specific technology roadmap which will secure the operational and market capabilities needed to enable the required eco system. These requirements were organised into three categories - functional design, solution architecture and market operations - with four levels of detail.

TABLE 1 **FUNCTIONAL DESIGN REQUIREMENTS**

CORE COMPONENT / FUNCTIONALITY	LEVEL 1 FUNCTIONAL REQUIREMENTS	LEVEL 2 FUNCTIONAL REQUIREMENTS	LEVEL 3 & 4 FUNCTIONAL REQUIREMENTS
OMS & Dispatch	8	37	216
SCADA & Control Centre	11	61	207
Reporting	18	50	200
DMS	1	11	210
DERMS	6	20	118
	44	**179**	**951**

TABLE 2 **SOLUTION ARCHITECTURE REQUIREMENTS**

CORE COMPONENT / FUNCTIONALITY	LEVEL 1 FUNCTIONAL REQUIREMENTS	LEVEL 2 FUNCTIONAL REQUIREMENTS	LEVEL 3 & 4 FUNCTIONAL REQUIREMENTS
Platform requirements	1	8	690
Interface requirements	1	13	247
	2	**21**	**937**

TABLE 3 **MARKET OPERATIONS REQUIREMENTS**

CORE COMPONENT / FUNCTIONALITY	LEVEL 1 FUNCTIONAL REQUIREMENTS	LEVEL 2 FUNCTIONAL REQUIREMENTS	LEVEL 3 & 4 FUNCTIONAL REQUIREMENTS
Engage Market - Functional Requirements	1	3	16
Procure, Dispatch, and Settle - Functional Requirements	6	12	118
Market Operations - Non-Functional Requirements	7	9	37
	14	**24**	**171**

The output of our analysis showed capability gaps in four areas: DMS, DERMS, other operational systems and market management systems.

6 TECHNOLOGY SOLUTIONS

6.1 DMS ADDITIONAL REQUIREMENTS

A distribution management system (DMS) enhances the visibility and control capabilities typically provided by SCADA, by providing functionality like online powerflow, state estimation and optimisation.

During the first phase of the programme, the ADMS functional specification identified the requirement for 11 advanced DMS applications. Most of these applications are supported within ESB Networks' current operational technology stack but are not currently implemented. The applications that are not currently supported include short circuit and fault location analysis, and adaptive protection settings. These will be required in a long term operational technology solution.

Substantial implementation effort will include providing the necessary data, configuring and testing these applications. Further detailed analysis may uncover additional capability gaps in the other licensed DMS advanced applications.

6.2 DERMS ADDITIONAL REQUIREMENTS

DERMS is an automatic control system which facilitates system management at a local level via real time dispatch of distributed energy resources and other controllable grid assets. DERMS adds to the visibility and control functions provided by SCADA. DERMS can provide granularity down to specific customer owned assets such as smart batteries. Such capability is a requirement within National Network, Local Connections Programme.

The ADMS functional specification identified the requirement for 20 DERMS applications. Of the 20 applications required, only 12 are fully supported within ESB Networks' current operational technology stack . The following functionalities are not supported: grid edge control, control instruction and fail-safe condition. The current system only partially supports constraint management, merit order queuing and black start.

6.3 OTHER OPERATIONAL ADDITIONAL REQUIREMENTS

The majority of SCADA functionality required is available in ESB Networks' current SCADA system, however the current SCADA instance does not support the suite of industrial protocols under consideration for DER management. From 59 functional requirements arising with respect to SCADA capability, only three functionalities are not supported by ESB Networks' current technology. These are accuracy monitoring, inheritance tags and email notification.

Likewise, most of the required OMS functionality required is already available in ESB Networks' existing OMS system. From 38 OMS functionalities required, only the field updates of faults functionality is not in use. The remaining L2 functionalities are supported.

6 TECHNOLOGY SOLUTIONS

6.4 MARKET MANAGEMENT TECHNOLOGY REQUIREMENTS

Once a constraint is identified by the operational systems set out in the previous sections, the DSO needs intelligence, such as visibility, availability, and price of DERs that are available within the congested network. An MMS provides this commercial visibility and supports the auction and selection process. An MMS also supports a market for flexibility services to meet user needs on the distribution system including DER participation in TSO/wholesale markets.

There are a range of technological options for implementing MMS capability. These include utility owned software, software as a service or platform as a service solutions. The options available are supported by different vendors, of differing levels of maturity, capacity and specialized / dedicated MMS capability. The suitability of these options from the perspective of transparency, efficiency, security and functional fitness is under review at the time of writing.

Irrespective of the technological model adopted, once implemented, the MMS software platform will conduct the procurement, bidding, tendering and DER selection of services required by the DSO. This platform will also conduct verification and settlement of services provided by DERs. The development of a proposed functionalities of an MMS system will include:

1. **Tender creation.**
2. **DER registration.**
3. **DER offers against tenders.**
4. **ESB acceptance of offers.**
5. **DER notification of acceptance or rejection.**
6. **Settlement and verification**

The MMS will be integrated with the DSO Portal, MMS and an ADMS/DERMS integrated platform as per the conceptual technical architecture illustrated in the National Network, Local Connections Data and Signals Guidance.

6 TECHNOLOGY SOLUTIONS

6.5 CYBER SECURITY

In addition to functional requirements, there is a growing need for increased levels of IT security. ESB Networks is designated as an Operator of Essential Services (OES) under the Network and Information Security (NIS) Directive. As such, ESB Networks' SCADA system is currently subject to NISD compliance assessments. Regulation 17 of the NIS Regulations sets out network and information system security obligations for operators of essential services. It states that operators of essential services shall take appropriate and proportionate technical and organisational measures to manage the risks posed to the security of network and information systems which it uses in its operations.

It also states that operators must take appropriate measures to prevent and minimise the impact of incidents affecting the security of the network and information systems used for the provision of the essential services.

ESB Networks will take the following principles into account when applying security measures:

1. **Effective in increasing the cybersecurity posture of an OES in relation to the threat landscape now and into the foreseeable future.**
2. **Tailored to ensure effort is applied to measures which will have the most impact in relation to enhancing the security of an OES.**
3. **Compatible to address cross-sectoral vulnerabilities and complemented with sector specific security measures.**
4. **Proportionate to the risks, with an emphasis on protecting systems underpinning essential services.**
5. **Concrete and easy to understand, to ensure the measures are implemented in full and actively enhance the cybersecurity posture.**
6. **Verifiable to ensure the OES can provide the National Cybersecurity Centre (NCSC) with evidence of the effective implementation of security measures.**
7. **Inclusive, to ensure measures are applied to cover all five themes under the NIST-CSF framework (Identify, Protect, Detect, Respond, Recover)**

7

Implementation Workstreams

Two implementation workstreams are planned. The first workstream will develop pilot capabilities to meet 2022, 2023, and 2024 piloting requirements. Each pilot will support and inform the development of longer term solutions.

This first piloting workstream will support ESB Networks, market participants and customers discover and develop the requisite organizational, commercial, and technical capabilities over the period 2022-2025.

The second workstream is focused on building an end state or longer-term capability by 2025 with full ADMS implementation. Pending the outcome of a competitive procurement process, ESB Networks will either augment its current OMS and SCADA functionality or implement a new fully functioning ADMS system on one single infrastructure and platform.

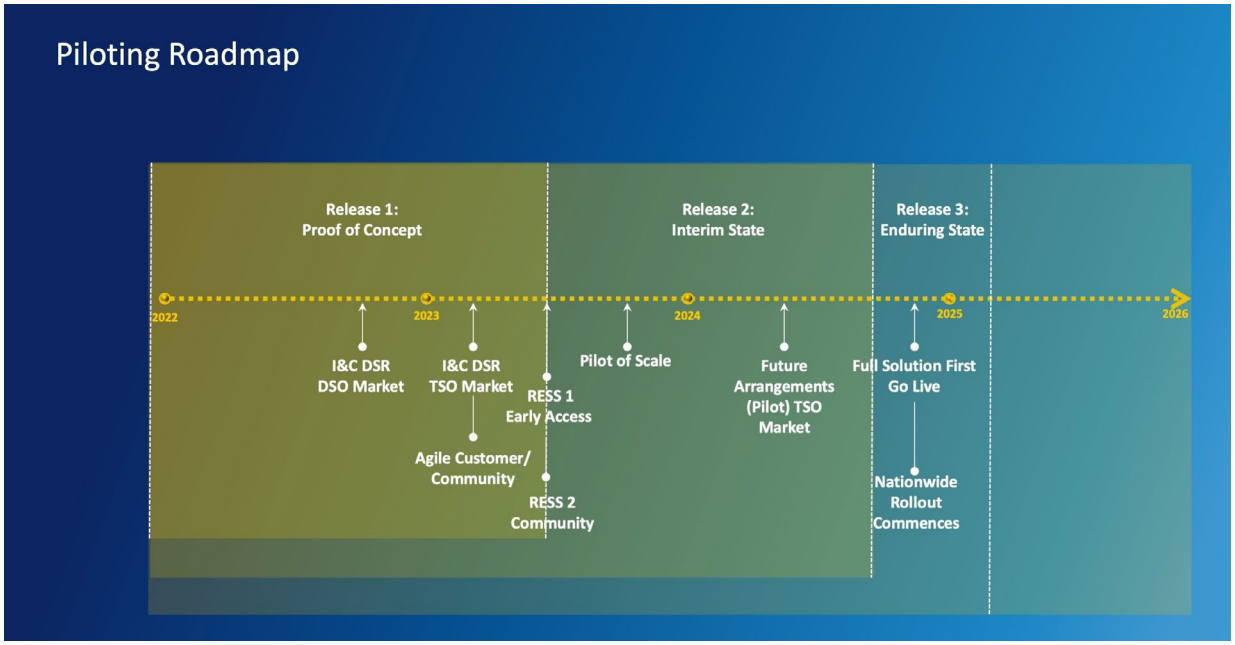
The MMS component is the subject of vendor and market review at the time of writing (as was completed previously for ADMS components). The implementation approach for the MMS component will be closely integrated with the pilot programme to follow

7 IMPLEMENTATION WORKSTREAMS

7.1 OPERATIONAL TECHNOLOGY PILOT

The operational technology piloting workstream will be broken down into 6 separate pilots, the technology development cycle for each running for approximately 1 year. In practice, that means that more than one version of the same process may exist or be in development in parallel between 2022-2025, building upon lessons learned in previous pilots.

Prior to each pilot commencing, the relevant technological capabilities will be defined during the consultative definition phase, as set out in the Flexibility Multiyear Plan. The below graph indicates the timeline for the full end to end piloting programme. Each pilot will include high level design, detailed design, build, test, and deployment stages throughout. There will be significant overlap between the start and end dates of each pilot.



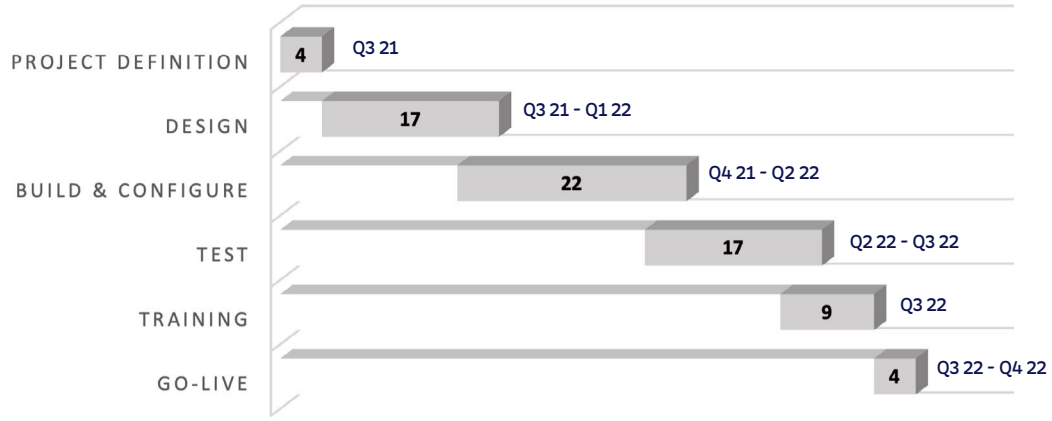
7 IMPLEMENTATION WORKSTREAMS

7.1.1 INDUSTRIAL & COMMERCIAL DEMAND SIDE RESPONSE DSO MARKET PILOT

The technology development cycle for the initial pilot commenced in Q3 2021 and will run until the end of October 2022 spanning for a total of 57 weeks. This corresponds to the Industrial and Commercial Demand Side Response DSO Market (I&C DSR DSO) pilot which encompasses ESB Networks' procurement of the Secure and Dynamic services to address constraints driven by demand (MWs). This pilot will use existing tools and systems currently available at ESB Networks to deliver the following milestones:

- Identification of network needs.
- Procurement and bidding.
- Selection of DERs.
- Determining DER profile.
- DER dispatch.

RELEASE - P1 (AUG 2021 - OCT 2022)



The technology development cycle for the I&C DSR DSO pilot will be broken into phases. The pilot definition phases will include high level overall project planning and resource availability. During the design phase, analysis will be used to determine the pilot area settings including seasonal thermal limits, seasonal voltage limits, limit margins and sensitivity factor.

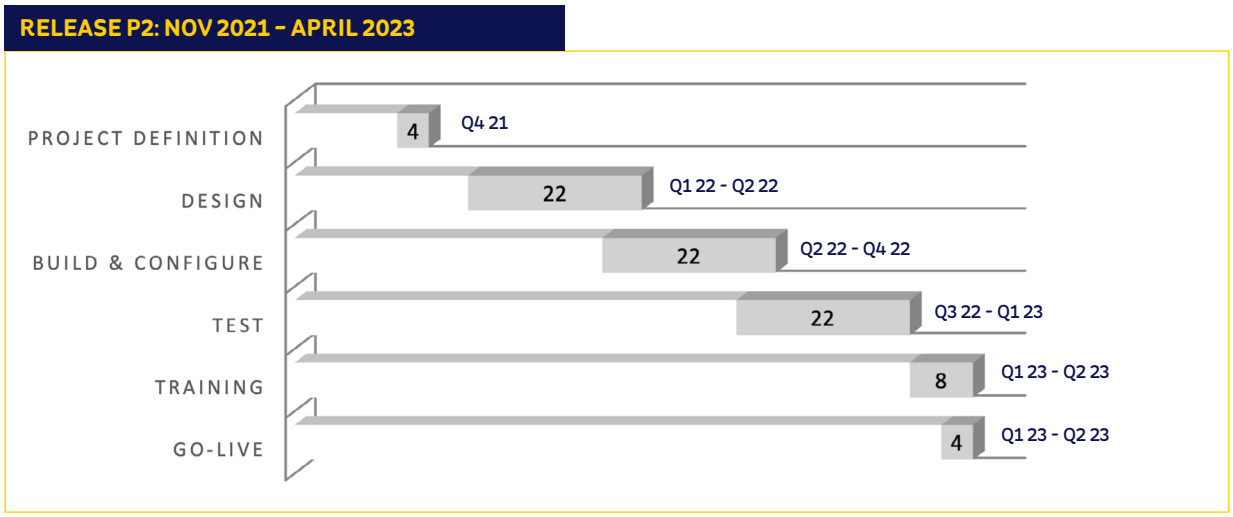
The pilot will require the configuration of network capacity application (NCA), feeder load management (FLM) and optimisation settings for specific pilot zone, development of offline tools to support processes including power systems analysis, DER selection and enrolment,

DER profile determination, and measurement and verification settlement. DER dispatch will be done by email on day ahead and by phone on intraday for delivery of services. Various test cycles will be conducted including UAT, FAT and SIT prior to "go live". Once pilot "go live" is reached, it will enter a monitoring phase.

7 IMPLEMENTATION WORKSTREAMS

7.1.2 INDUSTRIAL & COMMERCIAL DEMAND SIDE RESPONSE TSO MARKET PILOT

The second pilot preparation and design phase began in Q4 2021. Pending the outcome of its consultative definition process, this pilot could go live from April 2023. The second pilot will follow the same phase structure as pilot one.



The objective of this pilot, pending its consultative definition phase, is to allow distribution connected resources participate in wholesale energy or TSO markets, through the introduction of dynamic (week ahead, day ahead) instructions as to the network capacity available to support their participation. The pilot will use existing tools and systems currently available at ESB Networks, including network capacity allocation, feeder load management and optimisation applications and potentially its SCADA system for intraday DER dispatch.

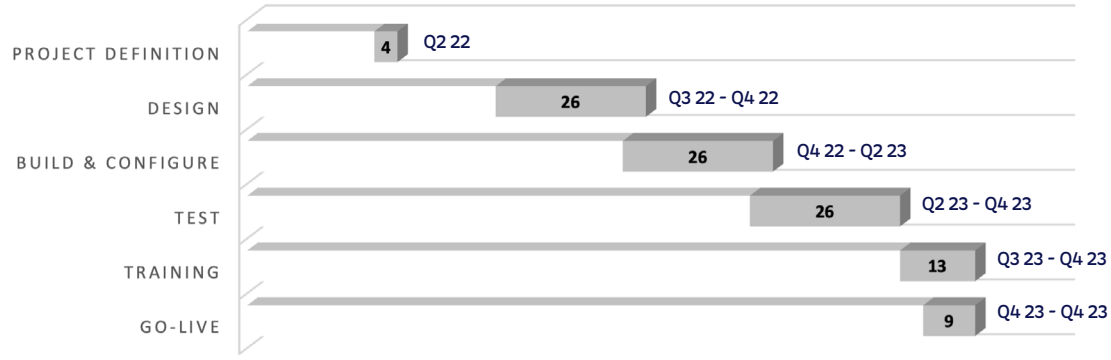
7 IMPLEMENTATION WORKSTREAMS

7.1.3 PILOT OF SCALE

Pending its consultative definition phase, the pilot of scale could commence in Q2 2022 and go live from Q4 2023. This pilot is intended to address distribution system thermal and voltage constraints by procuring resources for Secure, Sustain, Dynamic, Restore, Dynamic Access Rights (Instructions Set and RESS) as well as steady state reactive power services. The pilot of scale will utilise key DERMS functionalities such as load flow, contingency analysis, optimisation and operational forecasting using the enduring DERMS/ ADMS platforms.

The pilot of scale will follow a similar phased structure as the two previous pilots. There will be an additional hypercare phase focused on the on-site support of the new operational capabilities. Hypercare will be prior to the handover to ESB Networks for a live and operational system.

RELEASE - P3: (APRIL 2022 - OCT 2023)



7 IMPLEMENTATION WORKSTREAMS

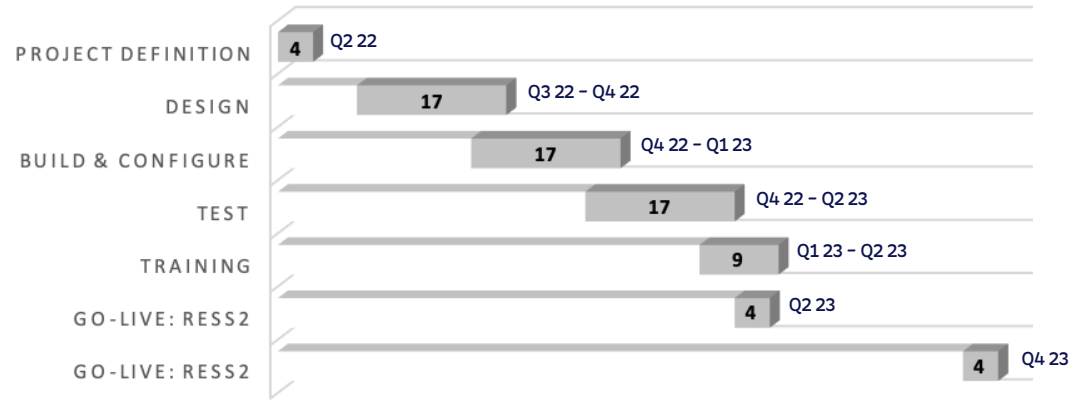
7.1.4 RESS-1 / RESS-2 PILOTS

The objectives of the proposed RESS-1 and RESS-2 pilots is to support DER management in specific geographical areas. Pending their consultative definition, both pilots will be run in conjunction, commencing from Q2 2022 with potential go live for RESS-1 from Q2 2023 and RESS-2 from Q4 2023. They will follow a similar phased approach as the three previous pilots.

The staggered go live of sites associated with the RESS-1 and RESS-2 pilots allows for each network area to be built into the relevant operational systems applications. Both pilots involve the same core technologies and thus would follow an identical deployment cycle/path of definition, design, build, test, training, go live deploy.

Interface design will include the development of macros to allow the ingestion of metering data. In line with the three previous pilots there will be design phases broken down into FAT, SIT and UAT followed by go live and a hyper care period.

RELEASE P4: APRIL 2022 – OCT 2023

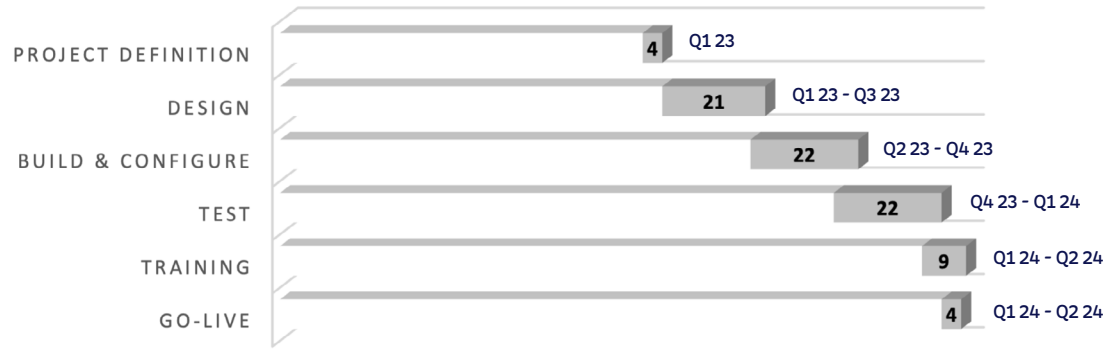


7 IMPLEMENTATION WORKSTREAMS

7.1.5 FUTURE ARRANGEMENTS PILOT 2024

Pending its consultative definition phase, and the timelines established by the SEM Committee for the Future Arrangements System Services process, the future arrangements pilot will go live in Q1 2024. This pilot will follow a similar technology development path to previous pilots and feed into the finalised enduring future arrangements operating on a different technological platform, to go live from Q4 2024. Like previous pilots this would also follow a period of detailed design lasting four months followed by build, test, training and deployment.

RELEASE P5: JAN 2023 – APRIL 2024



7 IMPLEMENTATION WORKSTREAMS

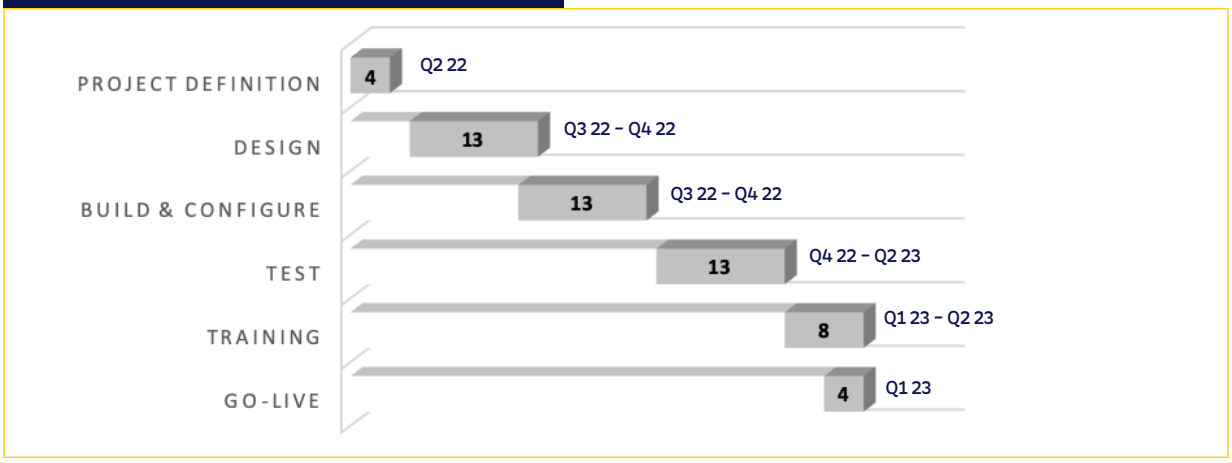
7.1.6 AGILE CUSTOMER / COMMUNITY PILOT

The final pilot known as the agile customer/community pilot relates. Pending its consultative definition phase, the objective of this pilot would be to roll out the dashboard functionality described in the National Network, Local Connections Platforms & Dashboards roadmap applying an agile delivery model, and using this technology to test behavioral responses to a range of stimuli, in defined locations across the country. It is anticipated pilot locations will be supported across the country in locations where communities or local authorities are undertaking a range of climate mitigation measures and could benefit from and engage with the dashboards provided.

The scope of the agile customer/community pilot will be centered on the development of set of standardised tools which could be made available to each participating community or local authority, to support their decarbonisation ambitions. These tools would provide information relating local electricity system within the community to support them to understand and quantify the impact of their actions. This pilot presents an opportunity for the NN,LC programme, and its stakeholders, to engage with communities and build understanding of how best to present information and of behavioral responses to different information and stimuli.

Pending its consultative definition phase outcome, the agile customer pilot could commence from Q2 2022 and within an agile cycle, its first go-live in Q1 2023. There may be a requirement to develop interfaces between NMS, SCADA and other applications to support data visualization within the pilot locations.

RELEASE P6: JAN 2023 – APRIL 2024



7 IMPLEMENTATION WORKSTREAMS

7.2 OPERATIONAL TECHNOLOGY DEPLOYMENT SCHEDULE

To roll out flexibility (including flexibility services for reliability and capacity reasons, and flexible connections for new generation and demand) at scale across the country, it will be necessary over time to integrate the new technological capabilities identified in the ADMS functional and non-functional requirements set out previously into production operational control.

The activities which would be required to implement and integrate these technologies, as well as indicated timelines and resources required, are set out in the following sections. The implementation of new technologies of this nature are typically comprised of different deployment cycles. Generally, deployment cycles are made up of phases including Predesign, Design, Build and Configuration, Data Import, Testing, Training, Go live and Deployment. Within each deployment, several new functionalities can be introduced.

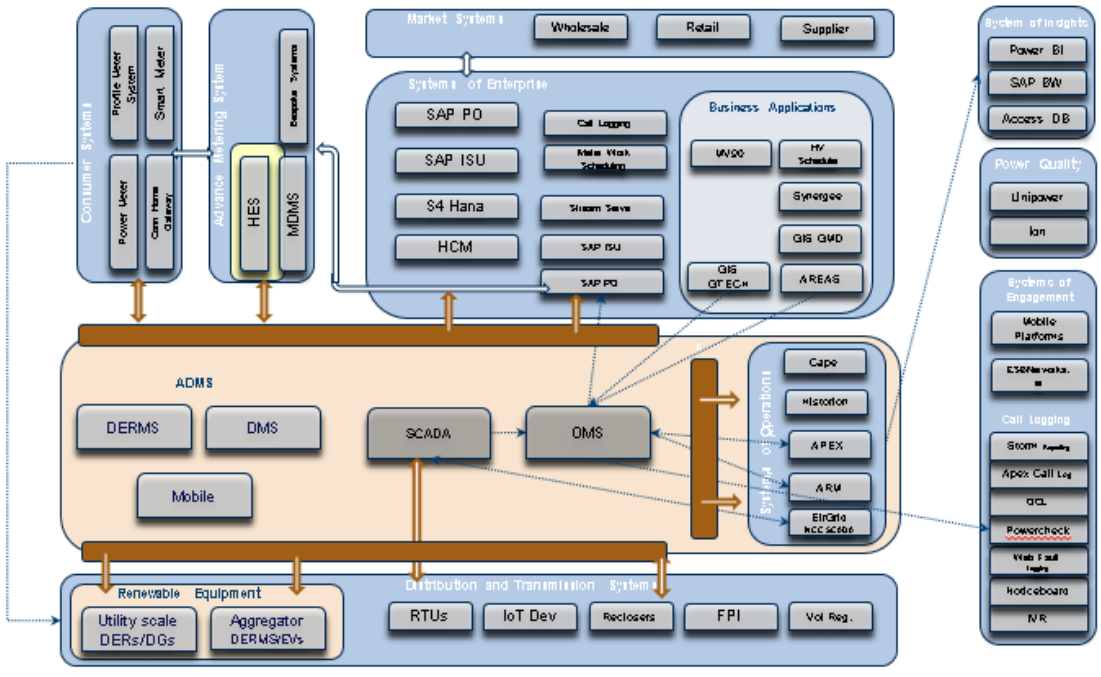
Pending the outcome of a competitive procurement process to commence pending the CRU target setting process in early 2022, ADMS implementation could commence from end 2022 and take approximately 5 years to complete.

The implementation of the system can be broken into a deployment plan as follows:

1. **Deployment 1 - ADMS set up**
2. **Deployment 2 - DERMS & SCADA**
3. **Deployment 3 – OMS**

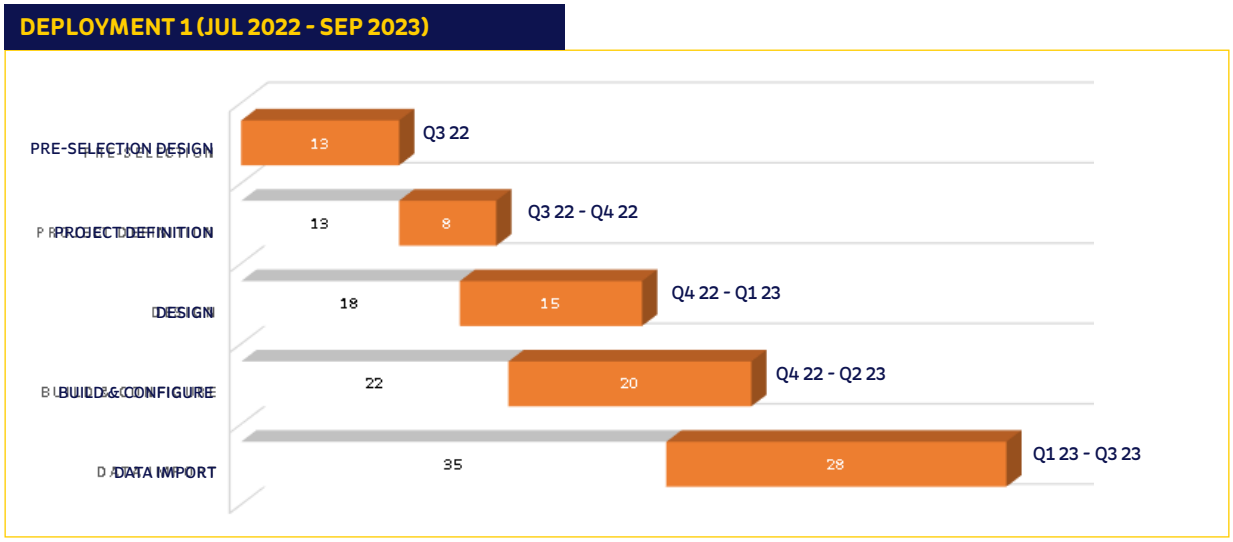
The graphic below presents the indicative to-be architecture. The final architecture will depend on several key factors including the outcome of market testing and further design activities.

INDICATIVE TO-BE



7 IMPLEMENTATION WORKSTREAMS

7.2.1 DEPLOYMENT 1 ADMS SET UP:



Deployment 1 relates to ADMS setup and would run for approximately 14 months. Throughout Deployment 1, ESB Networks would need to clarify all requirement gaps between the “as-is” and “to-be” system processes. There would be an initial requirement for high level project planning including resourcing availability and associated costings.

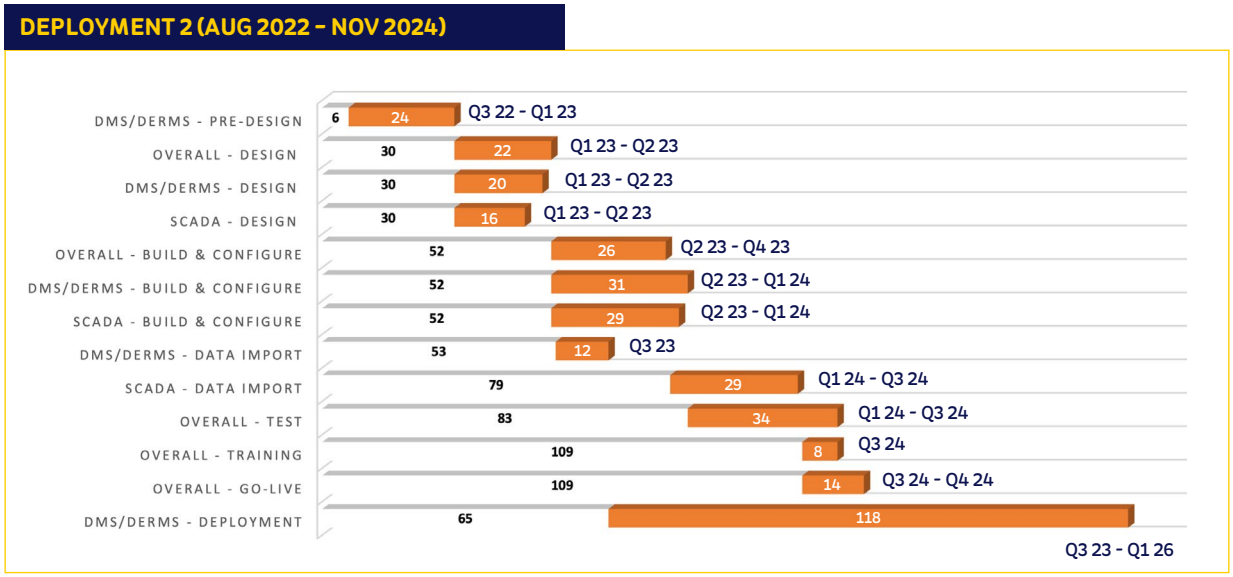
The next phase of the deployment would see the detailed design of ADMS architecture and infrastructure, interfaces, and configuration. This would be achieved by the scheduling of extensive workshops resulting in detailed design documentation. Once all documentation is signed off,

the project would enter the test phase of the release. Testing phase completion would allow deployment of software updates.

Importing of data to the new ADMS would take approximately 5 months and would require ESB Networks to review and modify data where required. Prior to completion, ESB Networks would review all data deliverables for quality, completeness, and correctness.

7 IMPLEMENTATION WORKSTREAMS

7.2.2 DEPLOYMENT 2 DERMS/SCADA



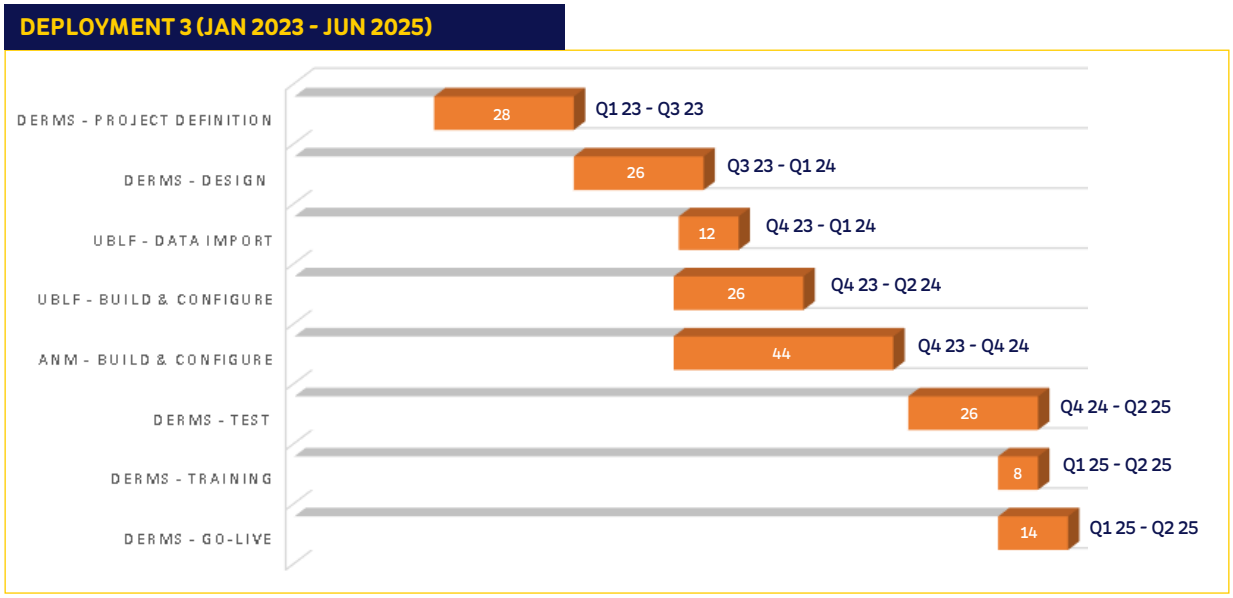
Pending its consultative definition phase, Deployment 2 would likely relate to DERMS/SCADA setup and would run for approximately 3 years. (Pending electricity market developments in the interim, there is an opportunity at that point in the programme to consider alternative technology sequences which may better meet requirements at that time). There would be an initial predesign phase where the requisite business, operational and market processes are defined. The next stage of deployment 2 is the detailed design phase which would include detailed design of product configuration, DMS/ DERMs interfaces design workshops and SCADA configuration workshops.

Once workshops are complete and detailed design agreed upon, the project would enter the build and configure phase. This would include the development for a minimal viable product for the 2024 pilot (listed above), the development and deployment of software, and loading of data to be used for the pilot.

The pilot would simulate different scenarios to test Unbalanced Load flow (UBLF) and DERMS by importing further data in relation to weather and historical load generation profiles. An automated process for data import would be developed throughout deployment 2. Prior to exiting deployment 2, a full end to end system integration testing, user acceptance testing, and functional acceptance test would be completed. This would be followed by penetration testing to identify any security breaches within the software. It is envisaged that the system go live will be followed by a period of hyper care period prior to full rollout.

7 IMPLEMENTATION WORKSTREAMS

7.2.3 DEPLOYMENT 3: JAN 2023 -JUN 2025



Deployment 3 is will run over a period of approximately 2.5 years. Pending future decisions taken regarding technology sequencing, it is likely that the focus of deployment 3 will be the deployment of an OMS. Deployment 3 is not dependent on the completion of deployment 2 however to support efficient resource management and noting the current priority of implementing DERMS,, it will commence after DERMS pilots have successfully completed and the R1 system is accepted in production. During the project definition phase, a detailed plan including resource availability will be outlined. This will be followed by extensive design workshops that will feed into the extensive detailed design documentation of the OMS system.

Detailed design phase will include OMS interface design with systems including SAP-ISU, CRM systems, SAP-ARM/APMS, MWFM, AMI, reporting/ DW, business process design and overall system architecture design.

Upon completion of design, deployment 3 will enter the build and configure phase. This will include the development of designed interfaces, testing and refinement. A period of one month would be set aside for customer data import followed by a further 6 months of FAT, UAT, SIT and penetration testing. Once testing is completed, ESB Networks employees would be trained on the functionality of the OMS system prior to “go live”.

8

Conclusion

Through the delivery of Phase 1 of the National Network, Local Connections Programme, the functional and non-functional technology requirements needed to meet the objectives of the National Network, Local Connections Programme have been defined, and an initial technology delivery plan developed.

8 CONCLUSION

The estimates and assumptions used in this assessment have been based on consultation with industry subject matter experts, evaluation of global best practices, perspectives from leading vendors and lessons learned from other prominent utilities.

Through public consultation in Q4 2021, customers and stakeholders have endorsed the rollout timeline and scope used as the basis of this document. Subject to regulatory targets set by the CRU in early 2022, the National Network, Local Connections Programme will proceed to act against this roadmap.

Near-term next steps include:

1. **Continued consultation**
   National Network, Local Connections Programme will continue to engage other energy stakeholders critical to the success of this programme, including the regulator, EirGrid, consumer advocacy groups and representative DER providers. The intent is for these stakeholders to provide feedback on the milestones and timelines and to consider changes based on their own requirements.

2. **Resourcing**
   Progress has already been made on defining a resource profile based on the activities and estimated time to execute them. This includes an evaluation of the resources required, the skills these resources need and the best way to secure these resources. This estimate will continue to be refined and assigned a cost value to better understand the overall cost to implement.

3. **Procurement approach**
   There are multiple options as to which vendor has the best solution to implement these capabilities based on the product maturity and cost to implement and operate. These options include engaging directly with ESB Networks current vendor set and potentially going out to market for a third-party provider. The National Network, Local Connections Programme is currently evaluating these options from a cost and performance standpoint.