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# NIA Project Registration and PEA Document

### Date of Submission

Aug 2024

### Project Reference Number

NIA2_NGESO081

## Project Registration

### Project Title

Virtual Energy System Data Sharing Infrastructure (DSI) Pilot

### Project Reference Number

NIA2_NGESO081

### Project Licensee(s)

National Grid Electricity System Operator

### Project Start

September 2024

### Project Duration

0 years and 7 months

### Nominated Project Contact(s)

innovation@nationalgrideso.com

### Project Budget

£1,450,000.00

### Summary

Digitalisation and data sharing are critical enablers to the achievement of net zero. This project will be developing a Pilot for the Data Sharing Infrastructure (DSI), by bringing together expertise from the ESO, project partners and the National Digital Twin Programme. The project will develop the DSI capability and demonstrate whether or not it can support scalable data sharing through an outage planning use case. The pilot is an important phase in developing the wider objective of the VirtualES and will leverage expertise from previous project stages to create a working pilot to demonstrate the technology.

### Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

### Problem Being Solved

- The energy system is changing rapidly and there is a critical need for enhanced modelling which can be achieved using interoperable digital twins supported by a Common Framework and Data Sharing Infrastructure. The volume of data needed to represent the energy system and the increasing number of observations generated in real time require transformational approaches to modelling.
- Skywise, the UK Building Information Modelling (BIM) Framework, and Open Banking are examples of valuable cross-sector collaborations underpinned by digital infrastructure. Whilst they are outside the energy sector, their best practice in terms of approach, scope, and content can be applied. Particularly relevant learnings relate to data security in Critical National Infrastructure applications, the use of Independent System Operator (ISO) and British Standard (BS), and the need for governance entities and participation guidelines.
- The proposed pilot helps to accelerate the development of the Data Sharing Infrastructure based on the suggestions and recommendation from the previous phase, taking this a step further to build on Proof of concept and link use cases to beta challenges.
- The project will collaboratively design the data sharing infrastructure, trust framework & security. The principles, wireframed through the previous phase of the demonstrator will become part of the enduring framework and be used in future VirtualES use cases. These will be tested as a proof of concept and form the VirtualES building blocks.

## Method(s)

This project will be working to develop the requirement components of the Data Sharing Infrastructure pilot as identified in the preceding project(s).
This project will be focused on Pilot Development and implementation. The project will seek to implement a pilot to demonstrate the VirtualES Data Sharing Infrastructure and help validate the VirtualES design and programme plans. The project will start with a functional specification and requirements catalogue developed in the preceding projects. The project will then include several iterative development cycles to evaluate options for implementing the use case and federation between nodes. This will follow the Government Digital Service (GDS) approaches for development. Initially, this development work will take place in a development environment before moving to pilot environments hosted by our network partners.

**Work Packages and Deliverables**

The project will follow a work package approach broken down into 2 phases with a stage gate at the end of the first phase.

**Phase 1:**

This phase includes the development of options and recommendations for core platform components, technical documentation and designs, and security technical specifications.
Further, it includes the development of a Gap Analysis document that highlights the current NDTP and Pilot target-state technical and related requirements. The aim is to have the initial codebase for building the Data Preparation Node (DPN) components available, along with supporting documentation for the baseline deployment.
This phase will be followed by a stage gate before going to phase two.

**Phase 2:**

Once a solution has been built to the required standard using modern software development approaches, a trial schedule and timeline will be created to ensure efficient execution of the trials. Supporting trial materials, including training documentation, will be developed to provide comprehensive guidance to trial participants. This documentation will include general user journeys, technical specifications, roles and responsibilities, testing criteria, service support information, and other necessary artifacts. DSI deployment and operation training sessions will be conducted to equip participants with the necessary knowledge and skills.
A live trial demo will be conducted, providing an opportunity to showcase the project's capabilities and benefits to wider sector stakeholders. Valuable feedback will be captured from both network partners and wider sector stakeholders, enabling the project team to gather insights and recommendations for further enhancements. Once the trials are successfully completed, a comprehensive trial report will be generated.
A DSI Pilot Show & Tell event will conducted to present the pilot findings and showcase the functionality of the platform to the wider sector.

**Use of Data**

The pilot will utilise the outage planning use case identified in the earlier phase of the project to showcase the capability of the DSI to share data between participants. To realise this, fictitious data of running arrangements, coupled with a simplified network topology of the electricity system will be used for the purposes of sharing between partners. The data and simplified network topology are fictitious so have no sensitivity attached to it, however we intend to test sensitivities to identify risks. Our final running arrangement to test seeks to use historic data and a very small subset of a ‘real’ part of the electricity system based on geographical locations of network partners. This data will be triaged appropriately before use in line with data bet practice guidance and appropriate measures will be taken to ensure an appropriate topology and data products are used for the pilot without risking security. The data used here is not at this time intended to replace the existing as-is process and does not interface with existing systems or processes to enable the pilot.

In line with the Electricity Network Association (ENA’s) ENIP document, the risk rating is scored Low
TRL Steps = 1 (2 TRL steps)
Cost = 3 (>£1m)
Suppliers = 2 (2 suppliers)
Data Assumptions = 1.
Total = 7(Low)

## Scope

The scope of this pilot project is to deliver the Virtual Energy System Data Sharing Infrastructure and develop the requirements, design, and plan for the delivery of the Virtual Energy System Minimum Viable Product (MVP) in the subsequent phase of the programme.
This pilot is a crucial step in advancing the development of the Virtual Energy System. Its primary objective is to deliver the initial implementation of the Data Sharing Infrastructure (DSI).
The project aims to develop a pilot of the data sharing infrastructure to support the transition of the Virtual Energy System from a concept to reality. This project will rapidly and iteratively develop a prototype and lay the foundations for the Virtual Energy System.
The pilot outage planning use case and other use cases being developed in the wider VirtualES programme, would individually and

jointly deliver benefits to the energy system through greater system operability and resilience; reduced greenhouse gas emissions; reduced consumer bills; and other wider benefits.
Given the interconnected nature of the energy system, it is likely that use cases can be driving similar benefits, for example use cases could be delivering flexibility from demand side response. For this reason, the Alpha phase of this project NIA2_NGESO065 (Nov-22 to July 23) created a standardised approach to how a benefit analysis is undertaken across the VirtualES use cases.
The benefits framework proposed in the previous phase considers the following benefit categories.
• Improved system operability and resilience
• Reduced carbon emissions.
• Reduced consumer bills.
• Other wider benefits
Other specific benefits are detailed later in this document.

## Objective(s)

The objectives of the project include the following:

- To move from desktop research to the practical implementation of the Virtual Energy System, implementing the foundational instance of the solution based on iterative feedback and development cycles.
- To validate and refine the logical architecture of the Virtual Energy System (including evaluation of solution options if applicable).
- To provide a tangible demonstration of the Virtual Energy System solution that can be used to build support, gather feedback, and prioritise requirements with users and broader internal and external stakeholders.
- To propose the plan and method to develop the solution further in the MVP phase. Including the scope, schedule, and cost estimates to deliver the MVP of the Virtual Energy System.
- To trial the end-to-end delivery method for implementing use cases and the ways of working with stakeholders, partners, and suppliers. Use the resultant learning to refine the delivery roadmap of the Virtual Energy System programme. Provide output to support development of the programme business case and future network business plans.
- To facilitate a common view across stakeholders on the vision, direction, sponsorship, committed scope and governance of Virtual Energy System, and its transition from innovation to socio-technical business change programme.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations because it is a transmission project.

## Success Criteria

**People**
Roles in the deployment, configuration and operation of data preparation nodes and data sharing mechanism identified with user persona's, skills and capabilities defined. Users engaged in demonstrations and testing with learning of project phase disseminated.
**Process**
New data sources capable of being added and updated in data preparation node (A) with an end-to-end demonstration of the user journey from which feedback and endorsement can be gathered from stakeholders. Additionally, project governance for development MVP phase including scope, procurement, funding and governance will be defined and approved by internal sponsors and regulator.
**Data**
Data received is proven to align to data sent with specific sets of operational outages planning scenarios shown with a range of date and time attributes of proposed topologies.
Additionally, initial data catalogue available in the data sharing mechanism which details the data products available and identifies participants sharing data.
**Technology**

- To prove the technology works as intended, the following validation is expected.

Two data preparation nodes (A and B) are deployed and configured in the test environment representing two independent organisations.

- Sample data ingested and standardised through data preparation node (A) with security controls applied.
- Connections made between at least two data preparation nodes (A and B) with the data sharing mechanism components providing the control plane.
- Sample data sent by data preparation node (A) received by data preparation node (B) and performance of security controls validated.
- Model received from DPN (B) can be imported to power system analysis tool.
- The DSM confirms identities and access details between at least two DPNs (A and B)

## Project Partners and External Funding

Partners responsible for project delivery are Mesh-AI and Arup.
Additional project participants include the National Digital Twin Programme (NDTP), SSEN-T, SSEN-D, NGET.
No external funding to be provided.

## Potential for New Learning

This project will consider the technical alignment between the VirtualES, National Digital Twin Programme, and how the pilot can be implemented by other users (network partners).
We expect that we will learn detail on how the data preparation nodes (DPN's) can be set up and utilised by partner organisations to enable scalable data sharing through the DSI. We also expect the project will provide clearer understanding for how the DSI can be operationalised and brought into use through the RIIO3 period through the learnings of the pilot.
The learning will be shared with industry as well as government and the regulator to help inform future sector developments. This will be directly with the National Digital Twin Programme through collaborative working and regular meetings with energy digitalisation workstreams in DESNZ and the regulator to help inform their work. The learning will also be shared with the VirtualES programme's industry advisory groups and wider audiences.
All reports and outputs developed will be published on the Smarter Networks Portal. With the architecture and security review there may be some requirements to redact sensitive information. This will be proportionate to the risks and with the aim of publishing openly as much as possible.

## Scale of Project

The project will be delivered following an agile approach over 7 months and will require significant industry and partner engagement throughout. Mesh AI will be the main technology delivery partner with Arup. The NDTP and network project partners will also contribute to ensure learnings and opportunities are realised. Given the significant policy development around DSI and Ofgem's Flexibility Market Asset Registration work, and the expected inclusion of the DSI as a regulatory requirement for RIIO 3 - real demonstration and testing at scale is required in line with government and regulator expectations for the development of the DSI.

## Technology Readiness at Start

TRL4 Bench Scale Research

## Technology Readiness at End

TRL5 Pilot Scale

## Geographical Area

This project is being delivered by UK based suppliers and funded by National Grid ESO, it therefore has a geographical scope of Great Britain.

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

£1,450,000

# Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

## Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

## How the Project has the potential to facilitate the energy system transition:

The pilot will help us understand how to deploy DPN across various organisations' IT estates while assessing the costs involved in implementing the DSI. If successful, the pilot will validate the technical viability of data sharing and pave the way for a scalable DSI.DSI is fully aligned with the recommendations of the National Digital Twin programme and with the Energy Digitalisation Task Force (EDiT) recommendations for a digital spine and data sharing fabric. The Energy Systems Catapult, who delivered EDiT, are part of the team advising the ESO on the development of the common framework.
The DSI will create a decentralised network where each actor, for example a Generator, Transmission or Distribution Network, could develop their own digital twins and then connect and share their data through the VirtualES. It will lay out the requirements, rules, and principles to which all constituent digital twins will need to conform so that they may connect and share data. The use case selected will enable an improved outage planning process in the medium term which in theory could support more expansive use of switches to enable generation to be utilised without passing through the transmission network.
The majority of benefits of the DSI will be delivered through use case implementations. It therefore delivers significant indirect benefits to economy and net zero with smaller direct benefits through Opex and Capex of future projects. Other more specific benefits includes the following:

- Enables a seamless process for search, find and consumption of data that can be scaled, especially if more frequent base model sharing is required in the future.
- Improved safety and grid resilience through more effective and frequent modelling.

Increased customer satisfaction through faster and less error-prone outage management process.

- Increased interoperability across different actors in the energy sector.
- Increased competition across power systems analysis software vendors due to increased interoperability of data.
- Reduces data redundancy as base network model is consistent across operators.
- Reduction of outage planning queues.
- Cost reduction in the whole process and efficient use of human resources time in engineering details rather than information gathering.
- Deliver open data and digital market enablement in our digitalisation strategy.

## How the Project has potential to benefit consumer in vulnerable situations:

N/A

## Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

## Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

## Please provide a calculation of the expected benefits the Solution

Given the stage pilot, it is not possible to quantify precisely the benefits that can be delivered. Furthermore, key initiatives across the

sector have not quantified overall benefits from data and digitalisation. Albeit they recognise that these are key enablers to unlock wider benefits delivered through system planning, markets, and operations (see RIIO2 decisions, EDiT, FSNR, data best practice).
We expect that through the development of this pilot we will learn how to deploy the Data Preparation Nodes in different organisations IT estates and begin to understand the costs associated with deploying the Data Sharing Infrastructure through the RIIO3 price control period as indicated by Ofgem in the FSNR work.
In a recently completed NIA project NIA2_NGESO0028 a review of the potential benefit categories of the VirtualES was carried out. Most of the benefits will be realised indirectly through delivery of use cases which utilise the resulting data sharing infrastructure. Direct benefits will include reduced development costs of bespoke solutions and reduced operational costs through reduction in duplication, collaborative development and data sharing.
At a high-level, benefit categories include reduced consumer bills, improved operability and resilience, reduced carbon emissions and other wider benefits.
To give a quantitative indication of the scale of the indirect opportunities that could be achieved through better use of digitalisation and data sharing, the 2021 Smart Systems and Flexibility Plan (SSFP) estimated that a smart and flexible energy system would deliver benefits of up to £10bn a year by 2050. This £10bn is from reduced generation capex and network costs estimated via a system model. If we consider the System Operator's role alone, even a small improvement of 1% to the current net balancing costs, due to better data-driven decision making, would translate to a saving of over £13m/year.
There is strong stakeholder support for greater openness and sharing of data across the energy industry as demonstrated by the Energy Digitalisation Taskforce and various digitalisation initiatives ongoing. The lessons learnt throughout the project will help bring coordination across the various data and digital twin initiatives currently in flight across the energy sector.

## Please provide an estimate of how replicable the Method is across GB

his project considers a scaled common framework demonstrator in a confined geographical area, however the common framework developed will be applicable across GB.
Following the successful completion of the pilot, the project may proceed to the MVP design, which is as follows:
Develop the requirements, design and plan for the implementation of the VirtualES MVP in the subsequent phase; then Strategic design: Continue the development of the Common Framework and the strategic design and planning for the delivery of the VirtualES programme post the MVP horizon.
The VirtualES programme follows a lifecycle approach broadly aligned to the Government Digital Service (GDS) Manual for the delivery of the DSI, going through the Discovery > Alpha > Beta (Private, Public) > Live series of phases. Underneath these high-level programme phases, the DSI will be implemented in tranches with each tranche mapped to a use case of the VirtualES. This is so that the delivery of the DSI and overarching service is organised in a manner that responds to real-world needs, with its scale and complexity growing in accordance with the requirements of the use cases it serves.
The ambition is to complete the implementation of the DSI pilot by March 2025 (the focus of this document).

## Please provide an outline of the costs of rolling out the Method across GB.

At this stage the costs for rolling out the DSI beyond the Pilot are unknown. This work will support the expectation from Ofgem for network licensees to roll out a DSI during the RIIO3 period. The development of this work will support the creation of estimates for the MVP of the DSI as well as wider development during the RIIO3 period.

## Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☑ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and

analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

### Specific Requirements 4 / 2a

### Please explain how the learning that will be generated could be used by the relevant Network Licensees

This project will be delivered with ongoing cross-sector and in-sector collaboration, building on wider initiatives driving change in the energy sector. The development of the proposed 'data preparation nodes' and how they can be deployed, used, and scaled will be vitally important to future applications of the data sharing infrastructure and its wider use cases for other licensees in engaging with the DSI.
All reports and outputs developed will be published on the Smarter Networks Portal. With the architecture and security review there may come requirements to redact sensitive information. This will be proportionate to the risks and with the aim of publishing openly as much as possible.

### Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/a

### Is the default IPR position being applied?

☑ Yes

## Project Eligibility Assessment Part 2

### Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

### Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

A review has been undertaken through the Smarter Networks Portal, Programme Advisory Groups and direct stakeholder engagement and confirmed there is no unnecessary duplication. This pilot builds on the previous NIA phases (NIA2_NGESO065, NIA2_NGESO028) which led to the development of concepts of DSI as well as a standardised approach to benefit analysis for VirtualES use cases, considering improved system operability, resilience, reduced carbon emissions, lower consumer bills, and other broader benefits. This project helps to align development with National Digital Twin Programme and other initiatives which will help increase alignment in future phases by collaborating with the NDTP in the development of capabilities related to Pilot requirements. The project is also critical to other inflight VirtualES projects like CrowdFlex (10070764) and Powering Wales Renewably (10078792), which are all integral to VirtualES. More importantly, it does not duplicate the efforts of these projects.

### If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

## Additional Governance And Document Upload

### Please identify why the project is innovative and has not been tried before

Based on sector wide horizon scanning by means of desktop research and international engagement, ESO believes a Data Sharing infrastructure of this scale and scope has not been achieved before. There is also a need to build in a way that is scalable and aligns explicitly to the principles of the National Digital Twin programme.

Entities across the sector need to be supported and incentivised to share models and data extending outside of regulated networks. This presents development risks; The Common Framework content that was developed from previous phase needs to be

implemented, tested, and cross sector coordination is challenging. Therefore, innovation is needed to create new knowledge and develop new collaboration tools.

There are also existing precedents that encourage collaboration that are relevant to the Data Sharing infrastructure. The National Digital Twin programme and Centre for Digital Built Britain developed the Gemini Principles, which provide high-level guidance for digital twin development. The Energy Data and Digitalisation Taskforces have identified best practice in key areas for energy system data and digital infrastructure. The Energy Digitalisation Taskforce recommended a Digital Spine which the VirtualES and common framework could support. This pilot project will follow the best practice guidance established as part of the Common Framework project, however, as the guidance is only high-level, it will also develop detailed guidance specific to the Pilot implementation.

Without a Pilot and later an MVP there will be no DSI consequently making it impossible to achieve ESO's ambition to maximise collaboration with other organisations in the energy sector to deliver transformational change via VirtualES. To manage this risk the project has been developed as a series of phases delivering knowledge and experience as it progresses. This project proposal forms the next step of these phases, moving from wireframing to a proof of concept of critical components to practical implementation of the VirtualES.

## Relevant Foreground IPR

The project will primarily develop reports and documentary artefacts that will be published in the course of the project subject to security and commercial sensitivities.
Expected outputs include detailed user journey, detailed architecture, functional requirements for demonstrator use case, outline security and CNI assessment.
Expected reports include connecting models report, Data Standardisation Mechanism integration report Operational environment report and a report of the Trust Framework integration.

## Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. National Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at https://www.nationalgrideso.com/future-energy/innovation
- Via our managed mailbox innovation@nationalgrideso.com

Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" at https://www.nationalgrideso.com/document/168191/download

## Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

This is a cross-sector project and not a BAU activity to deliver the established ESO role. As such it does not have allocated business plan funding. The project outcomes will be used to define future implementation activities which may be progressed through future business plan proposals.

## Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The project is best suited to NIA funding due to the inherent risks: complexity of existing initiatives, standards and regulation, technical viability, data licensing, security, governance, enduring operating model.

## This project has been approved by a senior member of staff

☑ Yes