Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.
Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

NIA Project Close Down Report Document

Date of Submission

Jul 2025

Project Reference Number

NIA2_NGESO081

Project Progress

Project Title

Virtual Energy System Data Sharing Infrastructure (DSI) Pilot

Project Reference Number

NIA2_NGESO081

Funding Licensee(s)

NESO - National Energy System Operator

Project Start Date

September 2024

Project Duration

0 years and 9 months

Nominated Project Contact(s)

innovation@neso.energy

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.

Objectives

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.

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)

Performance Compared to the Original Project Aims, Objectives and Success Criteria

National Energy System Operator ("NESO") has endeavoured to prepare the published report ("Report") in respect of Virtual Energy System Data Sharing Infrastructure (DSI) Pilot, NIA2_NGESO081 ("Project") in a manner which is, as far as possible, objective, using information collected and compiled by NESO and its Project partners ("Publishers"). Any intellectual property rights developed in the course of the Project and used in the Report shall be owned by the Publishers (as agreed between NESO and the Project partners).

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Project Aims

The DSI Pilot aimed to develop and test the Data Sharing Infrastructure (DSI), using the anchor use case Electricity Outage Planning, with stakeholders across NESO, TOs, and DNOs. Its objective was to create a tangible demonstrator of the DSI, a Proof of Concept (PoC), which could serve as a testbed for the DSI Minimum Viable Product (MVP).

The Pilot intent was to derisk the delivery of the MVP and ensure it would support a variety of future data sharing use cases and validate its ability to be widely adopted across the broader energy sector. The Pilot has intentionally chosen a sub-set of the DSI concept to develop and test.

In summary, the DSI Pilot aimed to:

- Demonstrate functionality of DSI by applying it to a real energy sector test case, Electricity Outage Planning
- Validate the logical architecture
- Assess if the DSI can scale to meet the needs of wider energy sector data sharing applications
- Understand potential barriers, challenges and incentives to its adoption

Work packages and delivery milestones

The project was executed through iterative developments in capability. This process involved a sequence of mobilisation and gap analysis, iterative capability build, network partner onboarding, and trials.

Throughout the project, additional milestones were incorporated, and some timelines were adjusted in response to the gap analysis and onboarding of Network Partners. These changes are detailed in the Required Modifications section of this document.

Mobilisation and gap analysis

In the first period of the project the delivery team was formed, and a review was undertaken of the requirements that had been outlined in the previous Alpha phase (NIA2_NGESO065). These requirements were evaluated against the capabilities that existed in the first release of the National Digital Twin Programme's (NDTP) Integration Architecture (IA).

The baseline functionality was defined for both the Data Preparation Node (DPN) and the Data Sharing Mechanism (DSM) to confirm understanding of requirements identified in previous phases and align them to the iterative capability build milestones. The architecture and development principles were reviewed and ways of working were set up to deliver to them.

By deploying an instance of the IA the delivery team were able to perform a hands-on review of existing capability and review assumptions made from previous work. The outcome of this was a gap analysis which resulted in some additional development scope being identified, this is described in the Required Modifications section of this document.

M1 – Team mobilisation
M2 – Azure tenant established
M3 – Baseline DPN functionality agreed
M4 – Baseline DSM functionality agreed
M5 - NDTP IA deployed on Mesh-AI tenant

Iterative capability build

Through the iterative capability build the team extended the IA to deliver the capabilities of the proposed DPN, they also developed the first implementation of the DSM data catalogue in another environment. Further development was undertaken through the changes resulting from the gap analysis which are defined in more detail later in this document. This extra development included creating a deployment package for Azure, from the existing AWS versions, and developing the data pipelines required for the energy use case.

M6 – DPN baseline functionality deployed
M7 – DSM baseline functionality deployed
M8 – Node A registered with DSM
M9 – Mock data product searchable and consumable
M10 – Node B registered with DSM
M11 – Base Model data product from Node A published in DSM
M12 – Node B has consumed a Base Model data product
M13 – Operational Planning data product from Node A published in DSM
M14 – Node B has consumed Operational Planning data product

Network partner onboarding and trials

In this part of the project, which commenced in parallel with the iterative capability build, the detailed trial user journeys were defined,

and sample model specifications and guidance to support Network Partners were developed. These user journeys were aligned to the solution development to include specific tasks as required by the implementation. Two in-person workshops (one use case focused and one technology) were held to share progress and gather feedback from Network Partners. Trial scripts were produced to describe each step of the trial activity and expected outcomes. Each network partner deployed a data preparation node and participated in an end-to-end trial of the DSI technical user journey as described in the DSI specification.

The specific trial participants and regions were added through the change described later in this report.
M15 – Trial plan developed
M16 – Use case model processes defined and tested
M17 – Trial scope validated with Network Partners
M18 – Trial started with Network Partners
M19 – Trial completion and reporting
M20 – Sector wide show and tell

Success criteria
The success criteria listed below, were defined at the start of the Pilot and grouped into People, Process, Data and Technology for ease of comparison with the key factors of the Virtual Energy System Common Framework.

Since the Pilot was planned to take place within sandbox development environments test data was not to be triggered automatically from organisational production systems.

The success criteria outlined here reference the 'DPN of the provider (A)' and the 'DPN of the consumer (B)', as defined in the application architecture and technical user journey. These criteria were addressed through a combination of technical development, trials, and documentation. Alongside the delivery of this NIA project, internal work was also carried out to support broader governance of the Data Sharing Infrastructure and to plan for the Minimum Viable Product (MVP).

People
PE-1, Roles in the deployment, configuration and operation of DPNs and DSM identified with user persona's, skills and capabilities defined
PE-2, Users engaged in demonstrations and testing to obtain feedback for iteration
PE-3, Learning of project phase disseminated and material outputs shared
PE-4, Personas within the MVP use case further defined, and requirements detailed

Process
PR-1, New data sources capable of being added and updated in DPN (A)
PR-2, Schema validated against a local DPN instance of the required standard
PR-3, Implementation of DPN datastores for standardised and subscribed data
PR-4, Completion of registration & integration process of DPN with DSM with effective security controls

PR-5, Issuing and confirmation of security tokens by DSM on successful registration and identification

PR-6, Requests for access from a data consumer are passed through to the data provider
PR-7, DPN connections between the organisations are established with effective security controls
PR-8, Data sharing agreements for participation in place/drafted covering data being exchanged – DELIVERY OF THIS SUCCESS CRITERIA WAS OUT OF SCOPE OF THIS NIA PROJECT - ADDRESSED THROUGH PROJECT CONTRACTS
PR-9, Further understanding of the digitalisation governance requirements defined for cross-reference with results of the upcoming Ofgem consultation – DELIVERY OF THIS SUCCESS CRITERIA WAS OUT OF SCOPE OF THIS NIA PROJECT - ADDRESSED INTERNALLY

PR-10, Consider experience of CIM interoperability tests (IOP) to develop a model testing methodology
PR-11, End to end demonstration of the user journey from which feedback and endorsement can be gathered from stakeholders
PR-12, Confirmed interface with requirements of Grid Code 139 and Long Term Development Statements
PR-13, Data best practice is applied to data catalogues and metadata
PR-14, Project governance for development of MVP phase including scope, procurement, funding and governance will be defined and approved by internal sponsors and regulator – DELIVERY OF THIS SUCCESS CRITERIA WAS OUT OF SCOPE OF THIS NIA PROJECT - ADDRESSED INTERNALLY
PR-15, Trust Framework principles are applied for pre-approved and not pre-approved data accordingly

Data
DA-1, Data sensitivities are considered and the data between the organisations is shared with security tagging which is confirmed to control access as expected
DA-2, Data format conforms to the specified standards (CIM/IES) and schema is assured for sharing
DA-3, Data received is proven to align to data sent
DA-4, Specific sets of operational outage planning scenarios shown with a range of date and time attributes of proposed topologies
DA-5, Models are integrated, with sample data received by data preparation node (B) to show a combined representation of neighbouring electricity network systems and topological configuration
DA-6, Initial data catalogue available in the data sharing mechanism which details the data products available and identifies participants sharing data

Technology
TE-1, Two DPNs (A and B) are deployed and configured in the test environment representing two independent organisations

TE-2, Sample data ingested and standardised through DPN (A) with security controls applied
TE-3, Connections made between at least two DPNs (A and B) with the DSM components providing the control plane
TE-4, Sample data sent by DPN (A) received by DPN (B) and performance of security controls validated.
TE-5, Model received from DPN (B) can be imported to power system analysis tool
TE-6, The DSM confirms identities and access details between at least two DPNs (A and B)

The Pilot Project met all success criteria effectively. In several instances, this was achieved by developing concepts and generating insights that will inform the long-term solution, rather than through direct solution delivery. Every stage of the user journey was tested in collaboration with Network Partners. While these proof-of-concept trials and early implementations presented some challenges, they provided valuable insights into user needs, which will guide future development. Further details on these learnings are provided later in this document and in the project reports shared on Smarter Networks.

Required Modifications to the Planned Approach During the Course of the Project

Change 1 - Results of gap analysis
Previous phases of the programme had investigated the opportunities for collaborating with the National Digital Twin Programme and the use of their Integration Architecture (IA) as the baseline for the Data Preparation Node. These previous phases had been research led through workshops and demonstrations with the DSI Pilot project providing the first opportunity for hands on development and testing.

As the IA was still in its initial development stage at the time of the previous workshops and demonstrations, a risk had been identified around its degree of readiness and maturity to fulfil the DSI pilot requirements. Further information was required to address this through a gap analysis. This gap analysis was the first activity undertaken as part of Pilot delivery. The conclusion of the gap analysis was that several components that had been evaluated as ready to use required further development to meet the needs of the DSI Pilot.

Added milestones
M21 – Azure readiness with GitHub Actions
Additional development was required to create deployment patterns for the requisite platform services in Azure. These deployment patterns were only ready for AWS. Additional capability was included to use GitHub Actions to support deployment automation and to support the deployment needs of Network Partners.

(Milestone M22 was used to refer to an option for Azure without GitHub Actions which was not taken forward)

M23 – One to many GRPC based sharing
Additional development was required to allow organisations to share data using the federation approaches defined in the Pilot by extending the existing IA capability which delivered one to one connectivity. The option developed during the pilot allows one DPN federator (Server) to share many data products to many organisations. To receive data a separate federator (Client) is required for each organisation receiving data from which they can then receive many data products from that organisation. This was closely linked to the implementation of M24. To support the delivery of this activity the delivery team engaged support from Telicent, the developers of the first released version IA.

M24 – Additional DSM to DPN integration
Additional development was required to implement the proposed approach to authentication (mTLS with certificates used for communications between DPN-DPN and DPN-DSM) and authorisation (dynamically produced Data Sharing Agreements issued and synchronised from DSM to DPNs). This was closely linked to the implementation of M23. To support the delivery of this activity the

delivery team engaged support from Telicent, the developers of the first released version IA.

M25 – Industry technical engagement and forums
To enable the project to gather critical feedback from Network Partners and from wider industry, additional documentation and preparation was required. This included further definition of requirements for the deployment environments. Further documentation was also developed to support Network Partners internal governance requirements and to support engagements with security specialists.

The additional work of this change increased the project costs by £492,000

Change 2 – Additional Network Partners
To facilitate testing with energy system users the project was joined by electricity transmission and distribution networks. Performing user trials with Network Partners was a critical part of gathering learning from the Pilot. These user trials were part of delivery partners plans but the official onboarding of Network Partners was delayed by contracting. To avoid delays to programme delivery it was decided to start the Pilot Project while the Network Partners were still in the process of agreeing contracts and being onboarded.

Each network partner attended two full day workshops, the first related to the use case definition and the second related to the technology. They reported progress through the partners board and performed their own internal project management to support implementation and the deployment of their DPN in the lead up to the trial events.

The Network Partners were requested to choose a sample area within their network to create a simplified model for testing purposes. Starting from real system data was identified as the best approach to understand the user journey for data standardisation. However, this data includes sensitive information which would not be suitable to share in a development system. Therefore, these models were limited to smaller regions and sensitive data was removed to ensure their suitability for use in development environments. (To be noted that in the future, once the DSI is adequately proven and tested, these data sensitivities will be able to be managed and controlled in the system) The NESO team formulated detailed specifications and guidance for these models. The processes were generally aligned with existing model submissions between transmission, distribution, and NESO.

Each network partner established a sandbox development environment in which to perform testing and trials. They each deployed the DPN into their sandbox, registered it with the DSM and then run the end-to-end trial user journeys to share, request access and receive data. Throughout this activity, the delivery partners teams provided support and gathered feedback.

Through this change the following Network Partners contributed to the DSI Pilot project via their RIIO2 Network Innovation Allowance (NIA):

- National Grid Electricity Transmission
- Scottish and Southern Electricity Networks Distribution
- Scottish and Southern Electricity Networks Transmission (registered a related NIA project NIA_SHET_0053)
- Scottish Power Energy Networks (representing both Transmission and Distribution)

Lessons Learnt for Future Projects

The DSI Pilot project has provided crucial insights to support the future development of the Data Sharing Infrastructure. Additionally, there are lessons that can be applied to broader future innovation projects. The project reports examine these in greater detail and will be shared on Smarter Networks and https://www.neso.energy/about/innovation/our-innovation-projects#Complete-Projects.

The project underscored the importance of hands-on Proof of Concept testing and iterative capability development based on user requirements. Involvement by Network Partners offered invaluable opportunities for testing and feedback collection. Establishing project collaboration entailed a complex contracting process; the learning from this process will be carried forward by NESO's innovation and procurement teams and Network Partners to facilitate future phases and enhance collaboration efficiency.

The learning and recommendations from the project are documented in the DSI Pilot Trials report which will be shared on Smarter Networks and https://www.neso.energy/about/innovation/our-innovation-projects#Complete-Projects.

1. Use learning from Pilot trials to assess the DPN design for further development.
Engage with future DSI use cases to re-validate and test the DPN concept alongside the technical solution design of the DPN PoC against industry needs and identifying the DPN minimum infrastructure layer.
2. Use learning from Pilot trials to assess the DSM design for further development.
Engage with legal and process design experts and key industry stakeholders to consider how the DSM PoC needs to evolve.
3. Develop a comprehensive source of documentation to support participation and development of the DSI

Bring together current DSI documentation into a live repository openly available to prospective DSI participants.

4. Prioritise the core requirements to support data sharing over detailed definition of individual use cases

Engage with future industry use cases of the DSI to understand data sharing requirements and prioritise appropriate data exchange solutions.

5. Encourage data standardisation

Support future industry use case participants to address data standardisation by developing a use case development framework with guidance to support data standardisation and formalising the description of a Use Case Lead role, i.e. relevant industry actor able to broker necessary agreements across use case participants.

6. Continue to prioritise DSI value creation

Engage with industry and upcoming DSI use cases to understand what are the core functionalities providing most value overall.

7. Continue to reduce adoption barriers by improving usability Address identified key barriers and keep engaging with users to test further adoption needs.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The DSI Pilot project has effectively achieved its objectives, positioning the overarching programme for success as it transitions to the next phase of developing a Minimum Viable Product.

The design and development in the Pilot has delivered a proof of concept for the DSI, enabling end-to-end testing of the technical user journey with Network Partners. As expected for a PoC, the Pilot phase solution is complex and required repeated manual interactions. This PoC offered crucial insights into the DSI's conceptual model, helping to reduce risks in future development.

Working directly with Network Partners has meant the DSI Pilot has collected a wealth of user feedback that can be used in future phases to understand needs and prioritise features for development. This includes a more detailed understanding of the varied deployment models that will be required to maximise adoption based on organisational architectural preferences and capabilities.

The use of the DSI Pilot solution has provided insight of the future needs to achieve scalable, secure and assured data sharing. The approach used with DPNs deployed within organisations and a DSM responsible for authentication and governance has been demonstrated as a functional solution. The experience from the Pilot will be reflected in future development to prioritise the ability to scale both by number of participating organisations and by number of available data products. This will necessitate developing a solution that is adoptable and resilient.

The project has also provided an opportunity to test the proposed approaches to boundary definition and model development to support the implementation of Grid Code modification 139 and the Long Term Development Statement modelling processes. This learning has been shared with the relevant programme teams and additional information is included in the project documentation shared on Smarter Networks and neso.energy.

Data Access

Details on how network or consumption data arising in the course of NIA funded projects can be requested by interested parties, and the terms on which such data will be made available by NESO can be found in our publicly available “Data sharing policy related to NIA projects (and formerly NIC)” and Innovation | National Energy System Operator.

National Energy System Operator already publishes much of the data arising from our NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

Foreground IPR

The project created software solutions for the Data Preparation Node and Data Sharing Mechanism using and building up open-source products, sharing relevant learning with related projects.

It also tested requirements for the broader development of the Data Sharing Infrastructure. These findings are documented in project reports and will guide future development phases.

The DSI programme shares its outputs openly via Smarter Network and neso.energy.

These results were presented in the DSI Pilot Show and Tell published on the neso.energy site.

Planned Implementation

The immediate next step from the Pilot is to consolidate the learning into plans for the MVP. This will include reviewing the documentation that can be shared through Smarter Networks and neso.energy.

Following this Pilot, an MVP will be iteratively developed based on prioritised requirements from an initial set of critical industry use cases, and the DSI service will be launched based on a defined Service Level Agreement (SLA). The target is to complete the core MVP development by the end of 2026 in readiness to undertake user acceptance testing and operational readiness trials.

The primary users during this phase will be the regulated networks (in preparation for the RIIO3 commitments), and early adopters and innovators. Additional feedback will be gathered from testing of the DSI in Private Beta use prior to its Public Beta release.

Following the appointment by Ofgem as the Interim DSI Coordinator in their decision for the governance of the DSI, NESO will coordinate requirements from the sector, and prioritise them to develop and deliver DSI functionality for the MVP to enable select Type 1, Type 2, Type 3 use cases.

The MVP will build on the outcomes and learnings, and where appropriate the code base, from the Pilot phase. The DSI design specification and requirements catalogue being updated following the Pilot learning will be used as the basis of the MVP development. It is expected that additional requirements and functionality will be identified, prioritised, and included during the MVP by NESO through its role as the Interim DSI Coordinator.

NESO will continue to collaborate closely with the National Digital Twin Programme for the MVP.

Net Benefit Statement

The DSI Pilot has provided invaluable learning into the requirements to achieve a scalable, secure and assured data sharing infrastructure for the energy system. As a proof of concept and pilot trial, the benefits of this project are primarily in the learning that will inform future development. By delivering this Pilot phase as a time bound development and trial, the risks of future implementation have been better understood.

The project has helped to confirm the conceptual approach of trust services provided by a Data Sharing Mechanism with organisational data preparation and sharing through Data Preparation Nodes deployed into organisations. It has also provided valuable understanding of the user experience and requirements of a wider range of technical and governance users.

Through the delivery of the Pilot Trials the Network Partners have further developed their understanding of the requirements to operationalise the DSI and have helped to inform onward project development.

While developing the sample data to be used in the Operational Planning use case trial, the team applied the approach proposed in Grid Code modification 139 providing an opportunity for testing. The learning from this was shared with the lead user for this in NESO and provides an understanding of the additional activities required to support adoption of the boundary definition.

The benefits of the implementation of the DSI include enabling faster, more secure, and standardised data exchange across the energy system—reducing duplication, improving coordination, and unlocking new opportunities for innovation. It supports better decision-making through timely access to high-quality data, enhances system resilience by enabling more dynamic and transparent operations, and lays the foundation for future digital services that can accelerate the transition to a net zero energy system. By embedding trust, interoperability, and user-centric design from the outset, the DSI positions the energy sector to meet growing complexity with greater agility and collaboration.

Other Comments

The Project outcomes and results contain confidential information and intellectual property rights that cannot be disclosed in this Report due to their proprietary nature. Should the viewer of this Report (“Viewer”) require further details this may be provided on a case by case basis following consultation of all Publishers. In the event such further information is provided each and any Publisher that owns such confidential information or intellectual property rights shall be entitled to request the Viewer enter into terms that govern the sharing of such confidential information and/ or intellectual property rights including where appropriate formal licence terms or confidentiality provisions. Dependent upon the nature of such request the Publishers may be entitled to request a fee from the Viewer in respect of such confidential information or intellectual property rights.

Standards Documents

No changes to standards have been proposed. The project has identified and selected standards to apply into future development and

the benefits of standardisation, these are called out in the project reports.