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.

NIA Project Registration and PEA Document

Date of Submission

Project Reference Number

NIA_SPEN_0067

Project Registration

Project Title

Data and Digitalisation - Discovery Continuity

Project Reference Number

NIA_SPEN_0067

Project Licensee(s)

SP Energy Networks Distribution

Project Start

February 2022

Project Duration

5 years and 1 month

Nominated Project Contact(s)

James Yu

Project Budget

£450,000.00

Summary

Data and Digitalisation - Discovery Continuity presents an industry-led, multi-partner programme to research and develop, for the first time, a multi-vector energy distribution system digital twin (EDS- DT), addressing critical challenges and catalysing a plethora of new prosperity-generating capabilities, opportunities, products and services for utility operators and stakeholders (supply chain, developers, users and society) while facilitating and accelerating the zero-carbon energy transition.

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

To realise Net Zero, we need to digitise our network; this forms a core parts of our on-going innovation and business as usual activities. However, there are key barriers in how current practice achieves this in the electricity networks. Specifically, the lack of standardised data formats that we use within our organisations, supply chains, and even internally spans many different formats, protocols, and standards. Asset monitors currently either utilise connection to the RTU or the use of bespoke software – often HTTP (unencrypted, internet transferred) to deliver analytics back to system analyst. This does not unlock the full benefits of the IEC 61850 standards used in the digital substations for communication. Also, there is absence of visualisation and simulation of the electricity transmission and distribution networks as a complete system in real-time. This absence leads to an inability to determine the full impacts and efficacy of using distribution connected assets to balance the national energy transmission system (NETS).

Method(s)

WP1 will focus on the development of the system specifications, architecture and use cases of the overall EDS-DT, which will be used as the basis to inform the development of the DTs representing various energy vectors, i.e. electrical network, heat and hydrogen, in WPs 2-4, and the industrial cluster DT WP5. As the individual energy vector DTs and the industrial cluster DT, are developed from WPs2-5, WP6 will integrate all DTs together to establish an overall EDS-DT, DT which will act as an overarching and coordinating

super-architecture ensuring consistency of scenarios, exogenous data and bulk energy flows, and will interact on this basis with all individual sectoral DTs in order to deliver the services required for the specified use cases.

Scope

The EDS-DT represents the operation and dynamics, over a wide-range of timescales and with varying levels of fidelity, of a real-world future multi-vector energy system, coupled and interacting with complementary DTs representing energy vectors/sectors predicted to have a novel and growing influence on distribution system planning, real-time operation and control, and forecasting functions. These include:

• A future electrical network, acting as the backbone of the energy system. The EDS-DT will be able to be interfaced with heat and hydrogen DTs at various scales and representing a wide range of applications and contexts, to represent the interaction of, and the challenges and opportunities associated with, of the interactions between energy from different vectors.

• A DT for heat, which enables the dynamic interactions between the future heat systems in buildings (covering domestic to large-scale residential or commercial buildings, and district heating applications) and electricity distribution networks, allows the latter to intelligently operate heat pumps and thermal storage assets in response to weather forecasting, shaving the power demand peaks and accommodating more intermittent renewable power generation.

• A DT for hydrogen, encompassing the production and use of low-carbon gas, alongside local gas distribution networks supplying local demands such as heat/transport (including potentially energy-intensive hydrogen applications such as rail and marine), with the electricity distribution network potentially enabling the coupling of renewable electricity with electrolytic capacity;

• A DT for industrial clusters, which represent independently-operated large-scale local energy systems having complex interactions with electricity, gas and storage facilities dependent on the nature of industrial energy demands and operational contexts.

Objective(s)

Maximise the success of discovery by feeding in additional learnings for users and use cases to inform the SIF outcomes

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A awaiting tool.

No impact has been identified that would cause adversity to any consumer vulnerability group (based on the PSR definition)

Success Criteria

Maximise the success of discovery by feeding in additional learnings for users and use cases to inform the SIF outcomes

Project Partners and External Funding

SP Energy Networks are leading, supported by The University of Strathclyde as the lead academic partner. The leadership of SPEN and UoS is justified by track records and strong research partnerships spanning more than 30 years and 40+ projects, delivering a range of benefits, including cost savings, risk reduction, enhanced safety and security of the electricity system, and creating jobs. This strategic partnership is a long-standing exemplar of business-academia co-productivity. The project will also benefit from several other utility and academic partners. UK Power Networks (UKPN), Scottish Water (SW) and National Grid (NG) will input specific business needs, contexts and challenges, and deploy learning and outcomes to inform and improve decarbonisation efforts. The project encompasses multi-vector energy systems and will utilise the expertise and capabilities of academic partners in the following universities: Glasgow - heat; Heriot-Watt - industrial decarbonisation; St Andrews - hydrogen.

Potential for New Learning

We will provide learning on methods to effectively monitor and predict the outcomes of a range of scenarios on networks of the future in the face of radical change due to electrified transport, heating and mass LCT penetration.

Scale of Project

Following the successful deployment on a sample network, we will then accelerate the rollout of the monitoring and follow up with rolling out the Digital Twin to cover our full network.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

An identified section of SPEN's Distribution Network

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£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 role, function and structure of electricity distribution networks in the UK are already undergoing change and this will become radical within the coming decade as the transition to a low carbon energy system continues and accelerates. Electrified transport and heat, in conjunction with massive penetration of LCTs will result in co-dependent sets of electrical demands that are localised, complex and less predictable, resulting in a need for both infrastructure upgrades and intensive constraint management of distribution networks. Cables and transformers (of which there are typically tens of thousands in an operator's network) have thermal limits that large peak loads from co-occurring EV charging and heat pump usage may violate, while excessive (and potentially unbalanced) power flows caused by PV generation may push network voltages outside of their statutory limits and cause power quality and other issues.

The EDS-DT represents the operation and dynamics, over a wide-range of timescales and with varying levels of fidelity, of a real-world future multi-vector energy system, coupled and interacting with complementary DTs representing energy vectors/sectors predicted to have a novel and growing influence on distribution system planning, real-time operation and control, and forecasting functions. Successful resolution of this challenge and opportunity will accelerate the transition to net zero by ensuring that flexibility opportunities are maximised, identifying and removing obstacles to the widespread adoption of LCTs.

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)

This is a research-based project. Benefits will be quantified throughout the project.

Please provide a calculation of the expected benefits the Solution

This is a research-based project. Benefits will be quantified throughout the project.

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

This project has the potential to inform a standard approach to the development of digital twins and data interoperability for this use case that can be rolled out across the UK.

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

This is a research-based project. Roll out costs will be quantified throughout the project.

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

The approach we are taking to design these platforms will be standardised and interoperable. This means the learning will be highly applicable for all network licencees as we look to share data between each other and third parties. It will establish monitoring and modelling for distribution networks will be applicable to all distribution networks, and will provide a standard digital twin to model a variety of problems facing DNOs.

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.

The need for an EDS-DT is a clear national priority, and is currently not addressed within future electricity distribution systems, particularly at the “last mile”. We estimate that the TRL associated with this is 1-3, with no understanding or demonstration at scale of DTs and associated applications that will enable planning and operation of future energy systems across timescales from milliseconds to months and longer.

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

A key novelty is the definition of an energy-information model which represents the real-world topology of multi-vector networks, creating interfaces within and between disparate elements of the energy system to enable the real-time definition of an operational envelope for the electricity distribution network based on relevant non-electrical constraints. This will permit the lower-cost operation and investment of the electricity network by facilitating greater understanding and access to flexibility inherent within non-traditional systems coupled across energy vectors.

Relevant Foreground IPR

The specific Relevant Foreground IPR is unknown for this project phase due to its low TRL. If the project is successful and progresses to where the identified optimal solution is being developed, Relevant Foreground IPR will be identified and reported.

Data Access Details

Access to this data must be requested by contacting SPInnovation@spenergynetworks.com Please provide the following information in your request:

- Affiliation, position and contact details of requesting party
- Relevant project and type of data required
- Reasons for requesting this data and evidence that this data will be used in the interest of the UK network
- electricity customers How data will be shared internally and externally by the requesting party

Any data request deemed unsuitable for sharing will be highlighted to the appropriate requesting party. After receiving the request we will provide the estimated date for completing the data provision based on other requests and our team workload at that time. All requested data remains the property of SP Energy Networks.

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

There is no allowance within the SP Distribution RIIO-1 business as usual funding that is appropriate to fund this innovation project.

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 has both technical and commercial risks including the safe and secure communication of data and developing a solution that is at least cost to the consumer. Due to the early TRL, the success of the project and associated financial benefits of the project cannot be determined at this stage therefore it can only be undertaken with the support of NIA.

This project has been approved by a senior member of staff

☐ Yes