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## NIA Project Registration and PEA Document

### Date of Submission

Mar 2023

### Project Reference Number

NIA2\_NGESO038

## Project Registration

### Project Title

Whole Energy System Network Planning Review

### Project Reference Number

NIA2\_NGESO038

### Project Licensee(s)

National Grid Electricity System Operator

### Project Start

March 2023

### Project Duration

0 years and 5 months

### Nominated Project Contact(s)

Robert Gibson

### Project Budget

£100,000.00

## Summary

Reaching net zero will require a significant coordinated effort, of which system planning and network development will be a key part. Should the Future System Operator (FSO) take on the role of a whole energy system planner, it must be able to coordinate across multiple energy vectors and plan the system and networks of the future. More effective strategic network planning performed in a whole energy system way can lower the costs of the net zero transition and deliver significant consumer savings.

Developing whole energy system planning will not be a simple process and will require careful consideration, engagement and coordination across the energy industry.

This project will undertake research into what the options are for performing whole energy network planning across multiple energy vectors (e.g. electricity, gas, hydrogen, CCUS).

### Nominated Contact Email Address(es)

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## Problem Being Solved

Currently, the Electricity Service Operator (ESO) carries out Electricity Network Planning (Network Options Assessment (NOA) & Holistic Network Design (HND)) and is currently on the journey to stand up a Centralised Strategic Network Planning (CSNP) which provides holistic network planning that considers multiple electricity issues. The Future System Operator (FSO) will, in addition, stand up Gas Strategic Network Planning capability. The FSO will look to integrate the Gas and Electricity network planning processes with the view to include other vectors (e.g. electricity, gas, hydrogen, CCUS). This project is the start of understanding how this can be done.

The UK is an early mover towards “multi-vector planning” and the first (and so far, only) developed energy market to introduce an FSO role. Developing whole energy system planning will not be a simple process and will require careful consideration, engagement, and

coordination across the energy industry. We need to understand what the use cases are for undertaking whole energy network planning across multiple energy vectors, as well as understanding the options available to us, and the advantages and disadvantages for each of these options in the context of delivering the energy system transition. This project seeks to build this understanding through research and analysis of existing best practice, tested through stakeholder engagement, to deliver an actionable set of use cases and principles for the ESO to evolve into the FSO.

## Method(s)

The project will be delivered through a multiphase approach:

### Phase 1

Phase 1 which will be a desk-based study focussing on four areas related to whole energy system analysis and (electricity and gas) vector-coupling: 1) Policy and Regulation 2) Project Level Examples 3) Academia and 4) Thought Leadership.

The outcomes from this phase are expected to be draft use cases of typical whole energy system optimisation problems that the FSO will need to solve. An initial view of the principles of whole energy system coordination, to be tested with stakeholders, that would maximise synergies across vectors and deliver the most efficient and economic outcome for UK plc.

### Phase 2

Based on the outcomes of Phase 1, the second phase will prepare material outlining use cases and draft principles for the FSO. Key stakeholder engagement will take place to test ideas and obtain feedback to enhance thoughts on use cases, fundamental principles, and implementation requirements for the FSO.

The outcome from Phase 2 will be cross-industry perspectives of the opportunities and challenges associated with whole energy system analysis.

### Phase 3

This final phase will build on insights from the previous two phases to refine the use cases and set out the guiding principles for whole energy system coordination that the ESO can follow in its transition to FSO.

A set of use cases will be refined that articulate where and how these multi-vectors interact, which (types of) stakeholders are involved, what (innovative) technologies and solutions this involves, highlighting key barriers and/or dependencies as well as possible synergies.

From the use cases we will identify the type of decisions an FSO will need to make regarding trade-offs between electricity and gas, to optimise infrastructure delivery and operation, as well as to optimise the decision-making by investors, infrastructure providers and market participants. These will inform the principles for whole energy system optimisation to be followed by the FSO.

Finally, gaps will be identified in evidence and analytical requirements in both the electricity and gas sectors to inform potential further work required, covering heating, power generation, power-to-gas and gas-to-power, transport and short/medium/long-term energy storage.

The outcome for Phase 3 will be a report setting out:

- An overview of best practice on whole energy system analysis and design;
- Use cases for typical whole systems optimisation problems;
- Proposed principles for whole energy system coordination/optimisation by the FSO;
- Defined gaps in evidence for the full spectrum of technologies/solutions to be considered;
- Recommendations regarding future projects to expand the evidence base for whole energy system coordination

In line with the ENA's ENIP document, the risk rating is scored Low.

- TRL Steps = 2 (TRL 1- TRL3)
- Cost = 1 (£100k)
- Suppliers = 1 (1 Supplier)
- Data Assumptions = 1
- Total = 5 (Low)

## Scope

The purpose of this project is to understand what the different options are for undertaking whole energy system planning across multiple energy vectors, as well as to establish the principles of whole energy network planning.

Activities will include:

**Research and analysis:** Undertaking desk-based research seeking international evidence in regulation, project innovation, and academia as the basis for research into the best practice on whole energy system analysis and design – informing draft use cases and an initial set of principles for whole energy system planning.

**Stakeholder Workshops:** Engagement with a range of sector representatives to test and enhance use cases. Exploring the synergies that can be obtained in the cross-sector management and delivery of energy projects, to enable the energy transition efficiently and economically.

**Analysis and Reporting:** Updated use cases and identification of trade-offs in the decision-making process and a refined principles for the analysis. Also, to include gap analysis in current evidence base for optimisation across vectors and technologies, and recommendations for ESO to close gaps going forward and position the FSO role for maximum impact and efficiency. Delivery in the form of report.

## Objective(s)

The primary objective of this project is to gain an understanding on the options available for undertaking whole energy analysis. This is supported by:

1. Delivery of results from desktop research into what is already done
2. Stakeholder engagement effectively undertaken throughout the project
3. Delivery of findings through a cohesive, publicly shareable, report

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

The ESO does not have a direct connection to consumers, and therefore is unable to differentiate the impact on consumers and those in vulnerable situations. Benefits to all consumers are detailed below.

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

## Success Criteria

This project will be successful if there is an established understanding of what options there are for undertaking network analysis across multiple energy vectors. This understanding should be built on a foundation of research and engaging relevant stakeholders.

This will take the form of feasibility study report that contains an overview of best practice on whole energy system analysis and design with:

- Use cases for typical whole systems optimisation problems;
- Proposed principles for whole energy system coordination/optimisation by the FSO;
- Defined gaps in evidence for the full spectrum of technologies/solutions to be considered;
- Recommendations regarding future projects to expand the evidence base for whole energy system coordination.

## Project Partners and External Funding

Project partner: DNV, no external funding contribution

## Potential for New Learning

We can expect to gain an established understanding of what options there are for undertaking network analysis and planning across multiple energy vectors. This also needs to include some high-level timelines to realise network analysis across multiple energy vectors based on the capability that exists within the ESO today, and in the FSO in the future.

As the first developed energy market to introduce an FSO role, the learnings will allow other interested energy parties to understand the thinking process and options for developing whole energy network planning roles.

## Scale of Project

This project will span five months with DNV delivering the work (as well as additional stakeholder engagement). This is a research project to provide the ESO with a further understanding on how to undertake cross vector network analysis.

**Technology Readiness at Start**

TRL2 Invention and Research

**Technology Readiness at End**

TRL3 Proof of Concept

**Geographical Area**

This project will cover the whole of the GB network.

**Revenue Allowed for the RIIO Settlement**

None

**Indicative Total NIA Project Expenditure**

£100,000

## 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:

Delivering a 'net zero ready' energy system needs a body capable of addressing challenges from a whole energy system perspective. Bringing together enhanced whole energy system decision making, supported by electricity and gas planning roles, the FSO will build this holistic view to address the increased operational and planning challenges facing the energy industry.

This project will be the starting point for delivering on this commitment. Whole energy system planning is a key driver for creating the FSO which has the potential for cost reductions of up to [£3-4 billion for consumers](#).

#### 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

Not required as this is a research project.

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

The outputs of this project will highlight the different ways of looking at cross energy vector analysis. Transmission and Distribution Owners will be particularly interested to understand how their network fits into the whole energy system.

In its nature as a research project, this project isn't replicable so much as a project that sets the basis for an ongoing improvement/optimisation process and principles that will apply to all types of energy sector stakeholders and in which all stakeholders can seek to take part.

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

This research project will highlight the different ways of looking at cross energy vector analysis. At this stage, costs cannot be estimated as the project outcome will be exploring options rather than developing an implementable solution.

### 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

#### RIO-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 learning that will be generated will help shape future roles of the FSO when it comes to designing how whole energy system planning comes together. Although there will only be one FSO, this project will set the basis for ongoing improvement/optimisation processes and principles that will apply to all types of energy sector stakeholders and in which all stakeholders can seek to take part.

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

This will be the first time that the ESO has undertaken this type of work across multiple energy vectors. The information provided by this piece of work will be vital for the ESO to be able to shape future network planning roles as it transitions to the independent body of the FSO. This independence is vital to ensure that there is no bias to any one energy vector or network.

#### 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

Currently the networks are analysed for individual vectors such as electricity and gas. Whole energy system network design would look at all vectors and study the interactions. As the first developed energy market to introduce an FSO role, this has never been done before in GB, and possibly the world.

## Relevant Foreground IPR

A feasibility study report that contains an overview of best practice on whole energy system analysis and design with:

- Use cases for typical whole systems optimisation problems;
- Proposed principles for whole energy system coordination/optimisation by the FSO;
- Defined gaps in evidence for the full spectrum of technologies/solutions to be considered;
- Recommendations regarding future projects to expand the evidence base for whole energy system coordination.

## 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:

1. 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.
2. Via our Innovation website at <https://www.nationalgrideso.com/future-energy/innovation>
3. Via our managed mailbox [innovation@nationalgrideso.com](mailto: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 research is a world-first, and as such, combined with the low TRL and expertise required, this project would not be funded as part of BAU activities.

## 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

Currently the ESO carries out Electricity Network Planning (NOA & HND) and is in the process of creating a Centralised Strategic Network Planning (CSNP) which provides a holistic network planning that considers multiple electricity issues.

The FSO will look to stand up Gas Strategic Network Planning capability in which Gas and Electricity outcomes will be delivered individually. Although the expertise in electricity is mature and world leading, how the ESO would look to drive synergies between the two and include other vectors is expertise we do not currently have within the ESO. Therefore, it is necessary to partner with a knowledgeable organisation that is unbiased towards any one network.

From an industry perspective, there is not a single established entity that has detailed operating planning knowledge across vectors. Therefore, NIA funding, would support this research, proposing a number of options on how the ESO could achieve the future ambition of the FSO from a whole energy network planning perspective.

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

☒ Yes