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

Aug 2024

Project Reference Number

NIA2_NGESO077

Project Registration

Project Title

FastPress

Project Reference Number

NIA2_NGESO077

Project Licensee(s)

National Energy System Operator

Project Start

March 2024

Project Duration

0 years and 6 months

Nominated Project Contact(s)

innovation@nationalgrideso.com

Project Budget

£600,000.00

Summary

This project explores the use of Artificial Intelligence to inform improved National Transmission System (NTS) network planning decisions, namely, to optimise the configuration of network assets to ensure sufficient pressure at NTS offtakes.
The aim is to develop an AI-based software tool that allows analysts at ESO to rapidly assess 'Static' day-to-day NTS Offtake scenarios, by bulk-solving more standard cases, allowing the prioritisation of less standard instances, and helping with the rapid assessment of different network configurations for more complex scenarios. As an extension, the project will assess the feasibility of using AI to optimise 'transient' scenarios, where inputs are flexible at more granular intervals, and inform longer-term network planning decisions to accommodate hydrogen.

Nominated Contact Email Address(es)

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Problem Being Solved

ESO Gas Network Planning Network Analysts currently use a network modelling simulation software (SIMONE) to understand, for a range of supply and demand scenarios, whether gas can be supplied to NTS offtakes from supply locations at obligated pressures, across 24-hour periods.
Network Analysts first run 1) a "static" scenario, assuming an end of day (EOD) flow rate of gas (flat rate), to solve across a given day, then 2) iterate a "transient" study, whereby gas supply & demand flow profiles, together with configurations of assets including flow control valves and multi-junctions, are inputted at more granular intervals.

The number of scenarios to be run day-to-day is currently prohibitive, and a need has been identified to rapidly assess and prioritise these, such that ESO can focus analyst expertise on more complex cases. Moreover, new capability is required to support new network configurations as may be required via hydrogen – this is only possible with enhanced simulation and broader analytical capability.

Method(s)

The project will seek to iteratively develop artificial intelligence approaches to rapidly prioritise operational and planning scenarios, through 4 concurrent workstreams:

1. User research: dedicated sessions with ESO Gas Network specialists and project partners to identify and document user needs
2a. Data science - Similarity and clustering: Development of Machine Learning techniques to rapidly assess past scenario runs to optimise network configurations for a given day.
2b. Data science – Optimisation feasibility assessment: Assess use of Machine Learning techniques and automation of SIMONE runs to assist in network planning decisions.
3. Backend engineering: assess potential for automation of model simulations and viable routes to deployment
Outcomes of the work will be measured against the success criteria set out in subsequent sections.

Scope

Develop a Proof of Concept (PoC) solution by following the below steps. Note, PoC refers to an AI solution that is trained and tested, accompanied by user-tested front-end infrastructure, but is not yet fully deployed.

- Conduct user research with identified domain experts and end users to better understand requirements:
  -Work with the Gas Network Planning team to understand user needs and refine solution requirements.
  -Gather users UX requirements and key success metrics.
  -Understand the process of running static versus transient scenarios.
- Collect, assess, and examine available data, including:
  -Understand data access, availability of actuals, existing assumptions set and SIMONE configurations.
  -Understand the implications on network configurations caused by maintenance or outages.

- Develop PoC models that can analyse and categorise different scenarios in bulk, and inform the analysts of the prioritisation of different network scenarios, as well as
  -Develop a methodology for rapidly assessing (or scoring) outputs from SIMONE for different scenarios.
  -Create a similarity metric to compare two scenarios.
  -Develop a method to evaluate success of scenario and to estimate the best configuration.
  -Develop benchmarking of performance to assess quality of advice.
- Explore strategies for assessing the feasibility of future NTS configurations as the role of hydrogen grows.
  -Explore automated network configuration optimisation strategies that can assess scenarios with new NTS configurations for situations where there are limited historic simulations to base recommendations on
- Develop a plan for the Beta phase to optimise and refine model performance and deploy the live solution.
  -Plan solution architecture for full deployment of solution.
  -Develop a front-end tool/dashboard that can be tested with the end users.
  -Set out an approach as to how AI could be explored optimise transient scenarios.

Objective(s)

- Develop a proof-of-concept solution to improve day-to-day decision-making on the NTS, by rapidly assessing past inputs / outputs on similar observed days.
- Improve operational decision-making by leveraging AI solutions to enhance modelling capability and maximise the value of expertise held within ESO.

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.

Success Criteria

- The PoC demonstrates an ability to identify close to final network configurations in ‘sufficient’ cases (with ‘sufficient’ defined and agreed with end-users)

- The PoC demonstrates an ability to calculate the acceptability of a given network configuration for a scenario, using SIMONE in an automated manner such that analysts can quickly identify which scenarios require further assessment.
- There is agreement from ESO end-users that the PoC tool demonstrates potential to result in 'material' improvements to existing ways of working once fully tested and deployed in future phases (e.g. through time savings).

Project Partners and External Funding

Faculty AI will lead development of the proof-of-concept, no external funding required.

Potential for New Learning

- Improved operational decision-making, by enabling rapid understanding of prior NTS configurations and the historical relationships between inputs and outputs.
- Ability of NTS analysts to run and solve a wider range of future network planning scenarios, unlocking new options to accommodate hydrogen.
- Potential to scale existing use of analytical tools for decision-making, running these in at least a semi-automated manner, identifying new solutions and maximising the value of analyst time.
- Promote wider understanding and adoption of AI solutions across the business, both for application within these projects but also across ESO.
- Learnings for ESO in how best to share, process and maintain data for analysis in a consistent and secure manner.

Learning will be shared internally through regular briefings, user research, solution documentation and presentation of key findings, with the ultimate objective to hand over any tools produced to ESO.

Scale of Project

The project spans 5 months with up to three project partners. The scale of the project is already the minimum viable envelope to develop a proof-of-concept solution, without which such tool development would not be feasible (and the learning would not take place).

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Applicable across GB (full NTS).

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£600,000

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 project develops new capability to rapidly assess the feasibility of future NTS methane capability requirements, and reconfiguration of the NTS as the role of hydrogen grows. This is critical for wider energy transition scenarios and decarbonisation of hard-to-abate industries (including gas) and supports ESOs cross vector remit.
Independent modelling from Arup on behalf of the National Infrastructure Commission indicates at least £46bn expenditure required to transform the GB gas system (NTS + Distribution) for hydrogen. As such, even marginal planning improvements delivered through this study have scope for considerable value.

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

In the cheapest hydrogen adoption scenario, NIC modelling estimates a total 'baseline' cost of adapting the UK Gas system of £46bn up to 2050, of which:
Hydrogen Local Transmission System (LTS) + NTS backbone costs reflect £19bn.
Repurposing NTS + Local Transmission System (LTS)infrastructure costs £12bn
The remainder associated to customer, industrial and distribution adaptations.
This will require critical decisions as to how infrastructure should be both a) built and b) repurposed, which will not be possible without requisite simulation tools. If these 'lowest' costs are to be achieved, this requires a step change in planning capability.
Even if work delivered through this project unlocks 0.1% of the investment value (through developing enhanced planning capability), this would represent £31m until 2050 (2023 prices). While it is not feasible to attribute value directly to the simulation tool, its value is best reflected as a share of the investment of which it is a critical enabler.

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

Solution applicable across the NTS.

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

Following conclusion of this phase, a further Beta/Live Phase would be required to finalise model development (from proof-of-concept to deployable product) and integrate the solution into ESO systems. It is estimated that the cost of this next phase would cost between £0.75-1.5m – these costs will be developed further within the scope of this 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

All IP and solution code will be handed over to ESO on conclusion of the project, as such all ESO users will be able to take forward the learnings and the solution developed. National Gas would be a further interested stakeholder, who will be able to adopt the learnings directly through their role as project partner and beneficiary of the planning capability that the solution enables. The final report will outline the findings of the project, outlining how machine learning can be applied to the gas planning process, this report will be disseminated on the smarter networks portal.

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.

This is the first attempted application of AI to this problem statement, as opposed to physics-based simulations that consider NTS topology and physical gas flows to NTS Offtakes currently in operation. The AI approach will rapidly assess combinations of previously observed inputs and outputs that 'solve' NTS scenarios on a given day, detecting patterns that may not otherwise be evaluated by NTS planning analysts; this reflects a vastly different methodology to existing approaches either within ESO or elsewhere.

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

- Models: Data science codebase, setting out the training and testing of PoC models.
- Report: Reporting to cover progress made, models developed and solution outputs
- Application: Front end application to visualise model outputs, with the design / functionality tested with end users

Additional Governance And Document Upload

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

The approach and application are novel, using machine learning to identify similar network configurations and supply and demand patterns that can be recommended to analysts as potential solutions to the scenario.
The proposed approach delivers new capability for network operations by:

- Enabling automated triggering of SIMONE runs and calculation of output success metrics, allowing analysts to focus time on more complex scenarios.
- Exploring deployment of SIMONE in a scalable cloud environment, making it more widely accessible to users.

As the solution is developed further, it can also bolster long-term planning capability by:

- Providing a flexible AI solution for use in network planning decisions - for example, delivering new capability to assess future network configurations that would be required under different hydrogen scenarios.

The primary innovation risks relate to typical risks inherent to data science projects, together with adoption into business as usual:

- Performance risk - an inherent risk within data science exploration, that the proposed solution may not be able to deliver the required level of functionality. This may be due to data quality or relevance to the problem at hand, or low predictive power of the features contained within it.
- Adoption risk: In line with this risk, if the solution cannot deliver technical performance, or provide sufficiently interpretable results, it may hinder adoption into business as usual.

Relevant Foreground IPR

- Models: Data science codebase, setting out the training and testing of PoC models.
- Report: Reporting to cover progress made, models developed and solution outputs
- Application: Front end application to visualise model outputs, with the design / functionality tested with end users

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

Due to the inherent risk of failure of the project (given it develops a novel application of data science techniques), it cannot be funded within the existing business as usual.

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 attempts to use AI to provide a rapid assessment of operational NTS scenarios and the overall TRL is low. Innovation funding is therefore more suitable for exploring the project’s potential and increasing TRL before transferring into BAU if proof of value can be delivered. This is a project that otherwise would not be pursued without the assistance of innovation funding.
- This is a novel application of AI methods both for this use case and across ESO – this brings an inherent risk that workable advice cannot be provided, a risk that is not suited for BAU funding.
- Standard ESO processes and procedures relating to data capture, storage, processing and sharing may need to be adapted to fully

integrate the solution into ESO architecture and run the solution at the frequency required (daily).

This project has been approved by a senior member of staff

☑ Yes