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

Jan 2025

Project Reference Number

NIA2_NESO105

Project Registration

Project Title

Volta: Real Time Prediction

Project Reference Number

NIA2_NESO105

Project Licensee(s)

National Energy System Operator

Project Start

January 2025

Project Duration

1 year and 1 month

Nominated Project Contact(s)

innovation@nationalgrideso.com

Project Budget

£1,600,000.00

Summary

This project will provide the control room with a modern Real-time Demand Predictor solution that supports real-time decision making. The current approach is based on historical data and methodologies and as the energy transition gathers pace theses will not provide the Control Room the level of insight and decision support required going forward. Modern algorithms and data analysis techniques will be developed and tested with the outcomes and learning feed into ongoing NESO project deliveries. This will assist NESO in its operational decision-making process as the complexity of managing a net zero carbon network increases.

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

NESO has a prediction tool in place that requires regular manual interventions by OEMs (Operational Energy Managers). When the demand forecast deviates from the real-time measurement, the OEM manually selects a historic demand curve, based on experience, that matches the actual demand profile to adjust the prediction to the real-time measurements (bending the curve). This can result in non-optimal balancing solutions due to last minute changes.

Method(s)

The project can broadly be broken down into model development, model testing and validation, reporting and visualisation:

- Model Development will follow an iterative and exploratory approach, which involves experimenting with a variety of model architectures to ultimately select the most effective solution for electricity demand prediction. This will include exploring the use of Time Series Models, Artificial Neural Networks (ANN), Kalman Filtering, Temporal Fusion Transformers (TFT), Times Net, and DeepAR.
- Model Testing and Validation against Evaluation Metrics will employ a time-based training-validation-test split methodology, cross-validation and sensitivity analysis.
- Reporting and Visualisation will be founded on the principles of User Centred Design to provide those using the Real-time Predictor with a best-in-class experience that supports their decision-making in an intuitive, transparent way.

The project will be delivered over 16 months with a local core team consisting of high-profile senior business advisors and data scientists from IBM and the University of Oxford, who partly know NESO from past and on-going project delivery work. The team combines deep industry insight, cutting edge data science expertise and user centric design skills. The Core Team can draw on further SMEs from Oxford, IBM Consulting and IBM Research, as needed.

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

TRL Steps = 2 (4 TRL steps)

Cost = 3 (>£1m)

Suppliers = 1 (1 supplier)

Data Assumptions = 2.

Total = 8 (Medium)

Scope

This project will explore the use of Machine Learning (ML) techniques to improve the minute-by-minute frequency-corrected electricity demand prediction. The project will be broadly broken down into three main deliverables:

- Model Development will follow an iterative and exploratory approach, which involves experimenting with a variety of model architectures to ultimately select the most effective solution for electricity demand prediction. This will include exploring the use of Time Series Models, Artificial Neural Networks (ANN), Kalman Filtering, Temporal Fusion Transformers (TFT), Times Net, and DeepAR.
- Model Testing and Validation against Evaluation Metrics will employ a time-based training-validation-test split methodology, cross-validation and sensitivity analysis.
- Reporting and Visualisation will be founded on the principles of User Centred Design to provide those using the Real-time Predictor with a best-in-class experience that supports their decision-making in an intuitive, transparent way.

Objective(s)

The Objectives of this project are to deliver the following

- Provide the NESO with 3 to 5 models capable of predicting frequency corrected electricity demand based on minute-by-minute observations of electricity demand and frequency,
- A clearly documented explanation of each of the different models and associated methodologies provided.
- Provide NESO with a clear assessment on the accuracy (in terms of a % improvement against the current model) and reliability (in terms of a reduction of number of times not providing a solution) of different machine learning techniques and methods.
- Provide NESO with a robust predicting solution (measured against the current approach) that aids in real-time decision-making in the control room, the solution should include level of uncertainty of the outcome (as a % or other agreed criteria once further learning is developed) and will contribute to the overall stability and reliability of the power grid.
- Provide NESO with a proof-of-concept real-time predictions tool (available to the Control Room for SME assessment) that can then be implemented into ESO operational systems

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations because the outputs of this project are focused on providing improvements to the real time operation of the GN electricity network.

Success Criteria

The following will be considered when assessing whether the project is successful:

- The project delivers against objectives, timescales and budgets as defined in the proposal
- Development of models that will provide a solution for the real-time prediction of electricity demand
- Successful testing of models developed against a set of evaluation metrics

A new UI that enables users to interact with the prediction models in an intuitive and transparent way

Project Partners and External Funding

The project partners are Oxford University and IBM. No External funding

Potential for New Learning

If successful, this project will pave the way for the Control Room to integrate modern ML algorithms and models into a key part of efficient real-time balancing. The real-time prediction of GB network demand has changed due to the increased complexity of the different energy source on the Network.

The new methods and models will provide insight and learning on the changing nature of GB demand at both a local and national level. This will also decrease the manual control burden, increasing balancing efficiency, and readying balancing for effective integration of increasing renewables.

The output will be knowledge, understanding and modernisation of a strategic part of the NESO Balancing Transformation optimisation strategy and enable progress and achievements of strategic objectives to be measured throughout the transition. Final learnings and recommendations will be disseminated through delivered reports, model documentation, and presentations to stakeholders at key project points. All relevant information will be available via the ENA Smarter Networks Portal.

Scale of Project

This desk-based research project will be conducted over a 12-month period by Oxford University and IBM in close collaboration with the NESO control room, product owners, business analysts and market participants

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Will be based upon the GB NESO area of operations

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

Total £1,600,000

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 current balancing capability is constrained by the existing balancing system, and the risk of developing solutions without a modernised prediction model is that solutions may not be fit for purpose either during the transition or in the long-term. This project will deliver new methodologies and modelling techniques that will aid the development of a strategic approach to incorporate balancing challenges and needs of the control room into a modelling framework.

The project will also create a solid understanding across the NESO of the significant complexities in the current and future balancing system and markets, framing the optimisation strategy and enabling the progress of strategic objectives to be measured throughout the energy transition. Through enhanced system understanding and analytic expression, the project outputs will benefit other projects and programmes within the NESO by providing a well-founded model that can be used to transparently engage with market players to facilitate future market changes that may be required.

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

This project will contribute to the success of the Balancing Transformation Programme, which, upon completion, would deliver direct customer benefits of up to £192m and be a key enabler of £3.5bn. Modernised prediction system to enable optimisation systems are required to underpin this transformation programme and unlock these customer benefits.

Without a modernised Real-time prediction model and methodologies for Balancing Optimisation (BO), there is a greater risk of incurring regret spend from building optimisation tools in the wrong order, without the correct inputs, or in a way that is incompatible with future developments.

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

This project will develop a set of models and ML techniques that will assist in the real-time balancing processes for system operation of the whole GB network.

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

At this stage the costs are unknown for rolling out this project learning across GB, this is due to the fact that NESO has sole responsibility for the real-time balancing of the GB network, therefore this project would not be of relevant to other members of ENA.

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 used to transparently engage with market players to facilitate future market changes that may be required as we move to a zero carbon energy system.

All relevant learnings and recommendations will be disseminated across industry to ensure all parties benefit from an improved understanding of the changing nature of network demand both at a local and national level.

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 project is unique to NESO as it has the sole responsibility to balance the GB electricity in real-time and the delivery of this project will deliver Innovation into a key part of the balancing process.

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

- The project will investigate application of advanced ML techniques which have not yet been applied to this challenge directly.
- The goal of the project is to not only find the model that best fits current data and forecasting requirements but also establish a framework that can adapt to future changes and challenges in electricity system operations. This will be the first delivery of NESO's VOLTA program, our first attempt to deliver AI based solutions into our control room operation.
- RTP (Real Time Predictions) will feed the input to our national optimiser. By prestaging optimal solutions through machine learning, the system can quickly adapt to uncertainties. This leads to more accurate and reliable pricing strategies.

Relevant Foreground IPR

Foreground IP will be delivered in the form of end of work package reports, model documentation and presentations for the following work packages:

- WP1 – Documentation of Business Requirements, Data Collection and Pre-Processing
- WP2 - Documentation of ML Model
- WP3 - Assessment of different methods based on proposed evaluation metrics for ML and Deep Learning Model
- WP4 - Assessment of different methods based on proposed evaluation metrics for all models
- WP5 - POC Solution, Documentation & Training

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 Energy System Operator 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.neso.energy/about/innovation

3. Via our managed mailbox innovation@nationalenergyso.com

Details on the terms on which such data will be made available by National Energy System Operator 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

The Balancing Transformation programme is working to deliver a backbone IT strategy for hardware and architecture, however there is no equivalent scope for expressing the multiple interlocking optimisation challenges. This project will consider a fundamentally different approach to future development of the balancing system, challenging the existing design through thorough analytical interrogation. To enable innovative thinking and holistic consideration of the balancing system, this project is best placed outside of BAU.

Once the model and methodologies for GB network demand prediction are developed, further projects to consider implementation an integration into the new Open Balancing Platform (OBP) may be appropriate, either though innovation or BAU.

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 TRL of the overall framework is relatively low. Therefore, innovation funding is more suitable for exploring the project's potential and increasing the TRL through proof-of-concept prototype tools before transferring into subsequent development.
- There are increased risks associated with developing new and innovative prediction models for the whole balancing system which makes this project better suited to NIA.
- Conducting this project with NIA funding will ensure that the project findings can be shared more widely with other interested Network Licensees and wider industry.

This project has been approved by a senior member of staff

☑ Yes