NIA Project Registration and PEA Document

Date of Submission

Nov 2022

Project Reference Number

NIA2_NGESO022

Project Registration

Project Title

BC Forecasting

Project Reference Number

NIA2_NGESO022

Project Licensee(s)

National Energy System Operator

Project Start

November 2022

Project Duration

1 year and 6 months

Nominated Project Contact(s)

Daniel Drew

Project Budget

£350,000.00

Summary

BSUoS is the Balancing Services Use of System charge, paid by transmission connected generation and demand to cover the cost of balancing the electricity system. To set the tariff, an accurate forecast of the costs and the variability is required, but these balancing costs are highly volatile and difficult to forecast accurately.

This project is looking to improve existing short term (<12 month) forecasts by applying machine learning and cutting-edge forecasting methods. Additionally, the project seeks to increase the temporal granularity to weekly or daily.

Accurate BSUoS forecasting benefits all consumers by enabling better business planning and risk management by NGESO and its customers. It may also bring opportunities for the control room and planners to reduce spend by taking more cost-efficient actions.

Third Party Collaborators

UKRI (Hartree Centre)

Nominated Contact Email Address(es)

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Problem Being Solved

National Grid Electricity System Operator (NGESO) spends money to balance and secure the electricity system. These costs are

known as Balancing System Costs and are paid for through the Balancing Services Use of System (BSUoS) charges. BSUoS charges are then levied on suppliers and generators in order to recover the costs incurred by NGESO through system balancing. The CMP361 code reform seeks to change BSUoS charging by introducing an ex-ante fixed volumetric BSUoS tariff set over a notice period of 15 months. From April 2023, the code reform CMP308 will come into effect removing BSUoS charging from generation. CMP362 facilitates the implementation by introducing and updating required definitions from CMP308 and CMP361.

Balancing costs are the largest part of BSUoS and are highly volatile and difficult to forecast accurately. Given the upcoming code changes, NGESO has developed a new model to forecast the balancing costs for the next 24 months. This model will be used to set the BSUoS tariff for the financial year 2023/24.

NGESO are seeking to further improve the balancing cost forecast model to ensure tariffs are set as accurately as possible and to minimise the financial risk NGESO is exposed to on a month-to-month basis, in which the tariff is fixed but the balancing costs are variable.

Method(s)

This project will consist of four work packages which will develop and test solutions to improve the forecast accuracy and output resolution, and if necessary, optimise the code to meet NGESO requirements.

The work will focus on four areas:

1. Improving upon the existing modelling technique
2. Moving from a monthly resolution towards a daily resolution output
3. Exploring alternative modelling techniques such as machine learning methods
4. If necessary, profiling and optimising the model code for the deployment environment.

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

TRL Steps = 2 (4 TRL steps)

Cost = 1 (£350k)

Suppliers = 1 (1 supplier)

Data Assumptions = 2

Total = 6 (Low)

Scope

Four main work packages and one optional work package will form the basis for the project plan. These are as follows:

- **WP1** – Knowledge exchange and exploratory data analysis. Exploratory data analysis will be performed, looking at the current and proposed datasets in depth to determine what may be useful, and any limitations of the data, or additional processing needed. NGESO will explain the models they have developed and make them available to Hartree as code to ensure they can run these as a baseline for subsequent work

- **WP2** – Improve existing time series models. Ways of improving existing ARIMA models will be explored. The exact areas explored will depend to some extent on the findings of WP1, but it is likely to include; (1) Systematically exploring the choice of parameters trends and (2) the use of additional datasets as regressors. If successful the model can be run in parallel to the existing model, demonstrating the improved forecast.

- **WP3** – Improve temporal resolution of models. Adapt the models from WP2 to run at daily resolution, using similar approaches to WP2. Initially use the same models as in WP2, then adapt them for higher spatial and temporal resolution. This will likely entail a step up in computing power to allow the models to run in a reasonable time frame (although optimisation is included as a later work package). If successful the model can be run in parallel to the existing model, demonstrating the improved forecast.

- **WP4** – Exploration of alternative modelling approaches. This work package will focus on application of machine learning techniques such as Convolutional Neural Networks, Deep auto-encoders, and Recurrent Neural networks, to model and make predictions of balancing costs. Depending on the volume and type of data for each variable a suitable technique for each dataset will be selected for the modelling and prediction processes according to the literature. The performance of these models will be assessed and if they are not satisfactory alternative modelling techniques will be implemented to improve the results. If the model output is satisfactory techniques such as Monte Carlo sampling will be explored, to generate a probabilistic outcome for the trained models.

- **WP5** (Optional) – Code Optimisation. If runtime optimisation of the developed model is required, a code review and profiling pass will be carried out before preparing a detailed work plan.

Objective(s)

The objectives for the project are as follows:

- Develop a model to forecast balancing costs for 1-12 months ahead at a monthly resolution which uses more advanced statistical techniques than the current NGESO model and/or additional datasets.

- Produce a balancing cost forecast model with better temporal resolution (ideally daily) than current NGESO model.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

NGESO 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.

Success Criteria

The project can be deemed successful if:

- The new balancing cost model delivers higher accuracy forecast in comparison to the existing NGESO model.
- The new balancing cost model provides higher granularity output (target is daily) than the existing NGESO model.
- The improved model is deployable in a way which meets NGESO's business needs (e.g. ease of use, run time, practicality, cost).

Project Partners and External Funding

UKRI (Hartree Centre), no external funding contribution.

Potential for New Learning

Through developing a new balancing cost model, as well as accuracy improvements, insight will be generated into the drivers of balancing costs, and the relationships between different elements. Also, new modelling techniques might be developed that can be applied to other applications within NGESO. New learning will be disseminated through a project report and industry conferences if applicable.

Scale of Project

This project will span 18 months with UKRI (Hartree Centre) delivering the work, as well as additional stakeholder engagement.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The scope of the project will cover the whole GB system.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£350k

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 energy system is going through rapid and extensive change, with changes in supply and demand. This project will facilitate NGESOs role though the energy system transition by:

Financial
Accurate BSUoS forecasting benefits the customers by enabling better business planning and risk management. Ultimately, this benefits all consumers as more reliable risk estimation around balancing costs supports better risk provisioning.

Customer/stakeholders & Financial
BSUoS forecasts are published publicly, and are used by many industry participants, including suppliers and generators. Any improvement to forecasts will therefore allow industry participants to have more confidence in their financial planning.

System Security
With the ability to forecast balancing spend accurately in the short term and to a higher granularity comes opportunities for the control room and planners to reduce that spend by taking different actions (i.e. delaying outages). Model development might provide insights on the drivers and improve NGESO understanding of how costs might be reduced.

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

There are many benefits associated with this project that are not possible to quantify at this time. However, if the project meets its success criteria and produces a model with higher accuracy than the existing model, and the solution is implemented into live use, we would expect a financial benefit to be realised. This financial benefit is hard to estimate as forecasting costs with higher accuracy does not reduce the costs themselves, but there is value in enabling better financial planning.

The estimate below is based on just one hypothetical scenario, with some simplification, to illustrate how any financial benefit would be realised.

Hypothetical benefits scenario:

- The published June 2022 forecast of balancing costs for financial year 23/24 is around £3,500m.

- If this were the final forecast for tariff setting, this cost would be charged to consumers in the industry. Any over-recovery will be returned to consumers a year later through a 'k-factor' process.

- If balancing costs outturn at £3000m, the deviance of this forecast is £500m.

- If we assume the newly developed model has 10% better accuracy, and forecasts £3,450m, this gives a deviance instead of 450m. This would mean £50m less was over-recovered from consumers.

- After a year, this would be corrected for, but there is value to having the capital available for that year.

- This value can be calculated approximately by applying a 'Weighted Average Cost of Capital' (WACC) of 1.98%¥

- In this scenario, the benefit would therefore be £50m * 1.98% = £990k

- This project is costed at £350k and so in that one financial year this scenario would give a benefit of £640k.

- Note: If the new model is still more accurate but with reduced under-recovery (rather than over-recovery), there would still be benefit, but this would be felt by NGESO rather than the industry as a whole.

¥ WACC taken from Ofgem Dec-20 real terms 'vanilla' value https://www.ukrn.org.uk/wp-content/uploads/2020/12/2020-UKRN-Annual-Cost-of-Capital-Report-Final-1.pdf

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

The scope of the project will cover the whole GB system balancing, and so will not need to be replicated across GB.

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

The scope of the project will cover the whole GB system, therefore no geographical rollout is required.

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

Learnings generated from this project will benefit NGESO and its customers by improving balancing cost forecast accuracy and therefore enabling better business planning and risk management (ultimately benefitting all consumers). Also, new modelling techniques might be developed that can be applied to other model development projects within NGESO and used by industry participants in their internal models.

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.

We are not aware of any other publicly available balancing cost models that would be suitable for NGESO to use, and no other innovation projects working on this problem.

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

- Cutting edge time series modelling and data science techniques will be applied to a new challenge.
- Increased temporal granularity, looking at daily and weekly costs, will be a new element of the forecast.
- A wide range of large datasets is being considered for training the model.

Relevant Foreground IPR

The following Foreground IPR will be generated from the project:

- A balancing cost forecast model

Reports produced in the course of the project will be shared on the Smarter Networks Portal.

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

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 is a research based project where there are risks that the objectives cannot be met.
- The Project will utilise enhanced computational hardware and specialised expertise beyond that available internally within the ESO.

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

There are a number of innovation risks associated with this project that have been identified:

- There is a risk that there is limited benefit of using the new model and methodology if the project finds it is not possible to improve upon the existing model.

- There is also a risk that there is difficulty with incorporating the new model into internal operation (everyday business). Productionising the model will be dependent on internal IT.

This project has been approved by a senior member of staff

☑ Yes