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

Nov 2022

Project Reference Number

NIA2_NGESO025

Project Registration

Project Title

3MD (Market Monitoring Model Development)

Project Reference Number

NIA2_NGESO025

Project Licensee(s)

National Energy System Operator

Project Start

November 2022

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Caroline Rose-Newport

Project Budget

£250,000.00

Summary

National Grid ESO are required by our License and by the REMIT regulation (EU Regulation on wholesale Energy Market Integrity and Transparency) to monitor the market for suspicious activity relating to manipulation, insider trading, breach of Grid Code etc. Our current, manual, processes are not infinitely scalable or transferable as the market grows so greater automation and sophistication is required.

The development of a more sophisticated, Machine Learning (ML) based solution will be investigated to increase the efficiency of team activities and be scalable to new products and increasing market participant numbers.

Third Party Collaborators

UKRI (Hartree Centre)

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

National Grid ESO are required by our License and by the REMIT regulation to monitor the market for suspicious activity relating to manipulation, insider trading, breach of Grid Code etc. This is a new role for the ESO and, at present, we are limited in the number of

parameters we can feasibly monitor using manual investigation techniques which are not infinitely scalable, or transferable, as the market grows. Therefore, greater automation and sophistication is required.

Method(s)

This project will investigate whether ML will allow for the consideration of uncertain variables that cannot currently be factored into analytical techniques. It will investigate the development of statistical models which identify anomalous pricing and positioning strategies in relation to constraint data.

5 work packages have been defined. These will cover:

- WP1: Exploratory data analysis of National Economic Database (NED) data files
- WP2: Detect securing of artificial price
- WP3: Detect false physical notifications
- WP4: Detect constraint-related manipulation
- WP5: (Dependant on Successful Outcomes) Prototype integration

In line with the ENA's ENIP document, the risk rating is scored Low.
TRL Steps = 1 (2 TRL steps)
Cost = 1 (£250k)
Suppliers = 1 (1 supplier)
Data Assumptions = 2
Total = 5 (Low)

Scope

Whilst ML and hidden variable models are used across multiple innovation projects for different purposes and also in other industries and organisations outside of the ESO, they have not been applied in a utility for a similar purpose.

Learnings will be shared within the ESO where applicable, however this will be a non-default innovation project and, as such, detailed findings and models will not be shared externally.

Ultimately, knowledge of enhanced monitoring capabilities being used, may encourage market participants to better consider REMIT and Grid Code requirements as they develop new trading strategies and support the market monitoring team in working with trading parties to reduce instances of potential breaches. This may reduce costs to consumers through a reduction in incidents of prices that do not directly result from normal market supply and demand interactions. It will also enable detection of changes in pricing or positioning in response to the management of system conditions, reducing the risk for exploitation of dominant market positions where they arise because of geographic or technological monopolies.

Objective(s)

1. Develop methods for out-of-characteristic market prices, physical positions in response to system operability issues such as constraints by applying statistical techniques to identify potential market abuse.
2. Develop methods for detecting and characterising anomalies.
3. Enhance current manual investigative techniques by using multiple new data sources to generate alerts. This will enable detection of cross market events and ensure alerts better consider market externalities, reducing false positives compared with current monitoring systems.
4. Enable models of pricing and positioning to be developed that are individual to Balancing Mechanism Units (BMUs) which each have different economic drivers and therefore will behave differently given the same set of system and external conditions.

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

The project will be successful if it improves potential REMIT breach detection and provides contextual information regarding pricing and positioning this will be tested through:

1. 90%+ effectiveness at detecting known anomalies within historic datasets

2. An input/output method that enables live system data to be assessed in this way
3. A low level on the number of false positive investigations to review

Project Partners and External Funding

UKRI, no external funding contribution

Potential for New Learning

Through analysis of the statistical properties of the ESO's Economic Database and the development of new methods for detecting and characterising anomalies, the ESO's current investigative techniques will be enhanced significantly. Models which are individual to BMUs based upon historic market activity will reduce any sized based bias that may come about through standard threshold or rule-based detection and may better characterise availability and pricing of units for given system conditions that could be applied to other business activities.

This is a non-default innovation project and, as such, detailed findings and models will not be shared externally.

Scale of Project

This project will span 12 months and consist of desk-based research.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

This project will cover the whole of the GB network.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£250,000

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:

By incorporating more datasets, including the interaction between different marketplaces, detection of cross market mechanisms to manipulate ENCC (Electricity National Control Centre) decision making will be more readily identifiable. This may encourage more timely notification of changes in operating profiles and prices to the ENCC, making the plan more secure and reducing decision making pressure.

Furthermore, by applying machine learning techniques, anomaly detection can be individualised to the resource economics, size, and technology types, enabling market monitoring to identify anomalies across new technology types, and better support all market participants in improving compliance with market rules, without unintentional bias to larger BM Units that may result from standard rules-based alerting. This will become more important as the energy system has greater participation from small energy providers in the energy transition.

How the Project has potential to benefit consumer in vulnerable situations:

Principle benefits to the end consumer (including consumer in vulnerable situations) will be through challenge of generator pricing whereby a change in behaviour may be adopted and lower costs may be observed through the BM. These cost savings will be indirect and are not readily quantifiable. Realising them will depend upon ESO activity post identification.

Secondary benefits to the end consumer will be intervention by Ofgem following a case of market manipulation which is progressed through to settlement or fine levy issued in court. There is a high probability that a well-functioning detection tool might identify at least one significant issue that may be progressed through to a REMIT decision.

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

Knowledge of enhanced monitoring capabilities being used, may encourage market participants to better consider REMIT and Grid Code requirements as they develop new trading strategies. This may reduce costs to consumers through a reduction in incidents of prices that do not directly result from normal market supply and demand interactions. It will also enable detection of changes in pricing or positioning in response to the management of system conditions, reducing the risk for exploitation of dominant market positions where they arise because of geographic or technological monopolies.

As the approach will detect anomalous behaviour rather than specific identified risk factors it will ensure the monitoring function remains responsive to changes in market rules and new trading strategies. This would allow for faster identification of new problems and resolution with providers ahead of escalation through to a formal investigation where appropriate.

Should an issue be escalated, the maximum fine issued to date has been £37m and this compensation is provided back to

consumers. There is a high probability that a well-functioning detection tool might identify an issue that is progressed to a REMIT decision.

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

This will be a non-default project and therefore the models developed will not be shared with other networks for replication across GB. However, if successful, the approach will be applied by the ESO to the GB electricity market.

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

N/A

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

We are planning to share the following project results for 3MD (via a Completion Report on the Smarter Networks Portal):

- Learnings from the statistical/machine learning techniques can be disseminated to other network licensees.
- Outcomes of the project including a general discussion of functionality and detection capability can be shared alongside lessons learned from the process
- Discussion of applications for these techniques in other business areas (if identified through the workpacks) can also be shared

However, due to the obligations of REMIT as a PPAT (Persons Professionally Arranging Transactions), we will not be able to share any specific identified cases with anyone except OFGEM. We would also not be able to publish the full code or full data models developed due to ability to infer thresholds for detection or methods of avoiding detection

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

Please demonstrate how the learning from the project can be successfully disseminated to Network Licensees and other interested parties.

This will be a non-default innovation project and therefore detailed learning will not be shared with network licences.

Please describe how many potential constraints or costs caused, or resulting from the imposed IPR arrangements.<

There are no costs caused or resulting from the IPR arrangements

Please justify why the proposed IPR arrangements provide value for money for customers.

Knowledge that enhanced monitoring capabilities are being employed may encourage market participants to price and position in accordance with REMIT rather than potentially utilising a position of dominance.

The work-packs are structured so that each data model identifies an increasingly complex form of market manipulation and builds on the existing data model. Each work pack delivers a standalone code block which has been trained on historic versions of available live (day + 1) data points, this means it is individually useful without a reliance on completion of the next phase. At each stage, progression to the following work package is conditional on achieving acceptable detection rates within each of the areas identified to a suitable degree through historic data sets.

The costs of developing, implementing and maintaining these detection methodologies are outweighed through prevention of even 1 case of unacceptable pricing or positioning on large generators as these can become significant balancing costs which are then passed on to consumers. Furthermore, given that the project proposal enables significant additional volumes of data to be considered, this will reduce FTE time required to evaluate each incident as compared with traditional methods.

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 a new, unique, role for the ESO in the GB market. Although ML techniques are being developed and utilised elsewhere in the ESO, and in other industries, this approach has not been investigated or implemented in a similar situation within the ESO or the GB market to date.

There is no other function in the GB market specifically reviewing ESO facilitated markets for potential market manipulation so there will be no duplicate learning generated.

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

GB has never used sophisticated ML and hidden variable models for a similar application.

As the approach will detect anomalous behaviour rather than specific identified risk factors it will ensure the monitoring function remains responsive to changes in market rules and new trading strategies, this would allow for faster identification of new problems and resolution with providers ahead of escalation through to a formal investigation where appropriate. This represents a step change from the current process of identifying a risk and then setting up alerting for that issue which limits the team to known risks and to issues that may already require escalation.

Relevant Foreground IPR

We are planning to share the following project results for 3MD (via a Completion Report on the Smarter Networks Portal):

1. Learnings from the statistical/machine learning techniques can be disseminated to other network licensees.

2. Outcomes of the project including a general discussion of functionality and detection capability can be shared alongside lessons learned from the process
3. Discussion of applications for these techniques in other business areas (if identified through the workpacks) can also be shared

However, due to the obligations of REMIT as a PPAT (Persons Professionally Arranging Transactions), we will not be able to share any specific identified cases with anyone except OFGEM. We would also not be able to publish the full code or full data models developed due to ability to infer thresholds for detection or methods of avoiding detection

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

Until the initial analysis is undertaken, it is unclear what will be discovered from the data sets.

It is possible that the data analysis techniques do not work for the specific data sets available or that some data sets cannot be used, and it is possible that the identified anomalies do not fit the strict REMIT requirements against which the ESO reports.

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

This work will be exploratory based upon many data sets with uncertain outputs. Whilst it has the potential to dramatically improve detection of incidents and overall performance it is beyond the core requirements to comply with licence conditions. As a result of the numerous potential datasets, there is no clear design or path to delivery until key questions are answered and a Proof of Concept (PoC) is developed.

This project has been approved by a senior member of staff

☑ Yes