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 2021

Project Reference Number

NIA2_NGESO0013

Project Registration

Project Title

Advanced Dispatch Optimisation

Project Reference Number

NIA2_NGESO0013

Project Licensee(s)

National Energy System Operator

Project Start

November 2021

Project Duration

0 years and 9 months

Nominated Project Contact(s)

Rhiannon Calado

Project Budget

£750,000.00

Summary

This project will research best practices globally and advanced technologies available (or being developed), to assess the feasibility of developing an advanced dispatch optimisation tool for the Balancing Mechanism (BM), scope this tool, and set out a roadmap for how this, and other comprehensive optimisation tools could be developed for system operators. It is hoped these tools will evaluate extraneous variables and be 'future proof' for a rapidly changing energy landscape, which includes more diverse providers, services and dynamic parameters across the system. The project will also be an initial use-case for the wider Virtual Energy System (VES) programme, and inform the capabilities and considerations of how interconnected digital twins could provide substantial benefits for consumers and the whole energy system.

Third Party Collaborators

Google X

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

The current Balancing Mechanism (BM) dispatch tools are fed with a single dataset on which an optimisation is performed to produce a single set of advice. The wider security of the network (network flows, voltage control etc) are managed by the use of profiled group

constraints. However, there is an inherent uncertainty around many of the input variables (generation, demand, prices, constraint limits etc) and the Control Engineers apply their knowledge of this uncertainty to the advice generated, to determine what actions to take.

The level of uncertainty in the input variables is continuing to increase with the increasing amount of renewable generation that is driven by the weather. The demand side uncertainty is also increasing with the electrification of transport and heat and the likely introduction of more time of use tariff some of which may also be linked to the weather. There is likely to be increasingly more actions needing to be taken in the BM by Control Engineers to keep the GB system continuously balanced in future, as the system will be more complex with multiple variables needing to be accounted for across different time scales. We need new ways to optimise dispatch which will be capable of handling the large amounts of input data and using these to make complex decisions that are optimised for system security, reliability, cost and decarbonisation.

Method(s)

This study will split the project into two parts, an initial feasibility work package, and a more technical work package to deliver a comprehensive report on how a future dispatch optimisation toolset could be scoped and developed to optimise increasingly complex balancing actions on the GB system.

Risk Assessment

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

TRL Steps = 1 (2 TRL steps)
Cost = 2 (£750k)
Suppliers = 1 (1 suppliers)
Data Assumption = 2 (data supplied by suppliers for analysis)

Scope

This study will evaluate the inputs and elements necessary to inform the optimization algorithms, and the approach to optimization, with a report that will set out the development pathway for this tool.

The Report will address the following:

- recommendations for the approach to purpose driven modelling
- contemplation of use-case specific technology recommendation including simulation and modelling recommendations
- contemplation of inputs and approaches to data gaps
- contemplation of optimization approaches

Objective(s)

Objective 1: to understand what could be possible with existing, or new data and optimisation techniques to improve the way actions are taken in the Balancing Mechanism, through development of new tools.

Objective 2: have a clear view of what other work and research has been developed in similar use cases and other sectors (e.g. Digital Twins), which would establish a best practice approach to optimisation the BM for the GB energy system, and help quantify the benefits which could be delivered for end consumers.

Objective 3: use the understanding developed in this study to set out the next steps, and a roadmap for how innovative new tools would be delivered for the ENCC in future.

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 as a whole and those in vulnerable situations. Benefits to all consumers are detailed below.

Success Criteria

The project will be a success if the following can be achieved:

- Understanding that we could create a more comprehensive optimisation process which includes extraneous variables and be ‘future ready’ to adapt to a rapidly changing energy landscape.
- Insights and learning into of the tools currently available (or being researched) and the data or processes which will be required to achieve an advanced dispatch optimiser for the balancing mechanism.

- Better understanding of the benefits that would be provided by such a tool, for wider system efficiency, reliability, decarbonisation, cost reduction, increased competition etc.
- Clear understanding of the next steps to develop and deliver this tool into the ENCC and what additional data or expertise will be required to do so.

Project Partners and External Funding

The work is to be undertaken by X, The Moonshot Factory, formerly Google X which is Alphabet's innovation lab and a division of Google LLC.

Potential for New Learning

This project has the potential to create new learnings about how the ESO Balancing Mechanism could be designed in the future GB energy system, where more diverse types of providers are providing new services, and the system is operating under different parameters than it is today.

This project will also give insights into how all system operators (DSO/TSO) could leverage new optimisation techniques and digital twin technologies to improve how they could be operating their own system in future.

As this project will tie into the wider programme of activities for the Virtual Energy System (VES), it will help to understand the wider benefits of open data, and data sharing and how this could deliver substantial savings to consumers through better decision making and ultimately improve the energy systems ability to decarbonise while remaining resilient, at lowest cost.

Scale of Project

The project will include desk-based research and data analysis lasting approximately 6 months.

The scope of the optimisation possible would have significant impacts on how the GB energy system is operated, and deliver enormous benefits in terms of cost reductions, decarbonisation and system reliability. By leveraging experience from world leaders in optimisation algorithms and advanced data analysis, this study will help ensure the GB energy system is well positioned to understand how to incorporate cutting-edge innovation into system balancing mechanisms in future.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project will focus on the GB-ESO system.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

The total forecast NIA expenditure for this project is £750k

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 a rapid transition due to macro trends of decarbonisation, decentralisation and digitalisation. This will have an enormous impact on how the system is operated into the future. In order for the system operator to be able to respond to the large number of new participants, new technology types, new business models and changing consumer behaviours and optimise actions across multiple variables (e.g. lowest cost, lowest carbon, resiliency etc.) the Balancing Mechanism needs to be future proof. This project will set out the roadmap for how the ESO could develop and deliver an advanced dispatch optimisation method to be able to handle this comprehensive optimisation task with the uncertainty of future system parameters.

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

Not required.

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)

Not required.

Please provide a calculation of the expected benefits the Solution

This study will help us understand the development and delivery pathway for a new Dispatch Optimisation tool and how the tool could employ new techniques to assess the variability of the different input variables and enable optimisation across a range of likely scenarios. The scope of the optimisation could be increased to include network modelling and also cost modelling, where the likely future market impact of current decisions could be included.

Such a tool would be part of developing an integrated future Digital Twin network for the GB energy system envisioned through the VES initiative; a tool would leverage various Digital Twin capabilities, such as scenarios building, physical grid modelling as well as real time grid data tracking and analysis, to understand and predict market dynamics while projecting possible consequences that could result from a particular balancing action.

A new optimisation solution could provide the ENCC dispatch recommendations that would result in greater efficiency within the BM; improved optimisation across the range of system operability challenges, over different timeframes, to improve the GB energy system's ability to manage a transition to net zero carbon operation, at the lowest cost to consumers.

This is a research project, to estimate the value of these benefits requires a host of assumptions that will be tested and validated during the project. Due to the large cost of balancing actions on the GB system, even a small improvement due to a new dispatch optimisation tool would deliver large savings for consumers and the system.

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

The methods investigated will be specific to the ESO, however there should be learnings which can be applied to any network area (i.e. for DSOs, or international TSOs).

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

The outputs of this project will likely inform future IT investment of NG ESO systems that feed into the control room.

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

The report generated will provide a roadmap for how the GB system could integrate new methods and technologies for dispatch optimisation, this could be useful for informing future distribution system operators (DSOs) in developing their own processes and tools. The report should also help inform network digital twin programmes of the best practice when considering how this technology could integrate with DSO control room operations in future.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

Not required.

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.

No other innovation projects (IFI, LCNF, NIA or NIC) have explored Dispatch Optimisation using advanced techniques such as those proposed in this research.

NGESO has provided a letter of support to a project led by the University of Edinburgh, funded by the Alan Turing Institute which is focused on optimisation approaches for decarbonisation in control rooms, but there are significant differences in approach, scalability

and applicability to NG ESO processes and control systems.

There are currently two activities being developed by NGESO under RIIO-2, the Modern Dispatch Adviser (MDA) and the Modern Dispatch Instructor (MDI), that aim to provide more accurate advice to the Control Room using a modern optimisation algorithm and limited to providing a full end-to-end service from harmonisation of input of data through the output of actual instructions, respectively. The proposed research in this project will look further into the future beyond the capability of MDA and MDI, and an Advanced Dispatch Optimiser tool is intended to be developed alongside, or following on from MDA and MDI, to ensure coordination and efficiencies between these activities.

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

Not applicable.

Additional Governance And Document Upload

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

This project is novel for an electricity system operator, it is unclear what the learnings will be and whether a viable solution exists which the project can deliver a roadmap against.

Relevant Foreground IPR

The following foreground IP will be generated from the project:

- Report which includes the benchmarking of similar solutions worldwide and how a dispatch optimisation tool would be developed for the GB system, including any dependencies (data, processes, tools etc.).

No Background IPR is required to use these results.

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 box.SO.innovation@nationalgrid.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

Cutting-edge optimisation techniques and tools, beyond our current expertise, have not been explored for use in dispatch optimisation before and scoped for future development. This research could widen possible functionality of dispatch optimisation beyond what is currently being planned as 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

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This project has been approved by a senior member of staff

☑ Yes