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

Dec 2024

Project Reference Number

NIA2_NGESO075

Project Registration

Project Title

Dispatch Decision Intelligence

Project Reference Number

NIA2_NGESO075

Project Licensee(s)

National Energy System Operator

Project Start

August 2024

Project Duration

0 years and 7 months

Nominated Project Contact(s)

innovation@nationalenergyso.com

Project Budget

£550,000.00

Summary

This project will design and deliver key innovations to the Dispatch Decision Intelligence to improve decision support tools for control room engineers. This will be achieved through powerful developments and upgrades in performance, functionality and analytics. If successful, these upgrades will offer deeper and more accessible analysis, improved solution quality and reduced optimisation solve times.

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

NESO has a strategic goal to operate the electricity grid carbon free for periods of the year by 2025 and to be carbon free year-round by 2035[CH(1] [HB(2] [C(3] [M(4] . Achieving these goals will be impossible without using more low-carbon units on the grid. These units can be more highly fluctuating and smaller than traditional units, making them a challenge for grid balancing. In order to access the carbon savings offered by these technologies, NESO is in the process of transforming balancing services to make them more flexible, efficient and transparent.

Optimising and improving systems for efficient dispatch is central to meeting Net Zero challenges securely and affordably. In 2024, NESO introduced the Bulk Dispatch Optimiser on the Open Balancing Platform (OBP) and NESO is now readying the National dispatch optimiser on OBP for release in 2025.[M(5] [HB(6] These tools form the basis for NESO's automated solution processes to dispatch [M(7] however further innovations to enhance dispatch algorithms and improve explainability are required to maximise their

adoption and effectiveness.

Method(s)

This project focusses on delivering advanced Decision Intelligence to dispatch optimisation in order to enhance operator collaboration and trust with the balancing dispatch algorithms. This will be achieved through researching and developing six powerful technical upgrades that can be incorporated into the optimisation tools if the project is successful. These are detailed below and will be designed to enhance the performance, functionality and analytics of the tool, offering deeper and more accessible analysis, improved solution quality, and reduced optimisation solve times.

Overall, the project will develop suggested innovations for dispatch algorithms, and by evaluating the suitability of the Bulk Dispatch Optimiser (BDO) to acquire equivalent capabilities. Along with monthly project review reporting, there will be monthly code releases throughout the project. Each release will be reviewed and tested prior to release in accordance with a defined testing and delivery process agreed between the project partners.

Warm starts and heuristics (speed ups)

a. Warm starts: A candidate solution available at the beginning of a solve can be used as a “warm start”, giving the optimiser a better starting point to iterate from, potentially reducing the path to optimality. The project will consider feasible solutions for achieving optimisation from warm starts, this may be the solution from the previous National Dispatch Algorithm run but may need to consider alternatives when considering the overall power and response problem.

b. Heuristics: In addition to warm starts, this work package will investigate the design of heuristics for generating other candidates. Suitable heuristics generate feasible solutions independently from the main solve for use as a warm start or even during the solve time, with the aim of reducing overall solve time.

1. Intelligent early stopping: Early stopping is the process of terminating the optimisation computation when it is deemed likely that it is close enough to finding a truly optimal solution, trading off minimal further gains for faster total solve time. This is vital when considering complex optimisation problems, but deciding when to stop algorithmically requires careful consideration. This project will investigate and document-controlled forms of early stopping with more nuanced conditions for termination. Combinations of different approaches will be assessed on a suite of test scenarios to determine which combinations provide the best balancing of run time against solution quality.

2. Explanable optimisation(XO): The dispatch optimisation problem is highly complex, with many possible decisions that must respect multiple constraints. Explainable optimisation will give clear, objective reasons for why units are advised to be dispatched based on hard constraints. Not all of the information needed to make dispatch decisions is available as inputs to the National Dispatch Optimiser , and the project will consider runtime explanations alongside dispatch algorithms advice to highlight what additional information would be needed for future automation.

This project will deliver explainable optimisation design which specifies information provided from both online and offline dispatch algorithm run modes for dispatch explanations. This will include clarifications of any overlap in requirements and capability between offline and runtime use, and design of the required combination of XO runtime and offline run mode. The project will consider how to summarise and present the XO to the control room to ensure explanations of the optimisation advice are presented cleanly and effectively.

3. Transparency decision insight: The project will investigate how post-hoc insight could be used to determine whether early stopping of the optimisation solver may have led to a non-optimal solution advised out of merit-order. In investigating this in combination with explainable optimisation, it is envisaged that far greater intelligence of the solutions produced could be enabled, addressing advice in far greater depth.

4. Headroom and footroom interrogation: This will include engineering potential suitable run modes that removes the generation matching requirement from the objective and the constraints, enabling computation of boundaries between different cost bands. It is expected that this will demonstrate the capability of generating a forecast of headroom and footroom that satisfies dispatch constraints, adding in the constraint to satisfy merit order at each time point. The project will develop interactive visualisations to interrogate the effects of constraints on forecast headroom and footroom.

5. Modernised alarms: To increase control room decision intelligence and trust, the project will investigate alternatives to dual values for addressing solution sensitivity and alarm raisers, including what assumptions and computation they require. For offline calculations, greater computational load may be acceptable, but for real time use the calculation needs to be of comparable complexity to the current use of dual values.

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

TRL Steps = 1 (2 TRL steps)

Cost = 1 (<£500k)

Suppliers = 1 (1 supplier)

Data Assumptions = 2.

Total = 5 (Low)

Scope

The next steps in balancing transformation need to be carefully evaluated before an implementation pathway is defined. For this reason this project will consider delivering decision intelligence for dispatch in two ways: by developing suggested innovations for the Modernised Dispatch Algorithm and by evaluating the suitability of the Bulk Dispatch Optimiser (BDO) to acquire equivalent capabilities.

The suggested innovations to be developed for the dispatch algorithms include:

- Warm starts and speed-ups
- Intelligent early stopping
- Explainable optimisation
- Transparency decision insight
- Headroom and footroom interrogation
- Modernised alarms

As each of the above improvements are developed, they will assess whether a similar improvement could benefit the other optimisers including BDO and, if it could, how that could best be implemented following this project.

Objective(s)

The proposed innovations for Dispatch Decision Intelligence will meet the following objectives:

- Enhanced control-room user experience of dispatch decision advice through improved quality of analytic information offered and reduced optimisation solve times.
- The solutions will be evaluated for applicability to other available Optimisers (for example, the BDO).
- Support balancing engineers in decision making under time pressure.
- Reduce the balancing costs for NESO.
- By facilitating the dispatch of lower carbon technology units, support NESO in a swift and secure transition to net zero.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The NESO 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

This project will be deemed to be successful if the identified innovation opportunities can provide potential improvements to future dispatch advice tools, including: warm starts and speed-ups, and intelligent early stopping which aim to ensure that the dispatch algorithm runs accurately, efficiently and at a time scale which reflects the needs of the operations of the control rooms.

The development of explainable optimisation, the modernisation of alarms and the inclusion of head and footroom interrogation will support improved trust in the recommendations made, enable quicker decision making, decrease cost and facilitate carbon savings.

The project is designed to support NESO on their transformation journey, by helping decision makers to assess the capabilities of dispatch algorithms and BDO (Bulk Dispatch Optimiser). The report on BDO will help to estimate the work necessary to incorporate the innovations in National Dispatch Optimiser into BDO and give insight into the differing capabilities of the two different dispatch tools.

Project Partners and External Funding

Smith Institute

No external funding.

Potential for New Learning

Throughout the project, the NESO Electricity National Control Centre (ENCC) will be engaged to understand how decreased optimisation solve times and more accessible decision support could improve their ability to make decisions under time pressure.

The project will help to understand what, if any, compromises on solution quality are evident when mechanisms to decrease solve time, like early stopping and warm starts, are employed. Further to this, the outcomes are expected to improve the ability of the ENCC to understand why and how alarms are raised within the dispatch advice and empower them to understand why particular units were selected by the optimisation tools.

Final project reports will be published on the Smarter Networks Portal.

Scale of Project

BP1 of the balancing transformation delivered £48m in cost savings, realised through balancing costs and we hypothesise that improving situational awareness for balancing engineers and other stakeholders by providing additional decision intelligence through Modern Dispatch Advisor (MDA) could release further cost and carbon savings. In addition to optimising the balancing cost, improvements to dispatch would support NESO in their goals of maintaining security of supply while moving toward zero carbon and encouraging increased market participation.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

This project is being delivered by GB based suppliers and funded by NESO, it therefore has a geographical scope of Great Britain.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£550,000

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:

In December 2023, NESO launched OBP, an integral step in the journey to creating a modern, open, reliable, resilient and secure technology platform. As the next step in the transition, NESO released the Bulk Dispatch Optimiser (BDO) onto the new platform. This first step has been successful and the next step is to facilitate additional dispatch improvements. These improvements could be achieved by readying National Dispatch Optimiser for release onto OBP or by adopting the capabilities of National Dispatch Optimiserinto BDO. In either scenario, ENCC leadership aims to continue innovating and improving the functionality on offer to Balancing Engineers, by innovating additional functionality which can be incorporated into the OBP.

At runtime, ENCC engineers can use the advice explanations to help decide on what the best action to take is The methodologies and structure developed within this project could be reused for other optimisation models.

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

The expected financial benefits of this solution would be derived from the increased ability of ENCC to choose less expensive energy sources in the price stack, while knowing that the system is still secure for that price. This would accrue to a decreased balancing cost over time. Because the dispatch of renewable resources can be more complex, improving the quality of decision support on offer, in conjunction with other innovations such as the Bulk Dispatch Optimiser, should facilitate the choice of those lower carbon technologies, leading to carbon savings in the future.

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

As the DNOs navigate the transition to DSOs, a transition necessitated by the emergence of an increasing number of distributed energy resources at various scales on the grid, they may need to examine whether dispatch improvements made in the high voltage network may have corollaries in the lower voltage networks. The methods proposed in this project may be applicable to current and future DSOs.

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

This is very difficult to do, as DNOs are at different stages of digital maturity and also have varying requirements, depending on the needs of the particular geographic context which they serve. Any projects to translate these methods to DNOs would be necessarily bespoke.

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

As the DNOs navigate the transition to DSOs, a transition necessitated by the emergence of an increasing number of distributed energy resources at various scales on the grid, they may need to examine whether dispatch improvements made in the high voltage network may have corollaries in the lower voltage networks. The methods proposed in this project may be applicable to current and future DSOs.

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.

The MDA has not been deployed on OBP, and as such there is no other tool that performs the function it is designed to perform. It is true that the BDO could be adapted to perform the same function, and it is for this reason that the project encompasses both the development of the MDA and a review of the BDO, with particular emphasis on the adapting BDO to accept the innovations proposed. This means that the review of BDO should provide some clarity on the best way forward for balancing transformation and when this is enacted, there should be no unnecessary duplication.

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

For national dispatch to function as one of the tools available to inform dispatch, the Open Balancing Platform needed to be available as a foundational system. Work was paused on the Modern Dispatch Advisor in 2022 because these underlying systems were not optimal for further digitisation of balancing as a function. The launching of OBP in December 2023 has given the green light to a host of new capabilities which can now work together to enhance the control room operations. Further Innovations to the MDA and a review of BDO will help to ensure that developments in understanding of the balancing problem are reflected in the tools developed to support balancing engineers.

Relevant Foreground IPR

The following foreground IPR is expected to be generated in the course of the project:

1.Technical reports for all project deliverables.

2. Software code to guide implementation where relevant

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'. NESO 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 Innovation | National Energy System Operator (neso.energy)

3. Via our managed mailbox innovation@nationalenergyso.com

Details on the terms on which such data will be made available by NESO 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 MDA has not been deployed on OBP, and as such is a tool that has not yet been part of BAU. It is an innovation in its own right, and this project aims to build on that innovation with additional functionality which has now become appropriate to the complex problem of enacting dispatch from the control room.

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

Several of the capabilities we are aiming to develop may not have the impact we are hoping – for example, we may realise that warm start and early stopping capabilities compromise the solution quality in unacceptable ways or that the alarm raiser logic cannot be improved within the constraints of the mathematical problem being solved. These risks are low but mitigations have been proposed for them. In the case of explainable optimisation and head and footrool interrogation, there is a risk that the provision of these tools will not make a measurable impact on control room operations as they do not work within the timeframes/operational constraints of the control room. These are risks that can be mitigated with clear communication between the project partners.

This project has been approved by a senior member of staff

☑ Yes