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. Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

NIA Project Close Down Report Document

Date of Submission

Jul 2025

Project Reference Number

NIA2_NGESO075

Project Progress

Project Title

Dispatch Decision Intelligence

Project Reference Number

NIA2_NGESO075

Funding Licensee(s)

NESO - National Energy System Operator

Project Start Date

August 2024

Project Duration

0 years and 7 months

Nominated Project Contact(s)

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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.

Objectives

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.

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.

Performance Compared to the Original Project Aims, Objectives and Success Criteria

The project concluded with the completion of all planned deliverables.

Work Package 1 – setup & refinement: Legacy dispatch codebase was updated and refined where needed to utilise the most recent version of relevant software packages, in preparation for the main body of work carried out in subsequent work packages.

Work Package 2 – runtime improvements via warm starts & explainable optimisation baseline design: Impact of software updates were initially assessed, showing overall minor impact on performance. Analysis then proceeded to evaluate the impact of warm-starting the algorithm based on most recently available solution, leveraging the fact that the dispatch runs in 5min intervals. Analysis indicated in 48% of the cases a minor runtime improvement, 16% required complex processing to enable reusing the solution, with the remaining being marginally worse.
In parallel this work package introduced the basic principles behind XO (explainable optimisation) and HaF (headroom and footroom interrogation) methodologies.

Work Package 3 – skips due to early stopping: Optimisation algorithms within an operational context are typically used with a timeout, by which the best solution found is given. However, if left to run longer they would potentially find an improved solution in terms of cost, involving a different set of units (for dispatch this largely relates to response units). This WP established a basic approach to identify units which were not dispatched due to the algorithm timing out.

Work Package 4 – runtime improvements via early-stopping and improved heuristics for warm starts: Following from the warm-starting work in WP2, further analysis indicated that for the set of test cases available, identifying an initial solution using default solver approaches was easy, but improving upon that solution was challenging. Investigation of final decision variables values led to the idea of providing the algorithm with hints towards the solution, based on appropriate heuristics. This approach showed promise in

improving run times for more complex cases and could be applied to other optimisation problems solved currently in control room operations.
Within this WP the possibility of improving runtimes via early stopping of the solution algorithm was assessed, however given that such an approach would not impact the hardest to solve cases, this was not pursued further. Instead, the possibility of tightening the formulation was explored instead. While this does not improve performance for the majority of cases, it can be effective in harder to solve cases and offer significant improvements.

Work Package 5 – explainable optimisation (XO) results: A comprehensive methodology was developed that enables providing reasons why a specific unit was dispatched at a specific interval. This involved automatically checking unit data (including ramp-rates, prices, stable import/export limits) against requirements and generating an output of relevant explanations in a user-friendly tabular format.

Work Package 6 – headroom and footroom interrogation (HaF) results: The proposed methodology involved carrying out modified dispatch runs that identify available power limits (considering network limitations) up to a given price level. This was indicative of actual system margins and provides crucial information to control room users.

Work Package 7 – assessment of Bulk Dispatch Optimiser (BDO) formulation: BDO is a core algorithm currently deployed for dispatch in the control room. Relevant implementation was reviewed, and the following potential improvements were identified: 1) adjusting big-M constraints or using internal solver methods to model them (to ensure there are no numerical issues); 2) testing warm starting approaches; and 3) exploring further algorithm parameter tuning.

Required Modifications to the Planned Approach During the Course of the Project

No significant modifications however intelligent early stopping was initially proposed for investigation,Some discussions during the project revealed this workstream did not align with operational priorities for the MDA or BDO. It was agreed that greater focus should be given to workstreams that may improve the likelihood of reaching optimal solutions within operational timeframes.

Since intelligent early stopping deliberately terminates the solver before optimality is proven or the time limit is reached, it fundamentally conflicts with these objectives. Consequently, this workstream was discontinued to
and resource was re-directed to on tightening the formulation, cutting planes, and indicator constraints

Lessons Learnt for Future Projects

We should anticipate that testing and improving control room operational algorithms is case and context specific. As we have seen in this project, approaches which in principle could offer an improvement do not always bring a significant benefit, or the benefits are realized under specific conditions – in this case in harder to solve cases which might not be easily identified in advance.

The project provided a set of potential improvement options that could be assessed against any optimisation based decision support tool. To conclusively assess whether these options are beneficial, it is recommended to use a representative sample of production cases.

Finally, the Explanations for Advice methodology can form the baseline for explaining the output of more complex problems. However, solutions affected by constraints coupling asset behavior over time can be challenging to fully interpret.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

1. Developed and tested performance improvement options for dispatch optimisation algorithm including
   >Algorithm warm-starts and heuristics
   >Enabling tighter formulations
   >Tuning algorithm parameters
2. An Explanations for Advice methodology (EfA) which enables analyzing and providing reasons for the output of the dispatch algorithm. The EfA module uses knowledge of the raw and processed unit data, the cconstraints that define the optimisation problem, to provide a reason why specific unit MW movements have been made.
3. A Headroom and Footroom Interrogation (HaF) methodology which solves several optimisation scenarios to visualise the generation bounds available to the control room across the dispatch windows at different price limits. The resulting visualisation can help the control room prepare for forecast uncertainty.

Data Access

Details on how network or consumption data arising in the course of NIA funded projects can be requested by interested parties, and the terms on which such data will be made available by NESO can be found in our publicly available "Data sharing policy related to NIA projects (and formerly NIC)" and Innovation | National Energy System Operator.

National Energy System Operator already publishes much of the data arising from our NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

Foreground IPR

The following report is expected to be released to the Smarter Networks Ports:
>Final report summarising tested approaches, and the relevant methodology behind the Explanations of Advice, and Headroom and Footroom Interrogration modules.

Planned Implementation

The project has identified and tested performance improvement options for the existing dispatch algorithm. These approaches are applicable with appropriate modifications to other optimisation algorithms currently in production or being developed in the Open Balancing Platform (OBP) - this is a new IT platform that will eventually replace legacy control room IT systems.

It is recommended to apply and assess the impact of the proposed performance improvement options in other optimisation based algorithms currently used for decision support purposes in the control room.

In addition, the developed Footroom / Headroom interrogation methodology can extend existing visualisation tools for the control room and can be brought to production as part of OBP development.

The Explanations for Dispatch tool may be further extended and support off-line analysis to assess efficiency of dispatch and inform the ongoing skip-rates discussion.

Net Benefit Statement

Benefits of the delivered work can be summarised in the following:

Tools for algorithm performance improvements: The project provided a set of options to explore potentially improving performance of algorithms currently used in the control room. Maximising performance is critical in scaling the existing algorithms to increase the number of units that are entering the market, and in certain cases can lead to improved solutions and a potential reduction in balancing costs.

Improved situational awareness: Providing additional visibility on available dispatch power and associated prices can allow control room engineers to better quantify the trade-off between operational risk and economic efficiency, and allow further refinement of operational decisions and associated costs.

Improved transparency and confidence in dispatch processes: The ability to explain in an automated manner can help ensure that the dispatch processes are as efficient as possible, and readily justify decisions taken. This will help build further trust with internal and external stakeholders and potentially identify parts of the process that can be improved and reduce overheads further.

Note that an exact quantification of the above derived benefits as it would require the application of the above approaches in a sufficiently representative number of real-world scenarios. The analysis itself could require significant time, and would be made all the more complex by the fact that the platform where such tools will be deployed is rapidly changing.

Other Comments

The Project outcomes and results contain confidential information and intellectual property rights that cannot be disclosed in this Report due to their proprietary nature. Should the viewer of this Report ("Viewer") require further details this may be provided on a case by case basis following consultation of all Publishers. In the event such further information is provided each and any Publisher that owns such confidential information or intellectual property rights shall be entitled to request the Viewer enter into terms that govern the sharing of such confidential information and/ or intellectual property rights including where appropriate formal licence terms or confidentiality provisions. Dependent upon the nature of such request the Publishers may be entitled to request a fee from the Viewer in respect of such confidential information or intellectual property rights.

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N/A