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NIA Project Registration and PEA Document

Date of Submission

Oct 2023

Project Reference Number

NIA2_NGESO053

Project Registration

Project Title

Exploring the Economic Benefits of Co-optimising Procurement of Energy, Response and Reserve

Project Reference Number

NIA2_NGESO053

Project Licensee(s)

National Energy System Operator

Project Start

September 2023

Project Duration

0 years and 7 months

Nominated Project Contact(s)

Isabel Sunnucks & Thomas Pownall (ESO)

Project Budget

£500,000.00

Summary

Energy and balancing services are currently procured sequentially in separate markets. This means service providers must guess which market will bring them the most value and which market they are most likely to clear in. The result is likely to be suboptimal for several reasons, including inflated prices across wholesale and balancing markets as service providers add opportunity costs into their bids in each market.

There have been no quantitative studies to date that explore the theoretical historic and future efficiency savings when energy, reserve and response are co-optimised within GB. The outcome of this project will help inform the wider debate on future market reforms.

Third Party Collaborators

FTI Consulting LLP

Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

Problem Being Solved

As part of its Review of Electricity Market Arrangements (REMA), the Department for Energy Security and Net Zero (DESNZ) has identified moving to centralised dispatch as a potentially beneficial reform. DESNZ is currently assessing central dispatch as a standalone ‘incremental’ improvement to GB market design and as part of its assessment of nodal pricing, since nodal pricing would

entail introducing central dispatch.

The industry is debating whether the benefits put forward for locational pricing would manifest in GB, and if so, whether they outweigh the implementation disruption. Several cost/benefit modelling exercises are in progress to quantify which parties would win/lose from locational pricing.

One potential benefit of central dispatch is that it facilitates co-optimised procurement of energy and ancillary services. We do not believe that any of the existing modelling on introducing nodal pricing and central dispatch in GB has so far assessed the potential benefits of introducing co-optimisation of energy and ancillary services, either with or without nodal pricing.

We expect co-optimisation would realise substantial efficiency savings regardless of whether GB moves to nodal pricing, particularly as GB's response and reserve requirements increase to meet ESO's target of operating a net zero grid in 2035.

Method(s)

This project will consist of four Work Packages (WPs) and a mixed methodology of qualitative and quantitative approaches will be used.

Qualitative assessments will provide additional knowledge on the advantages and disadvantages of a co-optimised system (see WP1 below).

Quantitative modelling will be undertaken for WP2&3 to provide a robust assessment of the relative historic and future savings from co-optimising energy, reserve and response products.

WP4 will build upon these models to assess the relative merits/shortfalls of implementing the same co-optimised procurement method but under a nodal pricing system.

The following section outlines how this project will meet the measurement and data quality statement.

WP1: Qualitative discussion on co-optimising energy and ancillary services

This is a qualitative work package and therefore does not require the collection, storage and analysis of data.

WP2: Assessment of historical-cost savings upon co-optimisation

In this WP operational data collected from both the public data portal and internal databases (such as the NED) and will be analysed and compared using FTI's (project partner) PLEXOS model.

The ESO has undertaken several steps to ensure that provided data is of a sufficient quality. Firstly, the Request for Proposal undertaken specified the datasets the project would require. Upon receiving this, the data asks were then refined through setting up several meetings between the project partner, the project leads and those familiar with the datasets. Identified public data from the ESO data portal could then be shared, with the confidential data being shared once the contract containing the confidentiality clause can be signed.

The data will be shared via a SharePoint account and stored locally on an FTI server. The relevant confidentiality clauses will be adhered to.

It is acknowledged that there is a level of uncertainty in trying to re-create the system outcomes in 2021 using available datasets. However, if the initial modelling outcomes differ from what was observed in 2021, the project team will perform informed amendments to their assumptions until they accurately re-create the conditions witnessed in 2021.

In comparing the results, a robust estimate of the historical cost-savings from the co-optimisation of energy and ancillary services in GB across 2021 will be produced.

WP3 & 4: Quantify the potential efficiency savings for GB from 2025 – 2035 (and under a nodal market design)

The forecasted requirements for response and reserve services post-2025 (such as Slow Reserve) will be used to set the parameters of the model. Given how the GB energy system will evolve over this timescale, so too will requirements for services. It is therefore accepted that there is a level of uncertainty over these requirements. However, to mitigate against this where possible, internal Subject Matter Experts (SME's) who are involved with the defining of these service requirements have been consulted with the most accurate representation being utilised in the project.

WP4 is based on the same assumptions and therefore the same data quality measurements have been applied.

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

- TRL Steps = 2
- Cost = 1(£500k)
- Suppliers = 1 (1 Supplier)
- Data Assumptions = 1
- Total = 5 (Low)

Scope

The project consists of four work packages. These will be delivered through both qualitative and quantitative assessments. This project is an initial exploration of co-optimisation in a GB context, and we expect more detailed phases of work would be needed before any introduction of a co-optimised system.

Work package 1: Qualitative discussion of hypothesised pros and cons of co-optimising energy and ancillary services in the context of GB's wider market reform work. This work will consider potential issues such as computation complexity and cross-border trading in a co-optimised model.

Work package 2: Assessment of the historical-cost savings of co-optimised day-ahead and/or real time procurement of energy and ancillary services in the GB market.

- By modelling a reliable representation of the GB electricity market, the model then considers the counterfactual scenario wherein energy and Ancillary Services (AS) have been co-optimised. This in turn will provide a historic assessment of cost savings for a specific year.

Work package 3: Quantify the potential efficiency savings for GB from 2025 – 2035 co-optimising procurement of energy and ancillary services.

- In taking the current electricity market as the counterfactual, this work package would compare this against a fully co-optimised system. Doing so returns a future cost saving.

Work package 4: Quantitative assessment of the potential efficiency savings from the co-optimised procurement of energy and AS in a GB nodal market from 2025 – 2035.

- This work package tests the hypothesis that the procurement and utilisation of resources would be more optimal in a more locational pricing system as market participants would consider the physical realities and constraints of the transmission network and reflect this knowledge in their day-ahead and real-time bids and offers.

If this project finds substantial potential benefits from co-optimisation, next steps may include developing the work into a further phase to understand the design/deliverability challenges in more depth.

Objective(s)

The key objectives are to:

1. Enhance understanding of the advantages and disadvantages of implementing a co-optimised system within GB.
2. Assess historic and future efficiency savings which stem from co-optimising across energy, response and reserve products.
3. Explore the relative merits of locational pricing for optimised ancillary service procurement.
4. Disseminate key findings to stakeholders and inform the debate on the role of a co-optimised. electricity system, informing the wider REMA discussion about future dispatch mechanism options

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 considered successful upon the delivery of:

- A qualitative assessment of the relative merits and shortfalls of a co-optimised system which enhances understanding of key potential issues such as cross-border trading compatibility.

- A robust quantitative assessment of the historic and future efficiency savings of co-optimisation of energy, response and reserve.
- A robust quantitative assessment of the future efficiency savings of co-optimisation of energy, response and reserve in the context of a nodal wholesale market.
- The above findings in a timely manner which allows us to inform industry, DES-NZ and Ofgem of the merits/shortfalls in pursuing central dispatch and co-optimisation.

Project Partners and External Funding

Project partner: FTI Consulting LLP.

Potential for New Learning

1. The potential advantages and disadvantages of implementing a co-optimised system within GB.
2. A reliable quantification of efficiency savings for consumers if we had implemented co-optimisation across energy, response and reserve services in a specific historic year.
3. A deeper understanding of the potential future efficiency savings for GB consumers if energy, response and reserve were co-optimised between 2025-2035.
4. More informed understanding of how locational pricing could impact ancillary services procurement in the future GB system.

Scale of Project

This project will be the first step to understanding co-optimisation in GB. It will be a research project spanning seven months with FTI delivering the work. It will therefore be small in scale.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

This project will cover the whole of the GB network.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£500,000

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:

Transitioning to a high-renewables grid will require more extensive use of reserve and response markets due to renewables' intermittency, low inertia levels and greater scheduling uncertainty. More changeable energy balancing patterns at intraday are also expected. Developing more efficient ancillary services and intraday balancing procurement processes is therefore a key enabler for operating a zero carbon electricity system.

This project will deepen the ESO and industry's understanding of how a co-optimised system could streamline procurement of energy, response and reserve in the next decade. The historical assessment will also help to shed light on potential existing inefficiencies in current procurement processes. No existing studies have been identified which model the efficiency savings stemming from introducing central dispatch in GB alongside the co-optimisation of energy and ancillary services, either with or without nodal pricing.

The project also includes a qualitative assessment of future risks and opportunities from co-optimisation, including assessment of computation complexity and compatibility with EU trading arrangements. Knowledge of potential challenges will be key to supporting a robust implementation plan in the event that a more centralised dispatch approach is adopted.

This project will inform the industry debate on dispatch mechanism design within the REMA discussion at a time when market participants will be submitting their responses to DES-NZ to the next round of the consultation. In doing so, we hope to the outcomes can inform DES-NZ's opinions on the direction of the energy system transition.

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

This project is conducting initial research and therefore a calculation of the expected benefits is not appropriate. However, the potential benefits should energy and ancillary services be procured in a single process could be:

- Market participants would not have to guess which market they would be cleared in. They would not incur opportunity costs.
- The clearing algorithm chooses which market to allocate each asset to maximise overall social welfare – this means the most valuable assets would be dispatched for the most valuable services, also reducing the overall cost of production.
- Avoid the 'herding' phenomenon, where some markets are illiquid, and others are saturated.
- No recent international case studies are available to give a sense of potential benefits. One example from the early 2000s is CAISO (Californian Independent System Operator). Prior to introducing co-optimisation, operating reserves were around 10% of annual energy costs. Despite dramatic uplift in intermittent wind generation, operating costs are now around 2% of annual energy costs.

- Financial: avoided opportunity costs; lower cost of production derived from more efficient allocation of resource

It is expected that the implementation of central dispatch alongside co-optimisation would save at least hundreds of thousands annually. A reduction in ESO costs will therefore lead to lower costs borne to consumers

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

This research project will examine the relative merits and efficiency savings of a co-optimised system and the direction the ESO could take to optimise the procurement of ancillary services across GB.

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

At this stage, costs cannot be estimated as the project outcome will be exploring the relative merits of implementation, rather than developing an implementable solution.

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

This research project will examine the relative merits and efficiency savings of a co-optimised system and the direction the ESO could take to optimise the procurement of ancillary services. The results and the main learnings of this research will also be shared with the industry and inform current industry debate on dispatch mechanism design within the REMA discussion at a time when market participants will be submitting their responses to DES-NZ to the next round of the consultation. In doing so, we hope to the outcomes can inform DES-NZ's opinions on the direction of the energy system transition.

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.

There are two ESO-led projects with some similarities, however due to different scopes there will be no duplication. These projects are:

- Enduring Auction Capability is developing a clearing algorithm for co-optimisation of response and reserve. The expected benefits from EAC are similar to those expected from co-optimisation of energy, response and reserve, albeit on a smaller scale. Whilst this current work is not being undertaken through innovation, outputs from the NIA_NGSO0017 Frequency Response Auction Trial project have fed into it.
- Balancing Programme work on co-optimisation: NIA_NGESO033 Co-optimisation of Energy and Frequency-containment services (COEF). This project, working with Imperial, will enable the ESO to optimise how much frequency containment the ESO requires, considering inertia and energy simultaneously, whereas this project would assess the economic impact if a single market clearing algorithm were optimising for response and energy simultaneously.

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

No studies have been identified to date which model the efficiency savings stemming from introducing central dispatch in GB alongside the co-optimisation of energy and ancillary services, either with or without nodal pricing.

Relevant Foreground IPR

An interim report and a final report will be published on the Smarter Networks Portal and disseminated accordingly.

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 the ESO Data Portal
3. Via our Innovation website at https://www.nationalgrideso.com/future-energy/innovation
4. 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

Due to the uncertainty surrounding future market arrangements, and because the potential economic benefits of co-optimisation have not been modelled in GB to date, this project would not be funded as part of BAU activities.

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

- The ESO does not have the internal capabilities to generate this understanding nor disseminate the findings as part of BAU practices.
- The uncertainty surrounding future market arrangements makes this project better suited to NIA.
- The TRL of the project is relatively low. Therefore, innovation funding is more suitable for exploring the project's potential and increasing the TRL before transferring into BAU activities.
- Conducting this project with NIA funding will ensure that the project findings can be shared more widely with other interested network

licensees and wider industry.

This project has been approved by a senior member of staff

☑ Yes