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

Sep 2024

### Project Reference Number

NIA2_NGESO094

## Project Registration

### Project Title

Compatibility assessment of dispatch options with GB cross-border markets

### Project Reference Number

NIA2_NGESO094

### Project Licensee(s)

National Energy System Operator

### Project Start

August 2024

### Project Duration

0 years and 4 months

### Nominated Project Contact(s)

innovation@nationalgrideso.com

### Project Budget

£350,000.00

### Summary

Cross-border markets play a key role in GB's wholesale electricity market. Reforming electricity markets through the Review of Electricity Market Arrangements (REMA) programme is vital to the delivery of a fully decarbonised electricity system.
The REMA reforms under consideration, the move to a zonal wholesale market and review of dispatch arrangements, aim at better aligning the wholesale market and the operational needs of the GB system. The various market design options could alter the interactions between cross-border markets and GB wholesale markets.
The impact of these potential reforms on and interaction with cross-border markets is uncertain. This assessment will provide insights into the potential changes and implications that market reforms could introduce, allowing for informed decision-making and effective management of the GB cross-border market.

### Preceding Projects

NIA2_NGESO015 - FIC (Future of Interconnectors)

NIA2_NGESO030 - Enduring Cross-Border Balancing

NIA2_NGESO053 - Exploring the Economic Benefits of Co-optimising Procurement of Energy, Response and Reserve

### Third Party Collaborators

AFRY Management Consulting Ltd

FTI Consulting LLP

## Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

## Problem Being Solved

Cross-border markets play a key role in GB's wholesale electricity market, offering system flexibility and supporting security of supply, affordability, and decarbonisation. As more interconnectors are built, with capacity growing from the current 9.4 GW to potentially up to 24 GW by 2035, the role these markets play in GB's system will only further increase.
The direction of energy flows on interconnectors is determined by the price differentials between connected markets, with energy generally flowing towards the higher priced market. A lack of efficient price signals in GB means that interconnectors can at times flow counter to GB system needs.
Markets drive competition and innovation to benefit consumers and provide price signals which guide decisions on electricity supply and demand, investment in new generating capacity and flexibility, and the efficient operation of the system. Reforming electricity markets through the Review of Electricity Market Arrangements (REMA) programme is vital to the delivery of a fully decarbonised electricity system.
One of the REMA reforms under consideration, the move to a zonal wholesale market, aims at improving these price signals so they better reflect the operational needs of the GB system. In parallel, the review of scheduling and dispatch arrangements under REMA considers various design options that could alter the interactions between cross-border markets and GB wholesale markets at different timeframes.
The impact of these potential reforms on cross-border markets is uncertain, especially when taking into consideration the European electricity market redesign currently underway. REMA is also looking into other reforms such as the shortening of settlement periods or review of access rights that might interact with cross-border markets.

## Method(s)

The selected method to deliver this project is a qualitative analysis. This analysis should primarily concentrate on the interactions between dispatch alternatives for the GB wholesale market and cross-border market arrangements, as well as their impacts.
The options to be analysed combine dispatch and locational pricing arrangements and will be studied in two stages:
Stage 1 will cover the analysis of:
**National / Central Dispatch:** GB maintains a national wholesale price, but dispatch arrangements would be modified to reflect a fully centralised approach, akin to models which exist in Australia and ERCOT, Texas. This option is based on a gross-pool design and includes financial forwards markets with physical trades occurring only in real-time markets.
**Zonal / Self-Dispatch:** GB retains self-dispatch alongside zonal pricing. This option replicates many of the current arrangements in GB, including portfolio bidding (limited by zone) in a net pool and 60-minute gate closure. However, key differences versus the status quo emerge when allocating and calculating inter-zonal transmission capacity.
**State 2 will cover:**
**National / Self Dispatch:** Represents an evolutionary change to dispatch arrangements. Market participants would continue to decide when to schedule on a portfolio basis. Energy would be settled according to a single national wholesale price.
**Zonal / Central Dispatch:** Similar to the National / Central Dispatch model but assumes a version of zonal pricing exists in an Australian-style central dispatch regime. This option would facilitate co-optimisation of energy, transmission capacity and ancillary services simultaneously.
Cross-border market arrangements that will be included in this analysis are:
a) Explicit arrangements;
b) Implicit arrangements;
c) Volume coupling;
d) Price coupling.

To obtain a full understanding of the implications of market design options on GB's cross-border trade, the different cross-border market arrangements detailed need to be reviewed:
a) against the market design options previously described, and;
b) for all timeframes: long-term, day-ahead, intraday and balancing (post gate closure).

The questions to answer have been structured in two sets.
1) The exploratory questions set describes the generic questions that should be analysed for all combinations of cross-border market arrangement-market design option-timeframe.
2) The specific questions set includes specific questions that are only applicable to central dispatch options and that should provide

additional detail on the feasibility/operability of these options.
The specific questions should be considered as a guide and ideally be part of the response to the exploratory questions.
At the end of each stage, the consultant will provide a final report, a standalone executive summary, and a short presentation comparing the different options analysed and summarising key findings and conclusions.

## Scope

The scope of each stage of the project is clearly defined with questions requiring an answer. These exploratory questions are required for the assessment of each option in order to obtain the maximum value from the derived insights.

A. End to end process.

- General description: Describe the end-to-end process of how cross-border flows would be determined providing detail on:
  -Sequence of activities (including indicative timing) for cross-border capacity calculation.
  -Sequence of activities (including indicative timing) for cross-border capacity allocation, including detail on opportunities for modifying the flows (both by the market or the system operator).
  -Ownership of the different parts of the process (i.e., who would do the capacity calculation, who would run the cross-border markets).
  -Auction design (i.e., what price signals would be followed and how; bidding formats and compatibility with wholesale market products).
  -Interaction between interconnector auctions and wholesale/balancing markets both in GB and Europe.
  -Interaction with system operators (i.e., communication of schedules, programmes).
- Efficiency: Analyse the system-wide efficiency of different arrangements (i.e., operability challenges and benefits, impact on efficiency of interconnector flows (flows against price difference, interconnector capacity underutilisation, loop and transit flows)).
- Feasibility: Identify feasibility and implementation challenges and risks.
- Commercial impacts: Explore which market parties (interconnector owners/developers, traders, other parties) would be impacted by the changes and how. Map out what would be the likely changes and risks for each option versus how trading is conducted today and how congestion rent would be earned by interconnector owners. Define how settlement would change for interconnector owners and trading parties.
- Best practices: Provide detail on international examples, particularly from other jurisdictions where central dispatch is already in place in Europe (Poland, Greece, Ireland, Italy) and elsewhere (Australia, USA).
- New options: Suggest possible solutions that would allow efficient cross-border trading arrangements and that may be First of A Kind (FOAK), not implemented in any other market.

B. Interactions with other market reforms.

- OHAs: Highlight any special considerations for Offshore Hybrid Assets (OHAs) that may not be relevant for standard point-to-point interconnectors, including but not limited to offshore bidding zones and offshore wind farm market access.
- European market design: Detail what the impact would be of approved European Market Reforms, including (but not limited to) 15min Market Time Unit (MTU), 30min gate closure, change to ramping arrangements.
- Settlement periods and gate closure: Detail what the impact would be of the following potential REMA reforms: change to a shorter settlement period (15min or 5min), change to a shorter (30 min) or longer (6h ahead) gate closure time.
- Zonal: When analysing the zonal models:
  -Highlight the key differences with the equivalent national pricing models
  -Describe any effect on liquidity and congestion revenue.
  -If relevant, detail the difference that a low number of zones versus a high number could bring to cross-border market arrangements.

A set of specific questions is also provided, these should be considered as a guide and ideally be part of the responses to the exploratory questions through both phases.

## Objective(s)

The overall objective of the project is to:
1. Qualitatively evaluate the impact of potential reforms in scheduling and dispatch and wholesale market locational granularity on GB cross-border market arrangements
2. Analyse GB cross-border market arrangements both from the perspective of what is already in place and what could be implemented in the future. This includes:

a) Explicit arrangements - as currently present on the interconnectors BritNed, ElecLink, Nemo Link, Viking Link, IFA, and IFA2
b) Implicit arrangements including the two models currently present in GB:
• NSL model: implicit auction linked to GB N2EX wholesale hourly day-ahead market

• Irish model: implicit local auctions
c) Volume coupling - only focus on Multi-Region Loose Volume Coupling (MRLVC)
d) Price coupling – Single Day-Ahead Coupling (SDAC), Single Intra-Day Coupling (SIDC), Manually Activated Reserves Initiative (MARI), Platform for the International Coordination of Automated Frequency Restoration and Stable System Operation (PICASSO)

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A

## Success Criteria

The project will assess the impact of potential reforms in scheduling and dispatch and GB wholesale market locational granularity on GB cross-border market arrangements.
This assessment will provide insights into the potential changes and implications that market reforms could introduce, allowing for informed decision-making and effective management of the GB cross-border market. This involves the delivery of:

- A robust qualitative assessment of all market design options answering the questions as detailed in the scope in the form of a report, including comparisons between the different market design options and process diagrams to facilitate the understanding of the explanations provided.
- The report should also highlight any market arrangements that wouldn't work in combination with any GB dispatch and locational pricing option and should detail the rationale behind this.

The findings of this research project will feed into the analysis of GB's dispatch options, ensuring that any changes to GB's market design consider their effect on electricity trading across borders.

## Project Partners and External Funding

Project partner: FTI Consulting, no external funding contribution

## Potential for New Learning

- More informed understanding of scheduling approaches and their interactions with cross-border market arrangements. The report should also highlight any market arrangements that wouldn't work in combination with any GB dispatch and locational pricing option and should detail the rationale behind this.
- The implementation of market coupling between a gross pool central dispatched market based on financial trading and a physical trading market, has not yet been realised. Exploring this option has the potential to unlock new insights and knowledge in this field, paving the way for innovative and first-of-a-kind advancements.
- The results will feed into ESO's assessment of different dispatch options which is being used by DESNZ in the 2nd phase of their REMA assessment.
- Additionally, the results will be disseminated into several ESO cross-border workstreams e.g., market coupling, development of Offshore Hybrid Assets market arrangements, and network planning.
- An Executive summary document comprehending the main findings from both stages of the project will be published on the Smarter Networks Portal at the end of the project.

## Scale of Project

Project will span 4 months with FTI delivering the work.

## Technology Readiness at Start

TRL1 Basic Principles

## Technology Readiness at End

TRL3 Proof of Concept

## Geographical Area

Whole of GB's transmission network, including interconnectors.

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

350,000

# 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 NESO demands a full understanding of the interactions between cross-border markets and the future GB market reforms. Failure to comprehend these interactions could potentially have a significant impact on the energy advisory role of NESO. This is something that requires external research and expertise across cross-border and future market designs.
- The implementation of market coupling between a gross pool central dispatched market, based on financial trading, and a physical trading market, like the European market, has not yet been realised. Exploring this option has the potential to unlock new insights and knowledge in this field, paving the way for a successful energy system transition.
- This assessment aims to provide insights into the potential changes and implications that GB wholesale market reforms could introduce, allowing for informed decision-making and effective management of the GB cross-border markets.

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

We expect that the implementation of central scheduling and/or zonal pricing would significantly reduce consumer costs. Understanding the interactions between GB market reform and cross-border markets will allow for a maximisation of the potential benefit to the consumer of GB market reform.

## 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 is a research project so this is not applicable

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

This research project will qualitatively evaluate the implications on cross-border trade from significant reform in scheduling and dispatch arrangements and locational price signals. It will be forward looking, analysing not just the cross-border arrangements in place, but also potential future scenarios such as volume coupling and price coupling.

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

N/A as this is a research project

## 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 project will provide a qualitative view of the impact of self versus central scheduling and dispatch under both national and zonal pricing. The results will be shared with key stakeholders, including DESNZ, Ofgem and industry.
The results will feed into ESO's assessment of different dispatch options which is being used by DESNZ in the 2nd phase of their REMA assessment.
Additionally, the results will be disseminated into several ESO cross-border workstreams e.g., market coupling, development of Offshore Hybrid Assets market arrangements, and network planning.

### 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.

ESO has not done any previous analysis on the impact and interactions of REMA reforms on current and future cross-border trading arrangements.
So far, ESO assessment of scheduling & dispatch for REMA has involved:
Scheduling & Dispatch 'Case for Change'
Investigation into the economic benefits of co-optimisation
Analysis of storage utilisation in the current Balancing Mechanism
From an external industry perspective, some studies have been published by external consultancies covering a general assessment of REMA dispatch options (AFRY 'multi-client' study and Frontier Economics 'Assessing the impacts of implementing central dispatch in GB'). These studies acknowledge the important role of efficient interconnector flows in future market designs, but do not provide any detailed description or assessment of how trading could effectively be conducte

### 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

Cross-border markets play a significant role in the electricity market of Great Britain. The unique technological context, where all interconnectors are Direct Current (DC) links, combined with the market complexities introduced after the EU-Exit, demands an innovative approach to market design in order to adapt to these specific circumstances.
The implementation of market coupling between a gross pool central dispatched market based on financial trading and a physical trading market, similar to the European market, has not yet been realised. However, exploring this option has the potential to unlock new insights and knowledge in this field, paving the way for innovative advancements.

### Relevant Foreground IPR

A final report will be produced at the end of each stage of the project.

### 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 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 future level of interconnection expected, the specificities of GB's interconnector commercial arrangements and the impact of the EU Exit on interconnector operations, GB finds itself in a unique situation when compared with its neighbouring countries.
There is considerable uncertainty surrounding future market arrangements both for GB's cross-border markets and for GB's market design reform. Some of these reforms mean a radical change from what is in place at the moment, and no precedents exist that could be used as a proxy to understand the implications of those changes.
As far as we are aware, the analysis of the interactions between different scheduling approaches in GB with cross-border markets is the first of its kind. In particular, the analysis of market coupling between a gross pool central dispatched market in GB, based on financial trading, and a physical trading market in the connecting countries has not been done before. Given the significant potential impact of the currently uncertain future there is no guarantee that the solutions identified by the analysis will be applicable or the right ones.

### 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

There are several electricity market reform options under consideration that could allow GB to transition to a Net Zero future. However, none of these options have been proven internationally within a context that resembles the GB system which is interconnected with other European markets.
Flows across interconnectors represent a growing percentage of GB's energy mix. Progressing work on any of the reform options without further understanding the interactions with cross-border markets would be a major risk. This innovation study will mitigate this risk by building an understanding of these interactions, allowing the REMA programme and other stakeholders to progress their thinking with a full view of any impacts of possible reforms.
An innovation project will provide the complete picture of all the alternative future directions that we could consider given the complex nature of this rapidly changing, new and therefore unknown, environment.

### This project has been approved by a senior member of staff

☑ Yes