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

Aug 2023

Project Reference Number

NIA2_NGESO055

Project Registration

Project Title

QWID FLEXER

Project Reference Number

NIA2_NGESO055

Project Licensee(s)

National Energy System Operator

Project Start

September 2023

Project Duration

0 years and 6 months

Nominated Project Contact(s)

Alex Hart

Project Budget

£125,000.00

Summary

Operating a future energy system with high levels of renewables will require significantly more flexible, zero carbon capacity than currently available. Large amounts of short-duration flexibility will be needed to match supply and demand within the same day. During periods of high or low renewable generation, greater amounts of within-day flexibility (WDF) will be needed.

There is no widely agreed method for quantifying the need for WDF. Unless this method is developed, inconsistent and flawed methods may be used, leading to inefficiencies.

The project will seek to develop a rigorous, repeatable, transparent method for quantifying the need for WDF. The method will include identifying relevant data sources and how to process them, assumptions, treatments of averages and extremes, calculations and interpretation of results.

Third Party Collaborators

TNEI Services Ltd

Nominated Contact Email Address(es)

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Problem Being Solved

Operating a future energy system with high levels of renewables will require significantly more flexible, zero carbon capacity than currently available. Large amounts of short-duration flexibility will be needed to match supply and demand within the same day. During periods of high or low renewable generation, greater amounts of within-day flexibility (WDF) will be needed.

There is no widely agreed method for quantifying the need for WDF. Unless this method is developed, inconsistent and flawed methods may be used, leading to inefficiencies. It may also be difficult to confidently assess progress towards zero carbon operation.

Method(s)

This is a technical research project to develop a WDF calculation method.

The project will be structured around a series of workshops. Estimated at five over the six-month project. These workshops will cover:

- Kick off, project plan, definitions
- Method development, literature review, data benchmarking
- Analysis plan, interim review of results and tools developed, interim report
- Discussion of results and sensitivity analysis
- Final report, handover of outputs and tools

Historic data will be gathered on the variability of inflexible demand and inflexible generation and on average and extreme weather years. This historic data will be analysed to develop metrics that characterise the variability and can be used to project future variability. These metrics will be combined with scenarios of the future electricity system (FES) to quantify the future need for WDF, as the main zero carbon tool to manage the variability.

Tools will be developed in Python and Excel to make this a repeatable and adjustable process.

Project Partner, TNEI's approach will, wherever possible, rely on high-quality data sets gathered from credible public sources, or, where necessary, internal experts within the ESO. All statistical modelling will be evaluated according to best practice, including visual diagnostics (e.g., calibration plots), and quantification of appropriate metrics. All work will be quality assured prior to completion, in accordance with TNEI's ISO 9001 accredited quality management processes.

Determining appropriate sources of data and developing methods to cleanse and process them is a core part of this project. Part of determining which data sources to use will be understanding the errors they contain and their significance for the analysis. The proposals for future work at the end of the project will include an assessment of the errors and uncertainties in the method developed and how they could be improved by further work.

It is an explicit intention of the project that the method developed can be understood and reused by our stakeholders and it will be designed with possible future improvements in mind.

It is expected that most of the data used will come from public sources. Examples include:

- **Elexon** – historic demand and BMU generation data – accessed through a data portal and saved as CSV files
- **Sheffield Solar** – live and historic solar PV output with locational information – accessed through an API and saved as JSON files
- **European Centre for Medium-Range Weather Forecasts** – long time series of estimated weather data from historic reanalysis processes – accessed through an API and saved as netCDF or GRIB files
- **ESO Future Energy Scenarios** – scenarios of future generation capacity and demand – accessed from the ESO website as Excel files
- **UK Data Service** – heat pump demand profiles from the Renewable Heat Premium Payment Scheme and the Electrification of Heat Demonstration Project, both raw and cleaned versions are available – accessed as CSV files
- **National Grid Electricity Distribution** – the EV charging behaviour dataset from the Electric Nation innovation project – accessed as Excel files

All data gathered to conduct this project will require prior pre-processing, through developed code, to standardise and cleanse any bad and missing data. The consultants will use their expertise alongside scripts previously produced to identify and handle such data. Further processing may involve resampling, adjusting structures, and converting units.

The project will mitigate any issues with all these data sources, for example:

- Historic demand data will reflect trends in behavioural patterns in time. Appropriate statistical modelling techniques will be used to detrend this data. Historic demand data will probably also net-off the effect of embedded generation. Some of these effects can be approximately controlled for (e.g., by applying the PV Live data), but this will still be imperfect.

- Historic wind production data will also have trends (e.g., due to changing technology), which will need to be controlled for. Corrections may also be necessary to remove the presence of constraints within that data. In addition, the available data may be relatively short compared to the long-term variation in wind conditions year-on-year. This can be addressed with weather reanalysis data to enhance these historic observations.
- Historic demand and generation data is typically lacking information on unique events which may have had a significant impact on the profile at any given time. Efforts will be made to mitigate this, and their impact will be minimised by the aggregation of data to national level.
- Projected LCT data used within the FES may only consider expected or typical profiles (e.g., associated with Average Cold Spell conditions), which may mask the true range of possible WDF requirements under different future scenarios.

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

TRL Steps = 2

Cost = 1(£125k)

Suppliers = 1 (1 Supplier)

Data Assumptions = 1

Scope

The scope of the project is:

- Flexibility for balancing inflexible demand and inflexible generation across the whole of the electricity system (transmission and distribution)
- Flexibility for energy balancing only, excluding any locational component and therefore any network management component
- Flexibility for energy balancing only between 0.5 and 24 hours (energy balancing within 0.5 is considered frequency management and energy balancing over more than 24 house is considered adequacy)
- The need for flexibility only (not how much flexibility will be provided, how it will be provided, the benefits, the barriers, the business models etc.)

Objective(s)

The project is expected to:

1. Provide a clearly defined method for calculating the need for WDF
2. Provide an explanation of why this is the best method to use
3. Use the selected method to calculate the system need for WDF. Provide and discuss the results
4. Provide all of the tools required to repeat the calculation using the chosen method
5. Propose possible future work to build on this project

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 successful if:

1. A rigorous method is developed to calculate the need for WDF and explore how drivers change it
2. The ESO can provide industry with a clear explanation of how the method works and why it was selected, allowing industry to challenge and build upon it

Project Partners and External Funding

TNEI Services Ltd. No external funding contribution.

Potential for New Learning

There is currently no widely accepted, rigorous approach to quantifying the need for WDF. This project will develop a robust, transparent method (and relevant tools) quantify the system need for WDF. The method developed and all relevant supporting documents will be shared with industry and published on the Smarter Networks Portal.

Scale of Project

The project has been deliberately restricted in scope and scale to ensure it can be delivered efficiently whilst providing a robust method for the calculation of WDF.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

The geographical scope of the project is the GB electricity system.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£125,000

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:

Operating a future energy system with high levels of renewables will require significantly more flexible, zero carbon capacity than currently available. Large amounts of short-duration flexibility will be needed to match supply and demand within the same day. During periods of high or low renewable generation, greater amounts of within-day flexibility (WDF) will be needed.

Zero-carbon WDF will be essential to operating a zero-carbon system. There is no widely agreed rigorous method for quantifying the need for WDF. Unless this method is developed, inconsistent and flawed methods will be used, leading to inefficiencies. It will also be difficult to confidently assess progress towards zero carbon operation.

By developing this method, the ESO will be able to estimate future system requirements with more confidence and precision, reducing the extra capacity that is required to manage uncertainties, reducing the cost of ensuring system security.

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 method for quantifying the need for WDF will be a foundation for planning and operating an efficient and secure net-zero electricity system. The benefits will initially support how we explain system requirement in the annual Operability Strategy Report, and how demand and flexibility volumes are calculated in the Future Energy Scenarios. In the longer term, future work building on the outputs of this project could influence the way demand and flexibility are modelled in the ESO's operational processes and long-term planning.

A better understanding of the shape of future demand and the need for WDF could lead to efficiency gains across multiple ESO processes that each cost consumers billions of pounds each year. For example, in 2022-23 balancing costs were £4.1bn and the TNUoS revenue recovered to pay for network assets was £3.6bn. Both of these costs are expected to increase in future years as more transport and heat demand is electrified and more electricity supply comes from variable renewables.

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

The method is for an ESO specific requirement, as no other licensee is responsible for energy balancing and scope of the project will cover the whole of the GB system. However, the method will be developed in a way that makes it accessible for others to build upon. DNOs may choose to include concepts developed in this project for requirements they need to quantify.

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

The scope of the project will cover the whole GB system; therefore, no geographical rollout is required.

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 method is for an ESO specific requirement, as no other licensee is responsible for energy balancing. However, the method will be described in a way that makes it easy for others to build upon. DNOs may choose to include concepts developed in this project for requirements they need to quantify.

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.

This project will not duplicate the work of previous innovation projects. Some relevant work has been carried out adjacent to this project, e.g., FALCON (National Grid 2012-15); FREEDOM (NIA_WPD_023); IntraFlex (NIA_WPD_046); EQUINOX (NIC project WPDEN05 2022-25); CrowdFlex (NIA2_NGESO001), CrowdFlex SIF (2022-ongoing). These projects will be studied for relevant learning as part of the literature review.

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

A robust method for quantifying the need for WDF does not currently exist and a suitable approach to create one is unclear.

Similar to inertia, WDF is a fundamental requirement of the electricity system that historically was provided in abundance at low cost as a biproduct of fossil fuelled generation. Currently, the vast majority of WDF is provided by gas fuelled generation, changing its output in response to the wholesale price. In a zero-carbon system WDF will have to be provided by zero carbon sources.
Quantifying the need for flexibility is often an early step in projects about the value of flexibility. To some extent, it has been done before. However close inspection of the methods used reveals that this step has been done implicitly, opaquely, inconsistently and incorrectly.
DNOs and TOs tend to examine the benefits of flexibility for reducing network costs in just their area of responsibility. The whole system scope of the ESO means it needs to consider flexibility in a much wider context.

WDF interacts with transmission constraints, distribution constraints, almost every balancing service, energy markets and flexibility over shorter and longer timescales. It is this high level of interaction with other aspects of system operation that creates the need to define this system requirement with a high level of rigour and transparency. Hence this project to develop, justify, use and handover a method for quantifying the need for one specific type of flexibility.

Relevant Foreground IPR

A final report will be produced, which will capture all the learning generated, and this will be published for industry use.

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 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 National Grid ESO Data Portal at data.nationalgrideso.com
3. Via our Innovation website at 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

This is a research project to develop a new method, there is a risk that no satisfactory method will be delivered, and the objectives of the project cannot be met.

We currently do not have the skills and experience internally to deliver this project without specialist data science support.

The requirement to be able to quantify the need for WDF is not urgent yet. The ESO, and others in the industry, have methods that either estimate the need for flexibility, or manage to skip this step, and, whilst the methods are all flawed, they work well enough for now. They are either accurate enough, or workarounds have been developed to manage the weaknesses.

Over time, the consequences of the rough approximations we currently use will grow as the parts that are not properly defined and measured become more significant. Eventually the requirement to do this will be unavoidable. By choosing to begin developing the method now, as an innovation project, it will allow more opportunities and time for industry engagement and refinement of the method.

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

A large part of the project will be finding pragmatic solutions for problems with input data quality and sources of variability that resist neat categorisation. As a result, there is technical risk that the project will be unable to develop suitable solutions to replace existing methods.

This project has been approved by a senior member of staff

☑ Yes