

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 2022

Project Reference Number

NIA_WPD_072

Project Registration

Project Title

Q-Flex

Project Reference Number

NIA_WPD_072

Project Licensee(s)

National Grid Electricity Distribution

Project Start

September 2022

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Ryan Huxtable

Project Budget

£538,268.00

Summary

This project will demonstrate if flexible reactive power is possible, assess whether it is a solution to voltage problems, loss minimisation and thermal network constraints, and understand if participants are willing to provide reactive power as a service.

It will carry out engagement and literature review to document which technologies are able to provide reactive power flexibility and, undertake studies to demonstrate if optimised reactive power dispatch has the ability to defer network reinforcements and minimise losses. It will then carry out Cost Benefit Analysis to determine the financial and environmental costs/benefits achieved from the use of flexible reactive power, and carry out a market assessment to determine asset owners' interest in providing flexible reactive power as a service, before developing an initial market design.

Problem Being Solved

Significant growth in the number of Low Carbon Technologies (LCTs) connected to distribution networks is expected as the UK moves toward net zero carbon by 2050. This is both in terms of renewable generation and new loads such as the electrification of transport and domestic heating.

This increased LCT penetration on networks is raising the likelihood of issues such as increased equipment loading, increased network losses and breaches of regulated network voltage limits. The traditional approach to overcome these constraints is to reinforce the network or through network flexibility such as Active Network Management (ANM), System Voltage Optimisation (SVO) or active power flexibility services. Additional network infrastructure takes time and significant financial investment to build without fully understanding the future network conditions. The use of flexibility provides one method to operate the existing network more efficiently but new services and optimisation in this area are needed to release the capacity for accelerated LCT connections.

Method(s)

The innovation work is expected to be delivered through several linked work packages (WP) as follows:

WP1 - Current & Emerging Technologies Reactive Power Capability

WP2 - Q-Flex Reactive Power Studies

WP3 - Q-Flex Cost Benefit Analysis

WP4 - Reactive Power Flexibility Market Engagement & Development

WP5 - Q-Flex Project Report

Scope

This project aims to solve the problem outlined above by demonstrating that the provision of flexible reactive power is technically possible, assessing whether flexible reactive power is a solution to forecasted network constraints, and understanding if participants are willing to provide reactive power as a flexibility service.

This project will consist of the following five work packages which will run in parallel:

- **Work Package 1 (WP1): Current & Emerging Technologies Reactive Power Capability (4 months)**

- WP1 consists of gathering and reviewing literature of current and emerging technologies reactive power capability and controllability, as well as a review of relevant past trial results and control systems. This will be followed by developing and issuing questionnaires to asset owners, and developing a reactive power technology catalogue.

- The outputs of this WP will be a documented literature review, questionnaires on both existing and emerging technologies, a reactive power technology catalogue and a final WP1 report.

- **Work Package 2 (WP2): Q-Flex Reactive Power Studies (4.5 months)**

- WP2 consists of undertaking power system studies to demonstrate that optimised reactive power dispatch has the ability to defer network reinforcements and minimise networks losses. These studies will include assessment of reinforcement deferral, loss minimisation and the operation of reactive power flexibility.

- The output of this WP will be a report containing the case studies selected, the Q-Flex algorithm and results and analysis from the power system studies carried out.

- **Work Package 3 (WP3): Q-Flex Cost Benefit Analysis (5 months)**

- WP3 will involve carrying out economic Cost Benefit Analysis to determine the financial and environmental costs/benefits of deferred network reinforcements and minimised losses achieved from the use of flexible reactive power.

- The outputs from this WP will be a report containing the methodology and findings from the Q-Flex CBA, and the CBA spreadsheets developed.

- **Work Package 4 (WP4): Reactive Power Flexibility Market Engagement & Development (5 months)**

- WP4 will involve carrying out a market assessment to determine asset owners' interest in providing flexible reactive power as a service, as well as developing an initial market design for the procurement of reactive power from technology asset owners.

- The output of this WP will be a report containing assessment of the interest from providers in a reactive power flexibility market, and the market design.

- **Work Package 5 (WP5): Q-Flex Project Report (2 months)**

- WP5 will produce a report detailing the summary of learnings, conclusions and recommendations from the project.

A reactive power flexibility market does not currently exist, but could provide value to our customers and change the way we design and operate our network. The project will help gain an understanding on which commercial customers connected to our network are able to provide reactive power flexibility, and understand their willingness to do so through engagement and questionnaires. Following this, the project will design a new reactive power flexibility market.

Objective(s)

- Demonstrate that the provision of flexible reactive power is technically possible.
- Assess whether flexible reactive power is a solution to forecasted network constraints.

- Understanding if participants are willing to provide reactive power as a flexibility service.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A

Success Criteria

The project will be deemed successful if the following are achieved:

- A catalogue of reactive power technology produced that has been developed using feedback and information from asset owners and operators.
- Power studies have been carried out on multiple case studies within the WPD network which have been selected and approved by WPD Network Strategy.
- Cost Benefit Analysis carried out to determine the financial and environmental costs/benefits of deferred network reinforcements and minimised losses achieved from the use of flexible reactive power.
- A concept design has been created for a reactive power flexibility marketplace.

Project Partners and External Funding

The project partners on Q-Flex will be PSC and NERA.

PSC will be the lead project partner and will be responsible for carrying out work in all project WPs, leading all but WP4 where they will support NERA with the development of the market design. PSC have a strong background in the electricity industry, and have worked on innovation projects in the past for both WPD and other network operators.

NERA are economic consultants with a proven understanding of how flexibility markets work. They typically provide economic analysis and advice to corporations, governments, law firms, regulatory agencies, trade associations, and international agencies. Their main roles within the project will be within WPs 3, 4 and 5.

There will be no external financial contribution to this project.

Potential for New Learning

This project focusses on an area of flexibility that is not currently utilised. Reactive power flexibility is not currently procured but could help reduce losses on our network, help reduce voltage problems, and in the future help mitigate any reactive power constraints if they begin to occur. This project will provide the toolset needed for us to prepare to use these services in the future. Currently the potential of reactive power flexibility is not fully understood, and previous propositions for reactive power flexibility work have been limited.

The learning generated could be used by all Distribution Network Licensees once shared. All network licensees have a commitment in place to utilise flexibility if it forms a cost effective alternative to network reinforcement, and the additional services Q-Flex will bring could be of use to all. The outputs of the project are being produced in a way that means they are useful to other licensees at the end of the project – the catalogue of assets that can provide services will be fit for use on assets in any area, and the reporting on this will align with how it should be used by them. The initial market design carried out will be a guide to be used on any platform (e.g. Flexible Power which is currently used by multiple DNOs).

Scale of Project

The Q-Flex project will be desktop based, involving carrying out studies and design work that is also informed by engagement with relevant parties from across the industry. The outputs will include reports on findings on the suitability and benefits found from reactive power flexibility, as well as a catalogue of available technologies and an initial market design. This is an appropriate scale of project for the problem as further research and knowledge is required prior to trialling reactive power flexibility.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

This project will not be specific to any one license area. Case studies will be selected based on where the greatest need for the services are identified (constraints/losses) but this will likely be spread across all WPD licence areas.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

The NIA Expenditure that we expect to reclaim for the Project is £484,440 (RIIO1).

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:

N/A

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)

The Virtual Statcom NIA project has shown that the efficient use of reactive power in distribution networks reduces network losses. Q-Flex will optimise the reactive power distribution across the entire distribution network. This provides a financial benefit to electricity customers through lower energy bills and reduces network related greenhouse gas emissions. Q-Flex has the potential to reduce network losses by 3% (estimate based on Virtual Statcom), saving UK consumers an estimated £388 Million to 2050 on electricity bills and reducing emissions by an estimated 2.6 Million tonnes of CO₂ to 2050.

A flexible energy system is estimated to be worth in the order of £16.7bn pa out to 2050, according to the Carbon Trust and Imperial College London. Currently, whilst procurement for flexibility services is increasing across all DNO's, it is still a nascent market. This project will aid in providing a new type of flexibility service, which will help increase overall liquidity in the market and reduce the cost of services to the DNO and its customers.

Please provide a calculation of the expected benefits the Solution

The exact benefits of this project are not fully realised at this stage, as this is a research project, but at the close of the project the benefits of reactive power flexibility will be better understood.

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

The project could be utilised across all GB DNOs so is therefore replicable across the whole GB network.

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

The outputs of the project are being produced in a way that means they are useful to other licensees at the end of the project – the catalogue of assets that can provide services will be fit for use on assets in any area, and the reporting on this will align with how it should be used by them. The initial marked design carried out will be a guide to be used on any platform (e.g. Flexible Power which is currently used by multiple DNOs). The project will give an indication of the roll out cost of this, but has been designed in a way to minimise it.

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 learning generated could be used by all Distribution Network Licensees once shared. All network licensees have a commitment in place to utilise flexibility if it forms a cost effective alternative to network reinforcement, and the additional services Q-Flex will bring could be of use to all. The outputs of the project are being produced in a way that means they are useful to other licensees at the end of the project – the catalogue of assets that can provide services will be fit for use on assets in any area, and the reporting on this will align with how it should be used by them. The initial marked design carried out will be a guide to be used on any platform (e.g. Flexible Power which is currently used by multiple DNOs).

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 focusses on an area of flexibility that is not currently utilised. Reactive power flexibility is not currently procured but could benefit DNOs and their customers. No previous or current innovation projects work will be duplicated with the scope set out for this project.

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

This project focusses on an area of flexibility that is not currently utilised. Reactive power flexibility is not currently procured but could help reduce losses on our network, help reduce voltage problems, and in the future help mitigate any reactive power constraints if they begin to occur. This project will provide the toolset needed for us to prepare to use these services in the future. Currently the potential of reactive power flexibility is not fully understood, and previous propositions for reactive power flexibility work have been limited.

Relevant Foreground IPR

Foreground IPR which will be generated in the project will include: a reactive power technology catalogue, a high level reactive power flexibility market design, and reporting on each work package.

Data Access Details

Data from the project will be made available on the WPD website during the course of the project and at the completion of each work package.

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

As a reactive power flexibility market does not currently exist, and the capability of assets devices on the network and benefits of the service are not yet fully defined, it would not be appropriate to fund this work 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

There is insufficient activity in the Flexibility market at present and as such the risks associated with testing and trialling new concepts like this have a measure of risk beyond which we would normally undertake business as usual trials.

This project has been approved by a senior member of staff

Yes