nationalgridESO

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

Dec 2019

Project Reference

NIA_NGSO0030

Project Registration

Project Title

Impact of Long-duration Energy Storage Systems on GB Transmission Planning

Project Reference

NIA_NGSO0030

Project Licensee(s)

National Grid Electricity System Operator

Project Start

December 2019

Project Duration

0 years and 7 months

Nominated Project Contact(s)

Rebekah Pryn

Project Budget

£90,000.00

Summary

The ESO uses the Network Operability Assessment (NOA) process to recommend investment options to achieve a sustainable, economic and efficient future electricity grid. As the energy system rapidly evolves and the penetration of renewable resources increases, future uncertainty also increases. Thus, there is a need for bringing flexibility across the network. Through this project, we will analyse the impact of a range of energy storage systems on transmission network constraints. This will lead to more informed investment and operational decisions to ensure a secure, economic and efficient electricity grid.

Nominated Contact Email Address(es)

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Problem Being Solved

The ESO uses the Network Operability Assessment (NOA) process to recommend investment options to achieve a sustainable, economic and efficient future electricity grid. As the energy system rapidly evolves and the penetration of renewable resources increases, future uncertainty also increases. Thus, there is a need for bringing flexibility across the network. Through this project, we will analyse the impact of a range of energy storage systems on transmission network constraints. This will lead to more informed investment and operational decisions to ensure a secure, economic and efficient electricity grid.

By utilising a stochastic optimisation model within this innovative project, the added-value of energy storage on investment deferral and ancillary services will be identified.

Method(s)

The following deliverables are planned as part of this project:

WP1: The objective of this work package is to model the optimal sizing and operation of an energy storage system (ESS) placed upstream of a constrained transmission interface, whereby inflexible generation such as renewables and baseload exceeds rated transmission network capacity for periods of the year: This scenario would drive curtailment of excess generation unless the transmission interface was upgraded and/or an energy storage system was used to shift generation to times with available capacity.

WP1 Deliverable: The final deliverable is to quantify the economic opportunity of utilizing energy storage to reduce transmission network constraints and possibly defer network investments. The deliverable will include a range of sensitivity analysis (either visual or/and as a tool) in order to analyse the impact of different technical and non-technical specifications of energy storage systems based on the current, near future and also more ambitious market solutions.

WP2: Because of the strong seasonal variation of wind generation in the UK, it is likely that energy storage installations for reinforcement deferral will be partially utilized for portions of the year. It is also possible that during diurnal cycles some spare storage capacity become available for other purposes. Moreover, additional revenue streams might be necessary to justify the deployment of energy storage from an economic standpoint such as reactive support and black start.

WP2 Deliverable: This work package will investigate complications and opportunities to stack services throughout the year. Services to be analysed include Frequency Response, Reactive Power and Reserves.

Scope

A constraint is defined as an inability to transmit power to the location of demand, due to congestion at one or more parts of the transmission network. This inability stems from physical limitations of the assets. The ESO currently manages thermal transmission constraints through the Balancing Mechanism (BM). Transmission constraint costs (Thermal, Voltage and Stability) in 2018/2019 amounted to £420m. The NOA process recommends the optimum build combination to reduce constrains across the GB Network. In recent years, the level of constraints expected to be cleared through the NOA process has increased. This is partly due to the levels of inflexible renewables predicted to come onto the system. This is causing the ESO to consider alternative solutions to constraint management. Long-term storage could contribute in the future towards a more economic and efficient method of operating the system. This project aims to identify the value of a range of storage durations and technologies in the electricity market and what part it can play.

Objective(s)

The project aims to:

1. Model the optimal sizing and operation of an energy storage system (ESS) placed upstream on a constrained transmission interface
2. Explore potential alternative revenue streams available to storage during less constrained times of the year

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The following success criteria apply to this project:

- A report quantifying the economic opportunity of utilizing energy storage to reduce transmission network constraints and possibly defer network investments
- A visual/tool displaying sensitivity analysis on the impact of different technical and non-technical specifications of energy storage systems based on the current, near future and also more ambitious market solutions
- A report on the complications and opportunities to stack services throughout the year. Services to be analysed include Frequency Response, Reactive Power and Reserves.

Project Partners and External Funding

Form Energy will be leading this project.
No external funding.

Potential for New Learning

The project will be a sucess if the following learning can be acheived:

- Understand the impact storage on a large scale can have on the constraint management on the GB transmission network. A variety of technologies and durations will be assessed.
- The learnings from this project will be useful for DNOs as they start to consider flexibility alternatives to manage their own constraints.

Scale of Project

This project will be a desk based research activity.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The project will be undertaken using teams based within Form Energy and National Grid ESO.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

Network Innovation Allowance expenditure is: £90k

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)

1. The ESO spends ~£400m on mitigating constraints on the transmission network each year. Having a range of network solutions that can work together (physical network capacity and market solutions) could greatly reduce this cost, unlocking benefit for GB consumers.
2. A storage solution could reduce the amount of renewable curtailment on the network at times of low demand/ low market price. Allowing this extra renewable generation onto the network rather than constraining it off could majorly contribute to carbon emission targets.
3. Reduce requirements to constrain on conventional generation for voltage support and consequently reduce CO2 emission and help to achieve 2050 zero carbon target.

Please provide a calculation of the expected benefits the Solution

Not required for research projects.

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

DSOs and TOs can learn from the project finding and the results will be publicly available.

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

It is unclear at this moment of the costs associated with using large scale storage to solve constraints on the network. This project will assess the different options available and will estimate this cost.

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

n/a

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

From our Innovation Strategy published in April 2019, the following strategic priority area will be explored:

- Constraint Management

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

We are unaware of any projects that have undertaken granular modelling of all types of storage to solve GB transmission constraints. We are aware of the Smarter Network Storage analysis of service stacking and we will build upon this work, focusing directly on periods of service provision available when transmission constraints are not present. Storage on a higher deployment scale will be analysed in this project which could have an impact on service market conditions/behaviour.

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

We are unaware of any projects that have undertaken granular modelling of all types of storage to solve GB transmission constraints. Flexible assets will provide a key part in our network operation in future years and it is important we clearly understand their strengths as well as their limitations in order to accurately model their deployment on the transmission network.

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

Analysis must be undertaken before services are deployed/tendered for by the ESO. The associated risk with procuring/optimising a strategy which is not beneficial in that long-term Constraint Management costs could increase, therefore increasing costs for the consumer.

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 learnings form this project will be highly relevant to other networks and we will be sharing the results which could be very valuable to other network parties. Initial conversations with other networks are positive and suggest that they are interested in the learnings from this project.

This project has been approved by a senior member of staff

☑ Yes