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 2018

Project Reference Number

NIA_NGTO016

Project Registration

Project Title

WATTS – Weather Analytics for The Transmission System

Project Reference Number

NIA_NGTO016

Project Licensee(s)

National Grid Electricity Transmission

Project Start

September 2018

Project Duration

0 years and 9 months

Nominated Project Contact(s)

Robin Gupta

Project Budget

£360,000.00

Summary

Increasing amounts of renewable energy are creating new challenges for transmission system balancing. As both supply and demand in Great Britain become increasingly weather-sensitive, levels of congestion across transmission zone boundaries may experience increased variability. This could give rise to significant changes in the level of congestion from year to year, and changes in the likelihood of boundaries coming under stress due to extreme weather events.

The weather adds complexity by introducing spatial and temporal relationships between weather-sensitive demand and generation across the transmission system. Limited transmission capacity between zones leads to varying levels of weather-induced congestion in different parts of the country. When excess supply in one transmission zone cannot be safely transported elsewhere, it incurs a cost. Understanding the impact of a wide range of possible weather scenarios on transmission congestion is important in order to manage the network cost effectively and provide the best service to consumers as reinforcements can be planned in advance and proactively.

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

Increasing amounts of renewable energy are creating new challenges for transmission system balancing. As both supply and demand in Great Britain become increasingly weather-sensitive, levels of congestion across transmission zone boundaries may experience increased variability. This could give rise to significant changes in the level of congestion from year to year, and changes in the likelihood of boundaries coming under stress due to extreme weather events.

The weather adds complexity by introducing spatial and temporal relationships between weather-sensitive demand and generation across the transmission system. Limited transmission capacity between zones leads to varying levels of weather-induced congestion in different parts of the country. When excess supply in one transmission zone cannot be safely transported elsewhere, it incurs a cost.

Understanding the impact of a wide range of possible weather scenarios on transmission congestion is important in order to manage the network cost effectively and provide the best service to consumers as reinforcements can be planned in advance and proactively.

Method(s)

This feasibility project will assess the impact of the weather on electricity transmission congestion, modelling a simplified representation of the GB transmission system.

This research will focus on the following three areas:

Focus 1 - Long-term statistics of weather-sensitive supply, demand and transmission congestion
Focus 2 - The impact of future renewable generation deployment on transmission congestion
Focus 3 - The attribution of constraint payments to specific weather regimes

Scope

This feasibility project will be split into two primary phases. Phase 1 comprises data collection and processing, whereas Phase 2 is further sub-divided into sections addressing each of the focus points introduced in the method section above.

Phase 1
Weather modelling:

- 10+ years of hourly weather data of UK will be generated using a weather prediction model.
- Long-term weather data from global weather models will be extracted, resulting in 35+ years of hourly weather data

Data pre-processing:

- NGET's GB transmission network will be split into several zones
- Weather-sensitive supply, demand and weather data will be zonally-aggregated

Supply and Demand modelling:

- The total weather-sensitive generation and demand for each transmission zone will be determined as a function of the input weather conditions

Flow model:

- A model will be developed to simulate flows between transmission zones based on the supply and demand in each zone, and the transmission capacity between zones
- This will operate on a time-step by time-step basis
- Further development of this model will continue in Phase 2

Phase 2
Focus 1: Long-term statistics of weather-sensitive demand, supply and transmission congestion

- Determine long-term statistics of weather-sensitive supply and demand in each zone
- Apply the simplified electricity flow model to estimate long-term congestion statistics
- Assess the net impact of the weather on the observed long-term trends in supply and demand, and discuss the implications for transmission congestion
- Assess the severity of recent levels of congestion relative to the range that could occur given at least 10 years of weather data

Focus 2: Impact of future renewable generation deployment

- Investigate the statistical co-dependence of supply and demand across the GB network, and its implications for transmission congestion
- Assess the impact of increasing levels of renewable supply on transmission congestion, based on the expected future deployment of renewables

Focus 3: Attribution of constraint payments to specific weather regimes

- Identify recent constraint payment events using data provided by NGET
- Investigate the weather patterns associated with individual constraint events
- Use advanced data analytics techniques to identify the dominant weather regimes associated with weather-driven constraint payments
- Estimate the likelihood of weather-driven constraint payments occurring, based on a wide range of possible weather conditions, and place recent events into context

Objective(s)

- Analyse the profiles of weather-sensitive demand and supply in different parts of the system
- Combine simulated weather data with the flow model to estimate the impact of weather on transmission congestion in different parts

of GB

- Analyse the statistical co-dependence of weather-sensitive demand and supply in different parts of the GB transmission system
- Investigate the impact of planned renewable generator installations on transmission congestion
- Investigate the degree to which past constraint payment events can be attributed to the weather

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be deemed a success if:

- The impact that weather has on transmission load is understood in more detail, and clear evidence is presented for how large this impact is and where it most frequently occurs.
- An evaluation of the long-term impact weather has on transmission system demand can be made.
- A clear narrative is presented on how incentivising the connection of renewable generation based on location could benefit consumers.

Project Partners and External Funding

n/a

Potential for New Learning

- Better understanding of the impact of weather on supply, demand and transmission congestion in different parts of the GB transmission system
- A framework for transmission flow modelling that could be developed further, as well as be applied to existing tools used by NGET. This will provide opportunities for future use within both NGET's and other Licensees' network areas
- Estimates of the likelihood of weather-driven transmission congestion and constraint payments given a wide range of possible weather conditions
- Improved knowledge regarding the impact of future renewable deployment on transmission congestion
- Improved understanding of investment risks and rewards

Scale of Project

Creating a simplified transmission flow model will allow for a network-wide analysis of the impact of weather on transmission system congestion. Investigating the statistical link between constraint payments and weather events provides additional insight into the effect of different weather regimes on the transmission system

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

This project will be a desktop exercise.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£360,000

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:

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)

An enhanced understanding of the likelihood and severity of transmission system congestion and constraint payments will enable well-informed decision making and targeted system investments. Any reduction in the level of constraint payments or the postponing of planned transmission upgrades has the potential to deliver value to the consumer in the order of millions of pounds dependent on the market.

This is a research project and the quantitative savings will be reviewed as part of the project closedown report, and as part of any follow-on project(s).

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

The models used and developed during this project could be developed for any area of GB and for the network as a whole. Analysis will be conducted on areas spanning the full geographical range of GB to fully explore the applicability of the proposed work for the whole GB system.

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

No additional costs, beyond the funding of the project(s) themselves would be required to cover the whole GB system, as the method is designed from the outset to address system-wide issues.

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 results will inform contract and investment decisions as well as the planning of transmission system infrastructure, aid in the efficient management of the transmission system, and also help design targeted incentive schemes regarding future deployment of renewables.

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

This project fits within the Managing Assets value area of the Electricity Innovation Strategy.
☑ 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.

A thorough search did not yield any other projects that have investigated the combined effect of the weather on transmission congestion, or constraint payment events at transmission level. The work does build on the findings of previous NIA-funded projects, including:

- Weather Normalised Demand Analytics (WANDA) [NIA_SPEN0022]. This project analysed the impact of weather on demand at a primary substation level in Scotland.
- UK-wide wind power: Extremes and Variability [NIA_NGET0016]. This project used long-term historical weather data to estimate the frequency of different extreme wind generation events.
- UK Regional Wind: Extreme Behavior and Predictability [NIA_NGET0085]. This project analysed the underlying predictability of wind power and investigated the degree to which numerical weather prediction models can accurately forecast wind power generation.

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

The project will aim to evaluate the impact of weather on the transmission boundary constraints. The technology has a great potential to

bring the value for the customers by facilitating well-informed decision making and targeted transmission system investments. As an industry, there is only a limited amount of work being done to better understand this challenge and this work will provide the basis for our understanding of the capabilities of this technology and its limitations.

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

The nature of a research programme means it inherently carries a risk that the research may be unsuccessful and/or identify unforeseen barriers to implementation and National Grid is unable to consider research of this scale as business-as-usual. The NIA funding offers the most appropriate route for NGET to evaluate the how best the weather forecasting can support well-informed decision making and targeted transmission system investments.

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 inherent risk of the project is detailed above and the learning from the project will be directly relevant to all Network Licensees. For this reason, NGET believe this project is appropriately funded through NIA.

This project has been approved by a senior member of staff

☑ Yes