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

Jul 2017

Project Reference Number

NIA_SPEN0022

Project Registration

Project Title

Weather Normalised Demand Analytics (WANDA)

Project Reference Number

NIA_SPEN0022

Project Licensee(s)

SP Energy Networks Distribution

Project Start

August 2017

Project Duration

1 year and 5 months

Nominated Project Contact(s)

Jonathan Fox

Project Budget

£249,000.00

Summary

The study shall include all SPD primary substations across the central belt of Scotland covering both the west and east coast. The wide geographical area is to provide a broad range of input conditions for the machine learning algorithms to ensure applicability across the GB area.

The project shall be a desktop exercise using historic SCADA, generation and discretised weather data. Where available, the project shall use 10 years of hourly data. Each primary substation will be allocated a geographic polygon which represents the service area for the substation.

This data will be used to build and evaluate models which disaggregate electrical demand into load driven by weather conditions and load driven by other customer behaviour. Analysis of the underlying trends will be undertaken.

The output from the project will then be used in network planning and the completion of regulatory reports.

Third Party Collaborators

EUROPEAN POWER FORECASTING LTD

Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

Problem Being Solved

Forecasts of electrical load are used by network operators to determine the volume, type and location of investments.

Load orecasts are based upon the power flows through substations and are adjusted for the embedded generation on the network. Currently, there is no regular adjustment made for the effect of weather upon demand in the local area served by each individual substation. This means that it is extremely difficult to separate out the effect of weather upon demand and the effect of other customer behaviour upon demand (e.g. energy efficiency measures, increases in the number of electric cars being charged, the closure of industrial premises, etc.)

This results in additional uncertainty when making investment decisions leading to under or over investment in individual network areas and therefore suboptimal outcomes for customers. Additionally, it leads to inconsistent regulatory reporting. An example would be a mild winter causing demand to drop and the load index metrics becoming artificially low for that year.

Weather patterns and customer behaviour are two key drivers in electricity demand. By undertaking this project, it will be possible to better understand how these have changed historically within a given licence area and will provide invaluable insights into future demand scenarios. It will also highlight their relative significance and current trends. This will allow asset managers to develop better and more targeted investment strategies. Furthermore, accurate demand models will provide more realistic data for investment risk and cost-benefit analysis and subsequently lead to better returns for customers.

A comprehensive understanding of the effect of weather upon demand is a key enabler for the transition to a DSO model.

Method(s)

- An advanced numerical weather prediction model will be used to simulate hourly weather conditions.
- The location-specific weather data will be weighted by population density and aggregated across the areas served by each of SP Energy Network's primary substations.
- This will be used to create a weather normalised demand model.
- An embedded generation module will be implemented within the demand function in order to reduce generation-related uncertainties.
- The demand model will be trained against recorded data for the period of analysis using advanced machine learning algorithms.
- A comparison of the demand model results vs historical data will provide a level of confidence in the predictions.
- The results will then be used to infer weather vs customer-behaviour trends over the period of analysis and predict future demand scenarios.

Scope

The study shall include all SPD primary substations across the central belt of Scotland covering both the west and east coast. The wide geographical area is to provide a broad range of input conditions for the machine learning algorithms to ensure applicability across the GB area.

The project shall be a desktop exercise using historic SCADA, generation and discretised weather data. Where available, the project shall use 10 years of hourly data. Each primary substation will be allocated a geographic polygon which represents the service area for the substation.

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Objective(s)

- Analyse historical demand data and create normalisation models
- Evaluation of the weather normalised demand model
- Completion of uncertainty analysis against historical data.
- Analysis of demand trends – weather related vs customer behaviour.
- Creation of summary report and data files.
- Delivery of final presentation or paper at industry event/conference.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be considered successful if the aforementioned objectives are realised and the outputs become a useful part of SP Energy Network's suite of planning tools.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project shall be a desktop exercise using historic SCADA, generation and discretised weather data. Where available, the project shall use 10 years of hourly data.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The study shall include all SPD primary substations across the central belt of Scotland covering both the west and east coast. The wide geographical area is to provide a broad range of input conditions for the machine learning algorithms to ensure applicability across the GB area.

Revenue Allowed for the RIIO Settlement

none

Indicative Total NIA Project Expenditure

£249,000

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)

It is clear that an improvement in the ability to forecast the shape and scale of demand will lead to better targeting of investment and reduce the possibility of under or over investment taking place, subsequently leading to better returns for customers. Over the course of RIIO-ED1, the industry is due to invest £1.7 billion in reinforcement.

This is a research project and the quantitative savings of deployment will be reviewed as part of the project closedown report. The method for review will be a comparison between the existing methodologies for identifying load related investment and the opportunities provided by the models created by this project.

As noted previously, this project is also viewed as an enabler for the transition to a DSO model and thus facilitates further indirect savings

Please provide a calculation of the expected benefits the Solution

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As noted previously, this project is also viewed as an enabler for the transition to a DSO model and thus facilitates further indirect savings.

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

The SP Distribution network area was chosen because of the variation in weather patterns, customer types and generation technologies connected. This makes it widely applicable across GB.

The model built will be trained on data from both the west and east coasts, exposing it to different types of weather pattern. Additionally, the model will be exposed to urban, industrial and rural circuits.

The methodology built should be generator type agnostic and therefore suitable for use across GB. The large variety of types of generators connected to the SP Distribution network will allow this to be tested. The additional embedded solar module will ensure that the model is suitable for use by more southern Network Licensees.

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

Calculating and scoping for a wider roll out is part of the scope for this innovation project. Therefore, the following costs are only an estimate.

Assuming an 800km x 1000km box captures the relevant weather patterns accurately, the costs are estimated to be:

- £3,600,000 for the initial work and then

- £370,000 per year thereafter to provide updated forecasts

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)

This project is covered by the challenge of 'Operational and process innovation — driving efficiency and service benefits'. The specific stakeholder priorities that it addresses are '#1 Managing an ageing network.' and '#6 Preparing the network for low carbon technologies.'

☑ 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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes