NIA Project Registration and PEA Document

Date of Submission

Sep 2018

Project Reference Number

NIA_WPD_035

Project Registration

Project Title

CADET (Curtailment and Dispatch Estimation Toolkit)

Project Reference Number

NIA_WPD_035

Project Licensee(s)

National Grid Electricity Distribution

Project Start

October 2018

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Clive Goodman

Project Budget

£275,422.00

Summary

The development of distributed energy resources termed DER (such as wind, solar photovoltaic, hydro, landfill gas, CHP etc) will displace existing conventional methods of generation which historically have provided the necessary response characteristics to maintain the overall integrity of the network. The output of the DER is both variable and uncertain because of its intermittency. On the demand side too, uncertainties are growing due to changes in consumption patterns (e.g. with electric vehicles etc). This scenario is thus transitioning to a less predictable and more stochastic world.

The most common form of analysis undertaken by any DNO for network planning is a load-flow study taking into account the maximum coincident load. With more DER (particularly wind and solar photovoltaic generation), the snapshot of the maximum coincident generation, will also become relevant for network planning. Currently carrying out a multitude of modelling analysis using half-hourly flows at each network point, for different types of DER and demand technology presents WPD with a scaling problem – doing this for an historical year is manageable, but trying to do this for forward planning purposes, using a further number of future energy scenarios would be impracticable using the current software. It is therefore imperative that new modelling capabilities are required to address these challenges.

It has been recognized that WPD will need to develop "forecasting future energy volumes across the network (under different scenarios) to highlight opportunities for flexibility, operability issues and to identify when strategic reinforcement will be needed" in order to facilitate its transition from DNO to DSO. The purpose of this project is to develop customer behaviour models for all types of demand, generation and storage that can be used as an input to the Energy Curtailment (and/or dispatch) Estimation techniques that WPD is developing. There are about 17,520 half-hours in a year; preferably this project will identify sufficient commonality that needs to be assessed to arrive at MWh figures for a year to perhaps several hundred. Specifically, this project will provide a more accurate visibility of future curtailment and potential for flexibility required under modelled scenarios.

Third Party Collaborators

Jacobs

Solutions Mastery Ltd

Isaac Newton Institute of Mathematical Sciences

Problem Being Solved

The development of distributed energy resources termed DER (such as wind, solar photovoltaic, hydro, landfill gas, CHP etc) will displace existing conventional methods of generation which historically have provided the necessary response characteristics to maintain the overall integrity of the network. The output of the DER is both variable and uncertain because of its intermittency. On the demand side too, uncertainties are growing due to changes in consumption patterns (e.g. with electric vehicles etc). This scenario is thus transitioning to a less predictable and more stochastic world.

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Method(s)

The work will be carried out in three phases covering the four WPD's licence areas, comparing two innovative methods. Methods Alpha and Beta have different first phases, but share the replication phases 2 and 3.

Method Alpha Phase 1: Analysis of half-hourly data for a summer for the South West licence area will be selected for this analysis. The detailed analysis will consist of (a) development of the Stochastic Load Flow (SLF) Algorithm (b) assessment of load profile/correlations with meteorological data (c) assessment of hourly, daily, weekly and monthly groupings.

Method Beta Phase 1: Understand the three main independent variables affecting load profiles; weather, demand growth and generation growth across grouped climatic regions.
Perform a study based on the "Monte Carlo" method – that of repeatedly analysing random inputs (conditions) to establish the distribution of outputs (loadings).

 Phase 2: Expansion of Phase 1 techniques across a yearly profile (a) development of the WPD generation/demand clusters (b) for each cluster, repeating the studies described in phase 1, for a set location (c) development of other technology types excluded or minimised under phase 1.

 Phase 3: Generalisation of techniques to other locations (a) application of techniques to other licence areas and locations (b) iteration to grouping techniques based on data from other locations.

Scope

The aims of the project are to: (a) quantify the customer type behaviour to enable the estimation of energy curtailment and dispatch by network flexibility and (b) reduce the number of studies required to achieve the first aim to a reasonable level of accuracy by the grouping of sufficiently similar snapshots of customer behaviour before electrical analysis is carried out.

Objective(s)

The main objective of the project will be the development of customer behaviour models for all types of demand, generation and storage that can be used as an input to the Energy Curtailment (and/or dispatch) Estimation techniques that WPD is developing.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The Key Outputs will be:

1. A data table of a number of snapshots, each with a breakdown of the main customer technology types describing their output in per unit basis on a MW installed base.

2. A duration multiplier for each snapshot to describe how many half hours the snapshot represents.

3. An index for each half hour reduced into a snapshot so that the underlying attributes of the half hour can be extracted, allowing the grouped curtailment of that snapshot to be apportioned across those specific attributes.

4. The methodology followed to determine the snapshot groupings documented for future usage and dissemination to other network and system operators

Project Partners and External Funding

(a) Jacobs Engineering Inc.
(b) Solutions Mastery Ltd, Radstock.
(c) Isaac Newton Institute of Mathematical Sciences, Edinburgh.

Potential for New Learning

The project will provide a more accurate visibility of future curtailment and potential for flexibility required under modelled scenarios hence the benefits are relevant for all DNOs. The changes to the network practice to be adopted across the country will be made available through publications in open literature as well as on-line project documentation on the WPD website.

Internally, a series of workshops will be planned to disseminate the results and policy implications of the findings of the project. It is expected that this will eventually be rolled out nationally to other DNOs. The results will be disseminated through conference(s) and the reports will be made available through the WPD website.

Scale of Project

The project is planned to run over 12 months.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The four WPD licence areas.

Revenue Allowed for the RIIO Settlement

£0

Indicative Total NIA Project Expenditure

£247,880

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 project will provide a more accurate visibility of future curtailment and potential for flexibility required under modelled scenarios. This will result in savings by enabling the rollout of flexible services to be delivered in the second half of the RIIO-ED-1 period.

Please provide a calculation of the expected benefits the Solution

N/A (research project)

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

The method will be created in a manner to enable all suitable sites to be incorporated across all GB network licence areas.

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

As soon as the principles are established then the actual roll-out cost will be dependent on each DNO's in-house capabilities.

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 benefits of providing a more accurate visibility of future curtailment and potential for flexibility required under modelled scenarios are relevant for all DNOs are relevant for all DNOs. The changes to the network practice to be adopted across the country will be made available through publications in open literature as well as on-line project documentation on the WPD website.

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

WPD's Innovation Strategy (July 2018, pg33, Stochastic Load Flows) has identified the wider technical requirements (such as energy curtailment & dispatch) for the modelling of new connection applications and short term investment planning are becoming unachievable with the increase in data. This project will address this challenge by developing and comparing two innovative methods to reduce the amount of data required whilst maintaining an acceptable level of accuracy.

☑ 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.

This project is unique because it will assess in detail the daily, seasonal and yearly network variances so as to provide a more accurate visibility of future curtailment and potential for flexibility required under modelled scenarios.

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 is innovative as it entails detailed analysis of the daily, seasonal and yearly network variances which will provide a more accurate visibility of future curtailment and potential for flexibility required under modelled scenarios. This will ensure a better utilization of assets through the ANM (Active Network Management) and the dispatch of flexible services as an alternative to some reinforcements.

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

(a) The project will utilise the specialist skills of third parties (such as an academic institution and large multinational engineering & technology firm); these third parties have a major role to play in the research and technological developmental activities of network licensees such as WPD. (b) This project is particularly attractive for long-term, applied research which may not be subject to commercial pressures and where the risk of failure is likely and widely accepted. (c) This is a small-scale innovation project with lower Technology Readiness Levels (TRL). Nevertheless, WPD will maintain close contact with the research investigations and will have access to a wider range of activities being undertaken by these third parties.

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) The R&D project can only be funded via the NIA scheme as the method and potential benefits have not been proven. (b) It is a small research innovative project directly related to WPD and other licensees. The project has the potential to deliver financial benefits to WPD and its customers. (c) Dedicated project management reviews will be undertaken to control and mitigate the risks to the project.

This project has been approved by a senior member of staff

☑ Yes