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NIA Project Registration and PEA Document

Date of Submission

Feb 2014

Project Reference Number

NIA_NGET0138

Project Registration

Project Title

Frequency sensitive electric vehicle and heat pump power consumption

Project Reference Number

NIA_NGET0138

Project Licensee(s)

National Grid Electricity System Operator

Project Start

April 2014

Project Duration

1 year and 7 months

Nominated Project Contact(s)

Rhiannon Grey

Project Budget

£84,000.00

Summary

National Grid has a licence obligation to control system frequency within the limits specified in the 'Electricity Supply Regulations'; +/- 1% of the nominal frequency of 50.00Hz. System frequency is determined and controlled by the real time balance between system demand and total generation.

Historically, electricity generation has flexed to meet demand, in order to maintain frequency within the operational limits. However, this dynamic is likely to change in the future, as a result of both changing supply and demand, bringing with it new challenges for system operability.

Over coming decades, intermittent renewable generation will account for a greater proportion of the UK's electricity supply. For both commercial and technical factors, this type of generation is less flexible than traditional coal and gas generation and therefore less able to respond to frequency imbalances. In addition, new demand loads from electric vehicles and heat pumps are expected to change the demand profile. As uptake increases, these new loads not only have the potential to increase total annual electricity demand but also to increase demand over peak if no action is taken. Without appropriate measures in place, these loads could be inflexible; therefore the way in which the electricity system is balanced will need to change in order to remain economic, efficient and coordinated.

It may be possible to utilise increased demand loads from electric vehicles, heat pumps and other technologies in an innovative way to deliver cost effective solutions. One such option is frequency responsive technologies, capable of monitoring system frequency and temporarily adjusting their energy consumption accordingly. Such innovative solutions are relatively unexplored at present and little is known about their technical and commercial viability. Enhancing our understanding of the viability of this service, and of the challenges and opportunities surrounding it, would provide new learning that would allow industry bodies to realise a service that has the potential to cost-effectively address the challenges of transitioning to a low carbon economy.

At present National Grid does not contract, directly or indirectly, with domestic customers. However, with new demand sources likely to increase total annual and total peak power demand over coming decades, there is a great deal of potential for demand side response to provide an effective balancing tool. Therefore, the outputs of this project will also promote discussions of National Grid's involvement

in 'beyond the meter' activities.

Nominated Contact Email Address(es)

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Problem Being Solved

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Method(s)

Research

The desktop study will investigate the potential to use system frequency to control the power consumption of electric vehicles and heat pumps, and explore the value and cost of making these technologies frequency sensitive.

Specifically, the study will aim to test:

- The commercial challenges and opportunities of using EV charging and heat pumps for response
- The technical challenges and opportunities of using EV charging and heat pumps for response
- The logistical challenges of installing assets to facilitate the service.

The project will produce a report exploring the aforementioned areas.

Scope

The project is intended to investigate the potential to use system frequency to control the power consumption of electric vehicles and heat pumps, and explore the value of making these technologies frequency sensitive, through testing the associated commercial, technical and logistical challenges and opportunities.

The desktop study may build on experience to date of using technology which has the capacity to monitor system frequency and

temporarily adjust power consumption if a frequency imbalance is detected. This type of service is currently provided by Open Energi in the form of Dynamic Demand [™], through institutes and industries such as universities and hospitals, the water industry and commercial refrigeration. This project would instead focus on technology at a domestic level, and explore the viability and value of EV chargers and heat pumps capable of monitoring system frequency and decreasing or increasing power consumption depending on whether a fall or rise in frequency is detected. Alternatively to building on the experience of Open Energi, the study may consider existing innovative approaches which are not yet at a commercial level.

In testing the commercial, technical and logistical challenges of this service, the desktop study will aim to answer, but not be limited to, the following questions:

- How could this service work commercially
- What value could this service potentially provide and to whom would it deliver value?
- Where are the commercial conflicts and barriers, if any?
- Who could and should deliver this service?
- What is the impact on EV battery life of adjusting charge rate and on heat pumps of adjusting power consumption?
- What is the impact of this service on DNO networks?
- What is the impact on the end consumer?
- Does the service have the capacity to generate a significant financial benefit for the end consumer?
- How would such an approach be implemented?
- What is the most suitable approach to installing the technology in electric vehicle chargers and heat pumps going forwards?

The answers to these questions will provide an understanding of the viability and value of using frequency sensitive EV charging and heat pump power consumption as a means of responding to system frequency imbalances, as well as identifying barriers to introducing the service and areas for further research. From this, appropriate next step can be determined. If the desktop study indicates this service may deliver value, and is technically and commercially viable, a practical demonstration project may follow, in order to enhance understanding of how the service would work practically and how consumers may respond to incentives; however, a practical demonstration is not within the scope of this project.

Objective(s)

To complete a desktop study to investigate the potential to use system frequency to control the power consumption of electric vehicles and heat pumps, and explore the value of making these technologies frequency sensitive, through testing the associated commercial, technical and logistical challenges.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The output of the project will be a report that enhances understanding around the viability and value of frequency sensitive electric vehicle charging and heat pump power consumption as a means of responding to imbalances in system frequency.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The project is a desktop study to further understanding in this area; no pilot or trial will be included in the scope of the project.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project is applicable to electric vehicle charging and heat pump power consumption across GB.

The research will be undertaken by the supplier work area, this location is to be confirmed.

Revenue Allowed for the RIIO Settlement

Zero.

Indicative Total NIA Project Expenditure

Budget information will be added after the procurement event has concluded.

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)

Frequency responsive electric vehicle charging and heat pumps have the potential to be rolled out nationwide.

National Grid's 2013 UK Future Energy Scenarios project that 0.2 million – 0.56 million electric vehicles will be on the UK's roads by 2020, with an annual demand of 0.4 – 1.5 TWh (based on 2013 Slow Progression and Gone Green Scenarios). Projections also suggest there will be 0.3 million – 1.2 million heat pumps in the UK by 2020, with an annual demand of 0.9 – 3.5 TWh. The projected Gone Green figures for both electric vehicle and heat pumps increase exponentially up to 2030 and beyond.

For financial year 2012/13, the cost of reserve and response was £327.23 million.

Frequency sensitive EV charging and heat pump power consumption has the potential to deliver cost savings through reducing the requirement to procure other balancing services from traditional options. The desktop study will investigate the value of this service in further detail. The calculations below provide estimated cost savings, based upon the extent to which this innovative service reduces balancing costs.

Innovative service reduces balancing costs by 10% = £32.7 million cost savings

Innovative service reduces balancing costs by 20% = £65.4 million cost savings

Innovative service reduces balancing costs by 30% = £98.2 million cost savings

These estimated cost savings are based on the cost of response and reserve for FY2012/13; the annual cost of response and reserve is likely increase in future with increasing renewable generation.

Please provide a calculation of the expected benefits the Solution

Not applicable as the project is a desktop research study.

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

The desktop study will be conducted by a third party on behalf of National Grid in its role as System Operator for GB. As a

consequence, the study will consider electric vehicle charging and heat pump power consumption across GB, and therefore no replication will be necessary.

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

A practical demonstration project is likely to follow this desktop research project. The demonstration project will define the cost of roll out and determine how the service may be implemented.

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

Little is currently known about the potential to utilise increased demand loads from electric vehicles and heat pumps as a means of responding to system frequency imbalances, whilst delivering cost savings. The project will enhance understanding of the technical and commercial viability of this service and identify potential value and opportunities, barriers and areas for further research. Therefore, the findings could benefit market participants, such as aggregators currently providing other balancing services, by highlighting a commercially-viable cost effective service they can develop and deliver to the System Operator.

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

- 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