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

Oct 2017

Project Reference

NIA_UKPN0028

Project Registration

Project Title

Recharge the Future

Project Reference

NIA_UKPN0028

Project Licensee(s)

UK Power Networks

Project Start

October 2017

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Jack Lewis Wilkinson & Thazi Edwards

Project Budget

£239,750.00

Summary

The project will model the growth and profiles of on street, work, residential and commercial chargers connected directly and indirectly to the LV, HV & EHV distribution networks. Commercial fleet depots will not be included in this study. This is due to:

- These connections are expected to be sporadic in nature, making it impossible to predict the date, size, load profile and location that these depots will connect.

These connections must be approved by the network operator, so will not contribute to unplanned capacity shortfalls.

Nominated Contact Email Address(es)

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Problem Being Solved

The Office for Low Emissions Vehicles reported a 250% growth in the number of Ultra Low Emissions Vehicles (ULEVs) registered in Great Britain over the last 2 years. This ULEV uptake has been dominated by Electric Vehicles (EVs), and will continue to accelerate as battery technologies become cheaper and as government policy, incentives and investments continue to support them.

As the number of EVs increases, so does the electricity demand from them. This demand is expected to comprise of a significant proportion of load growth over the coming decades. It is therefore important that the accuracy of load forecasts are enhanced so that

the time and place of growth is confidently understood; especially for low capacity, behind the meter chargers, whose locations are unknown to the DNO. Risks could otherwise be posed to:

- A DNO's ability to predict firm capacity shortfalls, thus impeding its ability to provide a secure electricity supply to its customers. This is a key DNO obligation.
- Growth in EV uptake. This is because DNOs and possibly the SO may be forced to impose capacity caps, whilst reinforcements (with large lead times) take place on their networks. Government policy encourages the transition from Internal Combustion Engine Vehicles (ICEVs) to low emissions vehicles like EVs. DNOs & the SO therefore should aim to not be a barrier to this.

This project aims to reduce the uncertainties associated with the time and location of EV load growth, enabling more efficient planning of network interventions, a reduced risk of firm capacity shortfalls and a reduced risk that capacity caps will have to be imposed on parts of the network.

Method(s)

Three main streams of work will be used to complete this project:

1. Model Enhancement

The EV module of 'Element Energy Load Growth' model, which UK Power Networks currently uses to forecast EV load growth, will be enhanced. The enhancements will enable modelling of the effects of geospatially varying charger utilisations in complex environments, such as London, where low emissions zones and super charger infrastructure are likely to have large impacts on electric vehicle load distribution.

2. Charger Use Study

The Charger Use Study will have three main objectives:

a. Define and quantify the dynamic relationships between charger load profiles and demographic, geographic or other related characteristics so that suitable load profiles can be assigned to chargers in various locations.

b. Assess the impacts of commercial supercharger infrastructure and other uncertainties (such as government policies, smart charging, vehicle to home & vehicle to grid technologies); creating a set of scenarios which illustrate these uncertainties so that sensitivity analyses can be completed, demonstrating advantages and disadvantages of adopting various strategies, technologies and policies. These findings may be used to inform DNO EV strategies, and advise government on EV policy.

c. Formulate a methodology to validate the load growth model, acquiring the appropriate information to complete this.

The Charger Use Study will consist of four work packages:

- Literature & Data Review – to understand and learn lessons from research that has already been completed.
- GB EV Market Study – to understand the current market and the various ways in which it may change in order to characterise and detail each sensitivity scenario.
- Study of Charging Behaviour in regions with high electric vehicle penetration – understand how charging behaviours in regions with high electric vehicle penetration (such as California and Norway) are effected by demographic, geographic or transport network conditions, so that charger load profiles and utilisations are understood as electric vehicle penetration increases.
- Report – a publicly available report which details the studies taken place, their findings and lessons learned, but also recommendations on modelling parameters and sensitivity scenarios.

3. Reinforcement Impact Assessment

The study and forecasting model will be used to generate a set of load forecasts for all EPN, LPN and SPN substation under each set of scenario conditions. LV & HV impact analyses will be conducted using Imperial College's Load Related Expenditure Model. EHV impact analyses will be completed by UK Power Networks' Infrastructure Planning Teams.

Scope

The project will model the growth and profiles of on street, work, residential and commercial chargers connected directly and indirectly to the LV, HV & EHV distribution networks. Commercial fleet depots will not be included in this study. This is due to:

- These connections are expected to be sporadic in nature, making it impossible to predict the date, size, load profile and location that these depots will connect.

These connections must be approved by the network operator, so will not contribute to unplanned capacity shortfalls.

Objective(s)

- Publish a report on the outputs of the Charge Use Study's relevant learning.
- Revise the EV forecasting tool based on the Charger Use Study findings.

- Test the revised EV forecasting tool by developing revised load forecasts and assessing the potential impact on investment required in the medium to long term.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success of the project will be judged against the following criteria:

- The load forecasting tool is adapted so that the accuracy of its electric vehicle module is enhanced at a substation level.
- A study is undertaken to understand the way in which various charging infrastructures will be used in the future, developing a series of scenarios to illustrate the uncertainties and sensitivities which the load forecast will have.
- The study and forecasting model will be used to generate a series of forecasts which will be used to conduct impact analyses of the network.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

The reinforcement impact assessment shall be carried out on the SPN, EPN and LPN networks. As each assessment requires data specific to the licence area, load forecasts must be generated for SPN, EPN & LPN too.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The project will be carried out across all three of UK Power Networks DNOs.

Revenue Allowed for the RIIO Settlement

There is no revenue allowed in the RIIO ED1 settlement for these works.

Indicative Total NIA Project Expenditure

£239,750 is the total expenditure that UK Power Networks expects to be incurred during the duration of the project.

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 estimated that the project will save £525,039 (NPV) over ED2.

Please provide a calculation of the expected benefits the Solution

Although this project offers many benefits from risk reduction, the most concrete benefit envisaged is the ability to identify where load growth will require multiple substation assets to be reinforced that have different power ratings. In these cases, two or three assets (e.g. cables, transformers and switchgear) can be reinforced at the same time, meaning that fixed mobilisation and demobilisation costs can be combined.

The savings are realised in ED2, which is assumed to last eight years for the purposes of this calculation.

Base Cost: £787,558 NPV
This was calculated using the mobilisation and demobilisation costs of all large (>1£m) ED1 network reinforcements, assuming that this would be a similar figure to those in ED2. These costs are included in the table below:

Number of ED1 Reinforcements Over £1m		**Cost of Mobilisation & Demobilisation**	
£1,000k<>$3,500k	£3,500k<	£1,000k<>$3,500k	£3,500k<
32	34	£20,698.40	£29,389.14

Method cost: £ 262,519 NPV
The method costs is the new cost of mobilisation and demobilisation. This has been calculated by combining mobilisation and demobilisation costs of cables, switchgear and transformers at each reinforced substation, instead of reinforcing separately.

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

The project will be completely replicable throughout the whole of GB in both urban and rural networks.

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

The following work packages must be replicated by each DNO that wishes to realise the benefits of this project:
Assuming that other DNOs use the same tools and consultancies in the same way the UK Power Networks is planning to, the contractor costs are listed below:

- Process and input data into load forecasting model - **£5,000**
- Generate load forecasts for impact analysis - **£2,000**
- Carry out assessment of LV & HV networks using Imperial College's LRE model - **£31,000**

And an estimation for the cost incurred per DNO for internally completed work is:

- Carry out impact assessments of EHV network - **£54,000**

The total estimated spend is £92,000 per DNO. There are 11 other DNOs in GB, meaning that the total roll out cost across GB is estimated at **£1,012,000**

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)

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