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## NIA Project Registration and PEA Document

### Date of Submission

Apr 2018

### Project Reference Number

NIA\_UKPN0033

## Project Registration

### Project Title

TransPower

### Project Reference Number

NIA\_UKPN0033

### Project Licensee(s)

UK Power Networks

### Project Start

April 2018

### Project Duration

4 years and 4 months

### Nominated Project Contact(s)

Evie Trolove

### Project Budget

£2,143,717.00

## Summary

This project intends to encompass the necessary work to understand the value and further prepare the business for sources of network flexibility such as V2G.

### Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

## Problem Being Solved

The integration of renewable energy sources, and the forecasted growth of EVs present capacity, voltage and power quality issues to the distribution network. UK Power Networks forecasts between 1.2 and 1.9 million additional EVs on its network by 2030 leading to reinforcement costs of approximately £150k-250k/MVA (ca. £1,400 per vehicle based on an average 14kW charging rate after diversity). Until now there has been limited demonstration of V2G in the UK, in particular DSO services and revenue stacking have yet to be explored, both of which are key to unlocking the commercial business case and customer offer of EVs.

## Method(s)

This project explores V2G technology as one smart solution capable of reducing reinforcement costs due to electric vehicle (EV) uptake. UK Power Networks is evaluating the technical, commercial and customer proposition of V2G technology to the distribution network. This project will investigate network impact and flexibility services for several different vehicle customer segments from domestic, to commercial and public charging through demonstrator trials and collaborative research and development.

## Scope

The scope for this project is focused on UK Power Networks' activities contributing to several Innovate UK (IUK) V2G competition projects. The innovative trials will only evaluate the case for V2G equipment connected on our distribution networks for the above listed projects and will not be responsible for the connection of this equipment to the network.

A major challenge identified throughout the project to date is the complexity of the current V2G connections process. To develop a more fit for purpose approach, we have increased the project budget to fund the development and trial of a data-driven process to

automate the assessment of domestic V2G connections. If successful, this initiative will make V2G more accessible for domestic consumers and can be expanded to include all types of low carbon technologies. This aligns with the original objective of the project, which was to understand and prepare the business for sources of flexibility such as V2G.

Additionally, the duration of the project has been extended to account for delays to customer recruitment and installation of charge points due to COVID-19.

## Objective(s)

A greater understanding and use of mobile battery assets (vehicles) has the potential to defer network reinforcement and support network resilience, facilitating the connection of additional loads and low carbon technologies. It is estimated that the benefits of V2G could deliver in the order of £450 per vehicle (customer benefit) annually based on existing whole system flexibility markets. The project will carry out tests on existing and new flexibility services with the aim of being able to procure similar services under business as usual after the project.

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

## Success Criteria

The delivery of the following outcomes will be considered when assessing whether the project has been successful:

- 1) Exploration of system integration options to inform UKPN's approach on aggregator engagement and smart charging architecture
- 2) Tested DSO services interface platforms
- 3) Identified location-specific opportunities to resolve network constraints
- 4) Completion of tests for at least two flexible services with potential to procure in future
- 5) Review of V2G business case outcomes to inform potential smart savings in next regulatory period
- 6) Standardised requirements and specification for procuring types of flexibility from vehicle services
- 7) Exploration of future commercial contracts between UK Power Networks service procurement and aggregator bodies

## Project Partners and External Funding

The Innovate UK funded project lead partners are listed below. The total funding granted by Innovate UK to these projects is £11m, which does not cover the cost of UK Power Networks supporting activities. UK Power Networks is funding its contribution to these projects through the Network Innovation Allowance.

Lead partners: Nissan (e4future), Octopus Energy (PowerLoop), SSEU (Bus2Grid), Upside Energy (V2Street), Ovo Energy (Sciurus). Further information on role of other project partners is listed on the UK government site below: Chargepoint Services, Energy Saving Trust, Navigant, Open Energi, Imperial College London, National Grid, Newcastle University, Northern Power Grid, Nuvve, BYD, University of Leeds, Durham County Council, E-car club, EDF, Future Cities Catapult, Loughborough University, Southend on Sea Borough Council and Ubitricity.

<https://www.gov.uk/government/publications/innovate-uk-funding-competition-winners-2017>

External suppliers will be used to support UK Power Networks activities, the procurement process will include a tender for several workstreams.

## Potential for New Learning

This NIA project will involve capturing learning from all Innovate UK V2G projects relevant to UK Power Networks. This learning will be focused on understanding implications of V2G technology connected to the electricity network and the value of benefits to establish a future business case from local services. These UK real world trials will be the first to demonstrate deployments at significant scale and across several use cases. New learning reports will include a V2G network impact assessment, network cost benefit analysis and specifications for vehicle flexibility services.

Learning will be shared both through the requirements stipulated for knowledge dissemination defined by Innovate UK as well as through DNO specific communication channels including the Low Carbon Network Innovation conference and the Energy Networks Association Low Carbon Technology Working Group.

The project will contribute to the development of best practice V2G connections processes through the development of a common industry connections form in collaboration with ENA and the working groups undertaking review of Engineering Recommendation G99.

## Scale of Project

The large scale of this NIA project enables potential learning for demonstrator trials across several customer segments to test the network value proposition from different charging use cases including commercial fleet, domestic and public charging.

A significant financial investment is required in order to support and generate learning from a high volume of trial deployments. Benefits for V2G can only be realised once considerable levels of EV penetration have been achieved and more mature local flexible markets are developed. In order to release tangible network benefits at specific locations the V2G trials require the aggregation of vehicle assets in groups of several hundred kVA. This aligns with flexibility requirements set by recent UK Power Networks flexibility tender in 2017.

This project aims to demonstrate V2G with 300 vehicles. We believe this is appropriate to understand the potential value of the technology whilst remaining a very small proportion of the estimated population of EVs in UK Power Networks' area by 2030 (2.4 – 4.8m). Fleet recruitment has been more challenging than anticipated due to uncertain revenue streams, limited vehicles models and competing projects. As a result, the number of vehicles expected to participate in the trial has been reduced. This does not impact the scope/cost of TransPower deliverables.

### Technology Readiness at Start

TRL3 Proof of Concept

### Technology Readiness at End

TRL7 Inactive Commissioning

### Geographical Area

The geographical area will include sites where the IUK demonstrator trials take place. These locations will be defined as part of the site selection and customer recruitment phase of the project and will be focused on locations of network constraint. These locations include regions across all three of UK Power Networks' licence areas, however will be ultimately dependent on where customer recruitment is successful.

Innovate UK V2G project trials will be taking place across other network license areas, specifically the e4future project will include V2G trials in Northern Power Grid's license areas, however, this project will focus primarily on the impacts to only UK Power Networks' licence areas.

### Revenue Allowed for the RIIO Settlement

No revenue has been allowed in the RIIO-ED1 settlement specifically for vehicle to grid, this technology was not expected to enter the UK market at the time of the ED1 business plan submission.

### Indicative Total NIA Project Expenditure

£2,143,717 is the total expenditure which is expected to be incurred.

## 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)

By 2030, our current projection is that there will be over 70,000 V2G capable vehicles connected to UK Power Networks' licence areas, based on a conservative estimate that less than 5% of vehicles will be V2G capable. If the solution is rolled out at this scale it is estimated that approximately £8m savings in reinforcement could be made annually.

#### Please provide a calculation of the expected benefits the Solution

Local Value e.g. DNO reinforcement  
7.05 Total MW from UK Power Networks project trial  
£987k Approx. cost of reinforcement ~£140k per MVA  
Cost-Benefit for ED1  
Base Cost = £987,000

20% NPV saving estimate on reinforcement, reference taken in line with deferment actuals from FUN-LV project cost benefit analysis (Tier 2 LCNF) where an average of 200kVA capacity released enabled deferment on secondary reinforcement costs by approximately eight years.

Method Cost = ~£800,000 (20% saving on £987,000 by deferring eight years) NPV: Base Cost – (Method Cost – Benefits) = £187,000

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

By 2030, it is projected that there will be at least 6 million\* EVs in the UK, 5% V2G capable estimate, thereby totaling 290,000 V2G EVs with the potential to offer significant flexible services to alleviate local network constraints.

\*Element Energy, UK EV uptake, 2010, Extended Scenario projection

[http://www.element-energy.co.uk/wordpress/wp-content/uploads/2012/05/EVs-in-the-UK-and-ROI\\_final-report\\_10.12.10.pdf](http://www.element-energy.co.uk/wordpress/wp-content/uploads/2012/05/EVs-in-the-UK-and-ROI_final-report_10.12.10.pdf)

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

V2G charging infrastructure is not expected to require any additional costs to GB electricity networks over traditional EV charging infrastructure, on the contrary it is expected that reinforcement costs will be reduced for GB.

The costs of V2G chargers will be covered by EV customers. At this early stage of the market these chargers cost ~£6,000 which is more than double the cost of traditional EV chargers, however, this is expected to reduce significantly as a competitive market develops. Based on today's prices V2G chargers would cost EV customers approximately £83 billion across GB .

## 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

Once the project is complete, the learning could be used by all network licences as EV uptake will be nationwide. The learning will inform their flexibility arrangements, connection and planning processes to increase the facilitation of EVs.

### 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.

This NIA project has been scoped to encompass UK Power Networks' activities contributing to several Innovate UK (IUK) V2G competition projects. By pooling this involvement across a portfolio of V2G IUK projects UK Power Networks will ensure commonality, standardisation and no unnecessary duplication.

Until now there have only been research V2G projects in the UK that this project will build on. Earlier this year, Northern Power Grid commenced it's 'Vehicle to Grid (V2G) - the network impact of grid-integrated' project. However, the use cases and respective flexibility services in this project will not be explored in NPG's project or elsewhere previously in the UK.

### 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**

Vehicle to grid technology is still under development, trials have been conducted outside of the UK but have not been widely deployed and there are no commercial products in the market. The rapidly increasing high penetration of EVs in UK Power Networks' licence areas (particularly London) will enable a real world demonstration of network impacts and opportunities through development of the first UK local vehicle flexibility services. As yet, the UK market for these services is still under developed and EV penetration is low.

### **Relevant Foreground IPR**

n/a

### **Data Access Details**

n/a

### **Please identify why the Network Licensees will not fund the project as part of it's business and usual activities**

Relying on this technology to provide network flexibility currently poses too high a risk in terms of the business case, customer acceptance and operational performance to justify a viable business investment. Despite these challenges it is expected that this technology will grow through various trials regardless and UK Power Networks is best placed participating in this progression to inform industry learning whilst also mitigating any detrimental network impact. As an unproven business case, the Network Licensee believes that it is appropriate to use NIA funding to developing the solution at this stage.

### **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**

As noted in the NIA guidance, certain projects are speculative in nature and yield uncertain commercial returns. This is the case with this project. Additionally, this project requires the support from network innovation funding as the alternative funding arrangements, Innovate UK, are primarily aimed at investment for growth of new UK businesses and not the use of DNOs. The following risks are indicative of requirements for further research and development, through support of the NIA, before such solutions could likely be successful in a commercial environment: • Commercial – Customer uptake is low due to current EV penetration and high cost of V2G technology. • Technical – The availability, scalability and reliability for vehicles to provide flexibility services is currently unknown across these use cases. • Operational – The location, size or charging patterns of V2G assets may not be sufficient to meet mitigate constraints of distribution networks • Regulatory – A specific licence provision for vehicles to provide services to the grid does not currently exist.

### **This project has been approved by a senior member of staff**

Yes