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NIA Project Registration and PEA Document

Date of Submission

Dec 2019

Project Reference Number

NIA_WPD_049

Project Registration

Project Title

Electric Nation - PoweredUp

Project Reference Number

NIA_WPD_049

Project Licensee(s)

National Grid Electricity Distribution

Project Start

January 2020

Project Duration

2 years and 7 months

Nominated Project Contact(s)

Ricky Duke

Project Budget

£2,594,486.00

Summary

The Electric Nation V2G project will implement an EV bi-directional V2G charging platform to test the effects on low voltage networks for future use of this technology by electric vehicle users. The project will establish a network of between 90-110 V2G chargers within domestic properties. The chargers will be divided into 3 to 5 groups of circa. 25 units each; these groups will be offered to partner energy suppliers and aggregators who are offering or developing advanced energy services that can utilise battery storage. By utilising the Crowd Charge platform these partners will be able to easily and quickly experiment with charging and discharging the vehicle batteries to suit their energy trading requirements. The data gathered from the chargers will give a unique insight into possible future demands on the low voltage network driven by energy trading and grid services. Furthermore, the Crowd Charge platform will be used to control charging across the whole network, as an additional supervisory control layer, to keep within DSO specified current limits to simulate a constrained node in the LV network (feeder or substation). It is envisaged that an element of the properties may also have solar generation attached and study of the whole home demand will be included as part of the trial.

Problem Being Solved

It is already known that the transition to electric vehicles will double the load per house where a car is being charged (based on 12,000 miles per year) and bi-directional charging could be utilised in up to 15% of homes by 2040 (ref National Grid Future Energy scenarios report 2019). Such devices bring a potential issue for low voltage networks with multiple cycles of charge and discharge greatly increasing the throughput of energy; exacerbated by their higher connection powers (up to 7kW) and much larger battery capacities (up to 90KWh), in comparison to existing stationary battery storage. The energy flow for these batteries will be directed by various energy suppliers who will provide end users with low cost electricity or even pay for use of the battery flexibility. Understanding the nature of this energy flow is essential in developing connection policy and for facilitating sufficient network planning to avoid voltages deviating from statutory voltage limits.

Method(s)

In this project, up to 110 homes (minimum of 90) with existing EV users will be equipped with Vehicle to Grid (V2G) chargers to study and then manage the throughput of energy. To replicate the likely future situation, up to five energy service providers will be invited to provide unique V2G profiles which will be delivered via a Charge Point management platform (Crowd Charge); this should produce a wide range of use cases for which data will be gathered to produce charger use profiles. These profiles will be served to a network modelling tool (EA technology Network Assessment Tool) to model the effect on a range of networks at varying levels of EV penetration. In turn this modelling will be used to provide "V2G use envelope parameters" that will describe any constraints that need to be applied to the use of such assets. The constraints will then be distributed across the whole population of V2G installations taking

into account the requirements for vehicle use. As part of this distribution, any restrictions to delivery of energy service will be identified on an event-by-event basis and the cost of any non-delivery evaluated. This should inform the value of incentives required for a commercial low voltage network demand/export response service to be offered by the Distribution System Operator (DSO).

Scope

The scope of the project is to engage and recruit between 90-110 participants to install V2G charging and control equipment in domestic properties across WPD's four licence areas. The chargers will be split into various groups of similar size and assigned to the on-board energy suppliers (up to 5). Each supplier will then use their group of chargers to test their various energy services utilising Crowd Charge's demand management charger platform which provides optimised charging sessions, whilst keeping within the DNO network limits. The effect of these services on the LV network will be modelled and reported on, including the use of this real world V2G data in a network assessment tool.

Objective(s)

The aims of the project are as follows:

1. Explore and report on the impact of V2G charging on the LV network utilising end-user trial charging data and analysis.
2. Demonstrate, via modelling, to what extent V2G can assist with management of LV network demand.
3. Examine how sophisticated dynamic bi-directional energy services based on vehicle battery storage, from a variety of energy suppliers, may impact the LV infrastructure.
4. Provide recommendations for policy and commercial frameworks on V2G services.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success of the Electric Nation V2G project will be based on:

1. Presentation of the final report, data analysis and project's findings to WPD and key industry stakeholders at the dissemination event, held in the first quarter of 2022.
2. Recommendations/suggestions to WPD's V2G services policy and commercial frameworks.
3. Specify and provide a standard dataset that can be used by a network modelling tool to evaluate impact of V2G charging on LV networks.
4. Using a network modelling tool to forecast the effects of V2G charging at varying levels of uptake; this will be based on a mix of dynamic bi-directional energy services.

Project Partners and External Funding

Crowd Charge – Responsible for project management and delivery

EA Technology Ltd – Modelling the LV network and integrating trial outputs into the Network Assessment Tool

Potential for New Learning

V2G hardware, the associated energy trading services and how these interact and operate together while incorporating network control from the DNO, remains an unknown topic as a Business as usual (BAU) proposition to date. PoweredUp investigates these areas and will increase the understanding and collaboration between the DNO, the energy suppliers and the charging control platform service provider Crowd Charge in preparation for a future world where V2G charging is commonplace. As V2G technology and energy services have not been investigated in full yet, this allows for a great opportunity to increase the learning and understanding around the industry of which PoweredUp will contribute.

The outputs from this project will also feed outputs into industry workshops and consultations which will help shape the future for V2G as business as usual.

Scale of Project

Between 90 and 110 home installations for EV users with a trial of energy services and data collection over 18 months with c.30,000 charge plug in cycles. Total project duration of 2 years 6 months. Participants will be recruited exclusively from all four of the WPD licence areas.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL8 Active Commissioning

Geographical Area

This project will involve up to 110 installations within customers' homes spread throughout our 4 licence areas, South West, South Wales, East and West Midlands.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£2,335,083.00

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)

As electric vehicles scale upwards, it is anticipated that ~5,601 ground mounted transformers will be running between 100-110% capacity by 2030 (taken from the Network Assessment Tool), at a potential reinforcement cost of c.£84M.

By 2030, around c.25% of households will have a plug-in EV. On the vulnerable areas of the network identified for V2G assistance, 20% of the EV drivers would be recruited to provide local network support on behalf of the DNO (and their local community).

Assuming approx. 75 households per ground mounted transformer (x 5,601), this involves supporting 420,075 households. It is estimated around one in four (105,019) would have an EV by 2030. To maintain safe network limits for these feeders, 20% of the EV chargers would be contracted by the DSO to provide V2G balancing. The cost to provide the smart service (including compensating the driver) is estimated to be £15 per month (£180 p.a.). So for the 5,601 areas, controlling 21K V2G chargers would cost £3.8M per annum (based upon an operational business-as-usual case), instead of an £84M one-off reinforcement investment.

Please provide a calculation of the expected benefits the Solution

As we do not yet fully understand the impact of V2G across our LV networks, allowing suppliers and users to implement V2G units with no sight of profiles against it would mean that we would need to re-enforce the network appropriately to account for both the full generation and the full demand separately. This could cost up to c£15,000 per secondary substation, amounting to £84 million across the predicted 5,601 overloaded substations by 2030.

The project will aim to develop a set of operating parameters for which V2G can operate within our network, thus achieving goals of peak shaving and avoiding re-enforcement costs. By completing the project at a cost of £2.6 Million and an on – going cost of £3.8 million to control the chargers per year, over a 10 year period the project will save £35.8 Million. It is expected that solutions after this point will evolve to become more cost effective for on-going network control.

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

The proposed solution would be applicable to any GB network area, including single and three phase architecture, and can be flexibly implemented to any residential setting, tailored to suit individual DNO/DSO requirements.

Working with each network operator, the parameters for implementation can be agreed – and the overall savings can be estimated using similar methodology as outline in section 2b, for example to cover networks anticipated to 100-110%, or perhaps 100-125% etc. Appropriate reinforcement costs can then be applied by region to review the benefits offered by deferring or avoiding reinforcement.

The model could also be extended to evaluate implementation across appropriate commercial sites (which have suitable vehicles and significant flexibility to support the network).

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

When evaluating the cost of roll-out, we would assume that in the future EV users are responsible for the purchase of the V2G chargers as part of an overall energy supply arrangement that delivers favourable overall energy costs. The cost for licensing a software solution such as Crowd Charge would be circa £100 a year for a V2G charger and circa £30 a year for a simple smart charger. This is a new area of digital energy services and it is unclear whether customer, supplier or DSO would bear this cost or how it might be split. In addition, the cost of approving installations may be reduced due to this project providing guidelines and processes that simplify approvals for V2G installations. A DSO would have a set up cost of circa £50,000 to integrate the platform with any legacy monitoring or planning software applications and updates to these connections would incur additional charges as required.

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

V2G is expected to become a more utilized technology in the future with National Grid predicting that 15% of homes in GB will be equipped with V2G by 2040. It is anticipated that supplier will lead V2G operation, and it is important to understand how suppliers will want to use this resource and the effect that aggregated V2G will have on the low voltage distribution networks, one of the projects outputs will be a set of V2G operating parameters with other DNOs will be able to adopt.

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.

A considerable amount of research is being carried out in this area, however this is generally supplier or charger company lead and does not focus on the likely real-world situation for a DNO should many EV users utilise this technology. We have reviewed the current smart charging and V2G projects in the public domain including the following:

- Worldwide V2G Projects – UKPN 2018 report “Global Roadtrip” shows the projects around the world and highlights that DSO services are underrepresented generally (p.29) as are social considerations (p.30)
- UKPN SHIFT project
- Innovate UK V2G Projects – including Octopus, OVO, Nissan, AT Kearney, EDF, SSE Services, Cisco.

These fall into 2 main groups at present. The below highlights how this project would address a key future problem for DNO's as yet not researched by other innovation projects.

Single Trading Stack Provider

- Electric Nation (V1G)
- Innovate Projects (V2G)

Multipole Stack Provider

- Shift (V1G)
- Electric Nation Powered Up (V2G)

The project team is also aware of the UKPN project TransPower, which also focusses on V2G. We have discussed the project similarities and differences with UKPN. Whilst there are similarities within how the data will be collected and used between PoweredUp and TransPower, there is sufficient difference in the proposed outputs.

Through TransPower, UKPN will create a modelling tool to assess the impact of EVs on the network which will enable more appropriate connections assessments to be made. TransPower will also trial various DSO services with residential customers and fleets to understand where V2G could be most effectively deployed to help support the network and the value of this to the customer. PoweredUp will build upon the successful Network Assessment Tool, which was created within the previous NIA project Electric Nation, modelling different suppliers' V2G profiles on the network. The intention and aim of this is to create a set of generic operating parameters for V2G units into order to optimise customers' utilisation of V2G whilst protecting the network, providing cheaper connection costs to customers by avoiding re-enforcement.

We will work closely with the TransPower team to ensure that there is no unnecessary duplication, and we will share data and learnings throughout the life of the project and beyond.

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

Other projects, such as Northern Power Grid V2G Project and innovate projects are investigating the effect of V2G on the network from a single energy supplier point of view. Although this provides useful insight, it does not represent a real-world view of the energy market in the coming years where multiple energy suppliers will offer multiple dynamic energy tariffs for EV owners. PoweredUp's key differentiator is that, for the first time, Crowd Charge will engage with up to five different energy suppliers and their dynamic strategies, implementing these simultaneously across 90-110 V2G chargers using V2G to imitate a future world in which many streets have many EV's charging in this way, operated by different energy suppliers. This has not been trialled yet as only recently multiple energy suppliers/aggregators have begun to enter the market and provide these services.

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

V2G is a new technology, of which how energy suppliers will want to use is not yet fully understood. For this this technology to be

adopted in Business as Usual, we need to fully understand both the electrical effects on the network and the financial benefits for stakeholders.

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

Vehicle-to-grid bidirectional charging is a new technology that has only recently been introduced into a very limited number of homes, no more than 200 at this moment in time.

This project has been approved by a senior member of staff

Yes