

NIA Project Registration and PEA Document

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.

Project Registration

Project Title

Electric Nation - PoweredUp

Project Reference

WPD_NIA_049

Project Licensee(s)

Western Power Distribution South West

Project Start Date

January 2020

Project Duration

2 years and 6 months

Nominated Project Contact(s)

Ricky Duke

Project Budget

£2,594,486.00

Nominated Contact Email Address(es)

wpdinnovation@westernpower.co.uk

Problem(s)

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.

Objectives(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.

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.

Technology Readiness Level at Start

TRL 5

Technology Readiness Level at Completion

TRL 8

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.

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 in the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

£2,335,083.00

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 the GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and 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 Licensee's System

A specific novel commercial arrangement

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

Please explain how the learning that will be generated could be used by relevant Network Licenses.

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.

2b. Is the default IPR position being applied?

Yes

2c. Has the Potential to Deliver Net Financial Benefits to Customers?

Yes

Please provide an estimate of the saving if the Problem is solved.

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 financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost - Method Cost, Against Agreed Baseline).

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 in terms of the number of sites, the sort of site the method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

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.

2d. Does not Lead to Unnecessary Duplication

Yes

X

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)

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

Additional Governance Requirements

Please identify

that the project is innovative (ie not business as usual) and has an unproven business case where the risk warrants a limited Research and Development or Demonstration Project to demonstrate its effectiveness

X

i) 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.

ii) Please identify why the Network Licensee will not fund such a Project as part of its business as 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.

iii) Please identify why the Project can only be undertaken with the support of the NIA, including reference to the specific risks (eg 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