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

Nov 2020

Project Reference Number

NIA_WPD_055

Project Registration

Project Title

Dynamic Charging of Vehicles

Project Reference Number

NIA_WPD_055

Project Licensee(s)

National Grid Electricity Distribution

Project Start

December 2020

Project Duration

1 year and 3 months

Nominated Project Contact(s)

Ricky Duke

Project Budget

£474,741.30

Summary

There are sectors of the transport system, such as buses and heavy goods vehicles, which have proven challenging to electrify due to their high energy demands. Dynamic Wireless Power Transfer (DWPT) is a technology which has the potential to help these use cases decarbonise by extending the range of battery electric vehicles by powering the vehicle or charging the battery while it is in motion. This proposal aligns with one of the three focus areas from our Innovation Forward Plan: Electrification of Freight. This project will investigate wireless dynamic charging infrastructure and its impact on our distribution network. The project will produce models that will accurately assess the impact of a roll out of this type of technology across our license areas.

This project will assess the feasibility of deploying DWPT technology on UK roads and the electrical impact on our distribution network. This technology is a small continuous charging strip that is laid beneath the tarmac on major trunk roads. The electrical impact of this technology is not yet understood, as it would require many connection points across the length of charger, and there would be several challenges to understand such as earthing arrangements.

As part of this project, a scalable and transferrable model to evaluate the impact of DWPT on the energy network will be created. The project will also produce a set of electrical values which will be incorporated into the new WPD planner's tool. This is a key deliverable and will be shared with all RIIO licensed UK DNOs for their own use. The project can be broken down into the following work packages:

WP1 – Project Management – Set up of project and the maintenance of all the project management documentation.

WP2 – Technology Review – Review of current continuous charging systems & wireless systems worldwide, led by Cenex.

WP3 – Power Modelling – Coventry University will model the proposed technology on our case study network in Coventry, and asses electrical impact.

WP4 – Demonstrator Evaluation – Building on WP3, Cenex will include traffic data to provide accurate usage profiles for the technology and look at the viability of the technology including validation.

WP5 – Dissemination and Reporting – Final evaluation reports and dissemination to industry. This includes the transfer of deliverables into BaU.

Coventry City Council will lead the project with support from WPD and a consortium of partners: Cenex; Coventry University; Hubject; Midlands Connect; National Express; Toyota Tsusho UK and Transport for West Midlands.

Third Party Collaborators

Cenex

Coventry University

Hubject

Midlands Connect

National Express

Transport for West Midlands

Toyota Tsusho UK Ltd

Problem Being Solved

As outlined in the third problem statement in Western Power Distribution's (WPD) Innovation Forward Plan 2019 (Electrification of Freight), whilst electrification of small passenger vehicles is becoming more established, battery technology is not yet sufficient to meet the economic and technical requirements of larger and heavier urban and freight vehicles (e.g. buses, delivery vehicles). Dynamic Charging of Vehicles (DynaCoV) project using dynamic wireless charging technology is a potential innovation to address this, however the effect on the electrical distribution network would be significant and is not currently understood.

Method(s)

This feasibility study can be broken down into the following work packages and deliverables.

Work Package 1
Work package one will cover project management activities over the course of the project. This will include the production and execution of the data protection plan and communication plan, as well as day to day project management activities.

Work Package 2
Work Package two will look at researching the current technology available for Dynamic Wireless Power Transfer (DWPT) worldwide. It will include the review of learning and data collection, as well as the expected power requirements and an evaluation of the UK supply chain.

Work Package 3
This Work Package will carry out modelling of traffic flows and vehicle usage patterns to identify the extent of dynamic wireless charging required and assessment of the network impacts of dynamic wireless charging, which can be used by network planners to assess the network when a connection request for this system comes in. This may be delivered in the form of a load profile, with earthing and power quality assessments undertaken. The site will be selected for the case study and then the case study area will be modelled for network impact including load draw, power quality and earthing requirements and considerations. This work Package will then carry out the evaluation of the business case and then will proceed through the project gateway if proven viable.

Work Package 4
Evaluation of the desktop research and data modelling, leading to the development of a roadmap indicating likely adoption rates and timescales for dynamic wireless charging in the UK. This Work Package will also look at the physical installation and safety of DWPT systems.

Work Package 5
Providing delivery details of the next phase and the complete feasibility report. This work package will see the results disseminated to industry stakeholders.

Scope

This project is a tabletop feasibility study and research project to understand the electrical and physical impact of DWPT technology within the UK. Over the 11-month project, we will carry out modelling and simulations of a case study in Coventry to provide DNO's with the specification for connecting this to the distribution network.

Objective(s)

- Assess the electrical impact of DWPT technology on the distribution network
- Examine issues such as earthing and having multiple connection points
- Model DWPT on a selected case study within Coventry
- Review current DWPT technologies already available worldwide
- Deliver a set of Electrical values which can be adopted into WPD modeling as business as usual
- Report on the feasibility of DWPT in the UK

- Forecast DWPT uptake within the UK
- Evaluate the business case and feasibility for DWPT in the UK

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- Assess the viability of DWPT rollout within WPD's license areas, both electrically and physically
- Review of current DWPT or continuous charging systems available worldwide
- Development of model to accurately assess impact on the distribution network
- Delivery of a set of Electrical values for WPD to incorporate into in-house planning tools for BaU
- Dissemination of the results to other UK DNO's and stakeholders

Project Partners and External Funding

The project will be led by Coventry City Council, and the below delivery partners will be subcontracted for various elements of the project:

Cenex
Coventry University
Hubject
Midlands Connect
National Express
Transport for West Midlands
Toyota Tsusho UK Limited

Potential for New Learning

All of the work completed within this feasibility study will be disseminated by a public report in WP5.1. This knowledge will be a valuable resource for the industry in order to better understand DWPT.

Furthermore, the results of the models in WP3 will be publicly disseminated. The purpose of WP3.2 is to produce a set of electrical values/profiles that can be used by any UK DNOs to evaluate the impact of DWPT technology on their local networks. Therefore, this tool will be a key deliverable and dissemination piece.

Other work packages may involve additional dissemination. For example, within WP2 there will be several tasks that create a report to share findings within the consortium. These reports will be shareable externally as part of periodic dissemination for the project.

Tasks planned for external dissemination:

- WP2.1 & 2.2 – Research into DWPT technology and data collections and learning for existing projects.
- WP2.4 – Study of the use cases for DynaCoV using DWPT technology
- WP2.6 – Evaluation of the UK supply chain
- WP3.2 – Network impact assessment model
- WP4.1 – DynaCoV roadmap
- WP5.1 – Final project report.

Scale of Project

This project is a desk-based feasibility study which consists of research and literature reviews as well as construction of a model to assess future network impact & connections. The project will look at a specific case study within Coventry, but this will produce outputs which can be modelled with WPD's software to cover all WPD's four license areas.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The feasibility study will be a desktop-based study only with no practical testing carried out. All consortium partners are based in the UK except for project partner Hubject, which is based in Germany. The advantage from this funding will be for the benefit of UK industry.

The feasibility study will carry out a detailed case study of the DWPT technology and the network in Coventry, with the results being incorporated into WPD planning software and able to replicate the impact and results right across WPD's four licence areas.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

The project total expenditure is £417,712.90 of which £375,941.61 will be from NIA funding and £41,771.29 WPD mandatory contribution.

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 this project is a research feasibility study, part of the study will be to determine the full business case of the technology. The business case of installing and operating DWPT technology in the UK will be assessed including the associated energy network costs. The below business case has been formed using estimated figures from our Electric Vehicle strategy, and some assumptions made about DWPT technology.

This technology will benefit all customers through the ability to charge their vehicles on the move, thus saving them downtime waiting or charging at conventional chargers. It is also estimated that this type of technology could be utilised by the 40% of our customers who do not have access to off street parking, and for whom would be very expensive to install such a charger (between 4-5K). Utilising this technology will elevate the expensive network upgrades required when rapid chargers are connected to the network, approximately £120,000 per charger, whereas this technology is only estimated to cost around £57,000 in re-enforcements due to the connections being spread out over a much larger area, and an charge multiple vehicles at any one time.

Please provide a calculation of the expected benefits the Solution

This project is a feasibility study, of which the full benefits and business case will be evaluated during Work Package 3.

By researching and designing an appropriate connection for this type of technology, we estimate savings of £63,000 per charger connection of c.130kW. This project value is £417k, which means after 7 charger lengths have been connected the project will have recouped the spend and subsequent charger connections will save the customers money. This project will examine the business case in detail within work package 3.6 to determine the full benefits.

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

The findings from this feasibility study will be replicable across all UK DNO's on best practices on connecting DWPT technology to the distribution network.

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

N/A

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

The project will produce learning about the electrical impact of DWPT technology on the distribution network. This will be derived from a set of electrical parameters which will be established about the technology (based on a range of traffic flows and external factors), which could be integrated into any DNO modeling software or scenario forecasting.

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.

There are currently no NIA projects looking at dynamic wireless charging within 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

DWPT technology is completely new and has never been studied or trialed within the UK. Other projects, such as Electric Boulevards have looked at static wireless charging, but a continuous charger which can span many miles has lots of electrical challenges which must be investigated before we can design a connection to our network.

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

The technology is a low TRL level and there is currently little information available without carrying out a proper feasibility study.

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

Both Local and Highways authorities are already suggesting that continuous charging systems will be a key feature within the HGV charging network of the future. DNO's need to understand how these will impact the network and the future forecasting for rollout now. As relatively little is known about the technology and its low TRL level, this justifies the use of NIA.

This project has been approved by a senior member of staff

☑ Yes