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

Mar 2019

Project Reference Number

NIA_WPD_040

Project Registration

Project Title

Multi Asset Demand Execution (MADE)

Project Reference Number

NIA_WPD_040

Project Licensee(s)

National Grid Electricity Distribution

Project Start

March 2019

Project Duration

1 year and 10 months

Nominated Project Contact(s)

Matt Watson

Project Budget

£1,655,046.00

Summary

The project investigates the impacts of multiple LCTs deployed within a domestic property and the value of coordination.

Problem Being Solved

Following the publication of the Committee on Climate Change (CCC) report promoting hybrid heating systems as a “low regret” option, DNOs should be considering the network implications of CCC’s call for 10 million hybrid heating system installations across GB by 2035. Many of these installations will be in homes that have also adopted electric vehicles. Understanding the interplay between these two primary drivers of electrification is essential to plan future network developments. The third factor that the project will explore is the impact of domestic solar PV and storage installations on these. During the same timescale as hybrids and EVs are being adopted, solar PV costs will fall to a level that makes subsidy free installation an economic reality for homes that wish to save on the cost of their grid supplied electricity.

Several innovation trials have highlighted the possibilities for individual LCTs to provide flexibility to the DNO: EV- Electric Nation, HP-Freedom, PV and Storage-Sola Bristol. However, each of these investigations has looked at a single technology type in isolation. As such DNOs do not have sufficient understandings on how such systems may interact and whether the flexibility is complementary, optimal, or counter-acting.

Method(s)

The research objective is to better understand the feasibility of managing and aggregating multiple energy assets (EV, hybrid heating system and solar PV) affordably through the use of advanced algorithms to unlock value from energy markets. Through customer research we will also evaluate consumer trust in new technology that is taking greater levels of EV charging, heating system control, and design appropriate user interfaces and information systems to help drive adoption.

Based on the lessons learned from previous NIA trials (FREEDOM, Electric Nation and SoLa Bristol), MADE will carry out micro-economic and system-level analysis to extrapolate previous trial findings in order to:

- Build a microeconomic model for domestic multi-asset, multi-vector flexibility for GB today, this will: Identify the most attractive customer types; Identify the high potential service stacks; Quantify the value (£); Include a particular focus on DSO services.
- Understand how the combined operation of residential solar PV generation, heat pump systems and smart EV charging may

provide benefits to the consumer;

- Assess the whole-energy system benefits (including network infrastructure) and carbon benefits of large- scale deployment of the MADE concept;
- Consider conflicts and synergies between local community and national level objectives, in the context of the flexibility enabled by the MADE concept.
- Estimate consumer benefits of the MADE concept and inform the design of the market framework that would enable consumer to access the revenues that reflect the benefits delivered.

A 5 home technology trial in South Wales will be used to validate the modelled learning.

Scope

The proposed project runs for 19 months and has been broken down into 6 work packages.
Work Package 1: Project Management
PassivSystems will complete the project management for the duration of the project to deliver the system design, development and technical feasibility installation. The PM will use PassivSystems' project management processes and will oversee the flow of development work through PassivSystems' agile Kanban processes.
Work Package 2: Problem definition, approach and trial design
The projects deliver the consolidation of existing information across partners, development of the customer, DSO, local network and national network proposition, a documented set of use cases, establishing data protection and data management protocols.
Work Package 3: Modelling: Consumer, Micro-Economic, Local and National GB Network
PassivSystems will produce a high level control strategy, simulate the MADE concept (desktop exercise) and collaborate with Imperial College and Everoze to model the local network, national network and the microeconomics. All partners will apply advanced big-data techniques to analyse and quantify the success of different approaches, considering demographic parameters, consumer flexibility, different loading conditions, different generation periods, time of application of different prices etc. The system-wide benefits of a large-scale
rollout of the MADE concept, considering both local and national level infrastructure will be assessed. This will be enabled by advanced modelling approaches developed by Imperial College, that identify system solutions that deliver secure and cost-efficient energy supply while respecting national decarbonisation targets.
Work Package 4: ASHP/EV/PV Control & Aggregation Solution
PassivSystems' will design and develop its smart control to enable optimisation (by cost or carbon) of the EV charge point, the electric heating asset and the rooftop PV generation. The will include the PassivEnergy platform that aggregates demand across households and enables the demand flexibility to be traded with energy markets including the DSO. PassivSystems will develop its existing aggregation platform to ensure each vehicle has enough
charge for the next trip (based on consumer preferences) before calculating how much remaining capacity to sell to grid and/or support domestic heating (via heat pump, hybrid heating system, or hot water tank immersion). The controls will also manage the heat and transport assets and maximise the self-consumption of rooftop solar PV through a coordinated control strategy.
Work Package 5: Technology Feasibility Trial (maximum of 5 homes)
PassivSystems will deliver a 5-home technology trial; the field trial will test the technology deliverables and gather data on consumer EV charge and energy system outcomes.
Work Package 6: Technology, Customer and Network Analysis – Dissemination
The project partners will deliver an interim and final report on consumer, energy system and business model
outcomes. PassivSystems will be responsible for sharing the findings of MADE publically during and after the project is complete.

Objective(s)

The Project Objectives are:

1. Use the ability of managing multiple energy assets (EVs, hybrid heating systems and solar PV) to switch between gas and electric load to provide fuel arbitrage and highly flexible demand response services.
2. Demonstrate the potential consumer, network, carbon and energy system benefits of large-scale deployment of in-home multi-energy assets with an aggregated demand response control system.
3. Gain insights into the means of balancing the interests of the consumer, supplier, and network operators when seeking to derive value from the demand flexibility.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The Success Criteria are:

- A detailed understanding of technical feasibility of asset coordination (supported by a report and operational data).
- A detailed customer proposition for the MADE concept.
- A detailed understanding of the customer benefits of the MADE concept (supported by a report and operational data).
- A detailed understanding of the impact of coordinated asset control on the distribution network (supported by a report and operational data).
- A detailed understanding of the whole system benefits of coordinated asset control on the distribution network (supported by a

report).

- Dissemination of key results, findings and learning to policy makers, regulators, network operators and suppliers.

Project Partners and External Funding

- PassivSystems - Project management, home energy management system, PV optimisation and demand aggregation modelling. PassivSystems are contributing £100,000 to the project.
- Wales & West Utilities - Gas distribution network requirements, measurement and modelling
- Everoze – micro-economic energy modelling, commercial modelling.
- Imperial College – Data analysis and a whole-system assessment on the future GB electricity systems
- Delta-ee – Customer research

Potential for New Learning

The project will aim to demonstrate:

1. The ability of domestic EVs, EV charge points, hybrid heating systems, heat pumps, solar PV with smart control systems to provide fuel arbitrage and highly flexible demand response services.
2. The potential consumer, network, carbon and energy system benefits of large-scale deployment of domestic EVs, EV charge points, hybrid heating systems, and heat pumps with an aggregated demand response control system.
3. The savings available to a consumer if this flexibility is matched to the most suitable variable rate tariff on the market.
4. The impact on user experience of allowing the MADE platform control over the operation of their EV, EV charge point and heating (Options; heat comfort/car availability, cost and green).
5. How EV charging operates under automated control alongside other in-home assets. In particular, the impact on the asset utilisation of solar PV and efficiency (heat output relative to electricity consumption) of hybrid and heat pump heating systems of flexible control.
6. The macro energy system impact on the energy system of scenarios where a large percentage of customers install new large electrical heat and transport loads; modelling of the impact with and without the MADE platform.
7. How new large domestic electrical loads can be managed on the LV network by DSOs seeking to minimise network reinforcement costs.
8. Model the network impact of homes managing flexible electrical demand against fixed and variable rate TOU tariffs (BEIS expects £1bn of benefits from static TOU tariffs).
9. The means of balancing the interests of the consumer, supplier, and network operators when seeking to derive value from the demand flexibility.

Scale of Project

The project consists of extensive data analysis and network modelling. MADE will utilise the data from WPD's NIA portfolio (SoLa Bristol, Freedom and Electric Nation). Using the existing data combined with the project partner's innovative research and modelling tools will enable MADE to provide a business case and risk assessment of in- home multiple, integrated, automated energy asset controls.

In addition a small technology feasibility trial (approx. 5 installs) will be deployed to help develop real world understanding of system performance.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL6 Large Scale

Geographical Area

This NIA project is predominately a desktop exercise. Low level technical feasibility studies and installs will take place in South Wales using householders from a previous NIA funded project: Freedom.

Revenue Allowed for the RIIO Settlement

£0

Indicative Total NIA Project Expenditure

£1,399,542

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)

Previous DNO trials have highlighted the significant potential value of flexibility from LCT loads (My electric avenue highlighted up to £2.2bn of reinforcement avoidance by 2050, Freedom highlighted £300 million of reinforcement deferral in South Wales alone by 2050).This trial should evaluate the potential interactions between the various value streams to understand the total savings possible.

Please provide a calculation of the expected benefits the Solution

Based on the governments' decarbonisation of heat and transport agenda, a homeowner that has a conventional heat pump and a conventional EV charger, PassivSystems estimate that one feeder (£40k) would be required for every 4 homes, a cost of £9,279.28 per home.

As shown in previous trials, this cost can be reduced significantly though the use of inherent asset flexibility (smart charging, hybrid systems…) PassivSystems estimate that one feeder would be required for every 14 homes, at a cost of 2,900.90 per home.

An integrated optimised approach with supplemented PV and storage (the MADE method) could produce significant savings, PassivSystems estimates that one feeder (£40k) would be required for every 39 homes, at a cost of £1,531.35 per home. This would help reduce network reinforcements, in addition, a hybrid solution can also respond to constraint signals and prevent DUoS charges. Financial benefit= base cost – method cost = £2,900.90-1,531.53 = £ 1,369.37 per household.

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

Whilst the speed of deployment will vary on a regional basis, the deployment of LCTs is expected to grow significantly across GB. As such the learning should be replicable across all GB.

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

To achieve the optimized control of LCTs, new hardware and software is required. With economies of scale, the hardware cost to roll out an automated multiple asset control that will integrate with the majority of LCTS will be £100. In addition, an annual service fee of £30 -£50 will maintain and continually optimise to market conditions. This equates to a NPV of approx. £500-756 over a 25 year lifetime However these costs will provide significant additional benefits beyond DNO reinforcement avoidance which should help cover a significant portion of the costs.

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 deployment of LCTs will impact the whole of GB. As such the learning generated should be applied by all relevant network licensees.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

MADE supplements the DSO transition through the improved understanding of the potential for Demand Side Response in the domestic sector as per section 5.2.4. of the innovation strategy.
☑ 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.

The project has been designed to build on learning from previous projects and look at the value of coordination of LCTs. This does not duplicate other projects.

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

This trial brings together the learning latest learning from DNO trials on individual LCTs to investigate the combined impact of such technologies. This has not been done to date.

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

Such a project could not be funded as part of BaU activities due to its extensive scope and inherent risk. There is significant uncertainty on the combined impact of such LCTs. As such the effects will be initially modelled and then tried in a small technology trial.

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

The NIA funding has been chosen to help manage the commercial and technical risk associated with the project.

This project has been approved by a senior member of staff

☑ Yes