

NIA Project Registration and PEA Document

Date of Submission

Jul 2018

Project Reference Number

NIA_NGTO011

Project Registration

Project Title

Energy Highways

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Project Licensee(s)

National Grid Electricity Transmission

Project Start

August 2018

Project Duration

1 year and 8 months

Nominated Project Contact(s)

Robin Gupta

Project Budget

£332,210.00

Summary

This project will carry out a feasibility study to investigate what the infrastructure to support Energy Highways may look like and what technologies are either available or need developing to support this. An assessment of the potential performance and impact on the energy network will be carried out, and the potential hazards and opportunities will be assessed.

Nominated Contact Email Address(es)

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Problem Being Solved

Electric vehicles are an emerging technology that is expected to have a significant impact on the GB electrical network. The vehicle battery charging infrastructure will incorporate large amounts of energy storage and power electronics; all of which will have to be directly connected to the GB transmission or distribution networks.

Currently the electric vehicle power demand is met at a Distribution Level due to the relatively low power requirements, which is due to the low number of registered electric vehicles in the UK. The number and prevalence of electric vehicles is expected to increase by over two orders of magnitude in the coming years. The battery charging technologies are also advancing in the direction of fast rapid charging, which means high power requirement for a smaller duration. For wider acceptance of electric vehicles, the range anxiety of the users should also be addressed, especially for highways. It may require new infrastructure for highways with electric vehicles charging points supplied from the transmission network for better reliability and availability of electrical power. Further to this, there exists opportunities to exploit the existing power electronics in the charging units to provide multi-function services to the network. Savings can be passed to consumers when the power electronic assets are more effectively used; as the number of power electronic interfaces can be significantly reduced, preventing the consumer from paying twice for the same asset or service.

Method(s)

The concept of Energy Highways has been developed to try and develop an innovative method to provide savings to consumers. Energy Highways are normal motorways that have been constructed with electrical energy harvesting, energy storage and electric vehicle chargers integrated into their design to accommodate a future scenario where the majority of the 25 million vehicles (cars, buses, HGV, etc.) are electric.

This project will carry out a feasibility study to investigate what the infrastructure to support Energy Highways may look like and what technologies are either available or need developing to support this. An assessment of the potential performance and impact on the energy network will be carried out, and the potential hazards and opportunities will be assessed.

This project will look to the Maritime domain to see how this has been managed (albeit on a smaller scale) on board Naval and Commercial shipping. The naval industry is going through a similar revolution to the power system, and is seeing an increase in the use of power electronic assets and a reduction in synchronous generation; while also having to consider efficiency, reliability and the impact to the environment. Significant learning can be adopted from the naval industry, which can speed up and de-risk the adoption of low carbon technologies; such as electric vehicles.

Scope

The project is split into three work packages, which are outlined as follows:

WP1 – System Designs for Energy Highways

Work Package 1 aims to identify what a potential Energy Highway could look like at a system component level (e.g. Converter, storage system, charging station, transformer etc.), along with what performance/impact it is likely to have. It will include an assessment of the potential technologies that could be used (based on a review of market available equipment) and identify which technologies may need development.

WP2 – Risk assessment of Infrastructure

Work Package 2 aims to identify the potential system hazards of the concept Energy Highway infrastructure. A safety assessment will be carried out in order to highlight any areas which have the potential to threaten security of supply or negatively impact the existing electrical infrastructure. Mitigation options will be considered and assessed, along with potential opportunities, and if necessary areas for future research will be highlighted.

WP3 – Review of Electrification of Commercial Ships

Work Package 3 aims to provide an overview of the electrification and integration of energy storage to both Naval and commercial shipping. It will highlight any relevant synergies that apply to the Energy highways concept and look to provide estimations to the likely future electric infrastructure needs for shipping.

Objective(s)

The objectives of this project are to understand:

1. The different system level designs of energy highways and which designs are likely to have more benefit than others.
2. The impact that these systems could have on the network and what mitigations methods are possible.
3. The impact that the electrification of commercial ships could have on the network in terms of load.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

This project will be a success if:

1. System level designs of energy highways concept are produced and prioritized.
2. The risks and mitigation plans from Energy highways are understood and clearly outlined.

Project Partners and External Funding

n/a

Potential for New Learning

This project will provide an assessment of the risks that the electrical charging infrastructure will present to the network. This will ensure that mitigating works can take place, if significant risks are foreseen. This will be relevant to all TOs and DNOs; as the increase in demand from electric vehicles will impact the entire network.

[NOTE: this information can be used and reworded in question 2a below]

Scale of Project

The size of this project has been chosen to perform a preliminary assessment into the impact that these technologies will have on the network. This is seen as a feasibility study, which will inform future work in this area. A smaller project would likely lead results that have limited or no impact to transmission owners.

Technology Readiness at Start

Technology Readiness at End

Geographical Area

This will be a desktop based study.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£332,210

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)

Electrical charging infrastructure could be used to support the transition to a flexible transmission network designs. If the power electronic assets in the charging stations can be used as multi-function assets, this could reduce the cost of the services/cost of charging by 30% in some areas; due to the lack of duplicated power electronic infrastructure.

Please provide a calculation of the expected benefits the Solution

N/A

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

The understanding developed from this project can be translated into standards and guidance notes for all TOs and DNOs. The technical designs produced during this project could be used on any network.

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

The adoption of the technical understanding would be relatively cheap for each DNO and TO; around £50,000 of internal time to adopt the new modification to the specifications.

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

As the charging stations may also incorporate additional smart loads or energy storage, it is possible that these systems will be more complex than existing or historic loads. This may result in the charging station presenting new opportunities to the network, as well as further risks to system operation. The understanding from this new project will allow the risks to be quantified and understood. This will be relevant to all DNOs and TOs.

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

This project fits within the (chose from below) value area of the Electricity Innovation Strategy:

Service Delivery - Developing new service-based propositions and business models

- ☒ 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 have been previous investigations into the impact of electric vehicles on the network; however, no other project has gone into the detailed design of the charging infrastructure for the transmission network, looked at multiple use cases for the charging stations, and looked to adopt key learnings from the naval industry.

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

The technology has a great potential to bring the value for the customers and meeting Paris 2050 vision by facilitating large deployment of electric vehicles. Presently, there are not many electric vehicles and their charging need can be met at distribution level. Therefore, such a project has not been tried before. However, the increasing number of electric vehicles and varying charging needs may require the connection to these charging stations from the transmission 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 nature of a research programme means it inherently carries a risk that the research may be unsuccessful and/or identify unforeseen barriers to implementation and National Grid is unable to consider research of this scale as business-as-usual. The NIA funding offers the most appropriate route for NGTO to evaluate the how best the electricity infrastructure can support an electrified transportation system.

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 inherent risk of the project as detailed above and the learning from the project will be directly relevant to all Network Licensees. For this reason, NGTO believe this project is appropriately funded through NIA.

This project has been approved by a senior member of staff

☒ Yes