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

### Project Reference Number

NIA_SPEN_0068

## Project Registration

### Project Title

Net Zero Transport - Discovery Continuity

### Project Reference Number

NIA_SPEN_0068

### Project Licensee(s)

SP Energy Networks Distribution

### Project Start

February 2022

### Project Duration

3 years and 6 months

### Nominated Project Contact(s)

Dimitrios Athanasiadis

### Project Budget

£300,000.00

### Summary

Net Zero Transport - Discovery Continuity will facilitate the exploration of low carbon solutions by identifying the most efficient transition for the rail decarbonisation potentially using different low carbon solutions. It will also facilitate the investigation, for the first time, of the feasibility of developing resilient and flexible railway multi-energy hubs around 2500 railway stations and connecting these hubs to form a hub network to ensure grid flexibility, power security and emission reduction.

### Third Party Collaborators

Ricardo

University of Leeds

### Nominated Contact Email Address(es)

innovate@spenergynetworks.co.uk

### Problem Being Solved

Transportation generates the largest share of GHG emissions in UK (34% in 2019) and with 60% British rail not yet electrified, a solution is needed to mitigate the environmental impact of powering our rail networks. Rail decarbonisation requires extensive network upgrades which are often complex and extremely costly, e.g. rail electrification costs £1 million - £2.5 million per km. There are also problems with railway traction power supply lines which span wide areas, with feed stations connected to different electric grids (strong grids coexisting with weaker ones), power grids faults may cascade down to the traction power supply systems, causing trains to stall on track and cancellation of service routes, resulting in significant economic losses and public dissatisfaction.

Government studies support an agile approach in designing a sustainable, affordable and reliable solution for decarbonisation. There is opportunity to integrate hydrogen into rail decarbonisation; which is in the electricity and rail customers' interest in addition to considering technologies such as power electronic and storage. As well as significantly reducing carbon emissions and improving the stability of critical infrastructure for both railways and power sectors when the future energy system almost entirely runs on low carbon source.

## Method(s)

A desktop feasibility study to investigate the evisioned Net Zero Transport initiatives.

## Scope

- Supporting SIF discovery commencement through additional data gathering, formatting, reviewing and validation
- Support and accelerate the transition to SIF alpha

## Objective(s)

- Maximise the success of discovery by feeding in additional data gathering, formatting, reviewing and validation to inform the SIF outcomes

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A awaiting tool.

No impact has been identified that would cause adversity to any consumer vulnerability group (based on the PSR definition)

## Success Criteria

Maximise the success of discovery by feeding in additional data gathering, formatting, reviewing and validation to inform the SIF outcomes.

## Project Partners and External Funding

- **Network Rail** (infrastructure provider) brings information about the rail network and electrification costs for traditional transmission connections.
- **Ricardo Energy and Environment** (3rd party innovator) brings expertise in decarbonising electricity supplies and connecting traction network to distribution network through novel power electronic devices.
- **Leeds University** (academic user) brings rail and power electronic expertise from their Institute for High Speed Rail and System Integration.
- **ScottishPower ltd**, who have a new Hydrogen division set up to drive this topic.

This project is in place to safeguard the delivery and continuity of the associated SIF project.

## Potential for New Learning

This project will provide learning on 4 key methods to rail decarbonisation - hydrogen, power electronics, energy storage and direct renewable generation connections - and how they can save costs, carbon and time for electricity and rail consumers. In addition, this project will provide learning on the energy efficiency and flexibility potentials of huge energy exchanges at urban populous railway stations which serve millions of passengers annually in the UK’s busiest stations.

## Scale of Project

Net Zero Transport - Discovery Continuity facilitates a small-scale feasibility study and CBA. Beyond the demonstration phases, these solutions align with Network Rail and government targets of rail electrification and decarbonisation so will facilitate the reduction of diesel trains and promote rail decarbonisation, providing a decarbonised route for UK rail.

## Technology Readiness at Start

TRL3 Proof of Concept

## Technology Readiness at End

TRL4 Bench Scale Research

## Geographical Area

N/A

## Revenue Allowed for the RIIO Settlement

None

## Indicative Total NIA Project Expenditure

£150,000

# 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:

As the energy network transitions, renewable generation will grow so flexibility will become paramount. Networked energy hubs can offer flexiblity services to the power grid where possible, such as load levelling, demand side response, voltage and frequency, etc. Also, Hydrogen production will be key in the energy system transition where flexibility in generation will be crucial. Hydrogen production assets have a potential role to play in balancing supply and demand for electricity by turning down or off in peak periods and turning up when supply of renewable energy is high, either in response to price signals or direction from the system operator. Furthermore, they could ease network constraints by responding to signals from TOs or DSOs in the future.

## 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)

N/A

## Please provide a calculation of the expected benefits the Solution

This is a research-based project. Benefits will be quantified throughout the project.

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

The findings from Net Zero Transport - Discovery Continuity will facilitate the decarbonisation of the UK's railways in line with plans from Network Rail and the UK Government.

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

This is a research-based project. Roll out costs will be quantified throughout the project.

## 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 approach we are taking will provide a solution to rail decarbonisation across the UK. Network Licencees will play a part in rail decarbonisation along with rail providers, and can also benefit from the learning on power generation and storage for the future.

### 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

### 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.

This project is in place to safeguard the delivery and continuity of the associated SIF project.

The project team have been part of projects that have investigated solutions to accelerate the decarbonisation of the UK rail sector:

- Rail Safety & Standard Board (RSSB) T1199, Future Costs for Hydrogen and Battery Power for Traction (£66k) assessed several options for trackside battery systems and the costs for these.This project did not include the costs of electricity network connections. One of the recommendations was that further research was needed to assess the feasibility and costs including the costs of electricity network connections.

This was a major motivation for this project, which will leverage learning to assess the solutions from the electricity sector standpoint to develop an optimal demonstration.

Innovate UK has supported a number of First of a Kind (FOAK) projects that cover a range of new solutions for the rail sector, including Environmental Sustainability. Two relevant projects have been funded under these calls:

- Green Valley Lines (£110k); Assessment of renewable electricity generation and trackside electricity storage for South Wales railway using private wire -- this did not consider electricity connections.
- Daybreak (£399k); Development of a low-cost modular convertor connecting renewable electricity generation and trackside electricity storage systems to 25kV overhead line rail systems in parallel with a traditional 25 kV transmission connection. This project focuses on the convertor, which could be part of the range of solutions considered for this new project.

Research has been carried out to identify any similar projects.

- In EPSRC project ‘Intelligent grid interfaced vehicle eco-charging (iGIVE)’, an intelligent charging system was developed to support

V2G and G2V while ensuring safe and reliable operation of vehicle batteries.

- In EPSRC 'TransEnergy - road to rail energy exchange' a techno-economic supply chain analysis of energy storage technologies was conducted for application in UK rail and road transport.
- In EPSRC 'Creating resilient sustainable microgrids through hybrid renewable energy systems', a novel microgrid planning tool was developed.

### 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 project is in place to safeguard the delivery and continuity of the associated SIF project. This is the first instance where network operators have come together with Network Rail and industry experts to move towards a decarbonised railway.

### Relevant Foreground IPR

The specific Relevant Foreground IPR is unknown for this project phase due to it being a feasibility study. If the project is successful and progresses to futher phases where the identified optimal solution is being developed, Relevant Foreground IPR will be identified and reported.

### Data Access Details

Access to this data must be requested by contacting SPInnovation@spenergynetworks.com Please provide the following information in your request:

- Affiliation, position and contact details of requesting party
- Relevant project and type of data required
- Reasons for requesting this data and evidence that this data will be used in the interest of the UK network electricity customers
- How data will be shared internally and externally by the requesting party

Any data request deemed unsuitable for sharing will be highlighted to the appropriate requesting party. After receiving the request we will provide the estimated date for completing the data provision based on other requests and our team workload at that time. All requested data remains the property of SP Energy Networks.

### Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

There is no allowance within the SP Transmission RIIO-2 business as usual funding that is appropriate to fund this innovation project.

### 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 project has both technical and commercial risks, such as the availability and prevalence of data from key lines and stations and the replicability of the solution across national and international rail networks. Due to the early TRL, the success of the project and associated financial benefits of the project cannot be determined at this stage therefore it can only be undertaken with the support of NIA. This NIA is in place to meet all user requirements of the SIF scope and to derisk the delivery.

### This project has been approved by a senior member of staff

☐ Yes