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

Jan 2022

Project Reference Number

NIA_NGGT0184

Project Registration

Project Title

Gas and electricity transmission infrastructure outlook

Project Reference Number

NIA_NGGT0184

Project Licensee(s)

National Gas Transmission PLC

Project Start

February 2022

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Ian Bennett, box.GT.innovation@nationalgrid.com

Project Budget

£353,333.00

Summary

The interaction between gas and electricity energy systems is likely to increase as we progress towards Net Zero. Transportation systems in the UK and surrounding countries, across transmission and distribution will need to interact in order to balance energy production and use. The potential solutions for the decarbonisation of transport, heat, industry and power also interact and compete with several that have the opportunity to overlap. This project is a first step in understanding these interactions for the UK transmission networks. Thinking on whole energy has increasing relevance for operation and development of the gas and electricity transmission systems as we progress towards net zero and is a vital activity at this stage of our transition.

Nominated Contact Email Address(es)

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Problem Being Solved

The interaction between gas and electricity energy systems is likely to increase as we progress towards Net Zero. Transportation systems in the UK and surrounding countries, across transmission and distribution will need to interact in order to balance energy production and use. The potential solutions for the decarbonisation of transport, heat, industry and power also interact and compete with several that have the opportunity to overlap. This project is a first step in understanding these interactions for the UK transmission networks. Thinking on whole energy has increasing relevance for operation and development of the gas and electricity transmission systems as we progress towards net zero and is a vital activity at this stage of our transition.

National Grid Gas Transmission (GT) are the owner (TO) and Gas system operator (SO); they own, build and operate the high-pressure gas national transmission system, with day-to-day responsibility for balancing supply and demand in real time and we facilitate the connection of assets to the transmission system. National Grid Electricity Transmission (ET) own, build and maintain the electricity national transmission system, with day-to-day responsibility for ensuring the availability and capability of the network.

National Grid Electricity Systems Operator (ESO) operate the electricity network with day-to-day responsibility for balancing supply and demand in real time.

As a group, we play a pivotal role in connecting millions of people safely, reliably and efficiently to the energy they use. The gas network comprises approximately 7,630 kilometres of high-pressure pipe, 23 compressor stations connecting to 8 distribution networks and also other third-party independent systems and the electricity network complete.

The UK's gas market and sources of gas are changing. The UK now obtains less than half of its gas from the North Sea (or UK Continental Shelf - UKCS). The UK receives gas from Norway, continental Europe and further afield via LNG shipments into three import terminals around the country. Flexible sources of supply, such as LNG importation terminals, interconnectors and storage sites, can respond to demand more quickly than traditional UKCS supplies. Therefore, our network needs to be able to respond in real time to changing day-to-day and within-day supply and demand patterns.

Electricity changes?

We have committed to reduce our direct emissions to Net Zero by 2050 and to increase our influence to support the overall industry-wide transition to a low-carbon future. The UK Hydrogen Strategy demonstrates an ambition to migrate the NTS and wider gas network to transport Hydrogen. Our first activity is to develop the Hydrogen backbone connecting key industrial clusters and UK terminals.

The aim of this assessment is to provide a vision of the UKs net zero energy transmission system that will deliver net zero energy to industry, transport, heat and power. The output will also highlight key areas where there is increased interaction and where there may need to be changes to regulations and / or operating practices.

The current gas and electricity system deliver energy to industry and consumer. There currently is an interaction between the energy systems mainly through gas fired generation. Net zero will require an energy system that can provide low carbon energy whilst maintaining security, flexibility and resilience. The interactions are likely to increase with the introduction and increase in power to gas and the ongoing need for gas fired generation.

Future energy system operation is likely to look very different than today, and the study will provide some insight into the potential areas where this may need further consideration.

Method(s)

The energy system of the future will need to be more integrated to deliver a reliable, flexible, affordable and sustainable energy. The future gas system is likely to interact with other energy systems much more closely up to and beyond 2050. How these systems will interact and what changes are needed to facilitate these requires further consideration. This desktop study reviews data from several sources from both the UK and Global activities to determine the optimum method for interaction.

The project will deliver:

1. A determination of key data sets and their quality including modelling, scenarios, assumptions and sensitivities so expectations are clearly established

2. An independent vision of what a net zero energy transmission network could look like - validated by Imperial College - including integration of Electricity and Gas strategies providing a robust view of opportunities. To include an overview of the future interaction requirements between gas and electricity transmission networks.

3. Stakeholder alignment on what is needed to develop a net zero energy transmission network and their key requirements.

4. An outline of the key knowledge gaps that we need to answer, to deliver the future energy system network and an outline of further work on key areas that need to be considered and their impact on future policy.

5. Rich, impactful final report narrative that summarises and definitively concludes the fundamental discussion of the nature of the future NetZero energy system.

Measurement Quality Statement

The measurement approach used to meet Data Quality objectives will be through the identification of high calibre project partners whom are experts in their given field and the use of real data from National Grid sites and strategies. In this instance, the project will be limited to a desktop study to develop the concept from TRL2 to TRL3 and therefore will combine knowledge from other industries and strategic scenarios in the UK.

Data Quality Statement

The project will ensure that data used is of sufficient quality to deliver project objectives through phase 1 where the project team will review and determine the possible data sources and those that hold the most integrity. Several scenarios will be developed as it is unclear at this time of which is most likely to provide the optimum solution for the transmission system in the UK. The relevant data and background information will be stored for future access within the National Grid Innovation Sharepoint site and shared via the ENA portal.

Scope

The project will be split into 5 Phases

1) Phase 1: Kick-off and align on assumptions, data sources and requirements (Duration – 1 month)

· Create an efficient launch of project: Agree on project scope, data, modelling approach

· Determine key data sets and their quality

· Determine the activities and methods by which to achieve the outcomes of the future project phases

· Tasks 1.1. Agree on functional requirements

Prepare, conduct a project kick-off with Guidehouse and the NG parties. Formalise project set up: Project scope, planning & schedule.
✓ Agree table of contents and storyline for the purpose of Ph.5
✓ Agree scenarios, sensitivities and modelling approach. All stakeholders agreeto freeze the scenarios to ensure alignment on next steps.
✓ Envisaged stakeholder selection for the purpose of Ph.4
✓ Timing and organisation of progress meetings
✓ Schedule key meetings with project team (no surprises, and clarity on delivery)

· Task 1.2. Review and engage with other relevant work

To ensure relevance of our work and to maximize the project value we review and benchmark past and ongoing work done on the whole system approach and integrated modelling of electricity and gas infrastructure. For relevant ongoing work we assess if collaboration is possible to create synergies.

· Task 1.3. Identify and collect relevant data

Hold data gathering exercises with key ET, GT, ESO and GSO teams to acquire and agree upon the most relevant data sets. Define and gather relevant input data: investment costs, fuel price projections, emission factors, national H2 plans and climate targets

· Task 1.4. Log and agree on assumptions and setup data management

2) Phase 2: Develop insights into future integrated energy network (Duration – 4 months)

· Provide an evidence-based vision on how a pathway towards a “Net Zero Energy Transmission Network” could look like

· Develop insights into the future interaction between gas and electricity transmission, storage and conversion infrastructure to meet future demand in the various sectors

· Highlight the benefits of the whole system approach to maximize consumer benefits, i.e. of an integrated planning and operation of gas and electricity infrastructure

· Task 2.1. Develop NUTS1 datasets for selected scenarios and setup LCP model:

Review the datasets acquired in Ph.1 and develop NUTS1 dataset for each selected scenario. Setup the LCP model. Enhance and build upon the existing NG data, from Guidehouse and external sources.

· Task 2.2. Review developed datasets and LCP model setup with NG teams:

Engage with GSO/ESO, GT/ET future and regulation teams to get feedback on the developed datasets and proposed LCP model configuration. Update datasets and LCP model configuration based on feedback. Hold initial stakeholder engagement activity to align on models assumptions/inputs

· Task 2.3. Modelling pathways towards a “Net Zero Energy Network”:

Apply the LCP model for integrated capacity expansion and dispatch optimisation for gas and electricity transmission, storage and conversion infrastructure to match future energy supply and demand for each considered scenario. Major model outputs: installed

transmission capacity btw. model regions regions, installed storage and conversion capacity in each model region; insights into operation of the future integrated energy network.

· Task 2.4 Perform sensitivity analyses:
Vary costs of infrastructure types and assess the option of offshore P2G to gain further insights into the configuration of the future integrated energy network.

· Task 2.5. Analyse results and develop vision for the "Net Zero Energy Network", phase 2 report: Formulate an evidence-based vision on how an integrated UK energy network could develop until 2050 based on the quantitative outcomes of the previous tasks. The delivered Ph. 2 report specifies the major characteristics of the future integrated energy network, highlights the interaction between infrastructure and the resulting benefits but also clearly detail any limitations of the study and propose areas for further work. Validation of model and results by Imperial College.

3) Phase 3: External Engagement (Duration – 2 months)

· Conduct bilateral meetings: across phase 2 - to avoid any surprises during the stakeholder engagement event - Guidehouse to conduct bilateral meetings with key stakeholders to align and achieve buy-in through the following process:
1. Prioritise National Grid's 84 stakeholders from Project Union ahead of workshop(s)
2. Together with National Grid characterize into 'allies, enemies and swing voters' who have a whole system mindset
3. Identify critical stakeholders, evaluate their value drivers and pain points and identify strategies to 'swing' them towards an overarching consensus

· Facilitate stakeholder engagement event
1. Present findings from Phase 2
2. Facilitate workshop with key stakeholders and incorporate their feedback into the final report
3. Leverage appropriate tools and techniques to ensure stakeholder alignment during Phase 3 such as carousel and 'way forward'

· Collate stakeholder insights and determine action plan following completion of workshop(s) including any gaps in stakeholder engagement to inform future work

· Product Phase 3 report: Inclusive of stakeholder insights, gaps in feedback, and key areas to consider development of the future state network base on stakeholder input.

4) Phase 4: Data and Engagement Insight Review and Gap Analysis (Duration – 2 months)

· Review stakeholder insights and feedback and understand impact on proposed network structure

· Update proposed transmission network and model (if needed) following review of stakeholder feedback. Undertake gap analysis to identify knowledge gaps that would still need to be addressed

· Product report having consolidated findings, clearly providing recommendations for further analysis from 1) future policy shaping angle and 2) innovation project pipeline for use cases across the following sectors:
• Power
• Heat
• Transport
• Industry

5) Phase 5: Standards & Reporting (Duration – 1 month)

· Complete final technical report write-up

· Provide a final summary report

· Populate an ENA closure report document (if required)

Help National Grid identify if any standards need to be updated based on results presented in the report.

Objective(s)

The key objectives for this activity are as follows:

- To provide an internal and external vision of the future net zero energy transmission system that will deliver net zero energy to

industry, transport, heat and power

- To consider the main interactions between the future decarbonised electricity and gas transmission systems

- To determine what are the main areas of system interaction that need further consideration and potential policy and market / regulatory framework development

To better inform gas and electricity modelling for future scenarios, providing information such as likely production locations and end users, including an understanding of the balancing requirement and how this could best be managed with separately regulated businesses to enable and ensure the UK energy systems reliability and robustness

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The National Transmission Systems are key UK infrastructure for the transport of energy to consumers, including those considered vulnerable. In the net zero transition it is essential the vulnerable are not excluded by virtue of fuel inaccessibility. In maintaining a robust energy network across the UK through collaborative whole systems approach projects we are ensuring that vulnerable consumers are provided a consistent energy supply. This project supports the transition of the UK energy networks to net zero fuels which in turn supports the availability of energy to the vulnerable.

Success Criteria

The following key criteria need to be met for the project to be considered successful:

- Study objectives met to time and cost

- Clear understanding of the data sets utilised and why

- Stakeholder engagement and alignment

- Robust narrative that provides guidance for future interactions

Project Partners and External Funding

· Guidehouse - Guidehouse is the only scaled consultancy in the world to fully integrate commercial and public or government businesses within each of our industry segments because complex problems require both perspectives to address and outwit.

· National Grid Gas Transmission

· National Grid Electricity Transmission

National Grid ESO

Potential for New Learning

The approach for whole systems interactions between transmission systems in the UK has not been determined. This could lead to individual groups developing counter strategies. In order to meet the tight timelines for the net zero targets we need to move quickly in a collaborative and aligned manner. The learning from this project will be disseminated via the ENA portal and through the stakeholder engagement within the project itself.

Scale of Project

The project is a desktop study and modelling activity that will provide the transmission networks in the UK a view of the optimum method for interaction and development. The benefits of the project will be through the developed understanding of each company in how best to progress to a whole systems approach.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

United Kingdom

Revenue Allowed for the RIIO Settlement

Not applicable to this R&D project

Indicative Total NIA Project Expenditure

£320,000.00

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:

The results of the project will create knowledge in the transmission approach to whole systems that can be utilised as appropriate by UK networks to determine future strategies and approaches. It may also benefit interconnecting networks and systems. The aligned collaborative approach will enable a more efficient transition to net zero.

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)

RIIO-1 question N/A

Please provide a calculation of the expected benefits the Solution

There will be no direct benefits from this project. The project results will enable us to develop robust strategic plans for the whole systems approach and identify the most efficient route to net zero.

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

The findings will be relevant to other transmission networks and also may impact the distribution networks and other customers. The engagement sessions throughout the project will take these views into account and ensure they play a part in the final report.

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

☐ 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 findings will be relevant to other transmission networks and also may impact the distribution networks and other customers. The engagement sessions throughout the project will take these views into account and ensure they play a part in the final report.

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

RIIO-1 question 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.

The project will commence with a review of all current data sets, scenarios and whole systems approaches both within the UK and globally to ensure that we have a good understanding of the current landscape. A whole systems transmission approach has not yet been developed for 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

The whole systems approach in the UK has been discussed at a high level but a strategic framework from which to guide future work has not been developed. This project will pull together an innovative view of how the energy transmission networks can be managed in the UK as we transition to net zero energy sources.

Relevant Foreground IPR

The results of the project will create knowledge in the transmission approach to whole systems that can be utilised as appropriate by UK networks to determine future strategies and approaches. It may also benefit interconnecting networks and systems.

Data Access Details

Data developed through the project will be managed by Guidehouse to ensure business separation and provide an insight that is

usable by the network parties. Data will be managed as described in the NIA governance document.

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

Energy transition projects are not catered for in the RIIO settlements and the project is high risk and low TRL which would not be considered for BAU funding. However, this is an important piece of work that encourages collaboration across the energy networks.

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

NIA enables collaboration and in this case provides a base from which multiple energy networks can work from which can be difficult when they are working as separately regulated businesses. The whole systems approach is unknown and there are many routes that could be taken, there is a risk that without this work the different energy networks would spend time and money on contradicting systems.

This project has been approved by a senior member of staff

☑ Yes