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

Sep 2023

Project Reference Number

NIA_NGT0223

Project Registration

Project Title

Linepack opportunities in the current and future energy system

Project Reference Number

NIA_NGT0223

Project Licensee(s)

National Gas Transmission PLC

Project Start

September 2023

Project Duration

0 years and 7 months

Nominated Project Contact(s)

Kelvin Shillinglaw, box.GT.innovation@nationalgas.com

Project Budget

£466,667.00

Summary

National Gas Transmission (NGT) are committed to reducing emissions from the operation of the National Transmission System (NTS) and eliminating emissions by 2050. A key technology in this transition is hydrogen as an alternative for carbon fuels in heat, transport, and industrial uses.

Linepack currently provides flexibility in the NTS by strategically storing gas in pipelines and releasing the gas to meet demand for heat and electricity generation. The future energy system is likely to see increasing sources of renewable energy including wind and solar, however this supply can be intermittent. The project will investigate how the NTS of the future can support energy generation using linepack by assessing the value of linepack flexibility and investigating how the required market, policy and regulatory frameworks can be developed.

Preceding Projects

NIA_NGGT0184 - Gas and electricity transmission infrastructure outlook

Third Party Collaborators

Guidehouse

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Each year from 2014 to 2020 the use of pressure changes in linepack in the higher-pressure tiers of the National Transmission System and the Gas Distribution Networks cumulatively provided circa 100 TWh of storage to the wider energy system of Great Britain each year. To put 100 TWh into context, this suggests that c.10% of all the gas used in Great Britain in a year is stored and released via linepack. The pressure is typically managed in real-time to increase overnight so that there is more natural gas in pipelines closer to end-users ready to be utilised in the morning when demand for natural gas rapidly increases. In terms of scale, linepack on average stores and releases c.350 GWhs of energy every night over the heating season in Great Britain, for comparison, the combined equivalent value for the four pumped storage schemes is 11 GWh.

This is a critical service in providing the ability for heating and for electricity generation to be able to flex their demand, and without linepack and its ability to increase and decrease pressure to store and release natural gas, Britain's energy system would have to be fundamentally different.

For such an important element of Britain's energy infrastructure, there is a pressing need to better evidence and understand the costs of providing this pressure change in linepack, and also the value that it provides to the rest of the energy system. Existing market frameworks do not seem to promote a means of price discovery between market participants for this linepack swing, which is one of the reasons why the costs and value are not well defined at this time.

Method(s)

This project aims to demonstrate the role, drivers, cost, and value of linepack in the current and future energy system to support discussions on regulatory, policy, market framework, and business models relating to energy system flexibility.

To achieve this the project will first examines historic linepack trends and then assess the current impact. Once achieved, the project will then define the future role of linepack and examine the value/cost of linepack operations at 50 bar vs 70 bar. Finally, the project will outline frameworks (regulatory, policy, market) in a future system

To achieve this the supplier with use historical data, international case studies as well as host stakeholder workshops. The project will result in a technical report summarising the work undertaken and the outputs including business case and cost benefit analysis.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document NGT internal policies. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to our supplier's own ISO 9001 certified quality assurance regime and the source of data, measurement process and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and made available for review.

Scope

The project is split into four work packages detailed below:

WP1 – Examine historic linepack trends

Identify key drivers of linepack swing and flexibility over the last decade and how the role of linepack has evolved to support energy system needs.

1.1 Hold kick-off meeting and establish project governance and baseline scope activities

Ensure effective on-ramp to project activities, agree on key objectives and confirm relevant priority focus areas

Gather historic supply, demand and linepack swing data in the natural gas system

1.2 Define value in the context of energy system flexibility

Provide definitions and an approach for quantifying energy system flexibility, linepack swing, and value

Concisely articulate the service provided by linepack and how the gas system underpins variability in the electricity system, leveraging insights from energy market participant conversations

1.3 Conduct a robust analysis of historic linepack data and trends

Research the key drivers of linepack swing, mapping the evolution in the role of linepack over the last 10 years at a national and potentially linepack zone level

1.4 Develop a comparison and assessment of UK linepack trends with international counterparts

Evaluate international case studies to analyse historic trends, drivers and developments in linepack swing in other countries.

WP2 – Assess current impacts of linepack use

Assess costs associated with managing linepack flexibility and the value provided to existing gas and electricity network players, comparing these costs to other energy system flexibility alternatives.

2.1 Conduct a robust analysis of current linepack data and trends

Quantify the cost and value linepack swing has in the current natural gas system, using this to highlight the supply and demand of linepack across specific zones and the entire national system

2.2 Evaluate the use and impact of linepack across international energy systems

Research international case studies to understand the level of linepack swing managed in other markets

2.3 Develop a comparison and analysis of alternative methods for energy system flexibility

Identify other means of energy system flexibility that could play the same role as linepack in the current system

Research the relative costs of deploying these options

Compare these options to linepack with a focus on supporting system balancing and network optimization

WP3 – Define the future role of linepack

Examine future supply and demand data to understand how linepack swing and the role of linepack could change over the next 10 years and the costs associated. Research other means of future energy system flexibility and the relative costs of deploying these options as opposed to linepack

3.1 Conduct a robust analysis of future linepack supply and demand data

Analyse how linepack swing and the role and drivers of linepack will change in both centralised and decentralised future energy systems in the FES System and Consumer Transformation scenarios

Produce cost and valuation models for each scenario

Investigate the impact 100% hydrogen will have on the energy capacity of linepack in the NTS

3.2 Conduct a literature review for feasibility of alternative means of energy system flexibility

Gather information to evaluate the costs and value associated with deploying alternative options instead of linepack to support future system balancing and network optimisation

3.3 Conduct a technical study to explore the qualitative and quantitative impacts of operating the hydrogen network at 50bar compared to 70bar to support increased linepack flexibility.

Quantify the additional amount of linepack available at 50bar compared to 70bar

Quantify the broad cost implications of operating the network at 70bar instead of 50bar

3.4 Prepare and deliver in-person workshop understanding the impact of a hydrogen future on flexibility

3.5 Align on technical and commercial requirements for business models prior to commencing WP 4

WP4 – Frameworks for linepack in future energy systems

Define several constructs of commercial frameworks, business models, regulatory designs and policy enablers to support valuing the flexibility provided by linepack in the future energy system. Identify key opportunities for NGT in linepack deployment across natural gas and hydrogen.

4.1 Prepare and deliver in-person commercial regime and opportunities workshop

Discuss the technical and commercial challenges involved with managing energy system flexibility in a rapidly evolving net-zero future

Consider models for potential alternatives to linepack

Leverage the learnings from work packages 1-3 to consider commercial framework and business model options and to assess opportunities for NGT in supporting optimal linepack deployment across natural gas and hydrogen in the future energy system

4.2 Outline commercial frameworks, business models and regulatory design options

Provide options for linepack related frameworks

4.3 Complete final report and project closure activities

Produce a final report including all work packages

Produce a summary which concisely captures the key findings and future opportunities

Produce an ENA Closure Report

Objective(s)

The objectives are:

Define energy system flexibility and the value of linepack provides today
Assess alternative options for providing this flexibility
How will linepack flexibility change with hydrogen in Net Zero energy scenarios?
What are the regulatory, market, policy barriers to deploying this flexibility in the future?
Conduct a technical study to explore the qualitative and quantitative impacts of operating the hydrogen network at 50bar compared to 70bar to support increased linepack flexibility
To deliver the project within time, cost, quality

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact on customers in vulnerable situations. This is because it is a transmission project.

Success Criteria

1. Techno-commercial expertise: to effectively demonstrate the role, drivers, cost, and value of linepack in the current and future energy system

2. Energy system flexibility understanding: to quickly navigate the nascent market for opportunities

3. Pipeline and NTS asset insight: to ensure the right decisions are being advised for NGT in an evolving and resilient world that consider current network operation and linepack deployment

4. Project delivered to Time, Cost, Quality

Project Partners and External Funding

Guidehouse

PremZero (sub-contracted)

Potential for New Learning

The project will provide understanding of the impact of hydrogen, and the wider future whole energy system, will have on linepack and how this understanding could inform regulation, policy and market frameworks over a variety of scenarios.

The findings from the project will be uploaded to the ENA Smarter Networks portal and will be shared via National Gas innovation social media.

Scale of Project

The project will predominantly involve desktop research.

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

None – hydrogen focused innovation project.

Indicative Total NIA Project Expenditure

£466667

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 project will provide insight into how linepack can be impacted and harnessed through the energy transition. The work will also provide insight into the impact of hydrogen upon NTS linepack. Future energy scenarios will be used to understand how linepack flexibility can be managed to support the future energy system. The end point of the project will be further evidence to support future regulatory, policy and market frameworks.

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

Value tracking

	Data Point	Data Point Definition
Maturity	TRL2-3	The project is research focused and will harness international work as well as developing understanding with NGT.
Opportunity	>50% or multiple asset classes	The study looks at linepack and associated assets, as well as in the context of the whole energy system can be applied to all compressor units on the NTS.
Deployment costs	-	Deployment costs are not known at the start of the project
Innovation cost	£466,667	The cost includes desktop based work, external cost is £350,000
Financial Saving	-	Any financial savings are not known at the start of the project.
Safety	-	Safety is not a focus of this project.

Environment	-	This work will not directly generate CO2 savings however the output can enable the energy transition and associated environmental benefits of hydrogen.
Compliance	Support compliance	-
Skills & Competencies	-	The project will not have a skills benefit.
Future proof	Supports business strategy	The project outputs have the potential to influence future market design an RIIO-3 business plan.

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

The findings form the project could be applied across the NTS where linepack in stored. Moreover, the learnings and understandings from this work could be applied to other networks that have linepack.

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

At the start of this study the roll out costs are not known – this is a research 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 project outputs will help to inform market, regulatory and policy reform for the energy transition and can aid in the development of NGTs RIIO-3 business plan to support these changes. The outputs will also support NGTs hydrogen strategy.

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.

The project proposal has been shared with the gas industry to avoid duplication. There will be no duplication of activities done as part of this program. This project will address a gap in National Gas' ongoing innovation work looking at whole system thinking and linepack.

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 study is innovative in two key aspects:

1) The project incorporates aspects of whole system thinking to understand how linepack could be utilised in the energy transition.

The research project explores how hydrogen will impact linepack in terms of economic and value terms.

Relevant Foreground IPR

This is a research project and it is not foreseen that the project will generate new foreground IP.

Data Access Details

Details on how network or consumption data arising in the course of an NIA funded project can be requested by interested parties, and the terms on which such data will be made available by National Gas can be found in our publicly available "Data sharing policy relating to NIA projects" at www.nationalgas.com/gasinnovation. National Gas data access is managed IAW provisions under 2.15-2.18 for the current NIA Governance Document.

National Gas already publishes much of the data arising from our NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

Data Quality Statement (DQS):

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

Energy transition projects and research is not catered for in the current RIIO-2 settlement and the project is high risk and low TRL which would not be considered for BAU funding.

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

Energy transition projects and research is not catered for in the current RIIO-2 settlement and the project is high risk and low TRL which would not be considered for BAU funding. NIA funding reduces this exposure to the risk and enables early stage research to be carried out.

This project has been approved by a senior member of staff

☑ Yes