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 2016

Project Reference Number

NIA_NGN_135

Project Registration

Project Title

Gas to the Future

Project Reference Number

NIA_NGN_135

Project Licensee(s)

Northern Gas Networks

Project Start

January 2016

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Gregory Dodds - 07966887355

Project Budget

£128,538.00

Summary

This proof of research project will employ the use of prescriptive analytics to support proactive strategy development and scenario analysis for the UK gas distribution sector.

The prescriptive analytics that will be employed in this project has the potential to go beyond current analytical capabilities in the UK gas distribution sector. Traditional analytics approaches are categorised as descriptive and diagnostic. These provide rich analysis of historic data but do not directly address future decisions and challenges. More recently, predictive analytics has provided forward looking forecasts. However, predictive analytics do not provide any optimisation capability to determine optimal future decisions. Prescriptive analytics enhances (not replaces), other analytical capabilities by integrating the knowledge gained from descriptive/diagnostic analytics, the forward looking trends of predictive analytics to provide actionable, forward looking insights. This enables decision makers to better take advantage of future opportunities or mitigate future risks.

To this end, a prescriptive analytics model will be developed to quantify, and clearly communicate the costs and benefits of investing in infrastructure assets to accept alternative sources of gas, so that we can meet the challenge of the Energy Trilemma, and maintain the role of the gas sector in the UK energy mix. The model will be based on Northern Gas Networks' assets and data but could be replicated across other GDNs.

The scope of modelling for this project will be limited to future shale and hydrogen gas scenarios. However, the final interface will illustrate how the model could be adapted to incorporate alternative sources of gas. These two scenarios have been chosen to limit the complexity of the model and to ensure that the project is not abortive.

The base case position is the existing RIIO GD1 business plan and will include a level of asset replacement to meet safety and demand constraints consistent with what is currently delivered (i.e. bases case assumes nothing changes). All scenario impacts will be measured against the 'business as usual' base case.

Third Party Collaborators

Business Modelling Associates

Nominated Contact Email Address(es)

innovation@northerngas.co.uk

Problem Being Solved

As the UK moves towards a low carbon economy we need to make sure that the gas sector remains relevant and can help to meet the challenges of the Climate Change Act. A significant factor influencing the role of gas in the medium and long term UK energy mix, is the scale at which the UK utilises alternative gas resources to meet energy demand. Here UK gas distribution network operators will not be passive players, as significant infrastructure investment will be required to make domestic shale, hydrogen and other alternative gases a viable part of UK's response to the Energy Trilemma.

Consequently, the UK gas distribution sector must be able to develop forward looking strategies and investment plans to support the UK in finding the optimal energy future to ensure the benefits of a low cost, low carbon energy source are delivered to customers. The volume of data and complexities involved mean that advanced data analytics that can provide actionable, forward-looking insights are required

Recent advances in big data analytics, termed prescriptive analytics, mean that the barriers of cost, time and expertise to access such advanced analytics are lower than ever1. This project will deliver a proof of concept prescriptive analytics model, to explore possible future scenarios for the gas industry, to assess the short, medium and long-term investment decisions, trade-offs and implications, of modifying the Northern Gas Networks network to accomodate shale and hydrogen gas.

Method(s)

The prescriptive analytics solution that will provide this functionality comprises two key elements:

- A prescriptive analytics model (linear programming, mixed integer optimisation) capable of holistically representing the current gas distribution network, as well as possible future investments, and scenarios for shale and hydrogen. The model will simultaneously represent current and future assets, network activity, current and future sources of gas (location, quality and quantity) and measure the impact on costs, greenhouse gas emissions, natural capital and risk for different investment strategies. This holistic and detailed modelling will ensure the scenarios developed will be robust, considering all interdependencies and knock-on effects.
- A user-friendly data visualisation tool to allow a wide range of users, including those from a non-technical background, to interactively explore the possible shale and hydrogen scenarios. The visualisation tool will allow users to manipulate key input variables and instantaneously see the impact on costs, greenhouse gas emissions, natural capital and risk.

Scope

This proof of research project will employ the use of prescriptive analytics to support proactive strategy development and scenario analysis for the UK gas distribution sector.

The prescriptive analytics that will be employed in this project has the potential to go beyond current analytical capabilities in the UK gas distribution sector. Traditional analytics approaches are categorised as descriptive and diagnostic. These provide rich analysis of historic data but do not directly address future decisions and challenges. More recently, predictive analytics has provided forward looking forecasts. However, predictive analytics do not provide any optimisation capability to determine optimal future decisions. Prescriptive analytics enhances (not replaces), other analytical capabilities by integrating the knowledge gained from descriptive/diagnostic analytics, the forward looking trends of predictive analytics to provide actionable, forward looking insights. This enables decision makers to better take advantage of future opportunities or mitigate future risks.

To this end, a prescriptive analytics model will be developed to quantify, and clearly communicate the costs and benefits of investing in infrastructure assets to accept alternative sources of gas, so that we can meet the challenge of the Energy Trilemma, and maintain the role of the gas sector in the UK energy mix. The model will be based on Northern Gas Networks' assets and data but could be replicated across other GDNs.

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Objective(s)

The objective of this project is to employ prescriptive analytics, to quantify the following for a range of shale and hydrogen gas scenarios:

The total Investment required (Opex, Capex and Repex) to facilitate future scenarios

Net change in GHG emissions (using the traded cost of carbon) to understand the benefit achieved in moving towards a low carbon economy. i.e. net change per scenario measured against the base case position

Volume of shale, hydrogen and natural gas imported and transported

The Resilience of Shale gas demand (redundancy of demand)

The Number and type of key technologies required (e.g. Steam Methane Reformers)

The Requirement for regulatory change.

A key objective is to ensure the objectives outlined above are communicated in an easily understandable and believable way. As such, the project will also provide a web-based graphical user interface that can demonstrate the different investment options for different levels of benefit (GHG emissions) for different 'futures' for shale and hydrogen gas.

Further, the model will quantify the overall uncertainty for each of the above listed variables across all scenarios, using error bars showing, for example, the 10th and 90th percentiles.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The project will be judged a success if:

The prescriptive analytics model represents and effectively communicates the different investment options and the associated benefit for a range of different 'futures' for shale and hydrogen through a graphic user interface.

The model provides information that is believable and can be understood and accepted at the correct 'order of magnitude' by NGN experts and wider industry. This information will include:

- Total Investment required (Opex, Capex and Repex) to facilitate future scenarios
- Net change in GHG emissions
- Volume of shale, hydrogen and natural gas imported and transported
- Resilience of shale gas demand
- Number and type of key technologies required (e.g. Steam Methane Reformers)
- Requirement for regulatory change

The model provides a simple user interface for manipulating scenarios

The model clearly demonstrates the art of the possible in terms of prescriptive analytics, scenario versus investment modelling, and the trade-off of cost, benefit and risk.

The model provides confidence that the prescriptive analytics model is an effective communication tool and that the technology can contribute to informing our approach to meeting the Energy Trilemma

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

Two key areas will be considered. The first being shale gas and the second being hydrogen.

The scope is limited to these two areas for the following reasons:

- The objective is to provide proof that this area of modelling can demonstrate scenario investment options.
- Alignment and synergy with two major projects already underway (TShale and H21).
- The model that is produced will not be abortive and will form the basis for future modelling into other unconventional sources.

Limiting to two major areas will provide value for UK customers as addressing all sources of unconventional gas at this stages would require significant costs, additional complexities and increased project risk.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

The geospatial scope of model will be restricted to the NGN network specifically, Yorkshire. In terms of model granularity:

- The shale model is expected to include the NTS, LTS, 30 Bar and 17 bar networks. The shale model will also include all PEDLS (Petroleum and Exploration Development Licence) in the NGN LDZ (Local Distribution Zone) and their potential connectivity to the NGN network (17 bar and above).
- The hydrogen model will represent the Yorkshire Cities that may be converted to hydrogen gas only with a high level connectivity between cities.

Revenue Allowed for the RIIO Settlement

NA

Indicative Total NIA Project Expenditure

Total External Cost - £96,500

Total Internal Cost - £32,038

Total Project Cost - £128,538

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)

This is a proof of concept research project that will not provide direct financial benefit.

This project will provide evidence for options for meeting the energy Trilemma and extending the life of the gas industry in the UK energy mix by demonstrating the affordability and viability of accepting alternative forms of gas into our network. This will provide significant benefit to customers through the provision of a low cost, reliable and low carbon energy source

Please provide a calculation of the expected benefits the Solution

Research project

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

The model logic and user interface will be fully replicable across all other UK GDNs. The majority of the model logic would be directly reusable in other GDNs although GDN specific data around network connectivity and costs data would have to be incorporated. The underlying technology is industry agnostic and has been applied in a wide range of industries. Although currently limited to Shale and Hydrogen the model approach could be applied to any gas type and could even be extended to include the whole of the UK energy mix (nuclear, renewables, coal etc.). One potential further development of this approach would create a UK wide gas energy futures model to inform industry/national energy strategy.

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

The model logic and user interface will be reusable reducing the cost of replicating the method to other UK GDNs (cost will be driven by need to update model with company specific data for other UK GDNs). Building a model to represent all UK GDNs in a single representation would require additional model development.

An initial estimate to expand model to a UK model would be £0.75m. This would dependent of data quality, network connectivity data, data availability and granularity of model.

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

All GDN's must develop strategies for GD2 and beyond to deal with the uncertainties of investment in their assets to deal with unconventional gas sources. This study will investigate a business modelling and analytics platform that fully integrates operational activities and financial impacts in a holistic approach that can assess various future landscape scenarios and optimise investment decisions.

The learning will form part of two major gas future projects currently live and funded through NIA with the learning disseminated to energy transportation networks and inform governmental departments.

The learning can also provide a basis for future scenario modelling and strategy development research and development.

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

☑ 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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

☑ Yes