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

Oct 2017

Project Reference Number

NIA_SSEN_0030

Project Registration

Project Title

Whole-System Growth Scenario Modelling

Project Reference Number

NIA_SSEN_0030

Project Licensee(s)

Scottish and Southern Electricity Networks Distribution

Project Start

October 2017

Project Duration

1 year and 7 months

Nominated Project Contact(s)

SSEN Future Networks Team

Project Budget

£225,000.00

Summary

The complete project will:

- Devise a methodology for local engagement that informs both the investment decisions of the DSO and of local decision-makers and other energy network owners to maximise the likelihood of investments and decisions that support an optimal whole system outcome
- Devise a methodology for whole-system energy scenario modelling which includes electricity, water and gas; distributed energy resources; EV uptake and other transport issues; housing and infrastructure development plans; and the Future Energy Scenarios
- Using the methodology, create a detailed, ground-up model of Generation and Demand growth scenarios from the present day to the year 2040, covering the distribution network served by specific Grid Supply Points in the three nominated areas of Scotland, from the Transmission/Distribution interface down to the 33kV level• Look beyond the current project pipeline of development for each technology considered, by using the National Grid Future Energy Scenarios as the basis of longer term modelling• Model the impact of the intentions and aspirations of wider local stakeholders, including the Scottish Government, local authorities and industries, and the wider communities within the areas concerned, especially the development of housing and infrastructure• Assess the effects of developments such as Gas Distribution Network extension on power flows, power import/export at the T/D interface, system stability and balancing services; similarly, the effects of planned developments by other infrastructure providers such as water and telecoms utilities• Overlay the results on our existing models of the network, and ask where flexible resources can be used. Use experience gained in previous projects (such as SAVE and NTVV), together with CMZ and Active Network Management deployments, to identify how these can provide option value and reduce total system costs over the range of future scenarios
- Develop a methodology for identifying the optimal holistic development strategy for the area concerned
- Identify the events and conditions which would trigger reinforcement investment and the optimum time to begin those investments in the four Future Energy Scenarios
- Assess the risks posed by increasing reliance on unconventional assets and virtual resources (such as aggregated demand response), to system stability and quality of service. Examine the failure modes and effects of these resources, when used in combination with other assets in the three areas concerned
- Document the methodology used in the modelling so that it can be repeated in other areas and the models updated over time as changes occur

Third Party Collaborators

baringa

Energy Systems Catapult

Nominated Contact Email Address(es)

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Problem Being Solved

Traditional network planning considers a relatively small number of factors, including connection applications and underlying load growth trends on a Distribution Network Operator (DNO)'s electrical network.

A key role of a Distribution System Operator (DSO) (as defined in the ENA Open Networks project) is to undertake "Whole system planning". This means taking into account factors broader than the immediate demands on the local electrical network when considering how to meet customers' needs. Whole system planning requires the DSO to:
• Make decisions on investment in network assets, or flexibility
• Consider local energy scenarios to realise optionality value and make least-regret investments
• Take into account all reasonable solutions across Distribution, Transmission, and other energy networks and sources
• Provide local investors, customers and communities with visibility to inform decisions in relation to their own investments
The foregoing has to be done in a manner which balances cost and reliability across all relevant energy networks.

The industry has been moving towards whole system planning, with projects carried out on Orkney, the Western Isles, and SW England, which have consolidated the aspirations of communities and developers, to connect Distributed Generation, and to use smart and conventional solutions to meet these needs. This now needs to progress further, so that the analysis considers the overall energy requirements of a local geographical area, taking into account the community; planning policy; transport policy; and other energy sources or sinks (such as gas networks). This has not yet been undertaken and will become increasingly important as decarbonisation shifts energy demands between fuels, and as additional decentralised generation seeks to connect.

We may need to plan proactively for appropriate TOTEX investment ahead of connection requests, while ensuring that any investment in capacity ahead of need is a low-regret option. The proposed study will gather evidence to assess the need for such anticipatory investments, and identify possible investment triggering factors. This will ensure that the risk of creating stranded assets is kept as low as possible through making the most effective use of flexible resources, demand side response, active network management, and constraints.

This approach will require a new framework for identifying energy needs that encompasses a range of future energy scenarios, taking into account insights into local developments and needs. The project is relevant to both Transmission and Distribution, and will be led by Distribution.

Method(s)

The Scottish Government is formulating its energy policy, and as part of this process have suggested the identification of three representative parts of Scotland in which they can explore the optimal solution for meeting the needs of these communities and associated businesses. This will include consideration of gas networks; electrification of transport; fuel poverty; and local energy aspirations. In response, we propose to:

1. Develop a methodology for undertaking a whole system assessment of the energy needs of a particular area, including:
a) Stakeholder Engagement approach
b) Local generation and demand scenarios
c) Existing asset condition and replacement needs
d) Investment options within and outwith the distribution network
2. Develop a methodology for selecting the optimal solution
3. Provide appropriate visibility to stakeholders
4. Test these methodologies in the following three areas:
a) Fort William
b) Dundee
c) Islay
These diverse areas will require us to examine the impact of multiple factors, such as:
• Extension (or contraction) of the gas network, altering electricity demand through gas substitution for heating; and the implications of this for network constraints

• Associated transmission constraint and adjacent distribution networks
• Resilience requirements, especially in areas with high dependence on electricity
• Local energy policies, aspirations, challenges and investments
• Expansion of small scale renewables, storage, co-generation and heat pumps
• The ability of local energy markets in a specific area (such as peer to peer energy trading) to alter patterns of supply and demand
• Uneven load growth in urban areas, with population shifts and new housing developments impacting specific areas, requiring a holistic view of energy supply and local development
• Our obligations to serve the entire community, including those in fuel poverty, using vulnerability mapping
• Impact of new central government encouragement and support for large and small scale battery storage
• Increasing uptake of EVs, including clustering effects, with a target date of 2040 recently announced for the withdrawal of petrol and diesel vehicles from the UK market and 2032 in Scotland
• Medium to long term national policy options, modelled according to National Grid's Future Energy Scenarios
• Continuing development of large scale, distribution-connected onshore renewable generation and the retirement of transmission-connected thermal generation

Scope

The complete project will:
• Devise a methodology for local engagement that informs both the investment decisions of the DSO and of local decision-makers and other energy network owners to maximise the likelihood of investments and decisions that support an optimal whole system outcome
• Devise a methodology for whole-system energy scenario modelling which includes electricity, water and gas; distributed energy resources; EV uptake and other transport issues; housing and infrastructure development plans; and the Future Energy Scenarios
• Using the methodology, create a detailed, ground-up model of Generation and Demand growth scenarios from the present day to the year 2040, covering the distribution network served by specific Grid Supply Points in the three nominated areas of Scotland, from the Transmission/Distribution interface down to the 33kV level
• Look beyond the current project pipeline of development for each technology considered, by using the National Grid Future Energy Scenarios as the basis of longer term modelling
• Model the impact of the intentions and aspirations of wider local stakeholders, including the Scottish Government, local authorities and industries, and the wider communities within the areas concerned, especially the development of housing and infrastructure
• Assess the effects of developments such as Gas Distribution Network extension on power flows, power import/export at the T/D interface, system stability and balancing services; similarly, the effects of planned developments by other infrastructure providers such as water and telecoms utilities
• Overlay the results on our existing models of the network, and ask where flexible resources can be used. Use experience gained in previous projects (such as SAVE and NTVV), together with CMZ and Active Network Management deployments, to identify how these can provide option value and reduce total system costs over the range of future scenarios
• Develop a methodology for identifying the optimal holistic development strategy for the area concerned
• Identify the events and conditions which would trigger reinforcement investment and the optimum time to begin those investments in the four Future Energy Scenarios
• Assess the risks posed by increasing reliance on unconventional assets and virtual resources (such as aggregated demand response), to system stability and quality of service. Examine the failure modes and effects of these resources, when used in combination with other assets in the three areas concerned
• Document the methodology used in the modelling so that it can be repeated in other areas and the models updated over time as changes occur

Objective(s)

1 Understand the possible patterns of change over a two-decade horizon in the distribution networks served by three GSPs in the nominated areas
2 Create a whole system modelling methodology, and subsequently three specific area models, for anticipating the impact of these changes and the options for responding to them, in various local Future Energy Scenarios
3 Demonstrate a methodology that allows the two-way transfer of knowledge and understanding between network operators and those that make investment decisions in the areas served by the network, to facilitate efficient whole system planning
4 Apply learning from projects in other regions to assess their value for reducing overall system costs and risks in the three areas, and to identify investment triggers for network improvements

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- A whole-system methodology is developed which enables a ground-up model to be constructed of a distribution area, looking forward for 20 years or more, under various scenarios, which can inform investment planning and decision-making
- The scenario analysis allows the company to examine the scope for applying flexible and distributed energy resources to meet the new DSO responsibilities in the areas modelled
- Improved understanding is gained of whole-system factors including the extension of the gas supply network and other utility developments
- Acknowledgment from local decision makers of the value of the methodology in allowing them to make the best decisions from a whole system perspective
- Dissemination of the outputs to all stakeholders, with continuing engagement

Project Partners and External Funding

None

Potential for New Learning

The full project adds to existing knowledge by:
• Delivering a new methodology for considering the whole energy system in a distribution area
• Exploring the options for a DSO to fulfill its responsibilities in the areas considered
• Developing strategies and planning tools useful to the DSO and other organisations for planning efficient network operations over the medium to long term
• Quantifying the value of flexible resources in particular regions and identifying the relevant investment triggers
• Providing a scenario-based planning tool which can be revised and updated going forward

Scale of Project

Initially, three areas have been selected for study, offering different characteristics and challenges. Once the methodology has been developed, it can be used in any other area. The project will cover three areas, as this is considered to be the minimum necessary to properly evaluate the methodology.

Technology Readiness at Start

TRL1 Basic Principles

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The study covers selected rural and urban areas in Scotland. Once the methodology is established, it can be applied anywhere.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£200k of which 90% (£180) is allowable NIA expenditure

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 knowledge development project. The learning developed will identify optimal strategies and possible options for adapting to change, and can inform and underpin all other distribution network planning and investment activities in the areas defined.

Please provide a calculation of the expected benefits the Solution

This is a research project

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

The learning from the project will be transferable to all other network licensees, however the methodology will not be rolled out elsewhere until it has matured and been validated.

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)
- [x] 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 study covers selected rural and urban areas in Scotland. Once the methodology is established, it can be applied by networks anywhere within GB.

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.

We have checked the Smarter Network Portal and are not aware of any similar projects in the UK. The project will not duplicate any system study carried out in any part of Scotland by either the electricity or gas DNO; and will not be identical to any models previously developed in other regions. We are not aware of any other long term, whole-system future energy scenario models (or of any future energy scenario models of lesser scope), which could usefully be applied in the northern Scotland licence area, given the high penetration of distribution-connected renewables (especially wind) and low population density in some areas. While other studies based on future energy scenarios are in hand, including an internal transmission level study within SSEN which aims to refine the annual Electricity Ten Year Statement down to GSP level, as part of the transmission planning cycle, these other studies do not involve such extensive external stakeholder engagement, nor are they so local in their analysis; nor are they focused on the distribution network.

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