Date of Submission

May 2021

Network Innovation Allowance Closedown Report

Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form.

Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

Project Progress

Project Title

Whole-System Growth Scenario Modelling

Project Reference

NIA_SSEN_0030

Funding Licensee(s)

Scottish Hydro Electric Power Distribution, Southern Electric Power Distribution

Project Start Date

October 2017

Project Duration

1 year and 6 months

Nominated Project Contact(s)

SSEN NIA Programme Delivery Manager –Joe McNeil

Scope

The complete project will:

- Devise a method 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 method 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 method, 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 method 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 method used in the modelling so that it can be repeated in other areas and the models updated over time as changes occur.

Objectives(s)

1. 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. 2 Create a whole system modelling method, 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. 3 Demonstrate a method 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. 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.

Success Criteria

A whole-system method 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 method in allowing them to make the best decisions from a whole system perspective

Dissemination of the outputs to all stakeholders, with continuing engagement.

Performance Compared to the Original Project Aims, Objectives and Success Criteria

1 Understand the possible patterns of change over a two-decade horizon in the distribution networks served by three GSPs in the nominated areas.

The whole system growth scenario model created in this project was used to create models for three separate GSPs of Islay, Fort William and Dundee. These GSPs were modelled utilising Future Energy Scenarios to forecast possible energy use changes over a 20-year period.

2 Create a whole system modelling method, 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.

The whole system model formed the basis of the three foregoing GSPs being modelled. Future Energy Scenarios were used as an input into the model as well as relevant network characteristics for each of the GSPs. The GSP models can demonstrate a range of possible future impacts and provide various investment options for mitigating impacts.

3 Demonstrate a method 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.

The model was created in collaboration with a host of stakeholders including gas utilities, water utilities, local councils and numerous others. Collaboration enabled inclusion of a wide range of inputs in the model and a design suitable for use by those outside the electricity industry as well.

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.

Learning from the model has provided SSEN with a greater understanding of investment trigger points and has also enabled a better understanding of where smart technology interventions can be used.

An initial build of the model has been delivered in line with the original plan. Following a review of the capabilities of this model and its user interface, an opportunity was identified to improve both the usability and the functionality, by allowing the user to vary the assumptions used to calculate the projections, so that the results of changes can be seen in conversational timescales. In addition, the updated tool enables the user to optimise the output for decarbonisation or for minimum cost.

Aside from this change the main project aim, objectives and success criteria have all been met. There was no significant change from these original criteria.

Required Modifications to the Planned Approach During the Course of the Project

The scope of work was extended to include an optimisation tool and a modified user interface allowing variation of the assumptions used to calculate the projections, such that the assumptions can be changed, and the results seen in conversational timescales. This work required a further two months and the budget was increased from £200k to £225k, although final spend was just over £200k.

Lessons Learnt for Future Projects

1. There is an appetite from stakeholders to engage but making contact is challenging. We had successful and substantial conversations with Dundee City Council, the University of Dundee, the Lochaber Smelter and the Islay Energy Trust as evidenced in the closedown report. Approaches on a multi-lateral basis via SSEN as an existing known stakeholder were far more successful than bilateral approaches directly to companies, even where the facilities manager or energy manager was known. For each of the three areas, the following was

achieved:

a. Dundee: We contacted 35 stakeholders of which 12 responded.

b. Fort William: We contacted 30 stakeholders of which 10 responded

c. Islay: We contacted 17 stakeholders of which 3 responded

2. There is less public information available for the gas sector compared to the electricity sector. We found that there was less detailed information on the distribution network at lower pressure levels in Scotia Gas Networks' Long-Term Development statement than in SSEN's equivalent for electricity distribution.
Secondly, some of the key parameters (such as the Peak Load Factor which expresses the contribution of gas load to a 1-in-20 worst case winter's day) are only available to market participants.

3. Public data sources are available to meet the majority of the model's requirements for modelling residential demand. Ofgem issues Typical Domestic Consumption Values (TDCVs) annually, the Department for Business and Industrial Strategy (BEIS) issues gas and electricity consumption data while the government publishes household sizes as part of the Census.

4. Modelling industrial and commercial demand requires information known to SSEN and/or the industrial and commercial consumer. Whilst we have not anonymised data in the model, this could be carried out further. The model nevertheless complies with General Data Protection Regulation (GDPR) since it refers only to the legal entities which MPANs are registered to, and not the personal details of officers or contact points at those entities.

5. The Future Energy Scenarios (FES) data set at GSP level is still developing. National Grid released a data set as part of the 2018 Future Energy Scenarios which estimated peak demand at each GSP. As shown in the closedown report, it was found that this corresponds well to the actuals measured by SSEN at each GSP. In our conversations with National Grid's FES team, they agreed that this dataset is at an early stage. We suggest ongoing feedback from the project to the FES team regarding this dataset takes place.

6. Geographic Information Systems (GIS) is a vital proportioning tool. Many of the public data sources are published on the basis of post-code, Lower or Middle Super Output Area regions. The service areas of electrical distribution substations and gas pressure reduction stations do not typically match any of these regions or boundaries. As such, GIS is a vital tool in proportioning numbers of residential consumers to each substation's service area.

7. The optimisation problem is non-linear but can still be supported by Excel. The optimisation problem as set out in the closedown report is non-linear, and currently has a constraint in which the user sets a defined date during the modelling period at which it would be economic for SSEN to carry out general reinforcement. The optimisation grows more complex if the model is required to, additionally, seek the optimum date on which this should take place. Currently, time-based optimisation is not performed as the problem is simplified by minimising the total cost summated over the study horizon as opposed to evaluating the cost in each respective year.

8. We are currently investigating wider scale deployment of this model to include all GSPs within our north and south network. However, this is dependent on a number of factors such as cost and potential duplication of effort with other models in development.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

The key findings/conclusions from the project are:

1. The expenditure by the DNO on general reinforcement is relatively small. The expenditure by SSEN on 33kV/11kV transformer upgrades and replacements which is estimated by the model is relatively small with respect to the overall capital expenditure on all network and demand-side activities in the region. This is a common finding across all of Dundee, Fort William and Islay.

2. The current trading price for carbon emissions would not itself drive change. The model only includes a small number of actors which are directly exposed to the traded price of carbon emissions, with the most likely being Lochaber Smelter and other key industrial stakeholders. The party most directly exposed to the carbon price remains large generators and large industrial loads through the Large Combustion Plant15 and Industrial Emissions Directives. Nevertheless, the model shows that if all demand-side activity were exposed to the carbon price, it is not enough at present to drive a different outcome (when joint carbon and cost optimisation are requested in the model) to today's business-as-usual outcome (where cost optimisation alone is requested).

3. Demand-side measures such as time of use tariffs, heat pumps and efficient home appliances appear to be the most cost-effective. Based upon the social benefits rating which we have offered as a starting point for discussion with stakeholders, and which identifies fuel poverty and air quality as the highest priority policy drivers in addition to carbon emissions, demand-side measures offer the most cost-effective carbon reductions, whilst delivering wider social benefits and not creating unreasonable general reinforcement costs to SSEN. This is a common finding across all of Dundee, Fort William and Islay.

Data Access

A final report was created by Mott MacDonald that provides more detail of the project findings. Please contact futurenetworks@sse.com for a copy.

Foreground IPR

Learnings from the project are available through this closedown report and the Mott MacDonald summary report. Any further development of the model or modifications to suit individual needs should be done through Mott MacDonald who created the model.

Planned Implementation

SSEN plan to use this tool when engaging with stakeholders such as local councils and also plan to further populate it with analysis being carried out with our Future Energy Scenarios (FES) work.

The tool requires some minor alterations to provide the full functionality SSEN is looking for. There are also plans to expand the use of this tool from 3 GSPs to include all SSEN's GSPs. (over 70). Once costs and timescales are understood SSEN will decide on how to proceed.

Other Comments

N/A

Standards Documents

The learning from this project has no implication on standards.