Date of Submission

July 2015

NIA Project Registration and PEA Document

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.

Project Registration

Project Title

Demand Scenarios with Electric Heat and Commercial Capacity Options

Project Reference

NIA_ENWL001

Project Licensee(s)

Electricity North West Limited

Project Start Date

Apr 2015

Project Duration

18 Months

Nominated Project Contact(s)

Rita Shaw, rita.shaw@enwl.co.uk

Project Budget

£500,000

Problem(s)

There is significant uncertainty around the timescale and location of future changes in peak electricity demand on distribution network assets. Factors contributing to that uncertainty include economic changes, energy efficiency, alterations in customer behaviour (such as peak relative to average behaviour, response to smart metering and increased use of air conditioning), and adoption of low carbon technologies such as distributed generation, electric vehicle charging and heat pumps. Alongside future uncertainty, volatilities in past peak demand can make it difficult to understand the past baseline eg related to economic activity, generator output and weather-dependence, alongside measurement uncertainties.

Heat pumps offer huge potential for carbon savings once electricity is decarbonised. But we consider rising non-diverse electricity demand from heat pumps is the most significant and uncertain long-term (from RIIO-ED2 onwards) effect on demand on the distribution networks. This is due to limited adoption so far, and uncertainty about future incentives for deployment and during operation.

DNOs need to make assumptions about the timescales and location of demand growth so they can invest efficiently in network capacity. Existing methods of demand analysis and forecast do not capture and address this multi-faceted uncertainty in a structured way. So we think there is a need to reassess and improve how we understand uncertain electricity demand, particularly how this is affected by electric heat. Secondly given that uncertainty, further analysis is required around how to make decisions about investing for capacity, including assessment of the commercial options to release network capacity, which may be cheaper and quicker to deliver than technical solutions on the network.

Method(s)

This project builds on the previous IFI projects 'Demand Forecasts and Real Options' and 'Load Allocation', the First Tier LCNF project 'Low Voltage Network Solutions', the Second Tier LCNF project 'Capacity to Customers' and our internally funded 'Power Saver Challenge' and 'Demand and Generation Dashboard' projects.

It first involves Development and Demonstration of better Technical approaches to estimating current and future load by distribution network asset, reflecting the associated uncertainties in load. It will progress from a best-view forecast based on past observed demand, to a set of scenarios based on a corrected version of past demand. These load scenarios are then the foundation for assessing two Commercial solutions to capacity problems. The project will Develop and Demonstrate a 'Real Options' approach to assessing when to use our 'Capacity to Customers' demand side management (DSM) technique versus various scales of traditional Grid & Primary reinforcement. The project will also do enabling Research on identifying and prioritising potential Commercial nonnetwork solutions to address secondary networks constraints associated with uptake of domestic heat pumps.

Scope

A. Load Scenarios with Electric Heat

1. Generate baseline and future scenarios of ‘Grid and Primary’ load with initial improvements to method (summer 2015)
2. Develop disaggregated domestic heat pump scenarios – moving on from the single domestic heat pump type in the ‘Transform’ model to up to ten heat pump / house type combinations, and modelling how load profiles are affected by both thermal load and supplier/ system operator incentives – working with DELTA EE and Imperial College (end 2015)
3. Deliver an improved assessment of thermal and voltage constraints for the secondary networks including heat pump inputs (early 2016)
4. Generate baseline and future scenarios of load at ‘Grid and Primary’ and secondary networks including various incremental improvements to inputs and method (summer 2016)

B. Commercial Capacity Options (based on Load Scenarios)

1. Definition of a ‘real options’ approach and tool to support decisions on DSM versus various scales of ‘Grid and Primary’ reinforcement under demand uncertainty
2. Identification and prioritisation of intervention options beyond the customer meter to address secondary networks constraints

This project is innovative because no other DNOs has developed this type of granular analysis of uncertain demand, or investigated these commercial approaches to capacity issues.

Objective(s)

The financial benefits of the project will come from ensuring that load-related investment is well justified, and in particular by identifying where the Capacity to Customers DSM technique or customer interventions beyond the meter can be used to avoid or defer load-related investment. This will be done by more accurately and credibly representing current and future load, to minimise load-related expenditure to deliver only the justified capacity. It will also provide the foundation for future use of commercial solutions where these can be shown to provide an overall cost benefit. These commercial solutions also offer the opportunity to release capacity more quickly than traditional network solutions (customer service benefit), and with lower environmental impact e.g. reducing electricity demand, avoiding embedded carbon associated with new network assets. It is also expected that the project will streamline analysis of demand in the planning process, allowing our engineers to take a more sophisticated view of current and future demand, without an increase in planning engineer resource.

Success Criteria

A. Load Scenarios with Electric Heat

1. Appropriate methods implemented to correct observed past Grid & Primary peak demand for weather effects and distributed generation contribution, balancing accuracy with cost.
2. Enhanced quantification of impact of growth of electric heating in 2022 and 2030 on the Electricity North West network under different scenarios – using analysis of different types of heat pumps in different housing types. High-level analysis of a provisional scenario to 2050.
3. Quantification of how other electricity value chain players’ influence of electric heating operation will affect this impact (either reducing the impact and / or increasing the impact at different times) in 2022 and 2030, with high level view to 2050.
4. Revised tools and methods available to generate credible Grid & Primary and secondary networks peak load scenarios by asset to 2030, reflecting the scale and sources of uncertainty in demand, with scenarios used for internal and external business requirements.

B. Commercial Capacity Options

1. Created a ‘Real options’ decision approach with supporting Excel tool(s), supported by the University of Manchester’s analysis, which uses demand scenarios to make an economic assessment of whether to use the Capacity to Customers post-fault DSR method versus traditional reinforcement.
2. Identification, initial assessment and ranking of ways that Electricity North West can mitigate (other than reinforcing the network) the impact that electric heating will have on their network (focusing on the customer side of the meter).

Internal / external dissemination of results from both aspects of project is detailed in the ‘potential for new learning’ section.

Technology Readiness Level at Start

Technology Readiness Level at Completion

3	6

Project Partners and External Funding

n/a

Potential for New Learning

The detailed load scenario results will be of most relevance to Electricity North West, but it is anticipated that aspects of outputs and method will be useful to other Network Licensees. So in addition to internal dissemination activities to maximise the value of the learning to efficient investment at Electricity North West, the following outputs are expected for internal and external dissemination.

- Documentation describing the load scenario methodology / revised approach
    - at Grid & Primary and the architecture of the spreadsheet scenario tools
    - for the secondary networks, and the architecture of the revised Future Capacity Headroom model
- Report from DELTA-EE on the defined heat pump / house types, uptake scenarios and load profiles, how these profiles would be altered by the rest of the value chain, the consequences for secondary network constraints based on use of our Future Capacity Headroom model, and potential customer-side interventions to address these issues.
- External dissemination workshop with DELTA-EE
- Report by University of Manchester on an appropriate Real Options approach and tool architecture for DNO capacity investment decisions (produced in forerunner IFI project)
- Report on the 'Capacity to Customers' DSM case studies explored using the Real Options tool, the savings DSM could deliver, and documentation defining the business process for the use of the Real Options approach for deciding when to use DSM versus traditional reinforcement, alongside a version of the Real Options Excel tool(s) and user guide for internal and external use.
- Academic paper and external dissemination workshop on the real options approach to assessing demand side management.

Scale of Project

To ensure consistency and to build on existing systems, analysis of past and future demand will be carried out for all Electricity North West-owned GSP, BSP, primary and distribution substations, HV feeder legs and LV feeder first legs across the whole network. The approaches for secondary networks and Grid & Primary will be separate but related (reflecting the different scale and nature of available baseline metering data).

The Real Options tool will be designed principally to consider specific investment projects at the Grid and Primary level, reflecting approval processes for capital projects, but may be used to set overall policy. The number of investment v DSM projects considered by the tool during the course of the Project will reflect the level of anticipated demand growth and size of investment programme.

Geographical Area

Strategic planning for the Electricity North West distribution licence area

Revenue Allowed for in the RIIO Settlement

Zero. Electricity North West’s RIIO-ED1 business plan for load-related expenditure was priced with a significant 20% reduction on traditional investment costs, based on the use of smart techniques including commercial arrangements such as demand side management. This Project provides the analysis framework to determine whether commercial smart techniques would be cost-effective in practice during ED1 and ED2. Electricity North West already bears the risk within its business plan submission that this 20% cost-reduction would not be delivered, so is not claiming any Direct Benefits in addition.

Indicative Total NIA Project Expenditure

£500,000

Project Eligibility Assessment

Specific Requirements 1

1a. A 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 systems and 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	☒

Specific Requirements 2

2a. Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees ☒

Please answer one of the following:

i) Please explain how the learning that will be generated could be used by relevant Network Licenses.

See 'Potential for new learning'

ii) Please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the Project.

Electricity North West published its high level innovation strategy as Appendix 23 to its Well Justified Business Plan in July 2013. This Project addresses aspects of the challenges described in sections '7.1 Load Impact Modelling' and '7.10 Demand Side Response'.

2b. Is the default IPR position being applied?

Yes ☒

No ☐

If no, please answer i, ii, iii before continuing:

i) Demonstrate how the learning from the Project can be successfully disseminated to Network Licensees and other interested parties

ii) Describe any potential constraints or costs caused or resulting from, the imposed IPR arrangements

iii) Justify why the proposed IPR arrangements provide value for money for customers

2c. Has the Potential to Deliver Net Financial Benefits to Customers ☒

i) Please provide an estimate of the saving if the Problem is solved.

The impact of the Project on the number and size of load-related investment projects undertaken in the RIIO-ED1 and ED2 regulatory periods will depend on how actual and forecast demand on the network develops over those timescales. Whether demand increases or decreases, the Methods developed in this Project will ensure load-related expenditure is efficient.

This project explores two smart commercial methods which Electricity North West considers (alongside other commercial and technical approaches) will contribute to delivering a 20% reduction in load-related expenditure costs relative to traditional methods over RIIO-ED1 (a £20m saving in the RIIO-ED1 business plan). Further savings can be expected in ED2 and beyond as demand levels increase. Key roles of the work on a Real Options approach for DSM and of the prioritisation of commercial options beyond the customer meter are to understand if, when and by how much they can efficiently reduce network costs in the context of overall demand uncertainty.

ii) Please provide a calculation of the expected financial benefits of a Development or Demonstration Project (not required for Research Projects). (Base Cost – Method Cost, Against Agreed Baseline).

As an example of the financial benefit of DSM for Grid & Primary reinforcement, we refer to the CBAs submitted with our well justified business plan for RIIO-ED1. Over a 16 year period, these CBAs suggested net financial benefits (method v baseline, as NPVs) of £0.24m and £0.14m respectively for DSM deferring 2MW of primary transformer or HV cable reinforcement, and £0.71m for 6MW of DSM deferring a grid transformer upgrade. Suppose as an order of magnitude that this Project enables 6 x 2MW DSM projects and 3 x 6MW DSM projects over RIIO-ED1. This gives a conservative net financial benefit of £4.4m (NPV). Compared to the Project cost of £0.5m, this would suggest enabling a net expected financial benefit of the order of £4m. However we consider that this project will address a major weakness in the CBA analysis which assumes a single certain view of future demand and therefore capacity requirements, and thus makes the assessment of benefits rather conservative. The real options DSM decision approach will reflect the latest view of DSM costs and future demand, and take into account the value from the flexibility of DSM capacity eg using DSM to defer or avoid reinforcement until it is clearly required, and the potential for DSM to be stopped if demand requirements fall.

This estimate of benefits excludes considering the secondary networks load analysis and beyond-the-meter interventions which this project only takes to Research stage.

iii) Please provide an estimate of how replicable the Method is across GB in terms of the number of sites, the sort of site the Method could be applied to, or the percentage of the Network Licensees system where it could be rolled-out.

It is anticipated that the Methods would be applicable to the Strategic Planning functions in every DNO.

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

Focusing on rolling out the Method for well-justified Grid & Primary scenarios and a Real Options tool for deciding when to deploy DSM, each DNO will incur costs in reviewing and improving existing systems for analysing data on past demand, and for producing probability-weighted demand forecasts as inputs to the options model. Once a DNO has a DSM technique ready for deployment as an alternative to traditional reinforcement, the roll-out of a real options tool will further require appropriate changes in business processes. Budget estimate of £300k per DNO licence area, so a GB roll-out cost of around £4m.

2d. Does Not Lead to Unnecessary Duplication ☒

i) Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

We have reviewed the ENA Smarter Networks Portal, and do not consider that this NIA Project duplicates other IFI, LCN, NIA or NIC projects already registered. There are a number of IFI/LCN projects in related areas (list available), but we are confident this project is addressing different areas or will build upon / supersede that prior learning. We will refer to these prior projects for comparison in the Project Close Down report. In particular no project appears to address demand uncertainty, the creation of probability-weighted demand scenarios, a real options model to assess DSR versus reinforcement, addressing the significant uncertainties associated with electric heat types and load profiles, or the range of beyond-the-meter options for addressing secondary networks constraints.

We identified some similarities with our high-level ideas for an options model and the approach in National Grid's Network Development policy for RIIO-T1 e.g. it considers a range of transmission reinforcement options against a set of scenarios, but without a formal real options approach, considering DSR or justifying the scenario probabilities. The University of Manchester reviewed National Grid's approach as part of the forerunner IFI project. Northern Power Grid's IFI projects on demand forecasting / scenarios were also reviewed at this stage.

ii) If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.