NIA Progress Report

NIA_ENWL001
Demand Scenarios with Electric Heat and Commercial Capacity Options

22 July 2016

VERSION HISTORY

Version	Date	Author	Status	Comments
V1.0	20/07/2016	Project manager	Final	Final version following internal review and comment

REVIEW

Name	Role	Date
A Howard	Programme Manager	21/07/2016
D Randles	Network Performance and Innovation Manager	21/07/2016
P Turner	Innovation Delivery Manager	21/07/2016

APPROVAL

Name	Role	Date
Steve Cox	Head of Network Engineering	22/07/2016

CONTENTS

1 PROJECT BASICS 4

2 SCOPE 4

3 OBJECTIVES 4

4 SUCCESS CRITERIA 5

5 PERFORMANCE COMPARED TO THE ORIGINAL PROJECT AIMS, OBJECTIVES AND SUCCESS CRITERIA 5

6 REQUIRED MODIFICATIONS TO THE PLANNED APPROACH DURING THE COURSE OF THE PROJECT 6

7 LESSONS LEARNT FOR FUTURE PROJECTS 7

8 THE OUTCOMES OF THE PROJECT 8

9 PLANNED IMPLEMENTATION 8

10 OTHER COMMENTS 8

11 APPENDIX 8

1 PROJECT BASICS

Title	Demand Scenarios with Electric Heat and Commercial Capacity Options
Project Reference	NIA_ENWL001
Funding Licensee(s)	Electricity North West Limited
Project Start Date	April 2015
Project Duration	18 months
Nominated Project Contact(s)	Rita Shaw (rita.shaw@enwl.co.uk)

2 SCOPE

Load Scenarios with Electric Heat

- Generate baseline and future scenarios of 'grid and primary' load with initial improvements to method (summer 2015)
- 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)
- Deliver an improved assessment of thermal and voltage constraints for the secondary networks including heat pump inputs (early 2016)
- Generate baseline and future scenarios of load at 'grid and primary' and secondary networks including various incremental improvements to inputs and method (summer 2016).

Commercial Capacity Options (based on Load Scenarios)

- Definition of a 'real options' approach and tool to support decisions on DSM versus various scales of 'grid and primary' reinforcement under demand uncertainty
- Identification and prioritisation of intervention options beyond the customer meter to address secondary networks constraints.

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

3 OBJECTIVES

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 eg 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.

4 SUCCESS CRITERIA

A. Load Scenarios with Electric Heat

- Appropriate methods implemented to correct observed past grid and primary peak demand for weather effects and distributed generation contribution, balancing accuracy with cost.

- 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.

- 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.

- Revised tools and methods available to generate credible grid and 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

- 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.

- 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 of the original registration.

5 PERFORMANCE COMPARED TO THE ORIGINAL PROJECT AIMS, OBJECTIVES AND SUCCESS CRITERIA

The project is on plan against the original aims, objectives and criteria.

This project aims to support better estimations of future (peak) load by distribution network asset, reflecting the associated uncertainties. A new methodology and supporting spreadsheets/management information systems for the generation of grid and primary loading scenarios have been developed. This was partially implemented in 2015 and delivers a scenario set with a more sophisticated representation of underlying economic and demographic impacts on electricity demand. The methodology has then been further developed with revised heat pump inputs and baseline data for Electricity North West's 2016 load forecasting requirements; this delivers a set of updated winter peak scenarios which reflect underlying changes in demand and the effects of new low carbon technologies.

Further details of the scenarios and methodology will be published this year.

A key input to this has been a programme of work with DELTA EE on disaggregated domestic heat pump scenarios. These have been successfully developed moving from the single domestic heat pump type (in the Transform model) to a set of six heat pump/house types combinations/types. The project has also scoped out the potential of various customer-side commercial options to manage domestic heat pump load on secondary networks eg additional insulation, oversized heat pumps to reduce resistive electric heat and incentivising hybrid heat pumps.

The rest of the project will complete the development of summer peak scenarios, reflecting analysis commissioned from the University of Manchester on future air conditioning load scenarios at distribution network level. This was informed by analysis developed at GB transmission level for the 'RESNET' project for National Grid.

As well as supporting the development and delivery of revised peak demand scenarios for the grid and primary network, the project has also carried through the revised inputs in a more aggregated form into new load scenarios for the secondary network, via updated scenarios in Electricity North West's 'Future Capacity Headroom' model (originally developed in the Tier 1 LCNF 'LV network solutions' project).

Regarding the Commercial Capacity Options, the project has met the objective to provide the foundation of future use of commercial solutions to release capacity more quickly than traditional network solutions. More specifically, a prototype 'real options' tool has been developed and used to compare traditional network reinforcements against post-fault demand side response (DSR) services. The developed tool is being aligned with the Cost Benefit Analysis (CBA) guidelines, set by Ofgem to analyse investments for DNOs' well justified business plan submissions.

The prototype 'real options' tool has been used to justify the deployment of a post-fault DSR contract as an alternative to traditional reinforcement, utilising the type of DSR technique developed in the Tier 2 LCN Fund project 'Capacity to Customers'. The tool was presented on 10 June 2016 at the 'Energy Management: Flexibility, Risk and Optimisation' conference at Edinburgh University's International Centre for Mathematical Sciences (ICMS).

6 REQUIRED MODIFICATIONS TO THE PLANNED APPROACH DURING THE COURSE OF THE PROJECT

Item 3 of the scope was to deliver an improved assessment of thermal and voltage constraints for secondary networks, including heat pump inputs. This was delivered as part of our work with DELTA EE, but the planned approach to delivery was changed.

The original intention was to analyse the impacts of heat pumps on the secondary network using the 'Future Capacity Headroom' model, developed in previous innovation projects. This was mentioned in the 'potential learning' section of the registration. However due to constraints in resourcing changes to this internal model to reflect multiple heat pump types, and longer-term plans for a revised version of the Future Capacity Headroom model as part of the NIA ATLAS project, the analysis of network impacts was undertaken by modifying the generic Transform v5 network model. This model was originally produced by EA Technology for the Smart Grid Forum, and used by DNOs in their RIIO-ED1 business plan submissions. This change of approach was a cost-effective way to deliver the required scope on schedule.

7 LESSONS LEARNT FOR FUTURE PROJECTS

Lessons learnt can be divided into three areas.

1. Domestic heat pump analysis (our sub-project with DELTA EE)

Domestic heat pump loading will vary significantly depending on type of heat pump, house type, operating regime and outside temperatures. The domestic heat pump profiles generated by this project have been offered for the next update of the Transform model in the 2016 governance period. Importantly the profiles are diversified and include the resistive electric back-up heaters which function in lower temperatures.

Key recommendations of the project were:

- Consider planning the network for a 'one in 20' winter peak rather than an 'average' winter peak ie 5.5 kW additional load per heat pump rather 2.2 kW.
- Explore further the impact that clustering of heat pump uptake could have on the LV network – combinations of different heat pump types and networks lead to variable impacts.
- Develop projects/trials to explore the cost effectiveness of 'customer side measures' that could be implemented to manage and reduce the impact of heat pump uptake on the LV network**,** such as increased insulation, oversized heat pumps and incentivising hybrids.
- Continue to engage with other energy stakeholders (eg National Grid and supply companies) to understand their challenges and priorities at the system level, and how this may influence the operation of heat pumps and impacts on the distribution network. The analysis in this report shows that 'optimising' heat pump operation (to increase the use of lower cost electricity generation) will likely increase the overall impact of heat pumps.

2. Methodology for developing peak load scenarios

The project is due to complete by the end of 2016. During the final months, the project's focus will be on completion, transfer of knowledge to the NIA 'ATLAS' project and internal/ external dissemination. The developed approaches have delivered significant benefits in delivering credible peak demand scenarios per substation, based on differences in domestic and non-domestic behaviour, and difference per local authority area.

However, the Demand Scenarios NIA project has exposed the limitations of focusing on the single half-hour or winter/summer peak demand, based on active power demand, and assuming the future relationship between MW and MVA is constant. The learning from this NIA project is being incorporated into the 'ATLAS' project (Architecture of Tools for Load Scenarios) which was launched in November 2015. ATLAS expands the scope of load forecasting from winter peaks, to year-round behaviour, covering maximum and minimum behaviour, active and reactive power demand, and represents the half-hourly behaviour of true and latent demand over a day. The project will benefit from the structured approach developed in the Demand Scenarios project to combine data on loading, connectivity and customers served.

3. Methods for 'real options' assessment of grid and primary capacity decisions including demand-side response

From two hypothetical case studies and one real case study, the project has so far demonstrated that it is feasible for a DNO to employ a 'real options' approach to compare different strategies and support its investment decisions. The prototype will be completed; and will include a demonstration of the Ofgem RIIO-ED1 cost-benefit-analysis approach integrated with real peak demand scenarios. The end of the project will identify the activities required to transition the tool and its application to business as usual.

Further information about the project is posted on our website at www.enwl.co.uk/future-nia.

So far this focuses on the heat pump analysis, but this page will be progressively updated as the project nears completion.

8 THE OUTCOMES OF THE PROJECT

Not applicable

9 PLANNED IMPLEMENTATION

Not applicable

10 OTHER COMMENTS

Not applicable

11 APPENDIX

This appendix detail is additional to the information provided on the smarter Network Portal.

The updated scenarios, referred to in Section 5, are shown at aggregated level in the chart below, but have been produced for each substation.