Demand Scenarios and ATLAS
Architecture of Tools for Load Scenarios
Credible scenarios of future demand and generation – which reflect the associated uncertainties – are key to efficiently planning our distribution network.

Our ATLAS project - ‘Architecture of Tools for Load Scenarios’ - addresses this area. It runs from November 2015 to December 2017, and is developing methodologies, prototype tools and specifications to develop the types of detailed loading scenarios and comparisons to capacity which DNO networks will need to plan the network to meet future customer needs.

The ATLAS project builds on the work in another project ‘Demand Scenarios with Electric Heat and Commercial Capacity Options’, which will close at the end of 2016. Both projects are funded under the Network Innovation Allowance (NIA).

The Demand Scenarios project has developed and implemented a revised methodology for producing annual peak demand scenarios per substation for the Electricity North West region, for use in planning and reporting.

Figure 1: Scenarios for winter peaks – sum across all Bulk Supply Points
Historic measured demand is corrected for the effects of metered exporting generation. Future scenarios take account of econometric modelling of underlying trends in energy demand including the effects by local authority of economic activity and population, and the differing effects of energy efficiency in the domestic and non-domestic sectors. They include the incremental effects on peak of those load types which are likely to be more important in future, such as electric vehicles.

We identified key contributors to future growth in peaks as being heat pumps and air conditioning, so the project developed and integrated additional analysis of the impact of these technologies. This enabled analysis of both winter and summer peaks on our network.

Project partner, DELTA EE used building physics modelling to develop diversified half-hourly load profiles of key ‘heat pump-house type’ combinations, to understand how load would vary significantly with temperature by type eg comparing an average and very cold winter, and validated these profiles with manufacturers.

Figure 2: Example heat pump profile

The heat pump work also developed uptake scenarios and investigated the impact of heat pump load on the secondary network, how potential interventions with customers could mitigate these problems and how profiles would vary with market signals encouraging flexible operation of heat pumps.

To improve analysis of summer peaks, the Tyndall Centre at the University of Manchester explored the scale and drivers of future increases in summer air conditioning load, informed by their work on the RESNET project.

In terms of future peak load growth, air conditioning load is potentially as significant as heat pumps for future load growth, and summer peaks could plausibly exceed winter peaks in urban areas in high-temperature scenarios.

Figure 3: 2030 summer peak air-conditioning load on Electricity North West network in median temperature scenario
The ATLAS P scenarios of half-hourly true demand and latent demand (generation) are being delivered per substation using a new ‘customer-archetype’ model being built by Element Energy. This expands on their previous load models with other DNOs to incorporate key learning from our Demand Scenarios project (such as on heat pumps, air conditioning, population and economic activity) and with more focus on minimum demand periods.

The work on Q scenarios builds on the work of the REACT project which investigated increasing Q exports at the transmission-distribution boundary.

ATLAS extends the analysis from just periods of minimum demand at certain GSPs, to deliver an integrated year-round approach for the whole of a DNO’s grid and primary network. Key inputs to the Q scenarios will be the P scenarios at primaries, historic Q/P ratio trends at primaries, scenario effects of the changing composition of demand and generation, and crucially the interaction of Q and P with the DNO’s network between primary and GSP. This latter aspect is being explored in two ways – via time-series network modelling in IPSA2 and via a spreadsheet ‘empirical’ approach. These two approaches will be compared to inform a recommended methodology for business-as-usual implementation which can deliver Q forecasts up to GSP level.

ATLAS will deliver richer loading scenarios across the DNO network, providing the platform for smart management of the network, and enabling informed discussions with National Grid and other stakeholders about future investments and solutions.

We use our peak scenarios to judge when it is efficient to use a traditional or smart solution to deliver network capacity. A prototype ‘Real Options’ Cost Benefit Analysis model has been developed to support decisions on whether to provide network capacity in a particular location by traditional reinforcement and/or by purchasing post-fault demand side response (transitioning to business as usual the technique developed in our Capacity to Customers project). A decision support model is required because these two strategic options provide different amounts of capacity and with different cost and risk profiles, and the efficient decision depends on a view of uncertain future demand. The prototype model has already been used to support a real business decision to purchase demand side response.

The ATLAS project significantly extends the scenario analysis in the Demand Scenarios project beyond peaks to half-hourly historic and scenario analysis covering:

- seasonal peaks and minima
- active power (P), reactive power (Q) and their combination in apparent power (S)
- analysis of measured, latent and true demand (including the effects of both metered and non-monitored generation)
- indicative comparisons to capacity.

By the end of 2017, ATLAS will deliver a methodology and prototype scenario tool for the grid and primary network, and a consistent methodology and specification for a tool for the secondary networks. The secondary networks tool will be implemented later to take advantage of ongoing data cleanse and improvements in load estimation at these voltages, associated with the introduction of a new network management system.

A key initial project deliverable in ATLAS has been to develop and implement a prototype tool for data processing in MATLAB. This takes half-hourly data for the ‘monitored component of true demand’ and corrects it for network switching, data loss and spurious spikes. This allows the year-round half-hourly analysis to be performed, including automatic identification of seasonal peaks, minima and load factor.

This has been successfully applied to five years of Electricity North West’s bulk supply point (BSP) and primary data. Estimates have also been made of the output of non-monitored generation, and their effect on suppressing measured substation demands.

This work is described in our data processing report at www.enwl.co.uk/atlas