

Mr Jared McKee  
98 Aketon Road  
Castleford  
WF10 5DS  
United Kingdom

5th January 2012

Mr Simon Bartlett  
Chairperson  
ES Cornwall Scholarship Advisory Committee  
PO Box 1193  
Virginia QLD 4014  
Australia

Dear Mr Bartlett,

**ES Cornwall Memorial Industry Scholar – Jared McKee  
Second Quarterly Report**

Please find enclosed the second quarterly report for the ES Cornwall Memorial Industry Scholarship which is a requirement set out in the scholarship rules.

This quarter consisted of two months at GE Energy finishing my first placement and one month at Northern Powergrid starting my final placement.

This quarter my responsibilities have included:

- Developing the meter-level load forecasting algorithm for GE's Demand Response Management System.
- Negotiating contracts with demand response aggregators to provide demand reduction or increased generation from industrial and commercial customers in response to distribution network constraints at Northern Powergrid.

Some details have been omitted to avoid revealing certain intellectual property of the host organisations.

I would welcome the committee's feedback and advice on the report, particularly concerning my proposed goals for the next quarter.

Yours faithfully,

Jared McKee

## **Introduction**

My tenure of the ES Cornwall Memorial Industry Scholarship commenced in July 2011 and continues until April 2012. My program is aimed at gaining exposure to projects which involve understanding and influencing customer behaviour in the electricity supply industry.

The program consists of two placements:

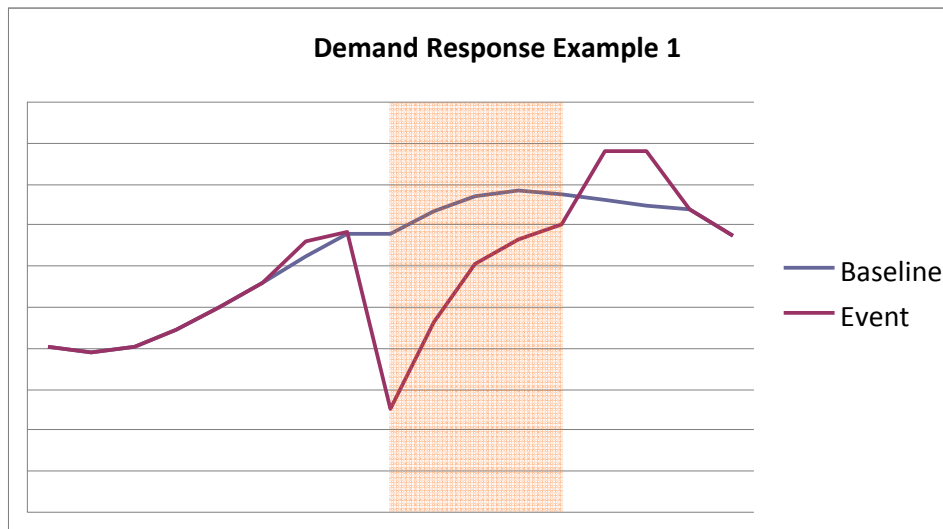
- GE Energy, Atlanta GA USA – July 2011 to November 2011
- Northern Powergrid, Leeds UK – December 2011 to April 2012

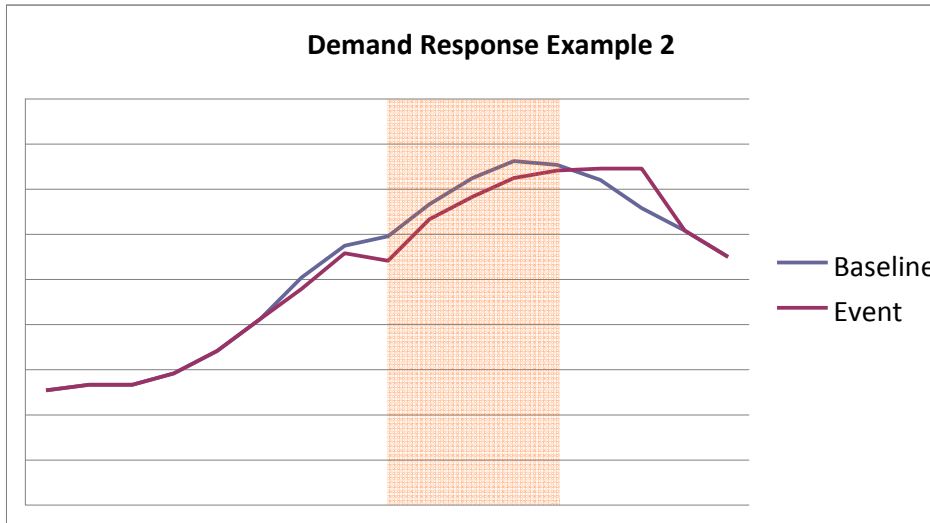
CE Electric UK changed their name to Northern Powergrid in late 2011.

## **Work Experience at GE Energy**

My responsibility at GE Energy for the final two months was to develop the short-term load forecasting algorithm for GE's DRMS (Demand Response Management System). GE had access to smart meter data from a number of demand response trials in the USA to enable the development of the algorithm. The data consisted of customers who had participated in Time of Use (ToU), Critical Peak Pricing (CPP) and Direct Load Control (DLC) events. Developing this algorithm resulted in a number of interesting learnings which will be discussed below.

The charts below illustrated examples of residential customer response during demand response events. The charts are an aggregate of smart meter loads during certain events for certain residential customers. The darkened area indicates the event period.





The first is a contrived example in which customers were specifically chosen because they had a significant response during an event. This example was included to highlight two important aspects of customer behaviour during a demand response event:

- The pre- and post- shoulder created before and after the event, potentially resulting in a new peak.
- The significant response at the beginning of the event, followed by a decaying response until the end of the event.

The second example shows the aggregate of all customers who participated in a certain event, irrespective of their attributes or response. The graph shows that, for this event, the combined peak demand reduction is negligible overall, indicating that many of the participants did not modify their behaviour enough.

The two most important lessons which can be learnt from this are:

- Demand response forecasting is important in determining when and for whom an event should be called. Without demand response forecasting, it is difficult to determine whether a demand response event will have a positive or negative effect, and therefore, whether it is the most appropriate solution to employ for a given network constraint
- Behaviour-based customer segmentation and targeting is essential to get an optimal demand reduction. Comparing the two examples shows that there are distinctly different customer behaviours during demand response events, some desirable and some not. It is important to target the desirable behaviours to save money and achieve the required outcomes.

## **Work Experience at Northern Powergrid**

I have started working on the CLNR (Customer-Led Network Revolution) project at Northern Powergrid. The CLNR project is the UK's biggest smart grid project. 14,000 homes and businesses in the North East and Yorkshire will be involved in this innovative £54 million project, helping Northern Powergrid to find ways for customers to reduce both their energy costs and carbon emissions in the years to come.

By way of background, some relevant UK terminology is listed below with comparisons to the Australian terminology:

- DNO (Distribution Network Operator) – is analogous to DNSP (Distribution Network Service Provider) as used in Australia
- MPAN (Meter Point Administration Number) – is used in a similar context to the NMI (National Metering Identifier) in Australia. It is used to uniquely identify customers, or more particularly, meters.
- Supplier – is analogous to Retailers in the Australian market

Northern Powergrid is a DNO, responsible for delivering electricity safely and reliably to 3.8 million customers across northeast England, Yorkshire and northern Lincolnshire. Northern Powergrid holds two separate DNO licences, Northern Powergrid (Yorkshire) plc and Northern Powergrid (Northeast) Limited.

Northern Powergrid has partnered with the following companies in the CLNR project:

- British Gas (supplier) – recruiting customers, communicating with and signalling customers, customer propositions, installing smart grid tech. in customers' homes, and more.
- Durham University – trial design, developing network models, simulating results of trials, determining the optimal mix of technology/customer solutions, designing/administering surveys, analysis of results, publication of papers, and more.
- EA Technology – network technology specification, analysis of optimal solutions, developing toolkit for engineers, updates to policies/standards/etc, cost benefit analysis, and more.

Currently DNO's main contact with residential customers is in relation to:

- restoration of supply following a fault
- customer connections
- network augmentation affecting customer supply
- stakeholder engagement / consultation

Suppliers in the UK are the DNO's primary point of contact for customers' electricity usage data and billing propositions. It is for this reason that, in order to trial customers' willingness to be flexible in their electricity usage and to establish the cost of that flexibility, DNOs must partner with suppliers.

DNOs have access to interval meter data for large industrial and commercial customers only. Certain suppliers have already begun installing smart meters for residential customers ahead of the planned United Kingdom wide 2014 Smart Meter roll-out; and DNOs do not currently have access to the corresponding interval meter data. DNOs are collectively working with the UK Department of Energy and Climate

Change (DECC) in order to define their Smart Meter data requirements from the 2014 Smart Meter rollout.

DNOs currently do not collect any residential attribute data (age, income, lifestyle, etc.) or business attribute data (annual turnover, employee numbers, etc.) and they have deemed it unnecessary obtain this information in order to fulfil their obligations in the immediate future.

The CLNR project aims to enhance the available customer information by determining customer load profiles and observing general customer behaviour during demand response events using a sample of CLNR trial participants. All input customer information necessary to complete the CLNR project will come from British Gas (interval meter, attribute and survey data) and Durham University (survey data).

My primary responsibility at Northern Powergrid over the last month has been to negotiate contracts with demand response aggregators to provide demand reduction or increased generation from industrial and commercial customers in response to distribution network constraints.

The contracts between Northern Powergrid and aggregators were inspired by and, in many respects, based on the STOR (Short Term Operating Reserve) scheme. STOR is a scheme in the UK operated by National Grid (transmission) to help balance generation and demand, keeping the grid stable. The scheme limits participation to customers who can provide a demand reduction or an increase in generation of at least 3 MW. Aggregators have stepped in to allow smaller customers to participate by "aggregating" their demand response to a total of at least 3 MW. The STOR scheme is an agreement between National Grid and customers/aggregators to reduce their demand by a contracted amount at short notice (within four hours) in return for an availability payment (constantly paid as long as they remain available) and utilisation payment (paid each time an event is run).

These aggregators also often participate in another demand response scheme called "Triad demand management". This is an agreement between suppliers and the customers/aggregators to reduce their demand on the "Triad days". "Triad days" are the top 3 demand days in the year for each customer which National Grid uses to determine the peak demand charges they will pass on to suppliers. Suppliers obviously want to reduce the demand on those days, so they have created this scheme.

The reason for trialling a similar scheme to STOR within Northern Powergrid is to determine what benefits DNOs can obtain from industrial and commercial demand response. Ultimately, it may be possible to work towards a unified approach for contracting demand response between National Grid, DNOs, suppliers, aggregators and customers.

Interestingly, the legal terms of the STOR contract prevent a customer or aggregator from participating in both the STOR scheme and our scheme if the time periods in which demand response events can be called clash. This means that DNOs need to compete with National Grid for the participation of customers and aggregators in demand response. Northern Powergrid has to set their rates to be equal to or greater than the STOR rates to provide a proposal that is more likely to be taken up by aggregators.

The reason why STOR contracts preclude customers/aggregators from participating in other conflicting schemes is because National Grid depends on the

customers'/aggregators' ability to reduce their demand relative to what their demand was immediately prior to the event. If they are participating in another scheme, and an event has already been called under that scheme, the customer/aggregator may not be able to reduce their demand any further. The customers'/aggregators' existing demand reduction is not valuable to National Grid because it does not help them resolve the grid stability problems as they develop – the stability problem will remain if the customer/aggregator cannot reduce their load as agreed.

DNOs have a further requirement beyond that of the National Grid – the customers' exact location on the network is of great importance in determining the value of any demand response provided. DNO's current trials are considering the use of demand response to alleviate specific network constraints, and therefore, only the customers strategically positioned near the network constraints are of value to the DNO.

A full set of documentation about the CLNR project is available here:  
<http://www.networkrevolution.co.uk/industryzone/projectlibrary>

### **Looking Forward**

Another of my responsibilities in the coming months will be to do a gap analysis, comparing the CLNR project bid to Ofgem with what is planned for delivery. This gap analysis will help me to fully understand the challenges faced when undertaking a project like this.

I intend to gain exposure to the work being done by British Gas, Durham University and EA Technology in the CLNR project. I will be meeting with them to learn more about their contributions to the project.

Towards the end of this quarter I hope to do some travel in Europe. I will be pursuing opportunities to visit distributors while I am travelling. As yet, no visits have been organised.