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10th April 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
Third Quarterly Report

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

This quarter my responsibilities have included:

- Completing the negotiation of 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.
- Working with Network Operators to trial the use of industrial and commercial demand response

Some details have been omitted to avoid revealing certain intellectual property of the host organisations. There may be the possibility of presenting more sensitive material to a limited audience upon my return to Australia with the explicit agreement of the host organisation – non-disclosure agreements, or similar, may need to be signed.

I would welcome the committee's feedback and advice on the report.

Yours faithfully,

Jared McKee

Background

This report was prepared by Jared McKee as the third quarterly report required under the terms of the ES Cornwall Memorial Industry Scholarship. My tenure of the 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 distribution and supply industries.

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

This scholarship was awarded in Australia by the University of Queensland, and therefore, comparisons to the Australian electricity industry may be made to give context to Australian readers.

I am currently 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.

The CLNR project is the largest of four second tier Low Carbon Network Fund (LCNF) projects awarded in 2010 by Ofgem. The four projects were:

- Customer-Led Network Revolution (submitted by CE Electric UK - now Northern Powergrid)
- Low Carbon London (submitted by EDF Energy Networks - now UK Power Networks)
- Low Carbon Hub (submitted by Central Networks – now Western Power Distribution)
- LV Network Templates for a low carbon future (submitted by Western Power Distribution)

Useful UK power industry terminology:

- DNO (Distribution Network Operator) – effectively equivalent to DNSP (Distribution Network Service Provider) in Australia
- Supplier – effectively equivalent to Retailer in Australia

The CLNR project consists of four key project partners:

- Northern Powergrid (DNO)
- British Gas (Supplier)
- Durham Energy Institute (part of Durham University)
- EA Technology

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 been known in the past as CE Electric UK, NEDL & YEDL and the Electricity Board – or the *'lec'y board*, as instantly recognised by locals.

Further information about the CLNR project can be found at www.networkrevolution.co.uk

Introduction

The following areas will be covered in this report:

- ***Executive View*** – an executive's view of the CLNR project – an excerpt of a presentation given by Phil Jones, President and CEO of Northern Powergrid, at the Future of Utilities conference in London
- ***Project Partners*** - about the project partners in the CLNR project.
- ***Project Approach*** - how the work has been approached/structured.
- ***Customer Flexibility*** – how customer flexibility is being tested in the CLNR project.
- ***Network Technology*** - network technology that is being tested in the CLNR project.
- ***Commercial Arrangements*** - more about commercial arrangements with demand response aggregators, including an evaluation of the success of those arrangements and what we learned.
- ***Challenges*** - challenges encountered in the project so far.
- ***Thames Valley Vision*** - summary of the Thames Valley Vision (another Low Carbon Network Fund project like the CLNR project).
- ***Other Responsibilities*** - other things I've done unrelated to the CLNR project.

Executive View

The following is a high level view of the learnings to date in the CLNR project presented by Phil Jones, President and CEO of Northern Powergrid, at the Future of Utilities conference in London in March 2012.

Customers:

- ***Cost incentives for the customer are weak*** – cost alone will be insufficient incentive to cause consumers to change behaviour
- ***UK market structure and culture is not optimised for this sort of engagement*** – current systems, style and economics are not designed to test future value
- ***Effective customer engagement is challenging*** – it's early days, but the indications are that the greatest uncertainties do not lie in the technological elements of projects
- ***No common classification exists for Small Medium Enterprise*** – our search of existing studies has identified a variety of classifications but no clear common ground (as exists for domestic)

Technology:

- ***Smart technology still needs to develop*** – the technology is often more elusive than the glossy sales brochures suggest…
- ***…but market testing is possible in innovation projects*** – specifying functionality before partnering adds project risk but is testing the feasibility of normal commerciality
- ***New technology vision and deployment requires genuine collaboration*** – technology suppliers' R&D may be usefully deployed (but beware the IPR dragons)

Outputs:

- ***Modification of workscope is certain*** – a three-year learning project must inevitably respond to changes in external assumptions (e.g. heat pump take up) as well as detailed emerging learning (e.g. optimum siting of storage devices)
- ***Companies and Ofgem are forging new ground*** – regular dialogue is important in order to continue to develop this important price control building block

- ***"Low-carbon networks" energises our people*** – existing and new staff are excited by opportunities and challenges presented by smart grids' innovation
- ***Many hands or too many cooks?*** There is strong commonality amongst projects – knowledge sharing and synthesis of 'overall' outputs remain critical
- ***"Conveyor belt" output management processes are vital*** – as an industry we need to develop mass production and absorption capabilities for the knowledge created that appropriately manage IPR and confidentiality risks

Where this is leading us:

- ***Cost efficiency and security of supply are rightly taken for granted*** – the support of low-carbon targets is an additional requirement on DNOs and not a substitute
- ***Economic payoffs for individual customers are absent*** – contrasting with the benefits falling to society, similar to waste recycling
- ***Customer "pull" may arise through enabling technology*** – accessible, simple information and control may engage customers
- ***The smartest solutions will be investment-lite*** – delivered without significant technology investment
- ***DNO business plans should comprise base case plus options*** – where value is generated by deferring investment as long as possible
- ***10-year outlook involves connecting more generation and new load clusters*** – thereafter we require a more operations-centric focus

Project Partners

The project partners in the CLNR project are:

- ***Northern Powergrid (DNO)*** – project management, network technology, commercial arrangements (eg. industrial & commercial demand response)
- ***British Gas (supplier)*** – recruiting customers, communicating with and signalling customers, customer propositions, installing smart grid tech. in customers' homes, and more.
- ***Durham Energy Institute (part of 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.

Northern Powergrid is expecting the following benefits to be delivered to DNOs:

- Novel technologies and integrated control schemes to release headroom from existing network assets
- New planning and design policies, standards and tools to help designers to determine the optimum design solutions
- New operational policy, procedures and systems to help control engineers manage network headroom in real time
- Enhanced customer engagement models and connections proposition
- Review of industry structure – commercial & operational relationships
- New training materials & courses

As an energy supplier, British Gas has a keen interest in the "smart grid". In common with other suppliers, they understand that the "smart grid" could be a benefit or a threat, and therefore, they

need to improve their understanding of it. At the moment, suppliers in the UK are talking less about carbon and more about affordability – an observation supported by some of my colleagues at British Gas.

Some other potential benefits to British Gas for participating in CLNR include:

- So far British Gas have experienced 100% access to install smart meters for customers participating in the CLNR project, significantly higher than for non-trial customers
- It may improve the appeal of British Gas to customers – customers choosing a supplier because they want participate in trials like those of the CLNR project

Interestingly, British Gas created a similar initiative to the Arizona Public Service Solar Gardens initiative described in my first quarterly report. Their initiative was called Energy Share (www.energyshare.com). The idea of these initiatives is to allow communities to invest in renewable generation and then be able to see the result of their investment in their community. For example, their investment could result in solar panels being installed at their local school. British Gas noted that they found the initiative difficult to scale.

Durham's involvement in the CLNR project exemplifies my reasons for wanting to be involved in this project. I believe their approach will be critical to the future operation of electricity networks.

> *"From Anthropology to Physics, Durham Energy Institute covers the spectrum of energy research but the areas in which we excel are those which lie at the boundaries between the traditional technical disciplines and the social sciences and humanities. We encourage such interdisciplinary work as we feel these areas will yield major breakthroughs. The small size and compact nature of the university is to our advantage as it naturally stimulates interactions between departments and disciplines. Thus, we are agile and responsive and we can quickly assemble bespoke-research teams."*

Project Approach

The following terms are key to understanding the structure of the project:

- ***Successful Delivery Reward Criteria (SDRC)*** – these are the project milestones by which Northern Powergrid reports progress to Ofgem. Northern Powergrid has up to £3 million at risk for failure to deliver to these milestones.
- ***Learning Outcome (LO)*** – the project has been divided into five parts, called learning outcomes. LO1-3 are being done in parallel first, trialling specific customer propositions and network technology. LO4-5 will follow, bringing it all together to determine and deliver "optimal solutions" to network constraints.
- ***Test Cell (TC)*** – these represent the specific groups of customer and technology combinations being trialled. The work is divided this way to track recruitment, installation, monitoring, etc. to ensure enough customers are recruited, the data sample size is large enough, etc.

Learning Outcomes:

- ***LO1 Monitoring*** – what are current, emerging and possible future customer (load and generation) characteristics?
- ***LO2 Customer Flexibility*** – to what extent are customers flexible in their load and generation, and what is the cost of this flexibility?
- ***LO3 Network Flexibility*** – to what extent is the network flexible and what is the cost of this flexibility?

- ***LO4 Optimum Solutions*** – what is the optimum solution to resolve network constraints driven by the transition to a low carbon economy?
- ***LO5 Effective Delivery*** – what are the most effective means to deliver optimal solutions between customer, supplier and distributor?

The full list of SDRCs and TCs can be found on the project website. They have been omitted for brevity.

Customer Flexibility

Customer offerings include:

- Subsidised appliances:
  - micro-CHP (combined heat and power)
  - Smart wet white goods
  - Electric vehicle charging and monitoring points
- New tariffs:
  - direct load control – some appliances are turned off during peak times for up to 15 days of the year
  - time of use – different electricity prices at different times of day
  - restricted hours – same as Time of Use, with some appliances programmed to turn off during peak times (this can be overridden)

Groups of customers were selected based on the presence of certain technologies. In some cases, the technology was subsidised. Technologies included:

- micro-CHP (combined heat and power)
- smart wet white goods
- heat pumps
- electric vehicles
- solar PV

These tariffs and technologies formed the basis for the division of Test Cells (eg. Test Cell 10a is all about the recruitment, setup, monitoring and analysis of residential customers with smart wet white goods who are on the restricted hours tariff).

Representative groups of customers were selected based on the following customer attributes:

- Residential:
  - age of household members
  - housing tenure (rented / owned)
  - household income level
  - thermal efficiency measure
  - rurality (urban/sub-urban/rural)
- Small/medium enterprise:
  - peak time electricity usage
  - size of organisation
  - business sector
  - single vs. multi-site organisations.

The following information will be collected for analysis:

- Smart meter data – all participating customers will need to have a smart meter
- Disaggregated load data – British Gas will install equipment to monitor individual appliances for some customers.

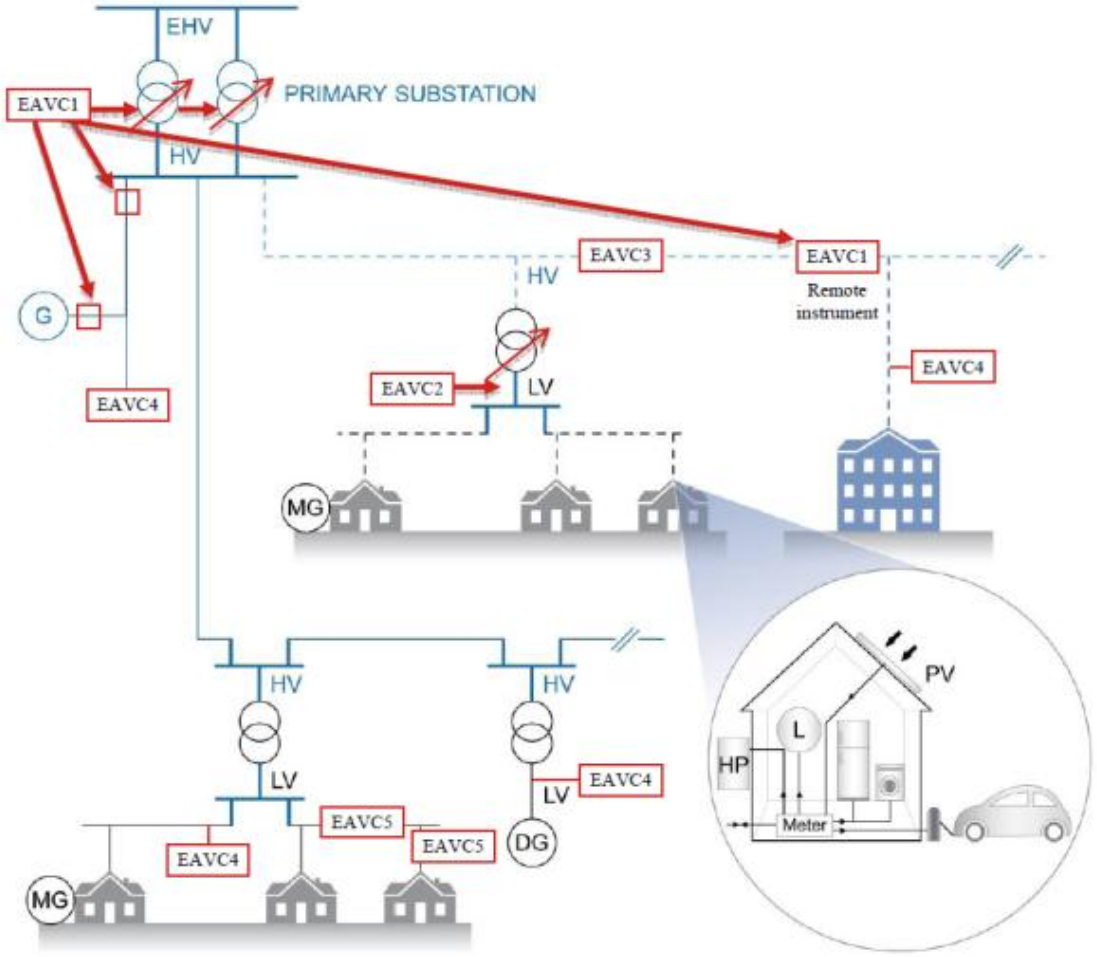
- Surveys – administered by Durham participants invited to fill out online survey
- Tours – interviews, photographs, audio recording, floor plans

Network Technology

The following network technologies will be tested:

- Enhanced Automatic Voltage Control (EAVC)
- Real-Time Thermal Rating (RTTR)
- Electrical Energy Storage (EES)

The following diagram gives an idea where the EAVC technology will be installed on the network:



The GE (originally developed by FMC-Tech) RTTR solution is being used for selected 66 kV and 20 kV overhead lines. Below are some pictures:

The EES devices to be deployed include:

- 1x 2.5MVA / 5MWh deployed to demonstrate voltage control and peak shifting of network loads.
- 2x 100kVA / 200kWh units to be connected at the LV bars of a distribution substation to support the local transformer and the HV network.
- 3x 50kVA / 100kWh units to be connected deeper into the network on an LV distributor, supporting the LV mains cable, local transformer and HV network back to the primary site.

The contract was awarded in December 2011 to A123 Systems Inc. for all EES devices. A123 Systems Inc. will supply, deliver and install in October 2012.

GUS, or the Grand Unified Scheme, is a system being designed by EA Technology as part of the CLNR project. The purpose of this system is to orchestrate the new technologies (EAVC, RTTR, EES and Demand Response) in such as way as to alleviate network constraints (particularly thermal or voltage constraints). One of my fellow graduate engineers from ENERGEX, Andrew Birch, now works for EA Technology and is playing a key role in the development of GUS.

Commercial Arrangements

Part of the CLNR project was to trial industrial and commercial demand response. This was to be done over two separate trials – one in winter 2011/12 and one in winter 2012/13.

The steps taken in the first trial were:

- determine what network side of the business wants from demand-side response
- determine the best market channel – directly with customers, through suppliers, or through aggregators
- build relationship with aggregators (chosen market channel)
- develop contractual terms
- gain experience from running the contract

Northern Powergrid signed contracts with KiWi Power and ESP (Energy Services Partnership) in January 2012 to trial the provision of demand response services from industrial and commercial customers. These companies were contracted to act as aggregators, engaging industrial and commercial customers on Northern Powergrid's behalf to provide demand response. The benefits of engaging aggregators were numerous:

- The aggregators already provided similar demand response services under STOR (Short Term Operating Reserve), operated by National Grid, and therefore, already had the experience and technology needed to deliver demand response services
- The aggregators already had an established customer-base of customers who were willing to participate in demand response schemes
- Using aggregators reduced the amount of communication required to initiate a demand response event. To initiate an event, only one instruction per aggregator was required, rather than one instruction per customer.

In the first trial, only three industrial and commercial customers were engaged – refrigeration, web hosting and mining businesses. This sample size was only large enough to provide anecdotal observations.

Below are a couple of graphs showing examples of the demand response provided by the refrigeration and web hosting businesses. The shaded area depicts the event period.

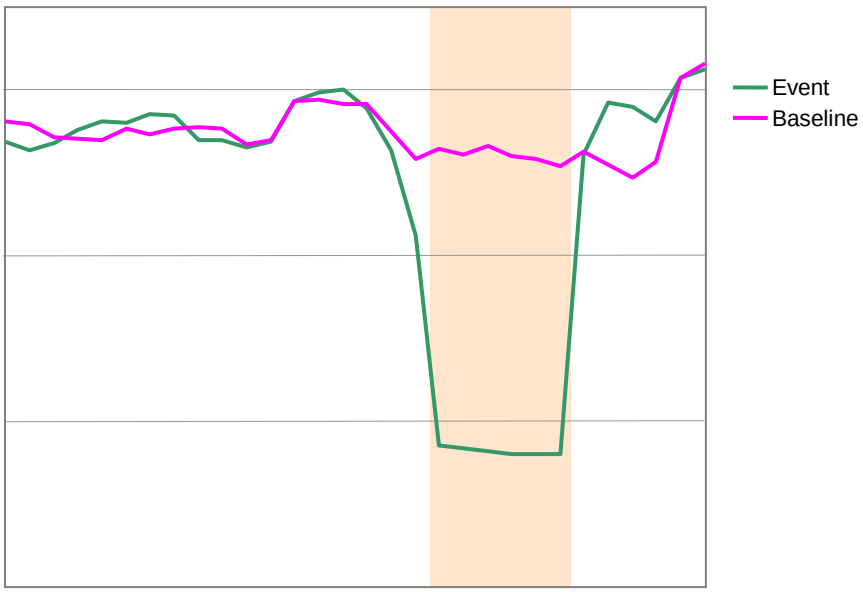


Figure 1 – Demand response provided by a refrigeration business

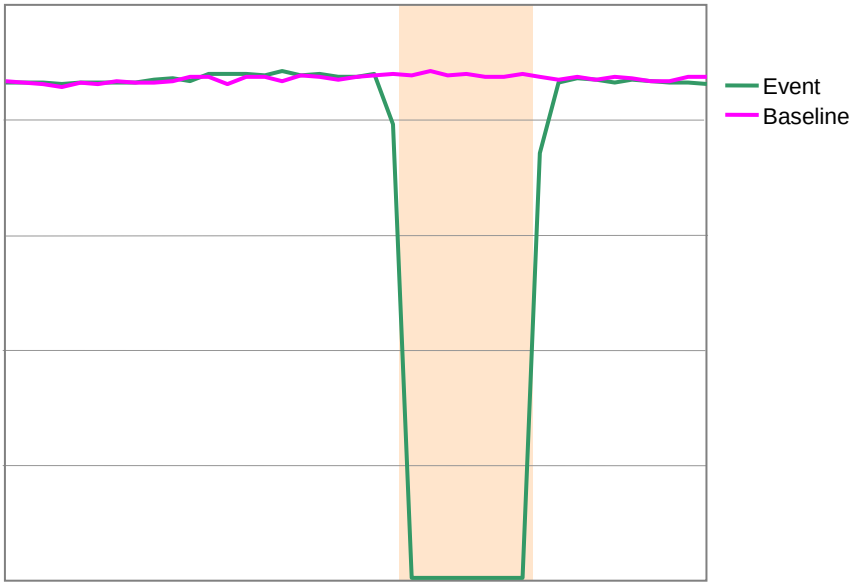


Figure 2 – Demand response provided by a web hosting business

The following events were called in the winter 2011/12 trial:

- 4x 1 day events were called across 3 sites
- 1x 4 day event was called across 2 sites

Of the 13 events, 9 were successful (delivered the contracted about of demand reduction).

Failure events:

- Fire on site which removed one site for the winter 2011/12 trial period
- Generator failure on 1 day, site resumed full availability the following day
- Demand response already provided for Triad, and therefore, the site was unable to provide further demand response as required by the contract
- Demand reduction delivered but not at the contractual level

The fundamental contract conditions for the winter 2011/12 were as follows:

- Contracted demand reduction (MW) – the amount of demand reduction the aggregator/customer is required to achieve during the event. This is measured by comparing their demand during the event to their demand immediately before the event.
- Availability Window (varies, but approx. 15:00-19:00, Mon-Fri, excluding bank holidays) – the time that the aggregator/customer is required to be available to participate in demand response events.
- Utilisation Payment (£/MWh) – paid for each event based reduction in consumption during the event. No extra payment is made for extra demand reduction beyond what was contracted.
- Availability Payment (£/MW/h) – paid for every hour the aggregator/customer remains available to call upon. It is calculated based on the contracted demand reduction and the number of hours they are available. This payment ceases if the aggregator/customer failure to deliver at least 90% of the contracted demand reduction.
- Response Time (20-30 minutes) – the amount of time the aggregator/customer has from the notification of an event to when they are required to have reduced their demand.
- When negotiating the contract, Northern Powergrid described the most “extreme” event that was likely to occur – one event every three years which lasts for up to 10 days. The

aggregators took this condition to their customers when recruiting. It was not a formal term of the contract; however, it was arguably a “gentlemen’s agreement” so we were careful to check with the aggregators before trialling dramatically different types of events.

The contract was heavily based upon the National Grid STOR (Short Term Operating Reserve) scheme. This was done for the following reasons:

- the market (aggregators and customers) were already familiar with the STOR terms
- it opens the possibility of a common “demand response market” from which DNOs, National Grid and others can source demand response with common conditions

Some of the things observed during the trial included:

- Half an hour before the start of the first event of the trial, the mining company reported a fire on site and was unable to provide demand response services for the rest of the trial. This occurred when a Northern Powergrid network operator initiated the event. The network operator observed that we could not rely on a single customer’s demand response to address a network fault – more than one should be used (increasing the odds of successfully maintaining supply, but also increasing the cost of demand response).
- In addition to participating in our trial, the refrigeration business was also participating in a separate demand response scheme to reduce demand on Triad days (the three highest demand days of the year which National Grid uses to charge suppliers for transmission costs). One of the events Northern Powergrid initiated conflicted with the demand response already being provided by the refrigeration business under the Triad scheme. This resulted in the refrigeration business being unable to reduce their demand further to meet the agreed demand reduction contracted with Northern Powergrid.

Some areas for further consideration in future contract revisions may include:

- “Demand reduction” verses “demand limit”
    - Demand reduction can be difficult to measure because it relies on strict rules around baselining the customer’s demand by either measuring what the demand was immediately before the event or taking some kind of average baseline demand for the same time of day in the past.
    - If different schemes (STOR, this one, etc.) call events at the same time and the customer is participating in multiple schemes, measuring demand reduction requires that the customer reduce their demand twice or more. In many cases this will be impossible. Unfortunately, the customers may not be considering this in the early demand response agreements. In the future, the price of demand response may increase if customers become wary of the difficulties associated with delivering demand reduction.
- The contract implicitly required that customers be available to participate in an unlimited number of events. This may, like the “demand reduction” methodology, cause prices to increase as customer realise that it may become a burden to deliver demand response in an unlimited number of events.

Flexitricity, another demand response aggregator, was engaged to undertake market research. In particular, they have been approaching industrial and commercial customers to find out what it would take to make them interested in participating in a demand response program. There may be the opportunity to recruit some of these customers for participation in the second trial in winter 2012/13.

More information about the demand response aggregators can be found here:

- KiWi Power – www.kiwipowered.com
- ESP – www.energyservicespartnership.co.uk
- Flexitricity – www.flexitricity.com

Project Challenges

- Customers with certain attributes were hard to find, particularly:
    - Customers with electric vehicles, who are British Gas customers, who have not opted-out of marketing material
    - Customers who are in rural areas, who are British Gas customers, with GPRS (2G mobile internet) connectivity, with electric hot water
- There are rules preventing a supplier from pulling the dropout fuse of another supplier's customers. This made it difficult to recruit customers from other suppliers to participate in the trial because the installation of more advanced metering requires the dropout fuse to be pulled. Solutions to work around this are available but can increase cost.
- Monitoring disaggregated loads (separate appliances) is always harder than it seems – a sentiment expressed by both British Gas in the UK and BC Hydro in Canada. Existing products often have unacceptable shortcoming, and therefore, custom solutions are often needed. More time is spent developing the monitoring solution rather than analysing the results.

Thames Valley Vision

The following projects were awarded second tier funding in 2011 by Ofgem from the Low Carbon Network Fund (LCNF):

- Flexible Plug and Play (submitted by UK Power Networks)
- B.R.I.S.T.O.L. (submitted by Western Power Distribution)
- Thames Valley Vision 2 (submitted by Scottish and Southern Energy)
- Capacity to Customers (submitted by Electricity North West)
- Flexible Networks for a Low Carbon Future (submitted by Scottish Power Energy Networks)
- FALCON (submitted by Western Power Distribution)

I was asked to produce a briefing on the Thames Valley Vision 2 for John Barnett, Commercial Director at Northern Powergrid. It looks like a very interesting project – one I would recommend to any future scholarship recipient who has similar objectives to my scholarship program.

About the Project:

The project is being led by Scottish and Southern Electric (SSE), a vertically-integrated energy company and the owner of Southern Electric Power Distribution (SEPD). The project is targeted at the Bracknell network – located in the Thames Valley, about 40 miles west of London.

The project's objective is to "demonstrate how SSE can prepare to meet the anticipated 'low carbon customer' demands, at lowest cost, without imposing delays or impacting Quality of Supply (QoS)."

Total project value: £32.2m
External funding: £3.8m
DNO compulsory contribution: £2.8m
Second tier funding request: £24.5m

Project completion date: 03/2015

Project Board:

- Southern Electric Power Distribution (SEPD)
- General Electric (GE)
- Honeywell
- Bracknell Forest Council (BFC)
- KEMA
- University of Reading (UoR)

Project Approach:

The approach taken in the project is “Model, Monitor & Manage” – the "three M’s”.

Monitor:

- Monitor over 300 LV substations, over 40 commercial/industrial customers and approximately 1000 domestic customers with smart meters.

Model:

- Establish a Centre for Smart World Analytics at the University of Reading
- Create a Tracking and Inferencing Model which will derive short, medium and long term demand forecasts – managing the more dynamic characteristics of customers in the future and overcoming the limitations of today’s capital planning based on average peak demands
- Develop unbalanced three phase LV state estimation
- Enable network operators and planners to forecast network constraints at LV nodal level
- Create new demand and generation profiles to indicate the impact of solar PV, heat pumps, EV charging together with a series of forecasts of likely customer adoption/take-up.

Manage:

- Engage domestic and industrial/commercial customers to highlight specific local network constraints and/or potential dispatchable demand.
- Facilitate real-time ratings, active network management and intelligent switchgear
- Deploy energy storage at LV substations, street cabinets and household locations
- Deploy HV network automation to enable constraint management via network reconfiguration

Project Plan:

Q2 2011	Consumer Consortium – first meetings held and terms of reference established
Q1 2012	Smart Meter/end-use monitoring installations; and 80% LV substation monitoring complete
Q2 2012	University of Reading Tracking & Inferencing (T&I) model built, tested and data integrated
Q3 2012	Network control devices installed and commissioned
Q3 2012	Network energy storage devices installed and commissioned
Q3 2012	Domestic/SME demand response solutions installed
Q1 2013	Low Carbon Smarter Network Centre opens at University of Reading
Q3 2014	Final University of Reading Tracking & Inferencing Model Report
Q3 2014	Fuel Poor Low Carbon Promotions evaluation results
Q1 2015	End of project report

Other Responsibilities

A problem I have found in both distributors I have worked for (Northern Powergrid and ENERGEX) has been how difficult it is to access and analyse data. In particular, SCADA data (historical load, voltage, etc. observations for network assets) seems the hardest to obtain. This is not to say that accessing and analysing the data was impossible – in fact, tools are available in both organisations to facilitate this task. Instead I am saying that it is a lot harder than it should be.

Accessing SCADA data is about more than just being able to select a specific network asset and view a historical graph. It is about the ability to access and analyse, in bulk, all network assets (of which there are many thousands) on a regular basis without wasting weeks of time manually extracting, transforming and analysing the data for each network asset individually.

In ENERGEX, there are four ways to obtain SCADA data:

- A graphical tool called "Sacsgraf" which allows the user to graph SCADA observations visually and copy/paste data to other tools. It is constrained by the fact that the user must manually select network assets a few at a time and copy/paste the data (a time consuming task).
- A command line tool, which can be used to extract data without interacting with a graphical interface, thereby speeding up the process when it has to be repeated for many network assets. The advanced user can even use windows batch scripting to perform bulk data extractions. The problem with this tool is that it can only extract 30 days of data at once and is very susceptible to failure.
- Telnet to a certain Unix server, run a series of scripts to extract the data to a folder on the server, FTP to that Unix server, copy the files from the Unix server to the local machine, write a script to transform the data into a usable format.
- A very slow web interface which seems to have a more modern interface than "Sacsgraf", but still requires the user to manually nominate each network asset they require data for – a time consuming task for thousands of network assets.

In Northern Powergrid, there a two ways to obtain SCADA data:

- A graphical tool called "PI Processbook" which allows the user to graph SCADA observations visually. It does not allow the user to extract the raw data at all.
- A Microsoft Excel add-in called "PI Add-in" which allows the user to use spreadsheet formulae to extract observations for network assets specified within the formulae. This tool limits the user to using Microsoft Excel (specifically Excel 2003 on Windows XP for compatibility reasons) for data manipulation – unless the user is willing to go through the process of extracting data and exporting it from Excel for every network asset of interest. Unfortunately, the structure that the data is returned in is virtually unusable for analysis and requires significant transformation. The required transformation results in spreadsheets approaching a size of 50 MB per network asset which operates very slowly from in Excel 2003 in Windows XP running in compatibility mode on Windows 7.

In both ENERGEX and Northern Powergrid I reverse engineered the network protocol used to extract SCADA data. This means that I could circumvent the need to use the (rather limiting) corporate tools provided for accessing SCADA data. To alleviate any security concerns of readers – well designed applications will implement security at the network protocol level, not the user interface level. Simply reverse engineering the network protocol does not imply that I circumvented any security measures.

The PI system in use by Northern Powergrid can be accessed by other OSI products – such as through their ODBC (open way of accessing databases), PI-API (C library for extracting data) or some of their new graphical data analysis tools. These all cost a lot of money and are not as flexible as they could be.

Some philosophical observations/opinions:

- System designers, including SCADA system designers, should publish the data access protocol specifications openly and freely.
- Electricity distributors should make data access and analysis a priority, including SCADA data – tools should be provided to allow rapid bulk extraction, transformation and analysis of SCADA data
- Electricity distributors should start asking questions about how they will approach the management of smart meter data – particularly given that smart meter data will likely form an integral part of the planning process in the future, like SCADA data today.
- Electricity distributors should start taking a more permissive approach to data – rather than giving the tools and access permissions to those who absolutely must have it, give the tools and permissions to everyone where possible.
- These same data access challenges can exists and should be addressed for other systems as well (eg. GIS, network connectivity, etc.)