Customer-Led Network Revolution
news

Issue No 2 Autumn 2012

Hello, in recent months the Customer-Led Network Revolution (CLNR) project has been coming on in leaps and bounds.

In a low carbon future, the electricity distribution network will need to be more dynamic and responsive. A smart grid that benefits customers will of necessity rest on a combination of new technology and commercial techniques, and involve suppliers, distributors and customers. Northern Powergrid and its partners, British Gas, Durham Energy Institute and EA Technology, are trialling a range of 'smart' solutions on the distribution network and supporting customers to be more flexible in the way they use and generate electricity.

Early technical and customer recruitment obstacles have been ironed out and trials are now properly under way. While it's too early to anticipate any results, we've learned a huge amount about the research process already and have some fascinating progress to report.

In this issue of the CLNR newsletter we cover developments in real-time thermal rating, customer recruitment, demand-side response with industrial and commercial customers, and a prototype software tool which could make a huge difference to network designers. Our profile of Andrew Spencer sheds light not just on the diverse background of a core team member, but also on how the research partners are learning to work together.

We're also interested in hearing from you: comments on our work, questions, suggestions and insights are always welcome. So please read on.

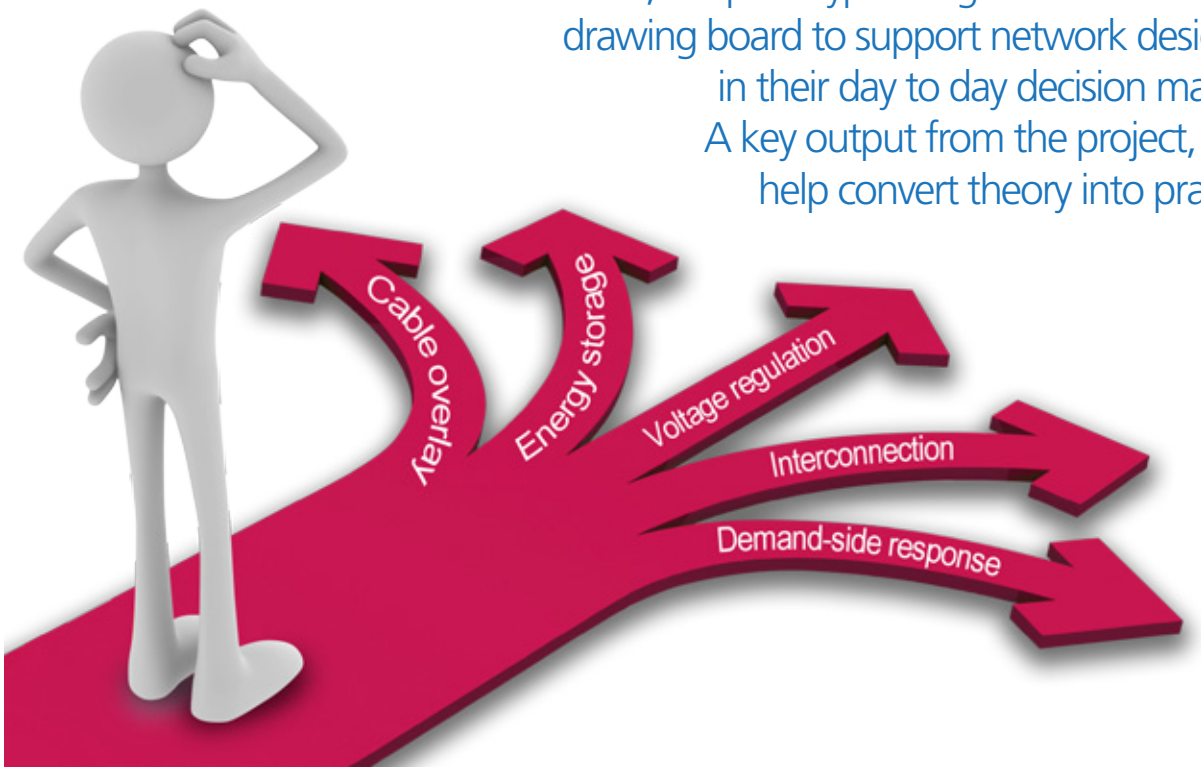
Regards,

Liz Sidebotham, editor

For further information on any of these articles or to suggest an item for inclusion in a future newsletter please contact **info@networkrevolution.co.uk** or call the Northern Powergrid media helpline: **01977 605 601** (Monday-Friday 8:30am to 5:00pm)

help for the low carbon network designer

Network Planning and Design Decision Support, or NPADDS, is a prototype design tool on the CLNR drawing board to support network designers in their day to day decision making. A key output from the project, it will help convert theory into practice.



As the network becomes 'smarter', with new devices connecting to it and customers taking and exporting power in different ways, network designers will be faced with many more variables. Network Planning and Design Decision Support, or NPADDS, is a pilot software tool that will feature as a key output of the CLNR project.

This tool will help designers cut to the chase, by assessing the network quickly and presenting a set of options of what's most likely to work in a given situation. With built-in network analysis and the ability to suggest conventional as well as 'smarter' solutions to alleviate network constraints, engineers involved in developing NPADDS believe that it will allow designers to consider the most cost effective options and make more informed design choices.

Low carbon technologies can have an adverse effect on the network. The CLNR project is testing a range of solutions such as demand-side response, real-time thermal rating and electrical energy storage. What is learned from these trials, including the amount of network headroom released and the costs associated with technical solutions, will be incorporated into the NPADDS assessment tool.

NPADDS will import network models from spatial data and integrate with existing design and asset management tools. It will model and simulate local loads and the range of potential solutions to allow designers to quickly understand the effect they have on the network. In this way, NPADDS will give the design engineer the ability to make appropriate assessments of the impact of smarter network technologies and operations. If it proves to be successful, the prototype tool could also be interesting to other distribution network operators, to support today's and future designers.

This work is being led by EA Technology and is forecast to deliver in late 2013.

relationships matter for demand-side response

Last winter's industrial and commercial demand-side response trial set the scene for larger trials this year.

Demand-side response from industrial and commercial customers is a crucial part of the CLNR project. In winter 2011-12, three customer trials were successfully completed: when asked to drop load or to generate, customers did so, which showed that when the network needs to reduce load, the response can make a difference and customers don't lose out.

For the coming trials, a major challenge is finding customers to take part in an unfamiliar activity, so we need to tackle this lack of awareness. So, as before, the CLNR team is working with third parties – commercial aggregator companies such as Flexitricity, Kiwi Power and Energy Services Partnership (ESP), whose sales teams will approach customers and suggest ways to change their practices so they can participate in a trial.

This winter the team is running trials in geographical areas on Northern Powergrid's network where it would be good to reduce demand from time to time in order to alleviate network constraints. Participants are rewarded for modifying their power consumption, whether they reduce their load, operate on-site generation, or run combined heat and power.

Relationships and contracts are key because these establish what the network operator wants to achieve, what's expected of the customer and what they will receive in return. The first industrial and commercial trial indicated not only that customers were able to drop load or generate when necessary, without disturbing their business, but also highlighted important changes to the design and accuracy of the contracts.

In the next trial, information from these refined contracts will be made available to GUS (grand unified scheme), the coordinated network control system being developed in the CLNR project. GUS understands constraints on the network: for example if it sees that a transformer is in danger of overheating because of too much load, it will look for industrial and commercial contracts in the right area and then have the option of 'talking' direct to aggregators such as Kiwi Power. The aggregator will then communicate with the customer – either through an automated system, or by simply making a telephone call.

If the winter 2012-13 trials go as planned, it will show that network operators can build relationships with customers and develop attractive-enough propositions for demand-side response to work. In turn, this will demonstrate what can be achieved from 'smarter' commercial and technical solutions working in tandem, as an alternative to putting more copper in the ground.

hot stuff: real-time thermal rating update

Real-time thermal rating takes the temperature to explore the available headroom of the network. Find out more, and watch a CLNR video explaining how weather affects the rating of the electricity network.

As much as the network revolution is about developing ways to accommodate customer uptake of low carbon technologies, it is also exploring how Northern Powergrid can get the most out of its existing assets. One way is to find out where there is greater 'headroom' in the network and use this information to release capacity. Real-time thermal rating (RTTR) is doing just that.

For years, overhead lines and underground cables have been managed according to static ratings, that is, how much current can be pushed through them based on assumed ambient conditions. But weather conditions and topography affect this capacity, especially of overhead lines. Sunny days and wind speeds as well as location - in a valley, on a hilltop, exposed to the wind and so on - all affect the temperature of a line. And the hotter it gets, the less current it can safely carry.

By attaching thermal rating devices at points along a line, it's possible to get real-time indications of the line's temperature at any given moment, in relation to the ambient weather conditions and location, which in turn allows the network operator to assess its actual rating under those particular conditions. What they have found is that there can be a significant range, depending on temperature and wind, to safely operate above its assumed rating.

In the future, as demand for electricity grows even more at certain times of the day, and also as more renewable generation devices connect to the network, there will be a greater range of power flow, and also power flows in both directions, placing ever greater strain on the network.

But if the additional headroom capacity can be released when the line's temperature is lower due to windy or cold weather, it may avoid the need for wholesale network expansion or reinforcement. And obtaining forecasts from local weather stations will add a relatively easy, no-cost element to this innovation.

So how might it work in reality? Imagine a length of overhead line with a town at the end of it, only fed by this line; the load is high but the wind is blowing, which cools the line, allowing the engineers monitoring it to make use of the greater amount of free headroom. However, if the weather warms up, the line may overheat.

Now the network is at risk. But if a thermal rating device can alert the system via an electronic signal that it can't cater for the increased load, it allows the network operator to relieve the constraint on the network in advance, either by turning on a generator, contacting customers to reduce load or other techniques.

Together with energy storage, voltage control and demand-side response, and with more knowledge about these devices, this may deliver one of the CLNR project's ultimate goals: cost-effective uplift in network capacity.

To find out more on how weather affects the network in this way, watch our video at **www.networkrevolution.co.uk/knowledgezone/video-library**

FEATURE: trial runs

Running trials on how to encourage customers to change their electricity use is a core feature of CLNR. Recruiting the trial participants has been instructive in itself.

Running trials to test ways that customers can change how and when they use electricity, via a combination of tariff incentives, efficient technologies and closer relationships with the electricity supplier and network operator, is central to our research. The success of these trials relies on customer recruitment, and this in itself has delivered some interesting results.

tariffs

Tariff options have to be commercially viable, reflecting the real cost of delivering electricity by 2020, and also be acceptable to customers. A good uptake will show that customers are prepared to be flexible in how they use electricity, in return for a rate that reflects the value to distribution networks.

Frontier Economics, working with the tariff teams from British Gas and Northern Powergrid developed three tariffs aimed at solving two different problems. The first two, Time of Use and Restricted Hours, are both 'regular' use tariffs, developed for customers on low voltage networks. With the time bands pre-set, both tariffs aim to reduce demand at peak times. Under Time of Use the customers are unconstrained in their electricity usage, whereas with Restricted Hours certain devices are switched off at peak times - though the customer can choose to override the restriction.

In contrast, on Direct Control, the third tariff, customers allow certain loads to be interrupted up to a pre-agreed number of times a year. This provides network operators with an additional tool to actively manage the network, reducing demand to overcome short term constraints. Direct Control is available to customers connected to the high voltage part of the network as well as to low voltage customers, making it attractive to larger energy users. If successful, this proposition may be a cost effective alternative to network reinforcement.

domestic customers

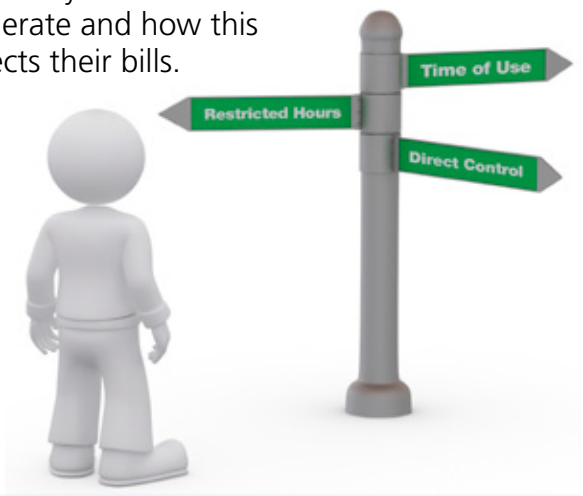
British Gas's half a million smart meter customers were well-placed to take part in these smart grid trials and their response to the idea was excellent. Higher than expected numbers signed up to the Time of Use tariff, attracted by its three-rate time banding which prompts customers to shift their usage away from the 4pm - 8pm weekday peak.

Even more interesting was the response from customers who jumped at the chance not only to take part in the trials but to have a smart meter installed too.

When asked, customers said their main reason for taking part was to save money on their electricity bills - reducing carbon emissions wasn't high on the list. But the added incentive of M&S vouchers at the start and end of the trial didn't tip the balance for many; the gift was welcome but they would have said yes anyway.

Many Time of Use trial participants claim they don't use electricity much during peak hours, so they won't have to change their habits all that much. But only when all the data has been analysed will the research team know if this is in fact the case.

In tests which focus on customers with low carbon technologies such as solar panels, customers are keen to know how much electricity their devices generate and how this affects their bills.



Air source heat pumps have been installed in the off-gas community of Llangattock, Powys

heat pump hold-up

While recruitment on Time of Use has been easy, other tariff propositions have been a tougher sell. Restricted Hours rested partially on customers with heat pumps, but small initial uptake of this technology meant that numbers of potential participants were limited. Heat pumps, it transpired, weren't well understood, and without sufficient incentives they were expensive - and tricky to fit in locations with limited space.

But with funding from the Department of Energy and Climate Change (DECC), British Gas have so far been able to install over 240 new heat pumps for customers and these are now primed for the trial. Some just have basic monitoring equipment attached, while others are 'smart' heat pumps with storage in the form of a 300 litre hot water tank which allows a home or business to use the stored heat when the heat pump's output is reduced over the peak load period on the network.

Where lack of customers has limited recruitment, trials have been adapted and some participants are simply being monitored for their 'live' usage instead.

sme challenge

Small and medium enterprise (SME) customers present a slightly different story. While customers are drawn to the trials initially, attracted by the prospect of lower bills and being 'greener', many withdraw when they realise more fully what's involved. SMEs are highly dependent on their electricity supply to run their business, and can't just reduce availability of essential equipment, as they'd have to do with the Restricted Hours or Direct Control trials. Many businesses already reduce their loads through energy efficiency measures and can't be any more flexible. Or they may be concerned about the size and impact of the monitoring or interrupting equipment. Some businesses have no say in their power use because they're in serviced properties, or part of a larger organisation, or they deal with electricity through a broker.

Still, the Time of Use tariff trial was filled quickly, as the three-rate time bandings are good for business: for most of the day they're on the middle rate while peak rate, in the later afternoon, is when they're powering down, so SMEs can see the benefit.

While it's disappointing that there aren't more SME customers involved, it is still useful to discover this about a portion of the customer base where there was little previous insight. Follow-up technical surveys and interviews by researchers at Durham University will inform the team more about other limiting factors.

The project team knows that any new pricing and usage systems have to benefit the customer as well as the network and supplier, and what these trials will show is where to strike the balance.

PROFILE:

Andrew Spencer, CLNR programme office manager

CLNR manager Andrew Spencer not only has decades of experience in the network distribution business, he's also adding his voice to the CLNR customer trials.

With his 33 years' service as an engineer and manager with Northern Powergrid, and extensive regulation and project management expertise, Andrew Spencer was invited to join the Low Carbon Networks Fund CLNR project to work with the project delivery team and improve overall project management and governance.

The £54 million smart grid project, the largest in the UK, brings great responsibilities and Andrew's role includes making sure that robust planning, monitoring and reporting arrangements are in place and that issues, risks and changes are managed effectively and discussed at the right level; all with the aim of ensuring that quality research outcomes are achieved, on time and on budget. Andrew also sits on both the CLNR Executive and Project Boards and he's keeping an eye on other LCNF projects to identify potential areas of mutual support.

Andrew is not just involved in the management of a low carbon research project; he is also an active participant in the low carbon future. PV roof panels at home support the increase in renewable generation that the country needs to reduce its carbon dioxide emissions - and keep his own electricity bills down. He is also signed up for CLNR enhanced monitoring, and might install a micro generation boiler, making him eligible for yet another of the CLNR trials.

How did he get to this point? In 1979 the Yorkshire Electricity Board (as it then was) sponsored Andrew to train as an engineer and he's not looked back. After gaining a first class honours degree in electrical engineering he cut his teeth on repairs and technical engineering, moved into primary construction and from there into his first management post in field operations construction. This was followed by major projects design where he gained a Masters degree in project management.

Andrew then moved into regulation, where he managed two distribution price control reviews, business separation and the introduction of the interruptions incentive scheme (IIS) before a move back to engineering brought him into Asset Management. Here he was instrumental in helping the Company achieve the PAS 55 certification for the optimised management of physical assets, before taking on the role of system performance manager.

So how is he finding his new role on the CLNR project? "Working with project partners from different companies has been a learning curve as each organisation has its own culture and ways of working. When a project is established, people assume that the participants can work effectively together from day one, but it doesn't happen like that; it takes time to get used to each other, adapt your habits and find common ways of working. As a distribution network we are orientated towards customer-contractor relationships, where the customer specifies all of the requirements and the contractor delivers to the specification. This project is different; it is a collaboration where all the partners have been involved in defining the outcomes, designing and running the trials and analysing the data to fulfil those outcomes.

"I also thought, at the outset, that the value of the project would only be realised towards the end, in 2013, when the trials are completed and the results analysed. But that's not the case. When you get together with other network operators, there is a lot of curiosity which I hadn't really foreseen – such as questions about our procurement process for the network technology. People really want to know about the journey as well as the destination.

"There is a lot of interest from our own asset management colleagues and a desire to translate what we're learning into our business plans. It seems that all network operators involved in LCNF projects are realising that they're in the same boat, trying to keep their own asset management functions up to speed and looking at how best to get the information out there – and when to do it. So there's a lot to think about; not only delivering the research but also how best to capture and communicate other lessons that are learned on the way. "

news in brief

a model network

A model 'smart network' will be on show at the second LCNF conference on 25-26 October 2012.

The Customer-Led Network Revolution team will be presenting the project's work at the second Low Carbon Networks Fund (LCNF) conference organised by the Energy Networks Association at the end of October. This year we'll also be showing our interactive model of a 'smart' electricity distribution network in the exhibition area.

The model shows some of the new technologies and interventions (such as energy storage and demand-side response) we have been developing to manage and moderate loads on a network. By pressing switches to manipulate the model, visitors will be able to see what different elements can do to a network, how to balance the increased stresses on a system and how extra capacity can be released.

joined up controls

The grand unified scheme will integrate and control the new network technologies and demand response.

Bringing new technologies into the network, such as electrical energy storage or enhanced automatic voltage control, and demand-side response to release new capacity, are essential elements of CLNR. But integrating all these devices and managing them in unison will produce even greater benefits. That's where the grand unified scheme (GUS) comes in – a control system to support more dynamic distribution networks.

Siemens, the supplier, together with the CLNR design team, has worked out a detailed specification for the GUS system and is now building it. Equipment will start to be installed this year, and be completed ready for our combined network trials in early 2013.

storing energy

Solutions insight: energy storage may boost the amount of headroom on the network.

Together with other technologies, battery storage may boost the amount of headroom on the network.

As storage devices affect the network upstream of their connection, the research team anticipates that batteries will make the greatest contribution when they are sited closest to the load or generation. The research team will trial three sizes of battery devices, each with a two-hour charge/discharge. They are placing these on six areas of the network, including rural and urban locations and at both high and low voltage.

This way they'll establish the best place to connect battery devices. For example, for the smallest (50kW) storage units, the team suggests the best position is approximately two thirds of the length of an LV feeder away from the substation. The trials will demonstrate the effectiveness of these design layout decisions.

in hot water

Electrically heated hot water trials have had a re-think.

The electric hot water trials have been redesigned and enhanced. Originally we wanted to monitor customers who heat their water electrically at peak times, and run restricted hours and direct control trials to see whether we could further manage the timing of these loads. But we have found that nearly all customers polled using electric hot water are on Economy 7/10 tariffs, existing time-of-use tariffs that shift water heating loads (as well as heating loads) to the off-peak evening period. Since the majority of customers are already taking advantage of these long-standing restricted hours tariffs we have had to reconsider our trials in this area.

Instead, we will now monitor customers with overnight electric hot water heating; we'll look at energy consumption profiles, get a read on the percentage of customers who regularly use the boost facility in peak periods and measure the amount of hot water consumed in a typical day. This will inform our view on how customers are using electricity today so that we may consider what this could mean for the networks of the future.

voltage highs and lows

Solutions insight: how to control voltage when there are greater changes in load.

Researchers are looking at how to control voltage and design the network in such a way that it can anticipate and control voltage drops or rises at the end of a cable, regardless of its length and without having to add conductor capacity.

With anticipated future changes in load and generation, the potential voltage swings at the end of a cable will be much greater, and the control system needs to detect the voltage at the far end of the network and make adjustments to keep it within statutory limits.

But with the right information, an overall control system can compensate for voltage shifts when necessary. So to enhance the view over the network, monitors have been placed at strategic points, which feed information back to the control system which keeps the voltage within pre-set limits.

CLNR is ‘fully charged’

The latest episode of Robert Llewellyn’s British Gas-sponsored Fully Charged show on YouTube

Robert Llewellyn (of ‘Red Dwarf’ fame) talks to Professor Phil Taylor of Durham University and the Durham Energy Institute to understand more about the Customer-Led Network Revolution, what it will take to achieve a smarter, more flexible grid, opportunities for energy storage and changing customers’ electricity use.

You can find it in our video library at
www.networkrevolution.co.uk/knowledgezone/video-library

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