



Customer-Led Network Revolution

SME Customers: Energy Practices and Flexibility

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Introduction

The Customer-Led Network Revolution (CLNR) Project is the UK's biggest smart grid project and at the forefront of the move towards a low-carbon economy. The £54 million scheme is collaboration between academia and business led by Northern Powergrid, the electricity distribution network operator for the North East and Yorkshire. The project is part-funded by the Office of the Gas and Electricity Markets' (OFGEM) Low Carbon Networks Fund (LCNF). The other lead business partners in the project are British Gas and EA Technology. Durham University and Newcastle University provide an interdisciplinary team of researchers to bring academic rigour and insight to the project.

This paper provides a synopsis of the research findings produced by the social science team at Durham University in collaboration with the engineering research team at Durham and Newcastle Universities. The full findings of the research can be found in the Durham University Social Science Research Report released in April 2014 (CLNR-L052).¹

The social science research conducted as part of CLNR has adopted a socio-technical approach to understanding the provision and use of energy services, in which energy systems are seen as constituted through the continual interaction of both social and technical entities and where demand for energy is produced through and essential to the workings of different practices in homes and businesses. We conceptualize energy use as shaped through the interaction of five different core elements, which together work to constitute energy-related social practices and the ways they are organised and distributed across spaces and time. These core elements we identify as follows:

- Conventions: constitution of what is considered to be normal energy use through, for example, standards, cultural expectations, design of appliances
- Capacities: the ability and potential for objects, artefacts, and techniques to use energy and provide energy services, constituted through their design, materiality, knowledge and craft
- Rhythms: the multiple temporalities operating at daily, weekly, monthly, annually through which activities are organised and patterned
- Economies: disposition towards and management of social, natural and financial resources and investments

¹ Full report available to download from the CLNR project website: http://www.networkrevolution.co.uk/wp-content/uploads/2014/05/CLNR-L052-Social-Science-Report-April-2014_2.pdf

- Structures: enduring features of the socio-material world, e.g. structures of employment, school hours, building structures, layouts and materials, systems of energy provision, family structures, household life-stages and social class

Methodology

The social science team at Durham University have developed two methodologies to help us understand the social dimensions of the CLNR trial: surveys (two instruments, one to be deployed with SMEs one with domestic customers); and qualitative face-to-face interviews. These lists were available for the test cells which had been successfully populated by British Gas as of June 2012, i.e.

- 1a (control group)
- 2b (SME distributed monitoring)
- 5 (photo voltaic with no further incentive)
- 9a and b (SME and domestic time of use tariff)
- 10b (SME restricted hours)
- 11b (SME direct control)
- 20 (photo voltaic panels with automatic or manual within premises balancing).

In addition to the collection of consumption data through a range of monitoring and metering arrangements, Durham University's social science team recorded 250 face to face interviews as summarised table ES1. Each of these interviews was conducted on the participants' premises and involved a semi-structured interview about electricity use and flexibility as well as a tour of the premises to record discussions of how different rooms and appliances were used as part of everyday life. In total, the social Science team has recorded 134 face to face interviews with CLNR participants (48 SME and 85 Domestic). These interviews are distributed across the test cells as below.

Table ES1 – Consumption Data used in this Paper.

Test Cell	Interviews Complete
TC1a	18
TC2b*	17
TC5	14
TC9a	32
TC9b	12
TC10b	9
TC11b	9
TC20	18
Informal SME Participants	5
Total	134

Research Findings: Learning Outcome 1 (LO1)

SME Electricity Demand: Analysis of consumption data for Test Cell 1b

SMEs have much more highly varied demand for electricity than households. Average daily demand is highest for Commercial & Office enterprises and lowest for those in the Public Sector & Other Industry classification. In terms of business size, organisations with 10-49 employees had the highest demand, suggesting that the relationship between number of employees and electricity demand is not linear.

The proportion of total electricity consumption concentrated in the early evening period varies between businesses, with much greater diversity than in households. Many businesses (41% or 723 of the sample of 1762) consume less electricity per hour during the early evening peak than during the rest of the day or night (a ratio of less than 1:1). In contrast, this was rare (2%) amongst households.

Smaller businesses (1 - 9 employees) tend to consume a higher proportion of their total electricity in the early evening peak period and limited consumption overnight (such as those in leisure, and hospitality industries). Larger businesses consume electricity more evenly across a 24 hour period, though may have larger total consumption and power demand per hour during the peak. This suggests that in terms of DSR larger businesses may offer more potential to be flexible by shifting demand to other times of day/night whereas smaller businesses may have relatively fixed electricity demand in the peak period.

The proportion of total electricity consumption concentrated in the evening peak varies by sector with Industrial businesses tending to consume a lower proportion of electricity in this period throughout the year while businesses in Agriculture, Hunting & Forestry, Fishing sector consuming the most.

Practices Giving Rise to Energy Use in SMEs

Key practices associated with electricity use across SMEs are: lighting, heating and cooling, refrigeration, and ICT. We also identified a range of business specific practices that create specific load profiles for certain businesses. Some business specific loads involve intermittent demand for high power, and these were found to be less fixed in time than lower power, day in day out processes and practices. These 'high power' practices could be flexible and therefore amenable to DSR interventions.

Connectedness is seen as a vital service that energy use provides, with servers and mobile devices often reported as being among the most critical appliances to business continuity. Ensuring connectivity between employees and data and between staff and customers should be recognised as an important feature of communications surrounding DSR.

Research Findings: Learning Outcome 2 (LO2)

Variability and Flexibility in SMEs Electricity Demand

Qualitative research was conducted with 52 SMEs who were asked what would affect their ability to be flexible about their electricity demand. Analysis of the data generated in this research suggests that variability and flexibility in electricity use among SMEs is related to diurnal (e.g. opening hours), weekly (e.g. shift schedules) or seasonal patterns of activities in pursuit of business goals with periods of flexibility and inflexibility being distinct for each SME. Seasonal patterns were more multi-faceted than the seasonal variation in household consumption - with different SME having different levels of 'business' and intensity throughout the year.

While there is much less homogeneity to the rhythms of business life than is the case with households we find that the ways in which SMEs may be variable and flexible in their energy use is derived primarily from:

- hours of operation

- modes of interacting with customers (on premises or remotely)
- operating requirements of business processes
- tenure arrangements

For SMEs, the potential to provide valuable demand flexibility centres on the scheduling, and interruptibility of practices. For example, some processes were described as being re-schedulable if they could be done at any time in the day or week without inconvenience but might be less interruptible if they cannot easily or cheaply be shut down once started (wasted materials or heat for example)

Conclusions

Our research shows that medium sized businesses (those with 10 - 49 employees) have the highest demand, suggesting that the relationship between number of employees and energy demand is not straightforward.

In contrast with the seasonal variation of domestic electricity consumption, which rises to a peak in December, for all sectors of SMEs electricity demand is greatest in January/February, after which there is a steep decline to April consumption levels.

As well as diversity in total demand, the evening intensity of SME demand varies more widely than in households with many businesses consuming less energy in the 4pm - 8pm period than at other times of day. The research indicates that smaller businesses (1 - 9 employees) tend to have more evening intensive loads, which suggests that larger businesses have demand that continues throughout the day and night. The smaller businesses in our sample are more likely to involve evening leisure and cooking activities which will close down over night, making their 24hr load profile more evening intensive compared to a factory that may be active throughout the night, for example.

SME participants identify heating, cooling and ventilation amongst their most electricity intensive uses. Where there is a reliable alternative heating supply interviewees indicate their preparedness to view heating loads as interruptible in exceptional circumstances by using alternatives like gas or biomass.

For those SMEs involved in food production such as pubs, hotels, B&Bs and child care facilities/activity centres, evening practices were most heavily influenced by socially extensive routines, with flexibility limited by advertised times of food service or children's meal times. Initial indications suggest however that there is some flexibility around how food services are delivered, through use of gas or by offering cold food in exceptional circumstances.

Qualitative analysis suggests some businesses have high power but intermittent loads associated with specific business processes. There are several accounts of machinery with relatively high power ratings being used for short periods of time. Although referred to as 'necessary', these activities are not fixed in time and could be moved outside of 4pm - 8pm period. For SMEs, the potential to provide valuable demand flexibility centres on the scheduling, and interruptibility of practices. While it is possible to differentiate between business processes which can be re-scheduled, it is also possible to differentiate between processes which are interruptible and those which cannot be stopped once underway. This creates a two-dimensional framework for identifying business processes which could

be engaged by demand side interventions. For example, some processes were described as being re-schedulable if they could be done at any time in the day or week without inconvenience but may not be interruptible once started (as doing so would waste materials or heat, for example). We conclude that interruptible practices could respond at short or no notice to a network intervention whereas re-schedulable ones can be moved in time in advance; and possibly on a regular basis, if an intervention can be planned in advance.



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