Resilience of electricity infrastructure

Response by the DEMAND Centre, Lancaster University

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Introduction

We welcome the chance to contribute to this inquiry. The Dynamics of Energy Mobility and Demand (DEMAND) Centre[1] is based at Lancaster University and brings together a consortium of researchers from eleven universities and a range of non-academic partners.

The DEMAND Centre is one of six research centres funded by the Research Councils examining end-use energy demand from different perspectives.[2] In total, the Centres represent a £43m investment aiming to ensure the UK is recognised as an international lead in this area of research.

The DEMAND Centre was established to contribute evidence on a vital aspect of energy research that has traditionally been neglected: an understanding of the underlying dynamics of energy demand.

The Centre tackles the fundamental question of what energy is for. Achieving greater energy efficiency is important, but the trend is often towards more resource intensive standards of comfort, convenience and speed. We lack a sophisticated understanding of how these trends take hold and of the underlying dynamics of demand itself. The DEMAND Centre takes this problem as its central challenge.

The neglect of this fundamental question means that policy and market arrangements for electricity are insufficiently focussed on the demand side. Whilst they may engage with questions of efficiency, demand response and 'load shifting', they do not effectively consider the changing dynamics of why and how electricity is being used in the first place, thereby overlooking an important domain that is potentially open to influence and intervention.

We therefore begin this submission with a statement about how our approach could inform the central topic of the Inquiry: The resilience of UK electricity infrastructure. We go on to provide answers to some of the questions posed by the Inquiry, in order to illustrate and give examples of our approach.

How can an understanding of end-use energy demand help build the resilience of UK electricity infrastructure?

Our central message for the Inquiry is this*: In interrogating the future resilience of electricity infrastructure, it is important to consider the patterns of possible future end-use energy demand, rather than taking these for granted, and to engage with the underlying processes through which energy demand is produced, sustained and changed.*

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[1] http://www.demand.ac.uk

[2] http://www.eued.ac.uk/home

Debates about energy futures routinely proceed without reference to primary questions about what energy is for, about the sets of 'end uses' on which energy demand depends. Yet energy is not used for its own sake, but as part of social practices like cooking, commuting to work, watching TV or conducting meetings. How these practices are carried out is shaped by, and influences expectations of infrastructure in a wide sense – not just the electricity infrastructure, but also transport infrastructures, the built environment, ICT networks and so on.

It follows that (i) future *changes* in these practices and infrastructures will have consequences for the resilience of the electricity system over future decades, and (ii) that the resilience of the electricity system could be strengthened through policies which have impacts on these practices and infrastructures. The central aim, a more resilient electricity system, could therefore be achieved in part through the pursuit of changes to patterns of energy demand rather than focusing only on the supply side. And these changes may, indeed, prove cheaper or have wider social benefits than the more commonly-considered alternatives. At the moment, these options are not 'on the table', so their costs and benefits (compared to other interventions) are not properly evaluated.

Some particular lessons that emerge are as follows:

1) We should not assume that future demand will look like current demand

Current government policies rely on scenarios and analyses of options for promoting efficiency and decarbonising energy supply whilst maintaining current standards of living. In effect these methods presuppose that present practices involving energy use will remain the same far into the future. This is highly unlikely: ways of living change all the time, both potentially leading to escalations and reductions in future energy use.

Our work on the histories of home infrastructures and domestic energy use, for example, shows how different energy using practices have changed from the 1940s to the present day.[3] Ideas of 'normal' standards – of heating (e.g. room temperature), bathing and laundering (hot water) – evolved alongside the introduction of gas and electricity and the relative decline in solid fuel between the 1920s and 1970s.

This longitudinal analysis can help in understanding how demand will be, and could be, shaped over the coming decades. A recent DECC commissioned report[4] notes that social changes are centrally important to patterns of future demand, but acknowledges that current modelling approaches engage with these in only very limited terms. A further key point arising from our work is that future innovations, including those designed to enhance the resilience of the UK electricity infrastructure, will themselves have an impact on demand.

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[3] DEMAND Centre project 3.1. This project will produce a series of papers to be published in 2015, some focusing more on the historical data, others on the role of professions and planners, and on the ways in which infrastructures and social practices shape each other.

[4] 'An analysis of D3 in DECC's energy system models' https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/341300/Analysis_of_D3_in_DECC_energy_system_models.pdf

2) We need a better understanding of the social dynamics of energy demand

To the extent that energy demand is included within energy policy, it tends to be considered either in terms of technical efficiency or the behaviour of individuals - with the implication that such behaviour can be changed through incentives or education. However, the research of the DEMAND Centre shows that energy demand predominantly depends not on individually chosen behaviours, but on the shared social practices that make up accepted normal and everyday patterns of living, working and moving around.

In considering changing patterns of demand what is currently missing therefore is a sophisticated analysis of the development of end use practices and the constant adaptation of the hard and soft infrastructures (gas, electricity, transport, logistics systems, organisational procedures) on which these depend. Such an analysis would identify the creative potential for future transformations in energy demand across different sites and timescales – including the introduction of more seasonally adapted forms of provision (in transport, at home and at work); in more forgiving and flexible interpretations of comfort; and through the systematic reconfiguration of institutions and incentives that reproduce resource intensive solutions/ways of living.[5]

3) Energy policy does not influence end-use energy demand as much as other policy areas: land-use planning, transport, even health and education all influence the underlying dynamics of energy use

The DEMAND Centre uses the term 'implicit energy governance' to describe the implications of non-energy policies on energy demand. One simple example is that changing the length, timing, or co-ordination of school holidays would have an impact on the ways in which daily lives are scheduled, and hence on the patterning and timing of when and how much energy is used.[6] There are many others. Our research will, for example, shortly begin to analyse how policies in, for example, the areas of health, higher education and the military have implications for energy demand.[7]

Developing this understanding reveals how policy agendas far beyond the narrow conception of 'energy policy' affect energy demand and therefore have implications for how resilient current and future supply infrastructures may prove to be.

Responses to consultation questions

Below we respond to a number of the Inquiry's consultation questions in order to illustrate how a focus on end-use energy demand could contribute to improving the resilience of the UK's electricity system.

Short term (to 2020): How resilient is the UK's electricity system to peaks in consumer demand and sudden shocks? How well developed is the underpinning evidence base?

As described above, there is a major gap in the evidence base on the demand side, with very little knowledge about why electricity is used at different times, including

[5] See DEMAND Centre Theme 3

[6] http://www.demand.ac.uk/24/10/2013/school-holiday-shakeup-brings-unintended-consequences-article-in-the-conversation/

[7] See DEMAND Centre project 4.3

during peak periods. A review conducted by the DEMAND Centre of the measurement of domestic energy consumption, shows that linkage of measured energy consumption to what people actually do in the home is extremely rare.[8] If we do not know what people are using electricity for at peak times, we cannot begin to influence these patterns in effective ways (in order to 'smooth peaks', or 'fill troughs'). We are undertaking some initial work in this area (including in collaboration with EDF R&D), but recommend developing a much stronger evidence base about what electricity is for used at different times (in domestic settings and for other reasons) in order to inform policy oriented around peak demand issues.

With such understanding the possibilities of and constraints on 'flexing' demand will be better informed, including giving insight into the potential implications for different social groups.

Short term (to 2020): What measures are being taken to improve the resilience of the UK's electricity system until 2020? Will this be sufficient to 'keep the lights on'?

Here we note the use of 'keeping the lights on' as an off repeated indicator of successful energy policy, and a commentary from DEMAND researchers that notes:

"*Instead of blindly insisting on the importance of keeping the lights on (and all that the phrase stands for) the real political challenge is to bring questions of demand into view. This is not just a matter of technological efficiency. What is needed is a fundamental debate about how much energy is enough, what does it mean to establish ways of living that call for much less power than we use today, and just how many lights could or should be kept on?*" [9]

Short term (to 2020): Will the next six years provide any insights which will help inform future decisions on investment in electricity infrastructure?

Over the next six years, a much better understanding of end-use energy demand will be developed, both at the DEMAND Centre and at the other five RCUK Centres. Given that all of the Centres are working with partners in industry and government, this should provide a good evidence base to inform such decisions. One example would be the understanding we hope to gain about flexibility of demand and our demand-side ability to cope with or adapt to greater intermittency of supply that might be a feature of some plausible energy futures.

Medium term (to 2030): What does modelling tell us about how to achieve resilient, affordable and low carbon electricity infrastructure by 2030? How reliable are current models and what information is needed to improve models?

As explained above, the dynamics of energy demand are insufficiently accounted for in energy modelling. Demand projections are too often based upon current

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[8] http://www.demand.ac.uk/10/02/2014/theme-1-report-the-rhythms-of-demand-january-2014/#more-1664

[9] Allison Hui and Elizabeth Shove 'All of this talk about lights hides bigger challenges' http://www.demand.ac.uk/14/11/2013/keeping-the-lights-on-the-conversation-13-november-2013/

assumptions, practices and standards, all of which are likely to change over time. The default strategy is to take present patterns of energy use entirely for granted, treating the perpetuation of current 'standards' as an unquestioned, non-negotiable part of the equation and focusing exclusively on the efficiency (or otherwise) with which these might be met.[10] This is insufficient, including in the face of EU demand and carbon reduction targets. The DEMAND Centre is working to help Transport for London to examine its long term travel demand forecasts. Our contribution will expand the consideration of demand drivers beyond the traditional transport demand variables of price, availability, income and quality of service, to include factors such as changing duration of work, increasing trips for care and changes to shopping patterns brought about through retail innovation. These are indicative of the types of information that might be needed in developing sophisticated modelling of future electricity demand. Indeed, looking ahead, if the government's low carbon vehicle strategy is successful, demand for transport becomes a key part of electricity demand over this period.

Medium term (to 2030): What steps need to be taken to ensure that the UK's electricity system is resilient as well as competitively priced and decarbonised by 2030? How effective would current policies be in achieving this?

Medium term (to 2030): Is the technology for achieving this market ready? How are further developments in science and technology expected to help reduce the cost of maintaining resilience, whilst addressing greenhouse gas emissions? Are there any game changing technologies which could have a revolutionary impact on electricity infrastructure and its resilience?

When considering long-term infrastructure and its relationship to resilience, it is important to consider the interactions between energy infrastructure and other infrastructure, such as ICT and transport. The DEMAND Centre is currently conducting a series of place-based studies to examine how infrastructures are designed and adapted, and how this changes practice.[11]

One example is the debate about switching to electric cars. The assumption that tends to be made, in modelling and policy, is that private car use will be retained, by substituting petrol for electric vehicles. However, as a recent OECD report[12] suggests, they will only save carbon emissions in the context of a massively decarbonised electricity supply system, re-engineered to cope with increased demand. Further, it ignores the fact that technological and social change influence each other. The future is not simply the same as the present, with technological substitutions.

Instead, it would make more sense to assume that electric vehicles, with shorter ranges, long charging times and a new electricity infrastructure, will themselves change the practices that underpin energy demand. Electric cars are likely to be owned, managed and used in a different way to petrol cars and may also have an

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[10] DEMAND researchers have for example considered assumptions embedded in the DECC 2050 modelling tool, discussed in "What is Energy For?: Social Practice & Energy Demand", Elizabeth Shove and Gordon Walker, *Theory, Culture & Society* 2014, vol. 31 (5) 41-58; Shove, E. (2015) 'Linking low carbon policy and social practice' in Strengers, Y. and Maller, C. (eds) '*Beyond Behaviour Change: Intervening in social practices for sustainability*' Routledge

[11] DEMAND Theme 3.1 Adapting infrastructure for a lower carbon society

[12] http://www.internationaltransportforum.org/jtrc/DiscussionPapers/DP201203.pdf

impact on the range of destinations to which people travel. There may be the opportunity to promote modal shift, to other forms of transport, including cycling for example. Over time, the 'need' for cars may change. The current 'need' for cars is the outcome of a historical process which includes the development of out-of-town supermarkets and associated forms of land use, the decline of high street shops and the gradual shift in shopping habits and routines. The 'need' for the private car is something that should be within the realm of policy intervention – through the planning system, for example.[13]

[13] "Unsustainable practices: Why electric cars are a failure of ambition", Nicola Spurling & Dan Welch, March 2014 http://www.demand.ac.uk/05/03/2014/unsustainable-practices-why-electric-cars-are-a-failure-of-ambition/