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The electric commons: A qualitative study of community accountability

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ABSTRACT

This study explores how energy might be conceptualised as a commons, a resource owned and managed by a community with a system of rules for production and consumption. It tests one aspect of Elinor Ostrom's design principles for successful management of common pool resources: that there should be community accountability for individual consumption behaviour. This is explored through interviews with participants in a community demand response (DR) trial in an urban neighbourhood in the UK. Domestic DR can make a contribution to balancing electricity supply and demand. This relies on smart meters, which raise vertical (individual to large organisation) privacy concerns. Community and local approaches could motivate greater levels of DR than price signals alone. We found that acting as part of a community is motivating, a conclusion which supports local and community based roll out of smart meters. Mutually supportive, voluntary, and anonymous sharing of information was welcomed. However, mutual monitoring was seen as an invasion of horizontal (peer to peer) privacy. We conclude that the research agenda, which asks whether local commons-based governance of electricity systems could provide social and environmental benefits, is worth pursuing further. This needs a shift in regulatory barriers and 'governance-system neutral' innovation funding.

1. Introduction

This paper explores the use of commons frameworks for urban energy management, in the context of a community-based trial of electricity demand response (DR) in a UK city. Despite substantial literature on smart grids, including discussion of their system value, DR, privacy concerns and community approaches (Beckel et al., 2014; Kloza et al., 2013), there remains a gap in scholarship bringing commons theory to this context.

The introduction provides background on the role of DR in a smart energy system, in particular in relation to community based motivation and privacy concerns, and outlines the potential contribution of commons approaches to these challenges, focussing on the mechanisms of community accountability. The second section describes the case study and methodology, and the third discusses the findings of the interviews and focus group in relation to attitudes to privacy and mutual monitoring for urban electricity DR. The conclusion highlights the policy implications of applying commons approaches to local energy systems.

1.1. Smart meters, feedback and demand response in a smart energy system

A 'smart' energy system, or smart grid, is defined by the UK government and energy market regulator as "one which uses information technology to intelligently integrate the actions of users connected to it, in order to efficiently deliver secure, sustainable and economic electricity supplies" (BEIS and Ofgem, 2016, p. 7). The need to decarbonise our energy system is leading to a shift towards decentralised and intermittent electricity generation, and potentially electrification of heat and transport (Quiggin and Wakefield, 2015). This creates a need for greater spatial and temporal flexibility in the electricity system. At the same time, innovation in information technology creates an opportunity to use 'smart' technologies to achieve greater distributed flexibility, including active management of the timing of electricity demand to support whole system balancing. Regulatory approaches for achieving this are being consulted on by the UK government (BEIS and Ofgem, 2016).

Abbreviations: CSE, Centre for Sustainable Energy; DNO, Distribution Network Operator; DR, Demand Response; IHD, In home display; LiM, Less is More; WPD, Western Power Distribution

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One mechanism for achieving flexibility is demand response (DR) – the decrease or increase of electricity demand in response to moments of scarcity or abundance. In a domestic setting, this can be achieved by shifting the time at which cooking, laundry, dishwashing, heating, and other activities take place (Bulkeley et al., 2014; Frontier Economics and Sustainability First, 2012; Strengers, 2013). The UK government aims to achieve domestic DR through a combination of direct feedback using in home displays (IHDs), which show real-time electricity consumption; indirect feedback through informative bills; advice and guidance; and motivational campaigns (DECC, 2015). Smart meters, which record real-time electricity consumption, are a key enabling technology for this, and are due to be rolled out to all households by 2020, as part of an EU directive implemented in UK policy (DECC and Ofgem, 2011; Council Directive 2012).

1.2. Motivating demand response

Smart meters by themselves will not motivate changes in energy consumption behaviour or social practices.[2] As Strengers (2013) highlights, energy is consumed through everyday practices, which are responsive to many other forms of feedback, in addition to feedback on energy consumption. The time at which people do laundry is influenced by factors such as the weather, clothing needs, work, school and social schedules, and social expectations of cleanliness. Factors such as housing costs, unemployment and changes in household composition also affect the energy consumption patterns in households (Bulkeley et al., 2014). Influencing changes in behaviour through policy interventions is complex. Several experts advocate the use of multiple approaches to inform the development of behaviour change policy (Chatterton, 2011; Darnton, 2008a; Gardner and Stern, 2002; Jackson, 2005), and emphasise the importance of testing these in practice (Darnton, 2008a). Forms of motivation that have been well-researched include price signals such as time of use tariffs and real-time pricing, and educational feedback through IHDs, detailed billing and emails. However, price-based incentives risk impacting those in fuel poverty and exacerbating social inequalities (Thumim, 2014).

The focus of this study is on community-based interventions. The concept of community is itself ambiguous. Burchell et al. (2014) identify six meanings of ‘community’ in the literature on community energy: “a place-based or local activity, an interest-based activity, a community-led and collaborative process with benefits distributed fairly and locally, a mid-scale activity, an actor with agency, and an experimental niche”. They also note the issues of “power, division, exclusion, conflict and oppression” which can be part of community.

Community-based activities can be supported by social mechanisms for behaviour change. Previous studies have made use of several social mechanisms for motivating shifts in energy behaviour, including social norms feedback (Burchell et al., 2016; Harries et al., 2013), peer learning (Catney et al., 2013), and civic concerns (Ehrhardt-Martinez et al., 2010). The Smart Communities project (Burchell et al., 2016) trialled the use of IHDs and regular feedback emails in a community in the UK. They highlight factors making their feedback successful: a focus on the local; supportive, regular emails; and a framing that emphasised the community working together which increased participants’ sense of self-efficacy. This was successful in achieving lasting, high levels of engagement with IHDs. These factors have a strong fit with the concept of ‘community’ and therefore support further research into community-based approaches.

A community-based programme may be a good way to achieve high quality feedback to households cost-effectively at a large scale, by enlisting the voluntary co-production of feedback by residents. The importance of high quality feedback in motivating energy behaviour change was identified by the VaasaETT (2011) study of 100 worldwide smart meter pilot studies. They found that the most important success factor was tailoring the programme to consumer needs, and that smaller scale trials of less than 100 participants achieved higher levels of energy conservation, perhaps due the quality of feedback provided to smaller populations.

1.3. Smart meters, privacy and community DR

Whilst smart meters can support the use of renewable energy by enabling balancing through DR, their use also raises concerns about privacy and data (Beckel et al., 2014; Döbelt et al., 2015). DR and smart meter data relates to activities as intimate as taking a shower, doing laundry, or watching TV, and as distant and shared as our national electricity infrastructure. It is thus both private and of public concern. Real-time electricity consumption data can reveal occupancy, a potential security concern if burglars can identify when a house is empty. Highly granular data (measured every second or minute) can reveal the ‘load signature’ of different appliances being used, indicating the “composition and behavior of individual households” (Horne et al., 2015). This can be used for targeted marketing by corporations, and is useful to researchers.

Privacy concerns about smart meters have the potential to impact their public acceptability. Evidence on this, however, is inconclusive. Horne et al. (2015) conclude that privacy concerns may lead to public rejection of smart meters. However, this may depend on context, and the acceptability of smart meters could be greater if the wider societal benefit of the smart grid is clearly communicated, and if individuals feel that they have control over the technology installed in their home (Buchanan et al., 2016).

Privacy concerns about smart meters extend beyond public acceptability. Key vertical privacy concerns in a smart energy system include the risk to political rights and freedoms from state surveillance; unequal power relations involved in big data; and potential for corporate profit from using personal data for targeted marketing. Naus et al. (2015) identify two dimensions of privacy: the ‘vertical’ privacy of individuals relative to large organisations such as energy companies, data companies and the state, and the ‘horizontal’ privacy of individuals relative to their peers. Solove (2002) describes two additional aspects of privacy: not being seen, and not being interfered with. Solove (2001) discusses the need for privacy theory in the age of ‘big data’ to consider the unequal power relations of individuals to large corporations and government, who can derive useful knowledge from large quantities of data.

Some computer sciences studies on smart grids seek to preserve privacy through the design of the information processing architecture of the smart grid. Souri et al. (2014) classify privacy preserving techniques in two categories. Those with aggregation have a local gateway which processes individual smart meter data, and sends only an aggregate to utilities or other parties, whereas those without aggregation carry out privacy-preserving operations within the smart meter itself, or by reliance on a trusted third party. In the UK, the trusted third party approach has been chosen, with the Data Communications Company set up for this purpose (Smart Energy Code Company, 2013).

Trusted third party approaches to data protection have ongoing vertical privacy risks, whereas aggregation approaches and in-meter data processing reduce this risk. The use of a trusted third party relies on that institution being trustworthy, and limits the user's control over where their data goes. Privacy-preserving operations carried out within the smart meter increase the computational requirements of the smart meter itself (Souri et al., 2014), with some also affecting system management functionality derived from the smart meter. Aggregation-based systems avoid the need to trust a centralised holder of data, and reduce smart meter computational requirements, but carry

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[2] There has been extensive academic debate about the relative value of behaviour change and social practice approaches to understanding and changing energy consumption patterns. This study follows Wilson and Chatterton (2011) in seeing both approaches as valuable and compatible.