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Differentiating 'the user' in DSR: Developing demand side response in advanced economies

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ABSTRACT

This paper reports on the current state of Demand Side Response (DSR) in the UK – an early adoptor amongst advanced economies – and the role of the end user in determining its future. Through 21 expert interviews we establish the current state of DSR, and expectations for its development. Whilst non-domestic DSR appears healthy, if fragile, domestic DSR is considered to be currently unviable, it's future success dependant on market innovations. In following how that situation is expected to change, we highlight key assumptions about prospective end users. These assumptions are shaping the efforts of the industry actors tasked with delivering DSR. We identify two visions of the user, one passive whilst technologies automate on their behalf, the other integrated to the point of themselves being an automaton. We detail a series of concerns about the limitations of these user visions, and the ability of industry to reach beyond them towards a more differentiated view. We conclude with a call to broaden the institutional landscape tasked with delivering DSR, in order to foster a greater diversity of end user roles, and ultimately greater demand responsiveness from a broader user base.

1. Introduction

In order to mitigate the threat of climate change, states are seeking to drastically reduce carbon emissions from their energy systems. Many are transitioning towards low carbon, renewable energy sources. The growth of renewable generation with fluctuating output complicates the fundamental operating requirement of electricity grids to constantly balance supply and demand. Even without such energy sources, this balancing requirement results in ongoing inefficiencies for generation and transmission because it means coping with the 'peaky' demand profiles that societies generate through the mass organisation of activity (e.g. the '9–5 working day') (Grünewald and Torriti, 2013). These fluctuations in both supply and demand create a strong case for the kind of flexibility Demand Side Response (DSR) promises. Domestic DSR is also positioned as a powerful tool for addressing energy poverty (Koirala et al., 2016).

DSR seeks to shift or reduce energy demand, both domestic and non-domestic, in response to excess or restricted availabilities of energy on the grid. This response might be in real time (i.e. automated), near real time (for example sending a signal to users), or prospective (for example fixed Time of Use tariffs which discourage consumption during high demand periods). The potential for DSR is part of the justification for smart meters, currently being rolled out in the UK at a cost of £11bn, and in many other countries across the world (Sovacool et al., 2017). Under the EU's 2030 Climate & Energy Framework (European Commission, 2016), member states are committed to 40% cuts in greenhouse gas emissions by 2030. Notably, most key future energy scenarios in the UK that have been developed in the past decade include DSR (e.g. UKERC, 2013), though how DSR will actually mature is less clear.

Key to realising DSR's promise is the end user. Traditionally, whether domestic or non-domestic, the *end* user has been just that – an isolated, terminal node consuming energy as and when required to meet their needs, which the grid is constantly managed to provide. By contrast, DSR requires that this actor becomes an integrated, dynamic component in the balancing of supply and demand. How the end user is enrolled to play this part is the key uncertainty to which we turn this paper's attention. Whilst previous research has envisaged how end users may play a greater role in the transition to low-carbon economies, (Foxon, 2013), and examined how end users might be expected to engage and interact with DSR (Mert et al., 2008; Spence et al., 2015), there has been little attention given to perceptions of end users held by system builders, and the way that the expectations of end users shape the development of DSR (Chilvers et al., 2018). We formulate this uncertainty as a question of sociotechnical design – what are the characteristics of this new user imagined by architects of DSR, and how

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amenable to technical intervention are they?

Following Akrich's (1992) notion of technological scripting, we argue that this imagined user will ultimately be rendered concrete enough to heavily influence DSR's mature form. Our study, consisting of expert interviews, focuses on DSR within the UK but we emphasise that similar energy system developments and debates around smart energy futures are ongoing, and relevant to, many other economies.

The paper proceeds by first outlining existing critiques of predominant energy policy. We then report on the current state of DSR in the UK, before focusing on how domestic DSR is expected to proceed over the next decade, drawing out two predominant visions of the user held by our expert interviewees. We subsequently identify three underlying concerns with this picture, discuss the implications of these observations, and put forward recommendations for ensuring that domestic DSR fulfils its environmental and economic potential.

2. Theorising the user in energy policy

Current DSR policy initiatives have emphasised the importance of incentivising behaviour change through dynamic pricing tariffs (Faruqui et al., 2010) and engaging citizens with the need for reducing carbon emissions (Spence et al., 2015; Whitmarsh et al., 2011), alongside the rollout of technologies (including smart meters and in-home energy displays) to engage citizens in 'smarter' energy use (Hargreaves et al., 2010). Research suggests that public acceptance of DSM Is likely to vary a great deal depending on the device and the way it is operated, with particular concerns where comfort and health standards are perceived to be threatened (Mert et al., 2008; Butler, Parkhill and Pidgeon, 2013).

Some limited research has considered interactions around DSR. In particular, privacy protections and data sharing have been discussed as necessities for many forms of DSR. Whilst privacy concerns appear limited amongst UK publics, this has been a key issue in other countries, and in the UK, a significant proportion of the population express unwillingness to share energy data (Spence et al., 2015). There are also some, predominantly economic, investigations of interactions between DSR users indicating, for example, cooperation is possible around energy demand scheduling (Mohsenian-Rad et al., 2010). We also note that there is some evidence that oversimplistic DSR programmes may be manipulated by consumers in order to make money (Chao and DePillis, 2013; Chen and Kleit, 2016).

Critics have raised fundamental concerns about the predominance of energy policy approaches that implicitly individualise the carbon reduction problem (Shove, 2014; Strengers, 2012). These concerns feature in Strengers' critique (2014) in which she argues that the 'solution' to the problem of carbon reduction is typically envisaged in conventional policy thinking as an 'engaged consumer' whom she dubs 'Resource Man'. Strengers elaborates that Resource Man is imagined to be a responsive and rational economic agent, styled in the image of the male engineers who design for him. He both actively monitors and automates energy consumption, and is perfectly integrated with price signals and the latest smart technologies, in order to ensure that the optimally efficient level of energy consumption is achieved. However, Strengers argues that the characterisation of individualised energy use promoted by this model grossly misrepresents the aspirations and practical realities of most people's energy consumption by glossing over key social dynamics and processes, that figure in the context of everyday experiential understandings of energy use.

In response, critics have called for a more contextualised view to better account for the wider socio-cultural, organisational, and political milieu implicated in social practices of energy consumption (Hargreaves, 2011; Shove, 2003). Whilst variation exists in the conceptualisation of 'practices' as a unit of analysis, they are commonly theorised as dynamically integrated assemblages of skills, materials and technologies, and meanings that emerge and become stabilised through their performance until such time as the links between them are undermined, broken, or replaced, and they subsequently die out (Shove and Pantzar, 2005). Rather than focussing on the 'moments' of individual behaviour and decision making, this more holistic approach attends to wider considerations including how practices operate and change, and what goals energy consumption seeks to achieve (Shove et al., 2012; Sweeney et al., 2013).

The broader policy implications of a practice theory perspective is that demand management is complicated and qualified by the variable social contours and trajectories of peoples' energy use. This has led to proposals for decentering the current emphasis on steering individualised energy consumption from the top down and repositioning demand management in more open terms in order to effectively engage with localised and collective practices and cultures of energy consumption (Chilvers and Longhurst, 2016). For example, alternative notions of the 'Energy Citizen' assert the necessity of public participation in energy governance and policy-making processes at all levels, incorporating ideas of sustainable development such as taking responsibility for climate change, fairness, and promoting the welfare of communities and future generations (Devine-Wright, 2007). Using this frame, citizens, practitioners, and other locally-situated stakeholders are considered to have a close understanding of how current assemblages of understandings, infrastructures, and practical knowledge are reproduced through daily routines at home, in the market, and in the workplace, and might therefore hold other key insights into how organised relations of energy consumption can be reconfigured to bring about significant cultural change (Foster et al., 2012; Stephenson et al., 2010).

A growing number of policy programmes and local initiatives have accordingly begun to illustrate the potentials of Energy Citizen ideals through such means as community renewable energy projects, localised micro energy generation, and energy co-operatives (Devine-Wright, 2007). In line with this, in 2014 the UK government published its 'Community Energy Strategy' (DECC, 2014) with the goal of supporting sector development. Whilst welcoming of the Strategy's intentions, Smith et al. (2016) have questioned whether such an approach risks imposing a "micro-utility" (P.429) template on community energy which ultimately hampers its effectiveness at sourcing alternative solutions. More recently practitioners have highlighted how simultaneous cuts in funding support have been detrimental to the goals of the Strategy (Community Energy England, 2017). These developments thus raise key questions about what elements have been put in place or are missing, and what links now need to be made, in order to overcome current obstructions to more sustainable energy practices (Shove, 2014). Yet, despite notable shifts in discussions around the conceptualisation of the user within energy demand broadly, there is little empirical evidence on how system builders within industry and policymaking perceive the role of DSR users (Chilvers et al., 2018). Given how key users are to achieving the vision of DSR, addressing these gaps is imperative. This research sets out how DSR users are conceptualised among stakeholders, and how these different conceptualisations affect possibilities for enacting future DSR policies.

3. Methods

The study draws on 21 semi-structured expert interviews carried out in late 2016 and early 2017. Interviews obtained the views of a range of participants engaged in the energy sector (see Table 1). Participants were recruited through existing contacts and snowballing, in part using the authors' own expert knowledge of the field to identify suitable participants (Littig, 2009, p. 103). The intention was to capture a snapshot of current expectations and intentions for DSR across a diverse range of stakeholders, and particularly the role of 'end users'.[2] Our

[2] 'End users' is a potentially problematic term to use in describing agents who are expected to have active roles in the functioning of the electricity grid, in its