Social Practice Theory on Tour:

Venturing beyond household aspects of smart grids

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***Abstract*— *Smart grids are promoted to resolve challenges of electricity production and consumption. Social studies of smart grids have been undertaken that utilise practice theory to explore and gain insight on the development of smart grids with a particular focus on households. This perspective usefully describes practices in which electricity is used in households. However, reducing smart grid ecologies to everyday household practices may limit the potential of practice theory to understand development of smart grids. Thus in this paper we explored the potential of practice theory to account for practices performed by actors associated with smart grids beyond households*.

***Key words*— Smart grids, practice theory, beyond households.**

I. INTRODUCTION

Smart grids are promoted in many national policies to accelerate transition to a low carbon, secure and affordable electricity supply [1, 2, and 3]. Techno-centric notions of smart grids are often described in terms of positive effects. Framed this way: smart grids tend to involve:

- integrating Information and Communication Technologies (ICT) with existing infrastructure enabling two-way flows of information of electricity consumption between utilities and demand side actors (e.g. smart meters in households); and
- enabling a two-way flow of electricity between utilities and demand side actors to accommodate distributed generation (e.g. local renewable energy) and low carbon practices and technologies (e.g. electric vehicles).

Smart grids are envisaged to increase energy efficiency, shift energy demand and increase integration of renewable generation into the grid [4, 5]. However, such techno-centric framings of smart grids say little about changes in behaviour of various social actors. Increasingly, social studies of smart grids have been undertaken using practice theory to explore development of smart grids and household behaviour [6, 7, and 8].

Following Giddens [9], practice theory provides an interesting way to understand social aspects of smart grid developments. Practice theory centres on activities of everyday life associated with electricity, water and mobility. Seen this way, people's attitudes, behaviour and choices do not drive consumption [10]. Rather, people perform practices (e.g. cleaning, washing, eating, etc.) that require resources. Household practices are neither static nor isolated; rather they are dynamic and shaped by relations and inter-dependencies that lie beyond households. For example, the use of air-conditioning in households is not a simple matter of turning air-conditioning units on or off. Rather, notions of wellbeing and convenience (perhaps even luxury) as well as the building itself and the air-conditioning unit are implicated in how practices are performed. In this way, practices in households that require electricity are shaped by multiple relations including human and non-human actors. Thus, a practice theory perspective can usefully reveal relations and inter-dependencies that reinforce notions of 'that is the way we do things around here'. However, framing practices around households may limit the potential of this perspective to account for smart grid developments.

A practice perspective framed around households does not account for practices developing among electricity supply side actors (e.g. utility firms) and regulators. By excluding practices beyond households, analysts may miss out other relations and interdependencies that matter in the development of smart grids. For example, development of smart grid infrastructure undertaken by electricity network operators may facilitate and constrain other aspects of smart grids: it frames subsequent activities, including practices associated with electricity production and demand. Thus, how smart grids are socially constructed beyond households is the question we begin to address in this paper. We do so by drawing on practice theory and explore the potential of this perspective to account for practices across the smart grid by taking a tour beyond the household.

II. EXPLORING THE BOUNDARIES OF THE PRACTICE THEORY APPROACH BEYOND HOUSEHOLDS

Drawing on a practice perspective, we can think of smart grids as an ecology of human (e.g. people) and non-human actors (e.g. technologies, artefacts and infrastructures). Practices of smart grids are not only developing in households, but also among supply side actors, regulators and various intermediaries situated between supply and demand.

Actors on the supply side in a conventional electricity system framework include various utility firms involved with power generation, transmission and distribution. These are often seen as technical actors with engineering skills who perform practices of developing and maintaining technical infrastructures. Technologies (e.g. power plants, cabling and substations) are important elements of supply side practices, but choices made by supply side actors in developing aspects of smart grids are fundamentally a social process.

Examples of supply side social processes associated with smart grid developments can be seen in various pilot and demonstration projects. In the UK, the Low Carbon Network Fund (LCNF) provides financial support to Distribution Network Operators (DNOs) to develop smart grid measures. These measures involve developing new practices for regional and local network infrastructure. Traditional measures involve practices of strengthening network infrastructure to meet increases in demand. A key part of smart grids is that they enable the use of demand response arrangements to manage load on a network.

Demand response involves measures deployed by a network operator (e.g. National Grid or a DNO) to engage firms with significant energy consumption to reduce electricity or generate their own electricity when requested. This aspect of smart grids is being developed to address short term disruptions on the grid and to reduce peak electricity demand. While demand response actions may benefit supply side actors, it may also require them to change the way they operate. Similar to households, firms perform practices that require electricity, such as manufacturing, running IT systems etc. Many firms also perform practices of managing their electricity consumption to control costs and may seek to avoid peak electricity prices, engage in demand response programmes. For example, demand response programmes provide firms with an opportunity to reduce load or shift to their own stand-by generators when requested. While this may involve a low carbon option for firms, it may also hamper a focus on reducing electricity consumed in the first place. A practice perspective may usefully reveal how firm practices associated with electricity are developing in relation to utility firms.

There are also intermediary actors involved in demand response initiatives. A key group, known as *aggregators*, act as an agent for firms who can reduce electricity consumption or generate their own electricity when requested. The aggregator can coordinate capacity from several firms and link this to transmission or distribution networks. To some extent the aggregator mediates changes in practices and permits shared learning to take place.

A final destination on our tour of smart grid ecology involves the industry regulators. Regulation is not developed in a political vacuum disconnected from the sector it regulates (*cf.* Moran [11]). For example, the way electricity sectors in the UK are regulated is built around a centralised model of electricity provision, supply and demand. Aspects of smart grids involving partial decentralisation of electricity supply and demand, such as distributed generation, may not be recognised or supported by the existing regulatory frameworks. Regulators may need to develop practices which enable them to further respond to and lead these new developments.

III. Summary and conclusions

Social studies of smart grids have been undertaken that utilise practice theory to explore and gain insight on the development of smart grids with a particular focus on households. This perspective usefully describes practices in which electricity is used in households. However, reducing smart grid ecologies to everyday household practices may limit the potential of practice theory to understand development of smart grids. Thus in this paper we explored the potential of practice theory to account for practices performed by actors associated with smart grids beyond households. We grouped these actors into supply side actors (e.g. utility firms); intermediary actors (e.g. aggregators); demand side firms; and regulators.

Drawing on practice theory to explore and gain insights across smart grid developments (beyond households) may be useful for two reasons. Firstly, it provides analytical consistency to account for smart grid developments including households, supply side actors, regulators and various intermediaries. Seen this way, practices can usefully be viewed as micro-level activities that are constituted by an ecology of which they form part; and this ecology is constituted and sustained by practices which comprise them. Secondly, aspects of smart grids are shaped by practices and is practice shaping: smart grid interventions are an outcome of various inter-related practices. Seen this way, aspects of smart grids such as demand response are not developed by one central actor. Rather, demand response is shaped by multiple actors and associated practices. Thus, practice theory may usefully reveal roles of various actors, including relations and inter-dependencies between actors (e.g. utility firms, firms, regulators, technology and service providers and other intermediaries); and explore resistance and change across smart grid developments.

We conclude that a practice perspective can reveal relations and interdependencies, not only in households, but also how practices are developing among supply side actors, regulators and intermediaries. However, while frames are important, boundaries are set by researchers. Seen this way, practice theory is performtive: how boundaries are drawn matters. For example, a focus on household practices does not only reveal important and potentially useful insights for developing smart grids, it also creates a frame for action. Indeed, practices in households matters in smart grid developments. However, a practice perspective has potential to reveal practices across smart grid developments and create frame for action beyond households. In conclusion, practice theory can make important contribution to understand how practices persist, routed in being, as enduring entities that are reproduced through recurrent performances. However, this practice perspective is not without limitation [12]. This perspective may reinforce the view that practices are locked in patterns of performances ingrained in the doings at the level of micro-activities, which

may not lend itself to understand innovation and change. Further research undertaken from a practice perspective may explore and describe what smart grids might become.

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