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How do meters mediate? Energy meters, boundary objects and household transitions in Australia and the United Kingdom

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ABSTRACT

This paper investigates the changing role of an integral but often overlooked technology within our energy systems: the meter. Empirical cases from the United Kingdom and Australia demonstrate the repurposing of the energy meter. No longer just an instrument of metrology, the meter is increasingly seen by utilities and governments as a key enabling technology for a raft of objectives, from tariff reform to peak load reduction. We draw on the Science and Technology Studies concept of a boundary object to explore these changes. A boundary object is conceptualised as positioned between different social worlds – such as those of householders, government, and utilities – and as having sufficient interpretive flexibility to mediate between their distinct interests. Here we use the boundary object concept to explain the ways in which the meter is being reconfigured, and in particular to analyse the role of householders in the transition to digital meters.

1. Introduction

In the energy sector, as elsewhere, there has been progressive digitisation of infrastructures, including electricity and to a more limited extent gas and heat. In keeping with this overall trend, metering technologies are changing from mechanical to digital measurement systems. Approximately 200 million digital meters have been installed worldwide, including over 3.9 million in the United Kingdom (UK) and 3.5 million in Australia ([1]: 21–22; [2]). Traditional mechanical meters provide limited functionality; they measure overall consumption over time, and need to be read on-site manually. Digital meters are in contrast able to provide many more functions, both to the utility and customer, including: frequent remote meter reading that provides much finer-grained consumption data, allowing improved network management and detailed customer feedback on energy use, facilitating easier and quicker switching of energy supplier; and managing export and import of electricity where customers have embedded generation. Digital meters are typically combined with additional services and technologies such as in-home displays (IHDs) or phone apps – wireless technologies linked to the meter but not a core element of it. The meter has thus changed from being a simple metrology device to something that performs or enables multiple dispersed functions, across different devices. In this way the digital energy meter is playing an increasingly important role in mediating the changing relationship between utilities and their customers.

In this paper we reflect on the nature and implications of the shift to digital meters, focusing on residential energy customers (hereafter referred to as 'householders') through three empirical cases in Australia and the UK, and using the Science and Technology Studies concept of a boundary object [3–5]. The value and relevance of the boundary object concept is in positioning the meter centre stage in our analysis, thereby reflecting recent industry and government framings of the energy meter as a key agent of change. Whilst we recognise there are multiple other possible conceptual framings we could draw on, ranging from social acceptability [6,7] to governmentality [8,9] or boundary infrastructures [4], the boundary object concept has been selected because of its central focus on objects and their social relations [3,5]. By instigating programs to replace meters in people's homes, utilities and governments have made the meters a focal point of action and discussion. This reframing of the meter, and the relationships it shapes and mediates, are issues which the boundary object concept helps us to understand. In other words, through a focus on the meter itself, changing social practices and relations are usefully brought to the fore. Moreover, a boundary object approach helps us explore the multiple understandings of the energy meter, across different communities and institutions. For a boundary object is defined as a tangible thing or concept that intersects multiple social worlds, wherein a 'social world' is defined as a group of people where "… at least one [common]

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primary activity… is strikingly evident … [e.g.] climbing mountains, researching, collecting" ([10]: 122). In relation to this analysis we define social worlds according to their primary activity within the energy sector, including energy utilities (retailers, distributors), householders (consumers, as well as 'prosumers'), and governments and regulators. Social worlds typically have slightly different understandings of the same boundary object – termed 'local tailoring' – which are not usually seen or shared with others, as Star ([4]: 607) explains "…local tailoring [is] a form of work that is invisible to the whole group…". The flexible interpretation of boundary objects is a defining characteristic, and is also described in terms of plasticity, with a boundary object being "… both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" ([5]: 393).

The main aims of the paper are twofold. First, drawing on recent empirical research in Australia and the UK to use the concept of the boundary object to assess the changing relationship between energy utilities and householders; changes which have been significantly mediated by the meter. With mechanical meters the social world of the householder was not engaged with their utility via the meter, and with digital meters this has altered. Digital meters are typically viewed by other energy social worlds (utilities, government) as a key 'enabling technology', allowing for greater engagement, interaction and influence on household energy practices. Second, the boundary object concept is used to explore conflicts in our case studies in Australia and the UK about the transition to more widespread use of digital metering. The idea of a boundary object was originally conceived to explain situations in science research where collective work (i.e. co-ordinated action across several disciplines or communities) was feasible even in the absence of consensus, because of the interpretative flexibility of boundary objects. With energy metering a number of difficulties have arisen as digital meters have been deployed, and yet in most cases the implementation of digital meters has proceeded: conflict has not impeded the 'collective work' of installing new meters. The concept of a boundary object thus provides a useful theoretical lens for exploring our cases, and below we explore the different understandings of the meter within discrete energy sector social worlds.

The paper is structured as follows: first, we outline our empirical research methods; second, we review the origins of the boundary object concept and how it has been applied subsequently; third, we present the main findings from our three case studies of the implementation of digital metering; fourth, in our discussion and conclusions, we reflect on the value of the boundary object concept in exploring changes to the utility-householder relationship, and the nature of conflict in our three empirical cases.

2. Methods

Our research has taken the form of qualitative social science case studies in the UK and Australia, in the period 2011–2016. Australia and the UK were selected for analysis because during this period there was active policy development and implementation of digital meters in both countries. In October 2008 the UK Government announced an intention to mandate smart electricity and gas meters for all households, with initial consultations on the program beginning in 2009 [45]. Further, since 2012 the UK has had new policies in place to support district heating, which has also necessitated new meters [11]. In Australia there has similarly been considerable activity with regard to the implementation of digital meters, especially in the State of Victoria where all households had digital electricity meters installed in the period 2009–13. Thus Australia and the UK have been at the forefront of digital metering policy development internationally – alongside Italy, California and Ireland, amongst others (see [1,12]) – and, crucially, have actually implemented digital meters, thus providing us with rich empirical material.

The first UK case study comprises the introduction of digital heat meters for tenants at the 1960s Wyndford social housing estate in Glasgow, Scotland. The estate is owned by Cube Housing Association (HA) and comprises circa 1900 flats in multi-story and maisonette blocks. In 2012 the old electric heating system was replaced by new district heating, including the installation of digital heat meters in each house. Fieldwork in 2012–2013 comprised a 10% sample survey of households' experiences before and after the new heating. The sample of 154 tenants was based proportionately on type and size of housing, from 26- storey flats (the most common), through 4, 12 and 14 storey blocks, to maisonettes and sheltered accommodation. Size of housing ranged from studio to three bedroom flats, with a preponderance of studio and one bedroom accommodation. Sixty per cent of the tenant sample were single person households; 26% 2 person, 8% 3 person, and 6% 4–5 person households. We also interviewed 50 owner- occupiers (44% single person households; 28% 2 person; 16% 3 person and 12% 4–5 person households), living in maisonettes, who had bought their house under the UK's 'Right to Buy' legislation. Participants were interviewed at home, using a 48 item structured questionnaire and also inviting general comments. Further evidence was derived from interviews with three HA officials, three managers from the energy company and a local politician, and from HA records on energy advice to households. Summary findings were fed back to householders and discussed with Cube HA, the energy supplier, and Glasgow Council officials and elected members. Full details of the study are available at http://www.heatandthecity.org.uk/_data/assets/pdf_file/0005/166919/H eat_and_the_City_-_2014_-_Wyndford_survey_final_report.pdf.

The second UK case study involves a wider overview of the major UK government-led program (2016–20) to install smart meters in all homes and many small businesses.[1] Research comprised a policy document review and analysis in early 2014 of government documents relating to the smart meter program and the standards-setting process, supplemented in 2016–7 with further research. The 2014 government document review covered all webpages and documentation related to the Smart Metering Implementation Programme published on the Department of Energy and Climate Change website in the sections of the site called 'How we work with stakeholders'; 'All publications'; 'Further information'; and 'Consultations relating to technological standards (Functional Requirements and SMETS 2). Supplementary research was conducted in 2016–7 to gather updated information on the latest progress of the program (from the DECC and BEIS (Department for Business, Energy and Industrial Strategy, DECC's successor department) websites), and data on public attitudes, perceptions and salient points of householder concern with the program (from prominent campaign groups and services, and a recent research survey publication [13]).

The third case study is of a metering program in the State of Victoria, Australia, with fieldwork undertaken during 2015 and 2016 including: twenty-five expert interviews across Australian government (state and federal), utility and metering companies, industry bodies, nongovernmental and standards organisations, plus twelve interviews in the State of Victoria specifically about its metering program with key decision makers in government, utilities and social advocacy organisations; attendance at several specialist meetings and workshops; and an extensive policy literature review of relevant Australian state and federal government documents. Topics of enquiry in interviews included the motivations for transitioning to digital meters, what learning took place as the metering program evolved, including how problems were resolved, and interviewee perceptions of the value of digital meters to other energy stakeholders. Full details of the study are available at http://www.utas.edu.au/smart-grids-messy-society.

These three case studies were selected for analysis for a number of reasons, including: their different scale, ranging from national (UK-wide) to regional (State of Victoria, Australia), and local or community

[1] See Pullinger et al. [37] for further details of the review process and documents covered.