Energy Research & Social Science 22 (2016) 125–136

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

# Laundry, energy and time: Insights from 20 years of time-use diary data in the United Kingdom

Ben Anderson

*Faculty of Engineering and Environment (Energy & Climate Change Division), University of Southampton, Highfield, Southampton, United Kingdom*

ARTICLE INFO

*Article history:*
Received 15 February 2016
Received in revised form
13 September 2016
Accepted 14 September 2016
Available online 21 September 2016

*Keywords:*
Demand response
Laundry
Electricity demand
Timing
Time use
Social practices

ABSTRACT

The uneven temporal distribution of domestic energy demand is a well-known phenomenon that is increasingly troublesome for energy infrastructures and sustainable or low carbon energy systems. People tend to demand energy, and especially electricity, at specific times of the day and they do not necessarily do so when the sun is shining or the wind is blowing. The potential value of demand response as a solution rests on understanding the nature of temporal energy demand and the timing of the interconnected domestic activities that drive it. The paper uses current and historical time-use diary data to explore the temporal change in laundry practices in the United Kingdom over the last 20 years. 'Doing the laundry' is frequently cited as a potentially 'flexible demand' and yet very little is known about when people do the laundry, who does it at particular times, how this has changed and what implications this might have for the flexibility of demand. Through this analysis of laundry, the paper starts to unpack some of the 'doings' that contribute to current known energy demand and considers the extent to which they may or may not enable flexibility in the context of consumer demand response.



## 1. Introduction

Whilst there is considerable focus on the reduction of overall energy demand in the context of climate change in the United Kingdom [21], increasing attention is also being given to understanding the drivers of electricity demand at particular times of day [73]. This is largely driven by the need to ameliorate the effects of regular demand peaks of increasing magnitude on an ageing local distribution infrastructure [68,19,71]; to reduce reliance on 'high-carbon high-cost' fuel sources during demand peaks [75] and to attempt to better match demand to localised, time-specific or intermittent low-carbon generation [4,52].

One proposed solution is to incentivise consumers not only to reduce demand but also to shift the timing of their electricity demand through Demand Response (DR). This is conceived as a socio-technical infrastructure [68,19] enabling flexible and adjustable pricing mechanisms as well as other forms of demand manipulation through a combination of domestic smart meters [42] and a communications infrastructure integrating control of generation, supply and demand in a 'smart gird' [31]. Whilst investigation of the technologies [32] scenarios [89] and consumer acceptability [2,28,47] of a range of smart grid concepts is ongoing very little is known about what people actually do that generates demand for electricity at specific times of day [79,74].

Clearly the variance and flexibility of the temporal distribution of electricity demand is of fundamental importance to the ability to shift the scale and timing of consumption in order to balance load on the network and adapt to intermittent or temporally inflexible (non-dispatchable) generation [19,4]. This is particularly so where the timing of (un)intentionally synchronised household activities play a significant role in creating peak demand periods [79]. Currently the dominant mode of incentivising the demand shifting is through differential pricing but, given the generally moderate to low price elasticity of residential electricity consumption [57,27,24], it seems clear that alternative approaches based on the re-configuration of consumers' electricity-demanding activities might be an additional tool as Australian work has shown [71,72].

Whether the levers are to be price manipulation or habit reconfiguration, it is clear that understanding what different people do at different times of day and how that generates demand for electricity is a predicate for understanding the practical value of demand response approaches across the domestic customer population [83]. There is also a strong argument that understanding how such demand has evolved over time will give a substantially more nuanced view of how it has come to be embedded in current ways of 'doing' everyday life [62,79]. This in turn may highlight the uneven distribution of energy demand across gendered domestic

*E-mail addresses:* b.anderson@soton.ac.uk, b.anderson@dataknut.ac.uk

http://dx.doi.org/10.1016/j.erss.2016.09.004

labour roles as work in the UK and Sweden has shown [46,51] and may also give some insight into how current patterns of activities may or may not be open to change as work in both Australia [48] and the UK [55] demonstrates. Finally, such analyses would also explore how wider social transitions in norms and everyday practices [65] as well as more specific studies of particular practices such as eating [16,66,81], heating [33,60] and laundry [60,86] have consequences for the timing and extent of energy demand.

The overall objective of this paper is therefore to use historical time diary data to explore the evolution of the temporal variation of 'doing the laundry' as an exemplar of a particular energy-demanding activity over the last 20 years in the UK. Although limited to a single country, the literature would suggest that the processes underlying the changes described may be found in other countries with similar social, material and normative arrangements [76]. As will be discussed, this is particularly the case for countries where the increasing labour market participation of women is associated with a reduction in time available for historically gendered routine domestic work [39,78].

This twenty-year timeframe demonstrates the value of time use diary data in analysing the cross-sectional temporal variation of these practices and in revealing aspects of their evolution through time. In so doing the paper contributes to emerging research themes at the intersection of energy and social science such as the need to explore novel methods to scale up 'human centered' research methods [11,67], to report analyses of representative population samples over time [67], to understand the evolution of energy use 'conventions' [67] and especially the dynamics of the gendered distribution of energy consumption [67]. In addition, the paper explores the value of identifying the distribution of portfolios of laundry practices across different kinds of people, as a stepping-stone towards what might be termed a 'practice-based' domestic energy consumption analysis.

## 2. Energy, practices and time

Whilst the academic and policy literatures contain an increasing number of studies of current energy consumption patterns through household metering and appliance monitoring [25,58,88,90,91], there has been little attempt to consider the interconnections between these patterns and the activities that underpin them. Thus rather than seeking to link activities through appliances (or lighting & heating systems) to consumption, the nature of the activities that generate the observed consumption is essentially ignored [62].

There are however a few exceptions that have attempted to take account of aspects of the timing and nature of specific activities more directly, generally using time-diary data as the basis for modeling energy demand [23,84,83,87,74]. Here, energy demand patterns are ascribed to the range of activities recorded using a variety of average/appliance use approaches and recent work [22] has highlighted the extent to which this approach may or may not be valid for different appliances in different contexts in France. As Palm and Ellegard's work shows, not only can such data provide empirically grounded models of demand but it can also reveal the variation in temporal demand that derives from differences in the sequences of activities people report. In doing so they highlight the potential to cluster consumers not by the usual socio-demographic characteristics but by the activities in which they engage [23; p. 177] potentially providing a focus point for specific interventions.

Recent studies using historical time-use surveys have revealed trends in the distributions of gendered domestic labour across a range of European countries and provide some hint of the consequences for energy demand patterns [39,45]. This is also true of more specific studies focusing on the relationship between domestic work and household technologies [7,18] and also studies of particular practices such as eating [16,66,81], heating [33,60] and laundry [60,86].

Nevertheless there has been little analysis of the evolution of the timing of patterns of domestic energy demand. This is unfortunate as considering such variation offers a critical tool for identifying loci of potential intervention, change [56] and routine re-configuration of the kind envisaged by Strengers. Of course foregoing or shifting demand presumes that activities can be straightforwardly 'shifted' in the domestic context. As yet very little is known about the kinds of consumers for whom this may currently be true [55,79]. The extent to which other social transformations may alter this proclivity in the future is also unclear although recent studies have highlighted the potential non-shiftable nature of tightly integrated family evening practices in Australia [48].

This paper's approach to this challenge draws on the argument that understanding temporal energy demand depends on understanding the timing, location, context, materiality and performance of a range of inter-connected social practices [62,79]. To understand how these connected practices might change in the future we need to understand how they came to be. As Higginson et al. [36] emphasise, to assume that practices are inviolable is to claim that they never change and that reductions in energy demand can therefore only be attained through increasing efficiency of the material components of a 'fixed' practice. Yet there is substantial empirical evidence that all social practices evolve, albeit at differing rates and with different trajectories [60,16,61]. In addition, consumers are able to adapt to disruptions to practices [77], especially if those disruptions are short-lived [36,71]. If practices have changed then they are in principle *changeable* irrespective of the anticipated levers. Understanding these trajectories of change is therefore crucial to understanding the barriers to and potential practical value of demand response approaches.

In response to these challenges, this paper uses historical time diary data to link the relatively sparse existing body of work on the timing of laundry to an analysis of the temporal 'footprints' of laundry practices through their traces in UK national time use surveys from 1985 to 2005. According to recent research 'washing and drying' constitutes around 14% of overall household electricity demand placing it roughly equivalent to lighting, cooking and audio-visual appliances in the absence of electric space heating [91; p. 28]. Reducing this general level of demand is one focus of ongoing efforts to increase appliance efficiency, to promote lower temperature washes, 'proper' load volumes and 'correct' detergents in Germany [40]. Other work has identified different drying practices in southern European countries compared to those in northern Europe where seasonal and weather factors reduce the opportunity for line-drying [59]. However laundry has also evoked interest as being a relatively synchronised [60] but 'flexible' [36,55] and 'shareable' [80] element of energy demand which may be amenable to active or automation-based time-shifting [19,3]. Qualitative studies of interactions with in home displays giving feedback on energy consumed have suggested that some forms of laundry may be difficult to shift [46] and that other laundry may already be done outside peak demand periods [48]. On the other hand it has also been reported that such tools can prompt more reflective 'planning' of laundry practices [34] and responses to the availability of the households' own microgenerated electricity [13].

An analysis of exactly when laundry is currently done and by whom would therefore lead towards some understanding not only of the value of shifting laundry from a DR perspective but also of the potential constraints to flexibility. By looking at multi-decade change in the timing and sequencing of laundry, light may also be shed on how the current patterns came to be, on the current social contexts in which they are embedded and how they may evolve in the future.