Energy Research & Social Science 23 (2017) 82–96

Contents lists available at ScienceDirect

Energy Research & Social Science

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

Original research article

Are consumers willing to switch to smart time of use electricity tariffs? The importance of loss-aversion and electric vehicle ownership

Moira Nicolson *, Gesche Huebner, David Shipworth

UCL Energy Institute, The Bartlett, UCL Faculty of the Built Environment, Central House, 14 Upper Woburn Place, London, WC1H 0NN, United Kingdom

ARTICLE INFO

Article history:
Received 9 December 2015
Received in revised form 9 July 2016
Accepted 1 December 2016

Keywords:
Demand-side response
Time of use tariffs
Loss aversion
Behavioural economics
Domestic
Electric vehicles

ABSTRACT

Smart time of use tariffs are a key part of most government's strategies to ensure our future electricity supply is clean, affordable and secure – but will consumers be willing to switch to them? This paper presents the results of a survey experiment conducted on a nationally representative sample of 2020 British energy bill payers. The data suggests that over a third of bill payers are in favour of switching to a 3-tiered smart time of use tariff, indicating a sizeable *potential* market for these tariffs. There is substantial variation in willingness to switch, driven by differences in loss-aversion and ownership of demand flexible appliances rather than standard socio-economic/demographic factors. This is the first time loss-aversion has been measured amongst energy bill payers and the results suggest loss-aversion is likely to stifle consumer uptake; 93% of bill payers are loss-averse (care more about avoiding financial losses than making savings) and loss-averse people are substantially less willing to switch to the time of use tariff ($p < 0.001$). A randomised control trial finds that loss-framed messages are unlikely to overcome loss-aversion to boost uptake. Marketing campaigns tailored towards electric vehicle owners, who were significantly more willing to switch, could increase uptake during and after the smart meter roll-out.

1. Introduction and literature review

A major challenge for renewable energy consumption, energy security and energy affordability is how to encourage consumers to switch from flat-rate electricity tariffs to time of use tariffs which charge consumers for their electricity according to the time of day they are using it [1–4]. This is because, in the transition away from fossil fuels, governments need to ensure that people can access the energy they need, at prices they can afford, when the sun is not shining and the wind is not blowing, particularly at times of peak demand. One solution is to increase fossil-fuel supply capacity for use at peak times [5], however this will be costly and could lead to an increase in net carbon emissions. Alternative ways to provide this flexibility include energy storage, interconnectors [6] and demand-side response (DSR), an additional but much less cited solution.

DSR, sometimes referred to as DR (demand response), can be defined as "a change in electricity consumption patterns in response to a signal" [7,p. 9].[1] Three main types of signal are price (e.g. static time of use tariffs and dynamic time of use tariffs), volume (e.g. load capping) and direct control contracts (e.g. direct load control in which a third party provider remotely switches appliances on/off) [8,9]. Static time of use tariffs charge consumers two or more fixed prices for their electricity depending on the time of day, day of week or season, with higher rates applied at peak periods, providing consumers with certainty about what price they will pay and when [10]. Consumers can save money on these tariffs by shifting their consumption away from times of peak demand, for example, by running their washing machines or tumble-dryers at off-peak periods, when the electricity rate is cheaper. Dynamic time of use tariffs offer consumers prices which could vary on an hourly

[1] DSR is defined in a number of slightly different ways however all of them assume that it involves a change in the timing of electricity use in response to some sort of signal [9,92,95]. This distinguishes DSR from another form of demand-side management called demand reduction, which aims to achieve an overall reduction in energy consumption [2,67].

* Corresponding author.
E-mail addresses: m.nicolson.11@ucl.ac.uk (M. Nicolson), g.huebner@ucl.ac.uk (G. Huebner), d.shipworth@ucl.ac.uk (D. Shipworth).

http://dx.doi.org/10.1016/j.erss.2016.12.001

or sub-hourly basis [11] and are most effective when combined with additional equipment that reduces peak demand by automatically turning off non-essential electrical devices [12,13]. However, until these additional automation technologies are fully tested and costed [4], it is expected that static time of use tariffs will be the predominant mechanism by which consumers are incentivised to undertake DSR [14]. This paper therefore solely discusses static time of use tariffs because they are the simplest form of tariff that can deliver peak-load reductions in electricity demand [12] without the need for any other technology than a smart meter. Although static time of use tariffs can be implemented without smart meters – in the UK, 13%–21% of energy bill payers are on 'legacy' time of use tariffs introduced in the 1970s to stimulate night-time demand for nuclear power – the provision of near real-time electricity consumption data from smart meters will enable suppliers to offer new types of 'smart' time of use tariffs (hereafter referred to as sTOU tariffs) which can charge consumers two or more rates for electricity without having to install additional meters. Before smart meters, these 'legacy' time of use tariffs required the installation of special meters that could record, for example, day-time and night-time electricity independently [15]. As such, the business cases for the majority of smart meter programmes around the world assume that consumers will participate in DSR through sTOU tariffs [16–19]. In the UK, for example, the Government's business case for smart meters relies on an additional 20% of consumers switching to a sTOU tariff by 2030, in addition to those who are already on 'legacy' time of use tariffs [4].

However, to work, sTOU tariffs require two types of consumer participation: (1) consumers to switch to a sTOU tariff (switching) and; (2) respond to the price signals by changing their consumption patterns (load shifting). Ample evidence suggests that, once on a sTOU tariff, consumers will shift their consumption away from peak times (see Ref. [12] for a literature review of 30 trials). However, it is one thing to create a set of tariffs and technologies that aim to change the timing of consumers' electricity use – it is another thing to design and market tariffs that the average consumer will actually switch to. The majority of consumers rarely switch their energy tariff or supplier, despite the large savings on offer [20]. In the UK, for example, in the two decades since the privatisation of the retail energy market, less than half of the British population have left their incumbent supplier [20] and, every year, more than half of British consumers forego hundreds of pounds worth of savings by not switching energy tariff [21]. Why is this and how can we prevent it from threatening consumer participation in DSR?

According to classical economics, consumers expecting to maximise their utility from sTOU tariffs will switch to a sTOU tariff and any increase in tariff choice enabled by smart meters will increase the number of sTOU tariff users by increasing the number of people for whom these tariffs offer maximum utility. However, the seeming failure of consumers to make decisions which maximise their net utility is well documented in all domains from health to personal finances and, for a variety of reasons, is particularly prevalent in the environmental sector [22]. For example, the discrepancy between actual and optimum levels of householder investment in energy efficiency is a well-documented phenomenon which has come to be known as the 'energy efficiency gap' [23–25] since Hirst and Brown coined the term in 1990 [23]. Economists have long recognised that market failures (including externalities, imperfect competition and imperfect information) can lead to suboptimal decision making [24], which they argue should be corrected as directly as possible, for example, by providing information to imperfectly informed consumers [25] or state interventions such as Pigouvian taxes, mandates and bans [24]. For example, to achieve its targets, the Irish energy regulator is making sTOU tariffs mandatory following the smart meter roll out [26].

However, it has not been until more recently that, following the early seminal work of psychologists Kahneman and Tversky in 1979 [27–29] and Herbert Simon [30], some environmental economists have proposed that people do not just fail to make optimal decisions because of market failures but because they are not rational decision-makers who evaluate costs and benefits like economist do [24,31–34]. The integration of psychology into a classical economic framework has become known as behavioural economics [35], a field which has documented numerous ways in which real-world consumer choices deviate systematically from those predicted by classical economics.

One of the most serious violations of classical economics which could stifle uptake to sTOU tariffs is loss-aversion [36]. Loss-aversion was first inferred from the observation that participants in laboratory experiments will turn down coin-toss gambles of the type in which they have a 50% chance of winning £110 or a 50% chance of losing £100–even though the expected outcome is that they would be financially better off from taking the gamble [27]. Loss-aversion is one component of Prospect Theory [27,29,37] which predicts that, rather than maximising their utility against a fixed budget constraint, people evaluate costs and benefits in relation to deviations from a reference point, which is commonly taken to be the status quo [36]. Downward deviations from the status-quo are perceived as losses and, according to studies on loss-aversion, people care twice as much about avoiding losses than gains [27,29,37], regardless of whether these losses are financial or otherwise [37–39]. In the energy tariff domain, for example, qualitative research by British energy regulator Ofgem found that energy bill payers tend to "focus too much on potential losses (e.g. higher prices, problems during the switching process) than potential gains" when considering whether to switch energy tariff and suggested this may explain why people do not switch more often [17,p. 3]. Loss-aversion could play an even bigger role in reducing switching rates to sTOU tariffs because, although consumers could save money by switching from a flat-rate to a sTOU tariff and shift their electricity use away from the peak times (gains), they could also see a large increase in their bills (losses) if they are unable to shift their electricity away from the expensive peak times. If consumers care twice as much about avoiding financial losses as they do about making financial gains, they will prefer to stay on their current tariff, rather than face the prospect of paying more if they switch to a sTOU tariff. Loss-aversion thus leads to another violation of classical economics called status-quo bias [42], defined as a preference for the current state of affairs [42]. Since the majority of British consumers are on flat-rate tariffs (80–90% [15]), status-quo bias would favour flat-rate over sTOU tariffs. Further, as noted, loss-aversion does not just apply to money and switching from a flat-rate to a sTOU tariff also means losing flexibility over when household appliances can be run, which could reduce comfort and convenience (losses), which studies of loss-aversion suggest will be weighed twice as high as the potential gains (savings from off-peak usage) [27,43].

However, although there are ample studies on loss-aversion [44–49], there is still a lack of evidence on the extent to which loss-aversion affects the average person and therefore disagreement over the extent to which loss-aversion poses a threat to people's abilities to make optimal decisions [36]. This is because loss-aversion has predominantly been measured in laboratory experiments amongst psychology students [27] or inferred from the real-world behaviour of the select group of individuals who participate in the stock market [48–51], individuals who are likely to have very different attitudes towards risk than the average person. Although there have been some attempts to study loss-aversion in the real world amongst more typical people (e.g. taxi drivers [52]), these studies have not measured loss-aversion directly, making it hard to rule out alternative explanations for the behaviour observed