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Cost-reflective electricity pricing: Consumer preferences and perceptions

Nina L. Hall [a,*], Talia D. Jeanneret [a], Alan Rai [b]

[a] Commonwealth Scientific and Industrial Research Organisation (CSIRO), 1 Technology Ct, Pullenvale QLD 4069, Australia
[b] Formerly Commonwealth Scientific and Industrial Research Organisation (CSIRO), 10 Murray Dwyer Circuit, Mayfield West NSW 2304, Australia

HIGHLIGHTS

- Electricity price rises can be limited by 'cost-reflective' pricing.
- We consulted residential electricity consumers on Time-of-Use and Peak Capacity pricing.
- Understanding of peak electricity demand must increase to enable demand shift.
- Interactive website could enable consumers to evaluate pricing options.
- Smart meter adoption may increase if voluntary and includes an in-home display.

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ABSTRACT

In Australia, residential electricity peak demand has risen steeply in recent decades, leading to higher prices as new infrastructure was needed to satisfy demand. One way of limiting further infrastructure-induced retail price rises is via 'cost-reflective' electricity network pricing that incentivises users to shift their demand to non-peak periods. Empowering consumers with knowledge of their energy usage is critical to maximise the potential benefits of cost-reflective pricing. This research consulted residential electricity consumers in three Australian states on their perceptions and acceptance of two cost-reflective pricing scenarios (Time-of-Use and Peak Capacity pricing) and associated technologies to support such pricing (smart meters, in-home displays and direct load control devices). An energy economist presented information to focus groups on the merits and limitations of each scenario, and participants' views were captured. Almost half of the 53 participants were agreeable to Time-of-Use pricing, but did not have a clear preference for Peak Capacity pricing, where the price was based on the daily maximum demand. Participants recommended further information to both understand and justify the potential benefits, and for technologies to be introduced to enhance the pricing options. The results have implications for utilities and providers who seek to reduce peak demand.

1. Introduction

The purpose of this article is to explore consumer interest and responses to the concept of cost-reflective pricing (CRP), within the context of current understanding of electricity pricing structures and delivery mechanisms, perceptions of energy affordability, and attitudes toward energy security. The need for this research is the growing demand for residential electricity in Australia, matched with a lack of price signals in the pricing structure that could otherwise encourage a change in consumption patterns.

In Australia, households are responsible for around 25% of Australia's total electricity consumption but constitute a higher proportion of peak demand (BREE 2013, Productivity Commission, 2013). Over the two decades to 2012, peak demand in each Australian state grew by 50–100 per cent. This was partly driven by increased air-conditioner ownership among households which more than doubled from around 30 per cent to around 70 per cent during the period (ABS 2011, DEWHA 2008). This growth required ongoing investment in network capacity. Between June 2007 and December 2012, real residential electricity prices rose 70 per cent across Australia, with around half of this rise due to the investment in extra network capacity (Productivity Commission, 2013).

Growing peak demand is not in and of itself an economic problem. Rather, the issue is whether the level of peak demand is economically efficient, which depends on whether the utility

* Corresponding author.
E-mail addresses: nina.hall@csiro.au, NinaLHall52@gmail.com (N.L. Hall), talia.jeanneret@csiro.au (T.D. Jeanneret), alan.rai17@hotmail.com (A. Rai).

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consumers gain from their peak demand are commensurate in value with the high cost of having it supplied. Appropriately structured cost-reflective prices could contribute to confirming whether the existing peak demand level is efficient.

In Australia, the majority of households pay time-invariant usage rates for their electricity, which provides no financial incentive to shift consumption from peak to non-peak periods. Consequently, existing evidence suggests that the prevalence of flat-rate, volumetric-based pricing in Australia has led to an inefficiently high level of peak demand (AEMO 2013). Reducing peak demand to an economically efficient level has been estimated to potentially generate savings of $1.5-$4.6 billion, over the decade to 2022, in the form of avoided network investment (Deloitte 2012).

Various forms of cost-reflective pricing (CRP) have been proposed to realise these savings. A CRP typically involves a two-part tariff structure, where one part is a constant demand charge and the second part is a time-differentiated charge based on the volume consumed (Simshauser and Downer, 2014).

To maximise the potential benefits from CRP for users and the overall electricity network, engagement by customers with their energy usage is critical. The CSIRO's *Future Grid Forum* identified a lack of awareness of: peak demand; management options; and alternative pricing structures; as key barriers to widespread uptake of CRP. Most residential consumers were found to "remain unaware of the impact of peak power use on electricity system costs and have limited incentive to act to address it" (CSIRO, 2013:2). However, shifting consumer behaviour and demand is not straightforward. Beyond price, AEMC (2012) identified convenience, awareness and understanding, to be additional influencers on users' decisions on the timing and amount of electricity consumed. This is supported by research showing social attitudes and consumer knowledge to be important in determining whether or not a proposed change – such as introducing CRP – is accepted and taken up (Stern, 1992). Thus, social attitudes are an important influence on the trajectory a technology will take (Boughen, et al. 2013).

Acknowledging these issues, the first of the two research questions explored in this research were consumer responses to three CRP scenarios, particularly how consumer knowledge and engagement on CRP can be increased and the drivers and barriers to support CRP. The second sought to understand consumer attitudes towards technologies to support CRP, namely advanced metering infrastructure (AMI; also known as 'smart meters'), Direct Load Control (DLC) and in-home displays. These questions were examined through responses to two CRP scenarios, Time-of-Use (ToU) and Peak Capacity pricing (described later). This research occurred in parallel but not interacting with two other major reviews. Nicholls and Strengers (2015) conducted a large survey of households regarding their views and likely behaviour change in response to different AMI and CRP scenarios, and Langham et al., (2014) evaluated the *'Smart Grid, Smart City'* trial of AMI in New South Wales. It is *anti*cipated that this research will have value for all stakeholders involved in the electricity system within and beyond Australia, including energy utilities and network providers as they seek to ensure investment in infrastructure is at an economically efficient level, and consumer advocates as they seek to prevent unexpected costs for consumers. Consumer understanding and likely acceptance of CRP expands the literature that is currently more dominated by consumer responses to demand-side technologies, such as smart meters. This paper's focus on responses to scenarios has increasing relevance and importance as Australian global residential electricity demand increases, and price signals are further introduced to adjust consumption periods.

2. Background

In Australia in recent decades, there has been a decline in average electricity demand for the average Australian household but an increase in consumption during peak times. This has resulted in a higher peak-average ratio (more commonly known as the lower network utilisation factor), and contributed to an increase in electricity prices (Productivity Commission, 2013). Currently, peak demand occurs for less than one percent of the billing period (approximately 40 h per year), but contributes up to 30 per cent of residential electricity charges (Productivity Commission, 2013).

2.1. Current Australian and International tariffs and meters

Residential electricity prices in Australia have historically been a two-part tariff, comprising a fixed charge for connection to the grid (historically a relatively small component) and a flat volumetric charge (Simshauser and Downer, 2014). This tariff has resulted in peak demand being under-priced relative to non-peak demand, providing no financial incentive to users to shift their usage from peak to non-peak periods (Simshauser and Downer, 2014).

To enable CRP, AMI has been installed in most new and many existing homes in different states. AMI and interval meters enable electricity consumption data in small interval (*eg.* five minute readings) to be directly communicated to the utility. The AMI installations occurred following the endorsement of the Council of Australian Governments in 2007 for a national staged rollout of AMI where benefits for consumers were considered greater than the risks (Strengers, 2010). In parallel, recent energy market reforms have seen the deregulation of parts of the energy industry, including phasing out regulated energy retail tariffs and dividing utilities into separate entities for generation, transmission, distribution and retail (ERAA 2011).

The status of uptake of cost-reflective pricing, deregulation and ownership status of the electricity network, and AMI installation (as at December 2014) is detailed for each Australian state and territory in Table 1. As shown, Victoria has the highest number of residential consumers on a ToU tariff, due to the high number of AMI units installed in a state-wide roll-out between 2009 and 2014 (Deloitte 2011, Vic Government 2015). The Victorian Government's experience in installing AMI units and ToU pricing on a mandatory basis has influenced other states to consider a voluntary approach (Legislative Assembly, 2013). All states offer a form of CRP, most of which are ToU, but also include inclining block tariffs.

To provide international context, CRP is currently operating in a range of Western countries. In the United States, utilities and electricity providers offer time-responsive tariffs, which differ across individual U. S. regions depending on each region's climate and demand peaks (Lampard and Aspinall, 2014, US EIA, 2012). In the United Kingdom, ToU has been trialled and new standards introduced to minimise complexity in tariff structure (Ofgem 2013). In France, the largest distributor offers tariffs based on different household electricity capacity, and in Italy, all households with a smart meter are placed on a ToU tariff (Lampard and Aspinall, 2014).

2.2. Potential consumer benefits and risks of CRP

Recent Australian-based research has examined the extent of households' ability to shift their electricity consumption away from peak periods. In seven trials of CRP, the average reduction in peak demand was between 13% and 40% (AEMC 2012). In other studies, low-consuming households were found to be able to shift