Energy Policy 123 (2018) 421–432

Contents lists available at ScienceDirect

Energy Policy

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

Are vulnerable customers any different than their peers when exposed to critical peak pricing: Evidence from the U.S.

Peter Cappers*, C. Anna Spurlock, Annika Todd, Ling Jin

Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720, United States

A R T I C L E I N F O

Keywords:
Time-based rate
Critical peak pricing
Vulnerable
Low income
Elderly
Chronically ill

A B S T R A C T

Recent broad-based deployment of Advanced Metering Infrastructure (AMI) enables the opportunity for broader adoption of time-based rates, and the benefits that result have been sizable contributors to making the investments cost effective. However, some stakeholders have raised concerns about the assumptions underlying the benefits assessments in AMI business cases. Such concerns are especially acute for certain subpopulations of residential customers. Low income, elderly and chronically ill (i.e., vulnerable) customers are believed to have less load that can be shifted or reduced to capture bill savings, lack the know-how or wherewithal with which to curtail usage, likely have more limited financial resources which may compel them to avoid high priced periods by reducing electricity for essential usage potentially causing them physical harm, and more generally may be more adversely affected by higher bills, which might possibly result from certain forms of time-based rates. There is very limited existing literature that addresses these questions specifically with regard to vulnerable subpopulations. This paper, based on a larger report, extends the existing empirical literature on the experiences of low-income customers exposed to critical peak pricing, and provides the first glimpses into the experiences of the elderly and those who reported being chronically ill.

1. Introduction

Ninety-eight percent of residential customers in the United States take service under flat or inclining block rates (FERC, 2012). Yet time-based rates provide an opportunity for customers and utilities alike to achieve a variety of benefits including: increased opportunity for customer bill management, lower utility power production costs, deferred future generation investments, and increased utilization of existing infrastructure (National Energy Technology Laboratory, 2008). Recent broad-based deployment of Advanced Metering Infrastructure (AMI) enables the opportunity for broader adoption of time-based rates, and the benefits that result have been sizable contributors to making the investments cost effective (National Energy Technology Laboratory, 2008).

However, some stakeholders have raised concerns about the assumptions underlying the benefits assessments in AMI business cases. Some contend AMI is not needed to implement time-based rates, although it may lower the cost of doing so and facilitate more diversity in the types of time-based rates that may be offered (Felder, 2010). Others infer that since less than 2% of residential customers at a national level take service under such rates (FERC, 2012), large groups of customers have consistently preferred stable and less volatile rate structures (Alexander, 2010). In addition, some observe that even mild forms of time-based rates (e.g., time-of-use) have sometimes drawn opposition from customers (Brand, 2010) which would potentially manifest itself in high attrition rates once customers are exposed to time-based rates. Furthermore, some have raised concerns that customer load response to such rates has been inconsistent, disappearing over time (AARP, National Consumer Law Center, National Association of State Utility Consumer Advocates, Consumers Union and Public Citizen, 2010). Ultimately, if a very small share of customers take up these rates, and those who do either quickly leave or don't substantially and persistently respond to them, then the benefits that utilities promote in their AMI business case are unlikely to come to fruition.

Such concerns are especially acute for certain subpopulations of residential customers. Low income, elderly and chronically ill (i.e., vulnerable) customers are believed to not use as much energy as their counterparts and so have less load that can be shifted or reduced to capture bill savings (AARP, National Consumer Law Center, National Association of State Utility Consumer Advocates, Consumers Union and Public Citizen, 2010). In addition, some assert that such vulnerable customers lack the know-how or wherewithal with which to curtail usage (Faruqui et al., 2010). Furthermore, vulnerable customers likely have more limited financial resources which may compel them to avoid

* Corresponding author.
E-mail address: pacappers@lbl.gov (P. Cappers).

https://doi.org/10.1016/j.enpol.2018.09.013
Received 29 May 2018; Received in revised form 7 September 2018; Accepted 11 September 2018

high priced periods by reducing electricity for essential usage (e.g., life-sustaining medical equipment, air conditioning) potentially causing them physical harm (AARP, National Consumer Law Center, National Association of State Utility Consumer Advocates, Consumers Union and Public Citizen, 2010). Lastly, if these customers are on fixed or limited incomes, then they may be more adversely affected by higher bills inducing energy poverty, which could result from or be exacerbated by certain forms of time-based rates (Welton, 2017).[1]

Based on these concerns, a set of research questions can be identified:

1. Do vulnerable subpopulations exhibit usage patterns (either in terms of their average usage or flexibility of usage) that differ from those of non-vulnerable subpopulations?
2. Do vulnerable subpopulations participate and stay enrolled in time-based rates at different levels than non-vulnerable subpopulations?
3. Do vulnerable subpopulations exhibit load response to time-based rates at different levels than non-vulnerable subpopulations?
4. Do vulnerable subpopulations benefit financially from time-based rates at different levels than non-vulnerable subpopulations?

Unfortunately, there is limited existing literature that addresses these questions specifically with regard to vulnerable subpopulations. Although there have been a few pieces of empirical research that focus on the low-income community (see Faruqui et al., 2010; Wolak, 2010; Smart Grid Consumer Collaborative, 2012), little to no research has been published on the elderly or those with medical needs.

This paper, which provides a summary of main content and conclusions from a broader report (Cappers et al., 2016), extends the existing empirical literature on the experiences of low-income customers exposed to critical peak pricing (CPP), and provide the first glimpses into the experiences of the elderly and those who reported being chronically ill. Specifically, our analysis provides empirical evidence of whether or not vulnerable customer subpopulations have preferences, load profiles, load response capabilities, and bill impacts that differ from their non-vulnerable customer counterparts.

For those states and utilities considering broader and more aggressive offering of critical peak pricing rates to residential customers, this analysis can contribute to the electric industry stakeholders' understanding of the degree to which perceived concerns about low income, elderly and/or chronically ill customers are, or are not, realized.

This paper is organized as follow. In Sections 2 and 3, we provide an overview of the data and methods, respectively, used to characterize the experiences of vulnerable customers to CPP. Next, in Section 4 we present the results of our analysis while in Section 5 we draw conclusions and implications based on these results.

2. Data sources

We had access to two electric utility pricing studies which had sufficient participation data, interval meter data, survey and other sources of demographic data to sufficiently analyze the outstanding research questions posited in Section 1 associated with vulnerable populations applied to a critical peak pricing rate design: Green Mountain Power (GMP) and Sacramento Municipal Utility District (SMUD).[2]

2.1. SMUD's consumer behavior study[3]

The SMUD study's main goals were to better understand how the enrollment approach (voluntary vs. default) affected enrollment rates, drop-out rates, and electricity demand impacts to different time-based rate designs (see Fig. 1). Specifically, SMUD's study included evaluations of three rate treatments all in effect during the summer months (June through September) of 2012 and 2013: (1) a two-period time-of-use (TOU) rate with a three-hour (4–7 p.m.) peak period, (2) CPP overlaid on an underlying inclining block rate, and (3) CPP overlaid on the TOU rate (see Table 1). The CPP rate was designed and implemented with 12 critical events called each year between the hours of 4 p.m. and 7 p.m. (i.e., 48 h in total) on summer weekdays, excluding holidays.

For the purposes of this analysis, only the customers exposed to CPP overlaid on the inclining block rate, including both enrollment approaches and treatments with or without the presence of an IHD offer, were analyzed. The default CPP with IHD treatment group was analyzed independently, while the Voluntary CPP with and without IHD treatment groups were combined in our analysis, in order to maximize our ability to identify effects when disaggregated by demographic subpopulations.

2.2. GMP's consumer behavior study[4]

GMP conducted a consumer behavior study that focused exclusively on opt-in event-driven rate designs. One of the study's main goals was to better understand the timing and magnitude of changes in residential customers' peak demand due to exposure to either critical peak pricing or critical peak rebate (CPR), as well as to observe customer preferences for different transition strategies towards these rates. As such, GMP's study included evaluations of two different event-driven rate treatments (see Fig. 2), all in effect for a 13 month period but broken into two epochs (Year 1: August 2012–April 2013; Year 2: May 2013-September 2013) designed to call 10 critical peak events between 1 and 6 p.m. (i.e., 50 h in total). However, only 4 critical events were called in Year 1,[5] while all 10 were called in Year 2.[6] These two rates implemented by GMP were: (1) CPR overlaid on the existing flat rate, and (2) CPP overlaid on a slightly reduced flat rate (see Table 2).

For purposes of this analysis, only the customers included in the CPP overlaid on the flat rate for both year 1 (August 2012 – April 2013) and year 2 (May 2013 – September 2013) of the study, including both treatments with and without an IHD offer, are analyzed and discussed. The CPP with and without IHD treatment groups were combined in our analysis, in order to maximize our ability to identify effects when disaggregated by demographic subpopulations.

[1] There is a much broader and more robust body of literature on energy poverty issues whose focus extends well beyond retail rate design issues, including: 1) identifying the conditions which cause households to lack access to electricity and/or rely on traditional biomass fuels (e.g., charcoal, wood, dung) for cooking due to low income levels; 2) impacts on global climate changes; and 3) public policies that attempt to mitigate or alleviate these various conditions (e.g., Richardson et al., 2009; Sovacool, 2012; Oppenheim, 2016).

[2] Because neither SMUD nor GMP's study was designed to have the power to identify load responses of disaggregated customer groups, we chose to combine multiple similar treatment arms for both utilities in our analysis, in order to maximize the potential of identifying any differences in load response, enrollment rates, and bill impacts. In particular, while we analyzed SMUD's default rate treatment independently, we combined SMUD's voluntary CPP rate treatment arms, both of which faced exactly the same rates and critical events, but one of which was offered an in-home-display (IHD) and one of which was not. We similarly combined GMP's voluntary CPP rate treatment arms, both of which were exposed to exactly the same rates and experienced the same critical events, but one of which included an IHD and one of which did not.

[3] For more details about SMUD's consumer behavior study, see Cappers et al. (2013a).

[4] For more details on GMP's consumer behavior study, see Cappers et al. (2013a).

[5] Events in Year 1 were called on: 9/14, 9/21, 9/25, and 10/5 of 2012.

[6] Events in Year 2 were called on: 7/5, 7/15, 7/16, 7/17, 7/18, 7/19, 8/13, 8/21, 8/22, and 8/28 of 2013.