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Residential electricity tariff analyses

Methodological overview and description of limitations

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1 Approach

To explore the complex relationship between retail tariff structure, household characteristics and cost, this work draws on real data from Victorian households and examines a set of standing offers available to consumers in one Victorian supply area. Each retail offer is applied to a year of metred energy consumption data for each resident in our sample set to build a picture of the distribution of retail bills across tariff types and customer classes. Though the outputs represent estimates of residential consumer electricity bills only, the grounding of the estimation method in real data means that outputs should be highly indicative of the types of bills seen by real energy consumers in Australia.

1.1 Data underpinning residential bill estimates

1.1.1 Household demographic data

This work leverages Victorian household data collected through surveying programmes conducted by CSIRO. The data includes self-reported demographic and building information provided by approximately 1,000 households from across the CitiPower and Powercor supply areas in Victoria. Approximately 90% of households in the sample reported using gas for heating, hot water or cooking, while approximately 25% of the sample reported having solar PV installed (with metering data showing that more than 90% of those homes exported power back to the grid at some point throughout the year).

1.1.2 Household energy consumption data

Approximately one year of half-hourly electricity consumption data has been collected for all households described in Section 1.1.1 for the year 2016. Average daily net load for homes in the sample without solar PV systems is 12.5kWh and 6.6kWh for homes with PV installed.

1.1.3 Retail electricity tariff data

The tariffs reflect standing offers available in Altona Meadows, in suburban Melbourne. The tariffs include flat, flexible and demand tariff offers from five retailers. Retail tariffs are per published tariffs provided by the ACCC in Q1 2018.

1.2 A note on privacy

We use differential privacy for reporting household cost statistics. Differential privacy (a popular methodology used by Microsoft Research, Google and Apple), is designed such that reported outputs would not noticeably change if an individual's data changes. This property makes it difficult for an attacker to infer if someone’s private data was part of the dataset. Privacy-preserving mechanisms that meet the standards of differential privacy often rely on additive noise with slow-decaying distributions, such as Laplace noise, whose scales are determined by the

amount of variation (from one individual to another) within the private dataset. For the energy cost dataset, to ensure individual privacy is maintained, we compute differentially-private averages and means of absolute deviation, and balance residual privacy risk with the utility of statistical data reported (i.e., how accurate they are in comparison to their potentially privacy-intrusive counterparts). Note that this necessarily means some reduction in reported result fidelity, though we have observed that the impact is small and the outputs remain representative of the sample population.

1.3 Presentation of cost estimates

For each household, we calculate typical flat, flexible and demand costs by overlaying the corresponding tariff structure from each retailer and averaging the resulting cost. Results show the mean cost and median absolute deviation in cost for subsets of consumer classes.

1.3.1 Categorisation of consumers

In describing estimated cost, consumers are categorised according to income level, consumption class, vulnerability, uptake of PV and uptake of gas.

- For consumption classes, low, medium and high energy consumers are grouped into equal-sized cohorts based on total annual energy consumption.
- Consumers are categorised as potentially vulnerable if they are not well placed to to respond to high bills through the acquisition of energy efficient, renewable energy technologies and meaningful behaviour change. Specifically, for the purposes of this study, a household is considered potentially vulnerable if they are a very low income household, a low income renter, a low income household with a large number of occupants, a low income household in an apartment, or a low income household with at least one old age occupant.

1.4 Sample biases

It is critical to underline that the sample of households used for this work is subject to skew and should not be considered representative of either wider Victorian or Australian households in general. Still, the sample does cover a substantial cross-section of Victorian households and by examining particular segments within the data, we can explore how tariffs may impact real Australian households.

Referring to data collected by the Australian Bureau of Statistics[1], the following significant differences between our sample and households across Victoria are worth noting when reviewing findings:

[1] Age data is sourced from ABS catalogue 3235.0 - Population by Age and Sex, Regions of Australia, 2016; household tenure, dwelling type, family type and solar uptake data is sourced from ABS catalogue 1410.0 – Data by Region, 2011-2016; household income data is from the 2011 Australian Census. Note that gas uptake was unavailable at a suitable resolution or for an appropriate reporting period and bias has therefore not been statistically assessed for this characteristic.

- Australians aged 50 and over are over-represented in the respondent sample.
- Australians aged under 40 are under-represented in the respondent sample.
- The distribution of household incomes in the respondent sample is similar to the full Victorian population, based on Census data from 2011. In particular, the median income groupings are consistent in both sets: $52,000 - $77,999. However, the CSIRO survey over-samples households with low incomes ($15,600 - $33,799) and very high incomes ($260,000 or more), while under-sampling households with moderate incomes ($52,000-$77,999) and high incomes ($130,000-$181,000).
- Home owners are over-represented in the sample (~85% versus 64.1% across Victoria).
- Lone-person households are over-represented (~30% versus 24.3%).
- Households with a couple and no children are over-represented (~40% versus 26%).
- Couples with children are under-represented (~25% versus 27.2%).
- One parent households are under-represented (~5% versus 6.8%).
- The sample contains no group households despite Victoria having 4.4% of its households within this category.
- "Other" household types are under-represented (~5% versus 11.2%).
- Townhouses (and equivalent semi-detached) homes are marginally under-represented (~10% versus 14.3%).
- Apartments (and equivalent) homes are marginally over-represented (~15% versus 12.6%).
- Households with solar PV are significantly over-represented (~25% versus 13.2%).

In general, older owner-occupiers (across a range of income bands) dominate the sample. Young higher income owner-occupiers are relatively well represented, though the number of young lower income renters is very small. Older renters in the sample tend to have lower household incomes. On the whole, the vulnerable customer class tends to be heavily skewed towards older consumers.

1.5 Assumptions, limitations and caveats

The development of bill estimates for the Victorian residential household sample relies on the following:

- For the purposes of retail and network flexible and demand tariffs, it has been assumed that public holidays are treated as weekends.
- For all retailers it has been assumed that timings for flexible and demand tariffs are in AEST (irrespective of season/presence of daylight savings time).
- All prices calculated exclude GST. This means, in many cases, customers will actually pay 10% more than the amounts shown.
- Usage data is from a sample of Victorian households. It may not be representative of the Victorian population.

- Tariff data is a subset of all available offers only and may not be representative of the full breadth and diversity of offers available on the market.
- Bill estimates are based on real historical electricity usage data. Behaviour change as a result of moving to different tariffs is not considered. The correct interpretation of the bills calculated is that they represent the best estimate of what bills would be if the household adopted specific retail tariffs and did not change their consumption patterns.
- Usage data is from 2016, so particular weather patterns of that year will have influenced energy consumption. These cost estimates may not accurately reflect outcomes for years with different weather patterns to 2016.
- Controlled load tariffs are excluded.
- Households in the sample are on a mix of retail offers. ~35% reported being on flexible or time of use tariffs, ~35% reported being on flat or single rate tariffs, and ~25% either did not know or gave an invalid response. Approximately ~5% of the sample reported being on controlled load tariffs. The rate of demand tariff uptake in the sample is unknown.
- The influence of tariff selection on observed household energy behaviour in the sample is out of scope for this work.
- Bill estimates consider consumers with and without solar PV systems installed. The presence and size of solar systems will significantly affect total retail cost.
- It is assumed that no solar customers have access to the premium solar feed-in tariff (i.e. no customer has access to 60c/kWh solar feed-in tariff).
- The minimum solar feed-in tariff is 11.3c/kWh (as-per the 1 July 2017 mandate); solar feed-in tariffs are as-per current gazetted rates provided by Retailers.
- The identified vulnerable customer classes reflect only a subset of those consumers who may be impacted by tariff structures and electricity bills. Note that vulnerable customers in the sample set include households with solar PV systems.
- The extent and type of concessions that consumers in the sample receive is unknown. No concessions are applied to bill estimates produced in this report.

CONTACT US

t 1300 363 400
+61 3 9545 2176
e csiroenquiries@csiro.au
w www.csiro.au

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