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Electricity peak demand consumption management

Analytics case study

How applied statistics and analytics helped an energy distributor quantify the effect of time-varying tariffs in managing peak electricity demand

Abstract

The Reward Based Tariffs (RBT) trial was a cooperative project between Energex and Ergon Energy (led by Energex), where the aim was to evaluate how dynamic electricity prices may be used to encourage households to alter their electricity consumption, particularly during high demand periods. This project represented one of the largest trials of time-varying electricity tariffs in Australia.

The core project objective was to measure the effectiveness of time-varying tariffs in encouraging households to shift their usage to outside peak load periods (4pm to 8pm) during extreme weather conditions. A multifaceted experiment was designed using random enrolment of participants into groups, including a control group. Other project objectives included:

- Creating community awareness and discussion
- Improving understanding of customer attitudes
- Understanding consumer actions in responding to different electricity pricing models
- Using trial findings to guide Queensland distribution network policy development regarding further network pricing models.

The Deloitte Decision Science and Analytics team assisted Energex by applying robust statistical methodology to test results, identifying any source of bias, and advising on the structure of high-quality reports such that the research is easily understood and consumed once in the public domain. In addition, our toolkit of advanced analytic techniques assisted in deriving as much insight as possible from the collected data.

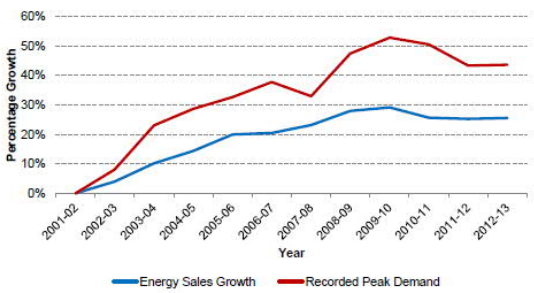
The challenge

Large population growth witnessed in Queensland over the previous decade is set to continue for the foreseeable future. Although we have seen as stabilisation of electricity growth at peak times in recent years, all long term forecasts indicate a future growth in peak demand (Figure 1) which will lead to a renewed need for additional investment in network capacity. The challenge is to achieve better utilisation of network assets.

Energex and Ergon Energy are both facing the peak demand challenge at the same time as unprecedented changes in consumer behaviour and technology are occurring. Increasing penetration of solar systems and improvements in appliance energy efficiency are complicating the picture around network investment. These and other changes are expected to continue to impact electricity consumption patterns into the future.

One way to lower the pressure on infrastructure is to better manage peak demand and potentially reduce the network cost component of electricity prices. Peak demand management involves using price and non-price measures to reduce consumer use of electricity during peak demand periods. A number of international and national studies have identified time-varying tariffs as a valuable demand management tool that motivates residential customers to reduce their electricity

FIGURE 1: SOUTH EAST QUEENSLAND PEAK DEMAND GROWTH (ENERGEX)



How we helped

Deloitte was engaged to provide assistance and advice around statistical analysis using appropriate analytical methods to ensure the validity and statistical significance of the trial results. Key activities included:

- Review of Control Groups to identify areas of bias and make suggestions to mitigate
- Advice on appropriate statistical analysis methods and assistance in statistical analysis of large interval meter datasets applying Deloitte's extensive experience in behavioural analysis of electricity usage
- Interpretation of statistics, including consideration of whether there was any bias in the reported results
- Exploratory analysis work including the application of advanced data mining and modelling techniques
- Advice on interpretation of data using Deloitte's extensive knowledge of electricity customer behaviour and attitudes.

The trial was designed to minimise bias, and to ensure external validity and statistically sound results. A Control Group was enrolled in each region. Test Groups shared the same regional Control Groups against which their performance was compared. Data analysis was undertaken using half-hourly energy consumption (interval data), customer survey results, and weather data.

Deloitte also assisted and advised in relation to the trial report structure (storyboarding) to optimally convey results to a variety of audiences.

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The results

This important piece of research speaks directly to the issues facing the future viability of electricity networks in Australia and around the world. Utilities are facing a perfect storm of increasing costs, competitive pressures from new distributed generation and storage technology, and customers who are increasingly demanding better value and personalised services.

Energex and Ergon Energy were able to publish trial results with confidence that the findings and methodology used for analysis would stand up to industry and academic scrutiny. along with a Summary Report for the study, de-identified interval meter data for around 500 control group and participant households with solar PV was published to https://www.yourpowerqld.com.au/rbt. While these people were opted out from the trial, this 'open data' meets a need for insight on households in South East Queensland with solar PV installed when such data has not previously been freely available.

The trial provided statistically significant results that showed consistent reduction in peak time usage by 8%-23% on event days, providing network benefits (reduced consumption) of 0.2kW-0.4kW per household.

A majority (89%) of participants reported an understanding of peak demand, and a small reduction in peak period usage was observed even on non-event days. Most participants easily understood the tariffs and favoured state-wide implementation.

Referring to the trial, Terry Effeney, CEO of Energex said:

"The trial has provided invaluable information on how customers responded to a variety of tariff structures aimed at encouraging households to shift their electricity usage to outside of peak periods (4pm-8pm) on up to 15 days per year.

The next steps now for Energex and Ergon Energy in conjunction with government, retailers and regulators, are to convert the results of the trial into tariffs that reward people for reducing their electricity use during peak times and in particular on days of high network demand. Both companies will continue to work with these key stakeholders toward achieving these goals."