Real-Time Pricing to Reduce Electricity Use in the United States

Sector(s): Environment & Energy

Location: Chicago, United States of America

Sample: 693 households

Target group: Urban population Families and households

Outcome of interest: Energy conservation

Intervention type: Information Pricing and fees

AEA RCT registration number: https://www.socialscienceregistry.org/trials/1342

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Research Papers: Rethinking Real-Time Electricity Pricing

Partner organization(s): Commonwealth Edison, Center for Neighborhood Technology

During periods of high electricity use that strain the grid, electricity customers do not have any reason to conserve because they pay a fixed price per kilowatt hour of power. In this study, the researcher evaluated the impact on electricity usage of a real-time pricing scheme, which charges households different prices throughout the day based on fluctuating wholesale costs. Households charged according to real-time pricing consumed less electricity in response to higher prices, primarily due to lower consumption during peak times.

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Power plants have limited capacity and peak times of electricity use during the day can strain the grid. Electricity customers do not have an incentive to conserve during peak times because, historically, they pay a fixed price per kilowatt hour of power regardless of the wholesale cost paid by the utility, which varies substantially with the amount of electricity needed to supply the grid. Real-time pricing, in contrast, charges households different prices throughout the day based on wholesale costs and might encourage households to adjust their electricity use according to price.

Real-time pricing could benefit households and utilities. Households might shift their electricity use from high price to low price hours, reducing their expenditures and leading the least efficient power plants to stop production. If households decreased electricity use overall, the utility companies might be able to reduce their required capacity, a key driver of companies' total costs, thereby achieving efficiency gains. How do households respond in their use of electricity due to varying prices that reflect aggregate usage?

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In the early 2000s, Chicago's electricity grid was nearing capacity. In response, Commonwealth Edison (ComEd), a large electric utility, partnered with the Center for Neighborhood Technology (CNT), a local NGO, to implement low-cost strategies to reduce household demand for electricity during peak times. In 2003, ComEd and the CNT established the Energy-Smart Pricing Plan (ESPP), a real-time pricing scheme. All ComEd customers in the Chicago area were eligible but interested households had to opt into the program to participate.

Person checking energy settings in the home.

Photo credit: Shutterstock.com

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The researcher partnered with ComEd and CNT to evaluate the impact of real-time pricing on the amount and timing of electricity usage. A total of 693 households opted to participate in ESPP. The 590 households randomly assigned to the treatment group followed ESPP, while the remaining 103 households formed a control group that continued to be charged the standard ComEd electricity prices per kilowatt-hour (kWh): 8.275 cents/kWh in the summer and 6.208 cents/kWh during all other seasons.

The electricity price charged to households assigned to ESPP varied each day according to the wholesale production and distribution costs and included a small discount for participating. ComEd fixed the price of electricity per kWh for the day during the afternoon of the day before, and households could check prices by telephone or internet. Additionally, households received special “High Price Alerts” by e-mail or telephone when the next day’s price would exceed 13.6 cents/kWh.

In 2006, three years after ESPP began, CNT introduced the Pricelight, a small plastic globe that reflects real-time changes to electricity prices by gradually changing color from blue to red as prices increase. As an extension of this study, CNT randomly assigned 47 households in the ESPP group to receive Pricelights in order to measure the impact of a device that makes changes in price more visible to consumers.

To measure the impact of ESPP on hour-by-hour and overall electricity use, the researcher acquired daily prices and hourly meter readings from ComEd between May through December 2003 and again between June and October 2006 to measure the impact of the Pricelight in combination with ESPP.

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Real-time pricing, coupled with making pricing easily known to consumers, may be an effective strategy for encouraging electricity conservation and for reducing strain on the grid.

ESPP households reduced their overall electricity consumption in response to higher prices, particularly during peak times of the day. They did not shift electricity use from peak hours to off-peak nighttime hours. A price increase of one standard deviation (1.5 cents per kWh) led to a reduction in electricity use equivalent to one in four households turning off a 75 kWh lightbulb. Additionally, having a Pricelight reduced households' electricity use at prices above 10 cents/kWh, suggesting that making it easier for households to learn electricity prices may lead to conservation. At the highest priced hours during the evaluation, having a Pricelight reduced consumption by 200W, the equivalent of one in five households shutting off a window air conditioning unit.

ESPP households conserved more electricity overall than households in the control group, an outcome primarily driven by the reduction of electricity use during peak afternoon hours. Electricity use among ESPP households decreased by five percent more than among control households during the evaluation. Estimates predict that this conservation could save households US$13 (2.7 percent) per year on electricity bills and reduce annual carbon emissions by 0.29 tons (4.4 percent) per household.

The results suggest that real-time pricing could benefit both households and utilities. A household's welfare might improve with lower electricity costs if ESPP enables households to minimize electricity use during peak price hours or overall. Utilities might experience efficiency gains stemming from a reduction in the capacity needed to meet demand, a large part of utility companies' total costs, due to households' overall decreased consumption. Further research is needed to determine if the impacts on electricity consumption hold in the long-term as this study measured electricity use for less than one year. Additionally, because participants chose to enroll in the program, the impacts of real-time pricing may differ if extended to the general population.

Allcott, Hunt. 2011. "Rethinking Real-Time Electricity Pricing." Resource and Energy Economics, Vol. 33, No. 4 (November), pages 820-842.