DEMAND-SIDE RESPONSE

Misperceived energy use and savings

Perceptions of energy use and potential savings are rife with systematic and problematic errors. Now research shows that these misperceptions are more important predictors than actual savings for consumer acceptance of a demand-side response programme, potentially limiting the effectiveness of such programmes for both utilities and consumers.

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Time-of-use (TOU) rate structures are demand-side response measures that aim to shift electricity use from high-demand times (on-peak and higher cost of electricity) to low-demand times (off-peak and lower cost of electricity). TOU plans can potentially help customers to save money if they shift their usage from on-peak to off-peak times. TOU plans can also help utilities move away from the dirtier power plants that are used at on-peak times to meet electricity demand. Shifting demand in this manner can allow utilities to better match available supplies of electricity from variable and renewable sources. The success of such plans relies on consumers' ability to change their electricity-use behaviour. However, research on perceptions of electricity use shows that people do not know how to most effectively save electricity in the home. For example, people usually mention "turning off the light" as the single most effective action, despite the fact that this has little impact on total home energy consumption[1–3]. How important are accurate perceptions of electricity use and savings in shaping and motivating behaviours to maximize TOU plan utility and consumer benefits? Writing in *Nature Energy*, Lee White and Nicole Sintov[4] provide evidence that perceptions of electricity savings, even when they are faulty, are a stronger predictor of intentions to remain in a demand-side management programme than actual electricity or monetary savings from the programme.

White and Sintov collected billing, electricity use and survey data from households ($N = 8{,}702$) that opted in to a TOU pilot programme administered by a large power utility in the southwestern United States. They found that households randomly assigned to a TOU rate (treatment groups) showed a statistically significant decrease in overall electricity use compared to those assigned to the control group. They also found that the more electricity savings people in the treatment groups perceived from TOU, the more likely they were to continue with the TOU rate.

Credit: Hill Street Studios/Getty

However, perceived savings were only slightly correlated with actual cost savings. Additionally, more accurate understanding of the savings negatively affected TOU acceptance. These results suggest that perceptions matter far more than reality for staying enrolled in a demand-side response programme.

The average decrease in on-peak use during the TOU pilot period ranged from 170–250 Wh (the average treatment effect from the difference in differences analysis). To put this in more understandable terms, this is equivalent to roughly three to four 60 W light bulbs being left off for one hour during the on-peak interval. This is a significant but small overall saving (roughly a 3–4% decrease in electricity use during on-peak times), and of similar magnitude to other prominent demand-side response programmes. For instance, a programme that provided social comparisons of energy use in the form of how much energy a consumer is using relative to their most efficient neighbours reduced electricity use by 2%[5,6]. One hypothesis for these small savings is that people may be motivated by these interventions to decrease their electricity use, but they may not know which behaviours would be most effective to change or how to change specific behaviours. Thus, misperceiving electricity use serves as a challenge for both decreasing electricity use and for shifting electricity demand to a different off-peak time.

This raises an important question for our research community: What is the most we can expect when we use behavioural science to decrease electricity use and transform our energy system? A common critique is that the lasting effects from the interventions we test are small. A classic study by Johnson and Goldstein[7] demonstrates how changes in default option, from opt-in to opt-out, leads to huge changes in organ donation consent rates. Their research proves that large changes are possible using behavioural science research and policy implementation,

without decreasing welfare. Pichert and Katsikopoulos[8] applied this idea to energy systems and found that when presented with a green electricity default option, people use it. But what is the most we can expect in terms of impact? It may be that in the energy domain we need to couple interventions that include both price and non-price incentives to reap far greater savings. Examples include combining interventions such as putting a price on carbon, correcting misperceptions of electricity use and savings, and using a variety of decision architecture methods[9] including social comparisons and providing feedback in terms of health benefits[10].

Successfully decarbonizing our energy system will require both top-down strategies, such as building infrastructure and storage for carbon-free electricity sources, and bottom-up strategies, such as changing the technologies we use and decreasing and shifting energy demand, to work in concert. The study by White and Sintov[4] suggests that the disconnect between perceived and actual savings may limit the effectiveness of demand-side response programmes. Their work points to the need to correct energy misperceptions so that we can design behavioural interventions to quickly decarbonize our energy system and actively address climate change. ❐

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References

1. Attari, S. Z., DeKay, M. L., Davidson, C. I. & Bruine de Bruin, W. *Proc. Natl Acad. Sci. USA* **107**, 16054–16059 (2010).
2. Kempton, W., Harris, C., Keith, J. & Weihl, J. *Marriage Family Rev.* **9**, 115–133 (1985).
3. Attari, S. Z., Krantz, D. H. & Weber, E. U. *Judg. Decision Making* **11**, 342–351 (2016).
4. White, L. & Sintov, N. *Nat. Energy* https://doi.org/s41560-018-0285-y (2018).
5. Allcott, H. *J. Public Econ.* **95**, 1082–1095 (2011).
6. Schultz, W., Nolan, J., Cialdini, R., Goldstein, N. & Griskevicius, V. *Psychol. Sci.* **18**, 429–434 (2007).
7. Johnson, E. J. & Goldstein, D. *Science* **302**, 1338–1339 (2003).
8. Pichert, D. & Katsikopoulos, K. *J. Environ. Psychol.* **28**, 63–73 (2008).
9. Johnson, E. J. et al. *Marketing Lett.* **23**, 487–504 (2012).
10. Asensio, O. I. & Delmas, M. A. *Proc. Natl Acad. Sci. USA* **112**, E510–E515 (2015).