ENERGY CONSERVATION

Correcting consumer misperception

For the well informed, taking actions to curb energy consumption from household appliances is uncomplicated. Now, research shows that simple information provision interventions can correct consumer misperceptions of the energy consumed by common appliances, offering hope to the rest of us.

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Global demand growth for electricity, now at a record high of 900 TWh (ref. [1]), continues to expand in ways that remind us of the importance of conservation. Although not immediately obvious, energy efficiency remains the biggest source of CO_2 emissions abatement worldwide. However, with some exceptions, current efforts to expand innovation policies for energy efficiency — such as building codes and standards, information programs, financial incentives and other market-based strategies like carbon pricing — have been limited at a national scale (ref. [2]). This raises questions about what can be done locally. In the residential sector, individual-occupant behaviour in buildings has been a major focus for conservation. The idea that behaviour change is needed to curb electricity consumption in buildings, particularly during times of peak use, is not new. Indeed, there is a substantial behavioural literature examining the human driving forces of environmental stress and energy-related behaviours, including, for instance, the effects of political influences, population growth, affluence, price and other non-price mechanisms[3–6]. However, the need for households to achieve conservation goals, whether for reasons such as saving money or other altruistic motivations, is far more practical and pressing. Writing in *Nature Energy*, Tyler Marghetis and colleagues from Indiana University test two interventions that target a key cause of inefficient household action to curb energy use — consumer misperception[7].

In a randomized online experiment, Marghetis and colleagues show that estimates of energy use for everyday household appliances such as lighting, refrigerators and electronics, can be subject to wild swings, as subjects tend to overestimate the importance of small, more frequently used appliances, but also systematically underestimate the importance of large appliances. This sort of evidence has plagued economists and behavioural researchers for two fundamental reasons. First, the effects of consumer misperception have been difficult to separate theoretically from competing theories about consumer inattention or imperfect information in billing feedback systems[8]. Second, the necessary infrastructure to actually measure the relative energy usage through submetered appliances has not been widely available. This means that most households do not actually know how much energy is being consumed by its component appliances. This type of behavioural failure is analogous to using a credit card or mobile phone shared data plan and not being able to break down one's spending habits or track individual usage.

There are good reasons to believe that consumers may be able to take effective actions to save energy in the household. Having regular reminders to unplug unused chargers or electronics, adjust thermostats or pay attention to lighting and other appliances could lead to significant savings, provided that households are sufficiently motivated and informed[9]. But if household estimates of appliance usage are largely inaccurate, the actions taken to save energy could be ineffective, despite the best intentions.

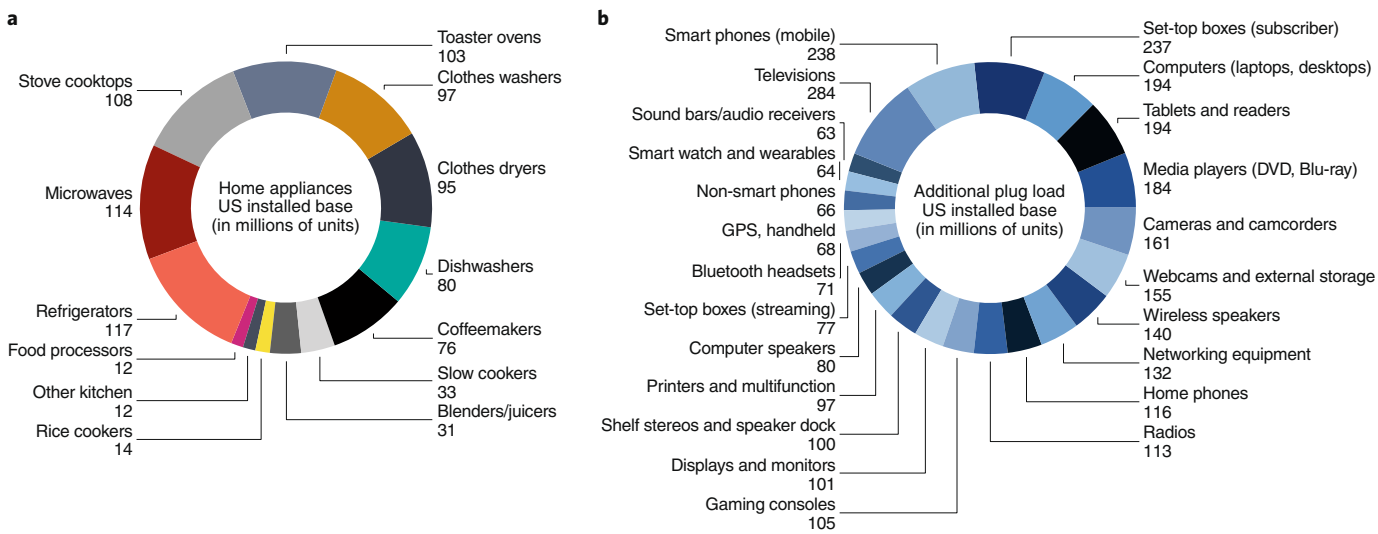

Fig. 1 | Installed base of US household appliances. a, Home appliances installed in the US, for appliances tracked in federal statistics related to energy use (data from ref. [12]). **b**, Additional plug load from consumer electronics that are not typically tracked in federal statistics related to energy use (data from ref. [13]).

If information about appliance usage would clarify the most effective actions for consumers to save energy at the point of use, then information provision could be an effective, inexpensive approach to promoting energy-efficient behaviour[10]. In their experiment, Marghetis and colleagues used a response-scale intervention, in which respondents were informed about the energy usage for common appliances at both low and high ends of the scale. This intervention improved numerical judgments about appliance usage through a well-known 'anchoring' mechanism. However, as would be predicted in many psychological experiments, anchoring improved numerical judgments about appliance energy use, but there was no significant effect on the participants' ability to identify impactful energy-saving behaviours at the appliance level. In other words, there was little evidence that anchoring mechanisms that improve appliance estimation skills would produce behaviour change.

By contrast, a second intervention focussed participants on a specific 'heuristic' that corrected a common misperception. The intervention informed participants that large appliances that primarily heat or cool use "more energy than people think". This simple heuristic, which was designed to correct inaccurate beliefs, improved understanding of relative energy use, and thus had the intended effect of boosting participants' ability to identify impactful energy-saving behaviours. These results provide fresh evidence that a deeper understanding of the behavioural mechanisms underlying the effects of information provision is needed to ensure that such interventions produce the desired behaviour change.

In a new world of smart home appliances and metering devices, the mechanisms tested by Marghetis and colleagues will only become more important over time. Figure 1a shows the best available US household estimates of the stock of appliances in the home. For example, refrigerators, stoves and cooktops, and washer/dryers have historically received attention in federal statistics due to their relatively large shares in the appliance stock. However, the sharp rise in consumer electronics and intelligent interconnected devices, specifically those that can exchange information and learn personal habits, will significantly broaden the menu of available appliances in the home. Importantly, these devices will continue to shift the relative significance of the electrical plug load for conservation behaviours beyond that of heating and cooling[4,10]. The breadth of significant appliance innovations given in Fig. 1b already costs about USD$18 billion annually in electric power. These include an estimated 3.4 billion consumer devices for a total of 143 TWh or about 15% of the global demand growth for electricity.

The growth of connected devices is easily expected to outpace the growth of traditional consumer appliances. In such devices, connected standby modes are also becoming more common, as 'things' will draw power continuously for two-way on-call communications. This means that determining the lifecycle power usage for these smart devices will create greater cognitive challenges for households to compare consumption across appliance categories in future years. This is not unlike the famous MPG illusion problem[11], where misperceptions about fuel efficiency often lead to suboptimal decisions when translating car efficiency into gas consumption and carbon emissions. In the context of household energy conservation, the study by Marghetis and colleagues paves the way for a class of simplifying heuristics that can help households make more informed decisions about appliance behaviours through relatively inexpensive information-based interventions. ❐

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Published online: 16 September 2019
https://doi.org/10.1038/s41560-019-0472-5

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