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Changing Household Energy Usage: The Downsides of Incentives and How to Overcome Them

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Changing Household Energy Usage

The Downsides of Incentives and How to Overcome Them

TO COMBAT CLIMATE CHANGE, THE INTERGOVERNMENTAL Panel for Climate Change (IPCC) calculated that greenhouse gas emissions in the energy domain should be reduced by 90%, compared to 2010 emissions, between the years 2040 and 2070. In Europe, residential households consume about a quarter of total energy used (excluding the energy that is embodied in products). To contribute to the carbon emission reduction targets set by the IPCC, households need to reduce their fossil-energy use.

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Household fossil-energy use can be reduced through efficiency and curtailment behaviors. Efficiency behaviors refer to one-off investments that reduce the fossil energy needed to maintain household activities. For example, a household may adopt solar panels, insulate the home, or replace an old fridge with a more energy-efficient one. Curtailment behaviors involve repeated behaviors that reduce household fossil-energy use. For example, appliances such as the TV may be switched off after each use, instead of being left on standby. Curtailment behaviors may also include switching energy use to times when

Monetary Incentives to Reduce Household Fossil-Energy Use

Practitioners and policy makers often use monetary incentives to promote reductions in household fossil-energy use. For example, subsidies have been offered for the installment of heat pumps, solar panels, or energy-efficient appliances, and differentiated tariffs and monetary rewards have been implemented in an effort to encourage households to reduce energy use.

Although there are limitations to the effectiveness of monetary incentives, some studies have suggested that they may sometimes be an effective tool to reduce fossil-energy consumption in the home. One study reported that, in 2011, of the nearly 5,000 Southern California households with solar panels, approximately 1,500 participated in third-party ownership programs, where solar panels and related equipment are offered to households through commercial companies. Such third-party ownership provides a monetary incentive because it reduces up-front adoption costs, in addition to removing the technical challenges of initial installment. This monetary incentive especially promoted solar panels among younger, less affluent, and less educated consumers.

Additionally, monetary incentives may sometimes promote curtailment behaviors to reduce household energy usage, such as those results shown in Figure 1 from a Japanese study. Participants were randomly assigned to three groups. The first group was offered approximately €1.70 for each 1% reduction in energy use. Members of the second group received the same offer combined with social comparison feedback that compared their energy use with

that of their neighbors. The third group served as a control and received no information. These groups reduced their energy use by 5.9, 8.2, and 1.7%, respectively. In this case, monetary incentives did seem to motivate consumers to curtail their home energy use, especially when combined with social comparison feedback.

renewable energy is available, thereby reducing household fossil-energy use. For example, a consumer could choose to use solar panel energy when the sun is shining. Efficiency behaviors usually produce a long-term effect after one focused effort, while curtailment behaviors require consistent commitment and vigilance. Efficiency behaviors often lead to larger energy savings than curtailment behaviors. Monetary incentives to change household fossil-energy use have mostly targeted curtailment behaviors. However, both types of behaviors may be required to meet IPCC emission targets.

These studies suggest that monetary incentives can sometimes effectively reduce fossil-energy use. However, when interventions provide monetary incentives, they usually do so as part of a package of supplementary strategies. In the first example, monetary incentives were provided in combination

figure 1. The percentage of energy saved by a study group receiving a monetary incentive, a group receiving a monetary incentive along with social comparison, and the control group. (Adapted from K. Mizobuchi and K. Takeuchi, “The influences of financial and non-financial factors on energy-saving behavior: A field experiment in Japan,” *Energy Policy*, vol. 63, pp. 775–787, 2013.)

with the removal of technical barriers to solar panel installation. In the second example, monetary incentives were most effective when provided in combination with social comparison feedback that showed how one’s energy use compared to that of neighbors. When controlling for such supplementary strategies, monetary incentives in and of themselves often appear to have much smaller effects or even none at all.

Here, we discuss three issues that have been found to undermine the effectiveness of monetary incentives in reducing household fossil-energy use. We conclude with a discussion of how incentives can be designed to effectively promote household fossil-energy saving. We believe that this advice will be helpful to the designers of energy markets, efficiency schemes, and other behavior change interventions.

Three Downsides of Monetary Incentives

Monetary Benefits May Lead to Rebound Effects

One limitation of providing monetary rewards for energy savings is that the saved money may be spent on other energy-

figure 2. The rebound effect. Money saved by using an energy-efficient lightbulb may be used on increased use of the lightbulb or spent on other energy-consuming activities. (FreelImages.com/Chris Cummings.)

consuming behaviors. For example, when purchasing new energy-efficient equipment (e.g., energy-efficient lightbulbs or a fuel-efficient car) leads to saving money (i.e., on electricity or fuel), households may use that extra money to pay for increased use of their new equipment (e.g., turn on more lights or drive more) or other goods or services (e.g., holiday air travel). Effective curtailment behaviors may also lead to monetary savings that can be spent elsewhere. If so, this will lead to an increase in energy consumption, a rebound effect, that may swallow up some of the initial reduction in energy consumption—and related carbon dioxide (CO₂) emissions (see Figure 2).

For example, providing free home insulation and energy-efficient air-conditioning did not reduce energy use. A Florida Power and Light study of the effectiveness of providing free home insulation and energy-efficient air-conditioning found no differences in energy savings among three treatment groups receiving various combinations of free conservation technology and a control group. Households that used electric heating and cooling were randomly assigned to one of these four groups. Energy savings for home cooling in the treatment groups in nonsummer months were 13% below the potential savings estimate. In summer months, energy savings were 1–2% lower than the potential savings estimate. For home heating, the savings were 8–12% lower than the estimate. Savings were lower because participants increased the temperature in their home during winter months and decreased the temperature in their home in summer months following the installation of energy-efficient technologies. The energy-efficient technologies saved participants money, which they then spent on greater comfort by increasing their use of heating and cooling equipment.

Although the rebound effect has not been studied for all energy-saving behaviors, energy savings do inherently lead to monetary savings, and any reward or monetary subsidy adds to the means that households have available for additional consumption, including additional energy consumption. Therefore, monetary incentives likely produce a bigger rebound effect than nonmonetary measures with the same behavioral effect.

The Incentive Is Not Worth the Effort

Monetary incentives for energy savings may activate a cost-benefit mind-set, which makes consumers focus more on the private costs and benefits. That is, they weigh the investment it takes in terms of money, effort, and discomfort against the money that can be saved. When the monetary savings are small, they may not outweigh the private costs. If people focus exclusively on the private costs versus benefits, they may not be likely to engage in the behavior.

Many behaviors that reduce household fossil-energy consumption may seem to have higher costs than benefits. Efficiency behaviors often take large investments, which are recouped from energy savings after a relatively long period of time. For example, the pay-back period for solar panels may be eight years or more. Research shows that most people have a strong preference for receiving money now,

Monetary incentives for energy savings may activate a cost-benefit mind-set, which makes consumers focus more on the private costs and benefits.

compared to receiving the same amount in the future. As a result of such temporal discounting, the monetary savings obtained from efficiency behaviors can be perceived as not worth the effort. The private benefits of curtailment behaviors, such as lowering the heater or taking shorter showers, may be perceived as rather small, too small to justify the increased discomfort. Thus, curtailment behaviors may also be perceived as too costly compared to the benefits.

Hence, when deciding to use monetary incentives and thus promoting cost-benefit thinking among consumers, it is important to carefully consider the private costs and benefits of the promoted behavior. When the private costs in terms of down payment, effort, and/or comfort are relatively high, the private benefits need to be high as well. In general, monetary incentives need to be large enough to justify and overcome these costs but usually are not.

Incentives May Crowd Out Intrinsic Motivation

A third downside of providing monetary incentives for reducing household fossil-energy use is that doing so may undermine people's intrinsic motivation to engage in behaviors they would have engaged in anyway (for a discussion on intrinsic versus extrinsic motivation, see Steg et al. in this issue). Indeed, many people engage in sustainable energy behavior without receiving monetary incentives for doing so. For example, they may sign up for residential energy-saving programs, switch to a green energy provider, or buy energy-efficient appliances because they are motivated to save the environment. When individuals engage in behaviors without receiving money or other extrinsic rewards, they display so-called intrinsic motivation. Research has found that offering an extrinsic reward in the form of a monetary incentive tends to reduce or "crowd out" intrinsic motivation for that behavior. Even highlighting the monetary rewards inherent to energy savings may undermine consumers' intrinsic motivation to change their behavior. For example, a study using three different advertisements for residential energy-saving programs, which highlighted monetary benefits, environmental benefits, or both benefits, found that those who received the advertisement highlighting environmental benefits were the most willing to enroll (see Figure 3). When highlighting monetary benefits, either alone or in combination with environmental ones, consumers' environmental motivations and willingness to enroll were reduced. These effects were especially pronounced among consumers who care about the environment, that is, who are intrinsically motivated to enroll in the program.

Monetary incentives may also influence the likelihood of obtaining so-called spillover effects (see Steg et al. this issue), where making people act to protect the environment in one area makes them more likely to act environmentally friendly in other areas as well, that were not targeted by the intervention. If people engage in an energy-saving behavior for the money, this does not increase their motivation to also engage in other pro-environmental behaviors that are not incentivized. For example, in one study, clients of a German energy provider were randomly allocated to three groups. The first group received electricity saving tips combined with a monetary framing (savings in euros), the second group received the same tips with an environmental framing (savings in CO₂), and the third group received no information and served as the control group. The first two groups showed higher intentions for saving electricity than the control group. The framing was combined with the provision of electricity savings tips; therefore, it is unclear if the tips or the framing influenced the intentions to save electricity. However, positive spillover on climate-friendly intentions beyond saving electricity at home (e.g., reducing energy use at work or reducing beef consumption) was found in the environmental framing condition only. Monetary incentives for specific energy-saving actions may

figure 3. The willingness to enroll in a residential energy-saving program emphasizing environmental, monetary, or environmental and monetary benefits. (From D. Schwartz, W. Bruine de Bruin, B. Fischhoff, and L. Lave, "Advertising energy-saving programs: The potential environmental cost of emphasizing monetary savings," *J. Experimental Psychology: Applied*, vol. 21, no. 2, pp. 158–166, 2015.)

therefore lead to less energy savings overall than other types of interventions having the same direct effect on behavior.

Hence, highlighting monetary benefits when promoting energy savings may backfire, especially among pro-environmental consumers. Monetary incentives lack the spillover effect on other energy-saving behaviors that other interventions may have. Therefore, monetary incentives need to be large enough to overcome this reduced intrinsic motivation.

In summary, although monetary incentives can be an effective means to reduce carbon emissions by reducing household fossil-energy use, they are often not cost-effective. To have any effect at all, the incentive needs to be large enough to justify the effort and other costs of engaging in the behavior. As energy costs are currently too low to significantly deter consumption, substantial monetary incentives need to be added to make cost-benefit analyses lead to fossil-energy savings. Also, the incentive needs to be large enough to more than compensate for any reduction in intrinsic motivation, which may be crowded out by the incentive. Further, incentives need to be provided for all behaviors one aims to encourage, as incentivized behaviors are not likely to lead to spillover effects. Finally, if the monetary incentive leads to more money in the hands of consumers, some of the energy savings may be eaten up by rebound effects created by the spending of this money.

Incentives to Reduce Household Fossil-Energy Use

In the light of the possible downsides of using monetary incentives, a crucial question is if and how interventions can be designed to more effectively reduce household fossil-energy use. We will discuss three possible routes. First, we consider

other strategies that may be more effective than monetary incentives to reduce household fossil-energy use. Second, we discuss ways to implement monetary incentives that may increase, rather than decrease, the receiver's intrinsic motivation to engage in sustainable energy behaviors. Third, we discuss research on the use of *temporary* monetary incentives as a means to change people's habits, thereby promoting a change in behavior in the long run.

Other Strategies

Monetary incentives are only one among several proven strategies to promote sustainable energy behaviors. Although there is clearly no "silver bullet," there are other strategies that may effectively reduce emissions by reducing household fossil-energy use under some circumstances. One such strategy is energy audits, which have proven effective at promoting energy saving, provided people accept the offer. Energy audits involve giving people tailored information regarding which changes in energy behaviors are relevant for the specific household, in person. The Achilles' heel of such strategies is to get people to accept the offer of an energy audit; when they do, energy audits are effective both because the conveyed energy-saving tips are personally relevant and because of the personal contact. In particular, research shows that people are more likely to act on information when it comes from someone they know or like.

As noted previously, environmental motives are often the reason that people perform both efficiency and curtailment behaviors. In contrast to small monetary savings, small environmental savings have been found to be perceived as worth the effort. Highlighting environmental benefits of reducing fossil-energy use tends to reinforce rather than decrease intrinsic motivation. Therefore, providing environmental arguments, for example by stressing CO₂ reductions, can sometimes effectively reduce fossil-energy use without the need for monetary incentives.

Social rewards have been found to sometimes motivate the reduction of fossil-energy use. Social rewards can, for example, involve recognition or praise by others for a consumer's reduced usage. The effectiveness of social rewards can be illustrated by a quasi-experimental study, which assigned employees to receive weekly monetary or social rewards for saving energy at work. The weekly monetary reward was between €0 and €5, and the weekly social reward was a grade between five and ten, depending on the energy saved. Half of the participants learned about their weekly reward in a private announcement, while the other half received it in a public announcement. The participants receiving (public or private) social rewards reduced their energy use, while the participants receiving (public or private) monetary rewards did not reduce their energy use compared to a control group (see Figure 4).

Social norm communication has also been used to reduce household fossil-energy use (see also Jans et al. this issue). Social norm communication provides information about the energy behavior of neighbors or other people. Social norm communication can be effective because people tend to be

figure 4. The percentages of energy saved per week for groups receiving monetary or social rewards (H. J. Handgraaf, M.A. V. L. de Jeude, and K. C. Appelt, (2013). "Public praise versus. private pay: Effects of rewards on energy conservation in the workplace," *Ecological Economics*, vol. 86, pp. 86–92, 2013, used with permission.)

Although monetary incentives can be an effective means to reduce carbon emissions by reducing household fossil-energy use, they are often not cost-effective.

motivated to adapt their behavior to be in line with others. For example, when solar panels are installed in a neighborhood, there tends to be a spur on solar panel adoption, independent of income or population characteristics. Moreover, the effect of installed solar panels on other households' adoption is stronger the closer they are in terms of space and time and the more the households therefore are exposed to this "information." This example illustrates that sharing information about others' adoption of an efficiency behavior can promote the behavior.

Social norms feedback on energy use has also been found to reduce households' everyday energy consumption. When consumers learn from social norms feedback that they use more energy than average, they tend to reduce their consumption. However, this effect also goes the other way. When consumers learn that they use less energy than average, they tend to increase their consumption. Possibly, when people learn that they are low users, they feel justified to increase their comfort, for example, by turning up the heater and taking longer showers. After all, their neighbors are doing it too.

To prevent negative effects on consumers using less than average, it has been suggested that social norms feedback about the energy consumption of others should be combined with additional information about the socially desirable behavior (see Figure 5). In one study, half of the consumers were provided with plain social norms feedback that compared their own energy use to that of their neighbors. The other half received the same feedback but additionally received information about the socially desirable behavior in the form of a smiley face when they used less and a frowned face when they used more than their neighbors. The group receiving both types of information saved the most energy, suggesting that the smiley face led those who consumed less than average to abstain from increasing their energy use to be like their neighbors. Based on these results, energy companies such as Opower have implemented this type of social norms feedback to motivate energy savings among their customers, which has reduced their average energy consumption by about 2%, according to an independent evaluation.

Hence, it is important that policy makers first test which factors influence the behaviors they aim to change. Based on that evaluation, strategies should be developed that can effectively reduce household fossil-energy use. There is still a need for more research to systematically compare the effectiveness of different strategies for reducing household fossil-energy use as well as testing their effectiveness for different types of behaviors.

Monetary Incentives May Sometimes Strengthen Intrinsic Motivation

Monetary incentives may not *always* crowd out intrinsic motivation. In some cases, monetary incentives may make people aware of their intrinsic motivation to reduce household fossil-energy use or increase the salience of this motivation. For example, a study in the United States found that offering a monetary incentive effectively promoted switching energy consumption to off-peak periods. However, switching was independent of the size of the monetary incentive. Instead, switching depended on the extent to which people felt morally obliged to shift their energy use to off-peak periods. The extent to which people felt morally obliged to switch energy use also did not depend on the size of the monetary incentive. In this case, it may be that the monetary incentive increased the salience of the morality of energy consumption and thereby activated people's intrinsic motivation for the behavior. Possibly, when the government employs what is perceived to be a strong regulation, this communicates that the targeted problem is indeed serious and something a responsible citizen should be concerned about. It has been suggested that such implicit communication from the government can reinforce internalized motivation in the form of a moral norm.

Hence, it seems that monetary incentives do not always crowd out intrinsic motivation to engage in sustainable energy behavior, but the reasons for this are not yet fully understood. More

figure 5. Social norms feedback comparing households' energy consumption to the energy consumption of neighbors, with a smiley face conveying the socially desirable behavior. (This figure was created based on data from P.W. Schultz, J.M. Nolan, R.B. Cialdini, N.J. Goldstein, and V. Griskevicius, "The constructive, destructive, and recon-structive power of social norms," *Psychological Science*, vol. 18, no. 5, pp. 429–434, 2007.)

research is needed into the conditions under which crowding out intrinsic motivation is more or less likely to occur and then if and how incentives can be designed to at least avoid crowding out intrinsic motivation for sustainable energy behaviors.

Temporary Incentives to Change Energy Habits

Like other interventions, monetary incentives may lead to durable fossil-energy savings if they produce a change in behavior and the new behavior becomes habitual. Habits are behaviors that people engage in automatically under specific conditions, without considering their motivation or the costs and benefits of the behavior. For example, in one study, people who were randomly assigned to pay extra for energy consumption during peak hours significantly reduced their peak energy consumption as compared to a control group. In this case, a monetary incentive indeed changed energy behavior.

The monetary incentive may have been strong enough to compensate for the effort needed to switch energy use to off-peak hours, at least for a while. Alternatively, the monetary incentive may have focused people on their intrinsic motivation to reduce fossil-energy use. The study showed that the group that received the monetary incentive also used less energy than the control group during off-peak times, when there was no incentive, and they continued using less energy after the incentive was removed. Possibly, the monetary incentive increased attention to energy consumption, reinforcing people's behavioral motivation to consume energy responsibly, and facilitated the formation of a sustained habit to reduce consumption. However, more research is needed on the conditions under which monetary incentives may lead to the establishment of new habits for sustainable energy behaviors.

In sum, engineers and economists who are designing energy markets and efficiency schemes should be aware that there are downsides to using monetary incentives but there are also indications that at least some of these may be overcome. Monetary incentives can sometimes remind people of or strengthen their intrinsic motivation to reduce household fossil-energy use, perhaps because regulations using monetary incentives may be perceived as a sign of the seriousness of the targeted problem. Furthermore, a temporary monetary incentive can be a means to break unsustainable energy habits and instill new, more sustainable habits. However, when developing cost-effective interventions to reduce household fossil-energy use, it may often be more cost-effective to use other strategies, for example relying on social influence.

Summary

We still need a better understanding of which incentives and other strategies influence which types of energy behavior, how, and under which circumstances. To achieve this, care needs to be taken to control for possible confounding factors that might influence behavioral and energy outcomes, which is most effectively done by randomly assigning participants to different treatment groups and a control group. When testing the effectiveness of monetary incentives and other strategies, it is important to

focus on those behaviors that reduce emissions the most. A disproportionate number of studies thus far have tested the influence of interventions on curtailment behaviors, while efficiency behaviors often lead to larger energy and emissions savings. To fully assess the energy savings following an intervention, it is important to take possible indirect effects (i.e., spillover effects) on other energy behaviors into account that are not directly targeted by the intervention. Finally, to improve the effectiveness of interventions, we need to understand why they may be effective, which can be done using surveys and other methods to measure these underlying processes. This will help policy makers develop cost-effective interventions to reduce emissions by reducing household fossil-energy use, without automatically relying on costly and ineffective monetary incentives.

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For Further Reading

W. Bruine de Bruin and T. Krishnamurti, "Developing interventions about residential electricity use: Three lessons learned," in *Delivering Energy Policy in the UK and the US: A Reader*, R. J. Heffron and G. F. M. Little, Eds. Edinburgh, U.K.: Univ. Edinburgh Press, 2016, pp. 442–447.

M. A. Delmas, M. Fischlein, and O. I. Asensio, "Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012," *Energy Policy*, vol. 61, pp. 729–739, 2013.

K. Gillingham, M. J. Kotchen, D. S. Rapson, and G. Wagner, "Energy policy: The rebound effect is overplayed," *Nature*, vol. 493, no. 7433, pp. 475–476, 2013.

M. Handgraaf, A. Griffioen, J. W. Bolderdijk, and J. Thøgersen, "Economic psychology and pro-environmental behavior," in *Economic Psychology*, R. Ranyard, Ed. Chichester, UK: Wiley Blackwell, 2017, pp. 435–450.

B. Karlin, J. F. Zinger, and R. Ford, "The effects of feedback on energy conservation: A meta-analysis," *Psychol. Bull.*, vol. 141, no. 6, pp. 1205–1227, 2015.

P. C. Stern, I. Wittenberg, K. S. Wolske, and I. Kastner, "Household production of photovoltaic energy: Issues in economic behavior," in *Cambridge Handbook of Psychology and Economic Behavior*. Cambridge, U.K.: Cambridge Univ. Press, 2017.

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