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## **1. Findings at a Glance: 10 Lessons for Policy Makers**

1. Policy makers aiming to promote sustainable energy behavior should make use of interventions such as social comparisons, that deliver information on the energy behavior of others. However, to maximize the effect of this type of interventions, policy makers should direct this information towards those who strongly care about the environment, and towards those who currently engage in sustainable energy behavior.

2. Self-set energy saving goals are a surprisingly ineffective intervention once they are scaled up with an energy-savings app. Less than 1% of contacted households signed up for the app and only 11% of these initial users continued to use the app for 4 months.

3. The most important policy characteristic influencing the acceptability of energy policies is the type of behavior that is targeted by the policy. Policies targeting the adoption of energy efficient technologies are evaluated as most acceptable. Furthermore, acceptability increases when the revenues of a push measure are used to decrease fixed costs of energy, thereby directly benefiting people. Importantly, acceptability also increases when revenues are allocated in a way that benefits the environment.

4. The more people care about nature and the environment, the more they see themselves as a pro-environmental person, and the more they feel morally obliged to save energy, the more likely they are to engage in a range of sustainable energy behaviors. Furthermore, the more people think their utility aims to reduce its environmental impact, the more likely they are to engage in sustainable energy behaviors. When organizations are perceived as aiming to reduce their environmental impact an environmental message is more likely to effectively promote sustainable energy behavior. However,

when people think the organization does not aim to reduce its environmental impact an environmental message is not effective.

5. Addressing behavioral change stimuli to households through games for children may help overcoming the low demand for energy awareness apps targeted to adults and a mix of tradition (e.g., card or board games) and innovation (e.g., Augmented Reality interaction) may prove the most effective approach to secure engagement.

6. Limited knowledge about energy costs represents a significant barrier to the households' adoption of new energy efficient durables. Providing tailored information about the potential of monetary savings from adopting new energy efficient durables induces households to purchase home appliances that consume on average 18 percent less electricity compared to those purchased by households that did not receive such information, and increases the probability that households purchase (at least) one energy efficient light bulb by around 9 percentage points. The provision of tailored information about the potential of monetary savings from the adoption of energy efficient appliances, based on the energy efficiency of the existing durables, represents an important policy instrument to increase residential energy efficiency.

7. Informational instruments are very important, but their effectiveness in increasing investment in energy efficient appliances depends on the way in which the information is presented. What and how it is delivered have a differential impact on investments. Interventions that deliver tailored information on potential monetary savings have a much stronger effect on investment than information on the energy usage cost of the appliances, in particular if the latter is delivered on the product webpage of online stores. The format (monetary savings versus energy costs) is a strong moderator of the effectiveness of information policies on investments.

8. The individuals' tendency towards the status quo is an important determinant of the level of energy consumption of European households. Although the preference towards the status quo might constitute a severe limit to policy-makers' opportunities to reaching the energy efficiency goals of the European Union, these findings prompt policy makers to design policy instruments taking this individuals' tendency into account, such as monetary premiums for replacing old appliances by newer and more efficient ones, or social-comparison feedback through apps or in-home displays that explicitly address the use of home appliances.

9. Local policy should play a more prominent role in the dissemination of environmental values and environmental awareness, which can be promoted through formal and non-formal education, direct political campaigns, and the support of specialized environmental non-government organizations.

10. Providing information on electricity prices can have a positive effect on electricity demand reductions if households are able to identify possible trade-offs in their energy service consumption. Households that are aware of alternative and more efficient electric appliances can reduce electricity consumption by switching to those technologies. However, when consumers perceive the electricity price to be higher than it actually is, providing actual cost information can turn out to be counterproductive in terms of energy demand reductions and CO<sub>2</sub> emissions as households might realize that they pay less than expected.

## **2. Introduction**

This policy brief outlines a set of policy recommendations based on the main findings of the project. The primary objective of the project is to identify successful factors influencing energy consumption and investments in energy efficiency. We used an interdisciplinary approach combining concepts from psychology, economics and engineering to identify social, psychological and financial barriers to energy efficiency. We summarize the main recommendations to policy makers in order to address these barriers.

The project has identified several effective tools in encouraging the reduction of energy consumption, such as feedback interventions using social norms and information disclosure regarding the benefits of energy efficiency. By contrast, an intervention that allowed households to set themselves energy saving goals did not prove to be scalable with an energy savings app. With respect to investments into energy efficiency, researchers have found a substantial degree of status-quo bias and a lack of energy-related financial literacy. These biases cause households to underinvest into energy-efficient durables. Scraping incentives to replace inefficient appliances are a policy tool that is likely going to counter the status-quo bias. This should be accompanied by education programs to increase the level of energy literacy among households and help them make optimal investments.

Regarding acceptability of push measures, researchers have found that it is important to redistribute the revenues for environmental purposes in order to increase acceptability. In addition, institutions should communicate their intentions regarding their environmental impact in order to affect households' behavior and social norms.

We follow the order of the deliverables in structuring this policy brief. Chapter 2 develops policy recommendations based on the current state of the literature. Our work on the behavioral responses in terms of energy use is discussed in Chapter 3. We then proceed to discuss the barriers to investments into energy efficiency in Chapter 4. Chapter 5 reports the results from the impact assessment of energy policies and Chapter 6 concludes.

### **3. Assessment of the Current Status of Knowledge and a Theoretical Framework**

In the project we assessed the current state of the art on behavioral and social barriers to energy efficiency and on the different instruments introduced to address these barriers. Through the review of the existing literature, we are able to provide some conclusions. First, feedback is an effective way to influence behavior related to energy use, in particular if the feedback is combined with a goal intervention. Feedback that provides peer comparison on energy use encourages energy conservation. There are other social influence approaches, such as interventions where the information is provided by block leaders that prove to be effective because they deliver the feedback less anonymously. The medium through which the feedback is offered can as well influence behavior, with feedback that uses the most engaging and interactive medium (such as a computer) being the most effective. This opens up to the possibility that further development of IT applications, social media, and cellphone messaging will ensure larger improvements in energy efficiency in the future. Second, audits improve energy efficiency because they increase awareness of possible improvements. The realization of energy efficiency gains however crucially depends on an effective follow-up action. Third, not only the content but also the way in which the information is presented proves to be important, with the timeframe, format, and metrics being strong moderators of the effectiveness of this type of interventions. Information campaign should make use of multiple translations of energy efficiency metrics or information metrics that match the problem-solving processes in order to simplify the decision-making process. As far as product labelling, the evidence is mixed and depends on the methodology used for the analysis. More research is needed to fully understand if labelling really improves energy-efficient choices. Fourth, standards, information programs, subsidies, and taxes are directed to the same types of external barriers. However, standards are an inferior instrument compared to the other interventions because they do not influence behavior by reducing the use of energy-using products and generate a welfare loss by limiting

the available choices. Information programs, subsidies, and taxes represent a more direct and efficient response to the targeted external barriers.

Another crucial point emerging from the review of the literature is the importance of targeting the policies. For example, policies should target investments that are less conspicuous in place of those that confer a status benefit. People in search of social approval are willing to invest in the latter without any policy intervention. Moreover, while some interventions are ineffective among those who care less about the environment, they could still deliver substantial benefits if targeted towards those who strongly care about the environment. This is because they make them more inclined to act on their values. Unfortunately, an effective targeting is a difficult task. Those who will most benefit from the intervention needs to be correctly identified and effectively reached. This implies a successful inclusion of the target population and exclusion of the non-target population. Moreover, in some circumstances, there are restrictions in the possibility to target a policy. For example, subsidies cannot be restricted to a specific group. In this case, one can think of targeting a marketing campaign. The campaign can target the consumers that are mostly affected by the distortion that the subsidy aims to address. The complexity and variety of barriers pertaining to individual behavior call for increasing insights from behavioral economics. There is a variety of barriers that pertain to individual behavior that cannot be addressed using economic and regulatory instruments. Moreover, economic and regulatory instruments fall short in cases of behavioral barriers such as status quo bias, bounded rationality, or among those with reference dependent preferences or with strong environmental preferences. For example, energy taxes, such as gasoline taxes, are a good solution because they are transparent, promote behavioral changes, and take into consideration the heterogeneity of consumers but they give rise to negative distributional effects.

In case of reference dependence, subsidies and tax credits are better than taxes, but subsidies produce a rebound effect, encourage free riding, and need a source of financing. Extrinsic rewards can sometimes crowd out intrinsic motivation to act pro-environmentally and consequently backfire and discourage the pro-environmental behavior they are meant to encourage. Ad hoc solutions, such as

default options that favor energy conservation, loss-framed messages, vivid information such as thermal images of heat losses and messages framed in terms of intrinsic goals and moral suasion are more effective in addressing the relevant barrier and motivate households to reduce energy use.

#### **4. Behavioral Responses in Terms of Energy Use and Consumption**

The research team ran a large field experiment on household energy conservation in Italy, a field experiment on the effectiveness of energy saving goals in Germany, a study among Dutch and Hungarian participants, a large survey study in Switzerland, Italy, the Netherlands and Germany, and a field experiment on the use of games and IT for behavioral change with schools in Italy and Switzerland.

The field experiment in Italy examined whether individual values are associated with heterogeneous responses to social information. Using data from a large field experiment on household energy conservation, we combined electricity metering and survey data to study how environmental values affect the impact of the program. We then leverage the role of values by augmenting social information messages with an environmental self-identity prime. Results show that individuals that endorse high environmental values respond more strongly to the social information. Moreover, enhancing social information by making environmental self-identity more salient boosts the social information impact, but only among individuals who acted pro-environmentally in the past.

Based on these results, we suggest the following policy recommendation. Given the importance of pro-environmental values in energy conservation, it is important to effectively design policy interventions in terms of intrinsic goals, moral suasion, and appeal to intrinsic values and deliver these interventions towards those who strongly care about the environment. This is because this type of interventions



makes consumers more inclined to act on their values. Informational interventions are perhaps ineffective in those who care less about the environment. However, an effective target is a difficult task and sometimes there are restrictions in the possibility to target a policy.

We ran another field experiment in Germany to test the effectiveness of energy saving goals. Self-set goals and plan-making have shown to be effective tools to change behavior in a variety of fields. An often-unanswered question relevant to policymakers is whether these promising interventions can be scaled up. In cooperation with a large utility and a specialized IT company, we develop an energy savings application for mobile phones that can be used by the majority of the population. The app allows randomly selected subjects to set themselves energy consumption goals for the following month. We promote the rollout of the app by a mass marketing campaign that is targeted at an entire German city with over 310,000 inhabitants. We find an extremely low demand for the app and a devastating attrition rate among users. While only 1,600 subjects started using the app, this number went down to 180 users just after a period of 4 months. We do not identify a causal effect of goals on electricity consumption among the few users.

The study shows that seemingly promising nudges may prove to be surprisingly ineffective interventions once they are scaled up. Due to the low demand by households, the energy savings app did not prove efficient in scaling up the goal setting nudge.

Based on the study among Dutch and Hungarian participants the findings suggest that, given the current situation, policy makers aiming to implement environmental policy measures that are acceptable to the public could best implement measures targeting energy efficiency (e.g., energy efficient appliances) or renewable energy sources. Policies targeting curtailment behaviours and changes in time of use were found to be less acceptable. Further, they could ensure that revenues of push measures are allocated in a way that benefits people or the environment, and strengthen the extent to which people see themselves as a pro-environmental

person or show that the government aims to reduce its environmental impact. That way, the acceptability of policies is likely to be increased.

Based on the large survey conducted in Switzerland, Italy, the Netherlands and Germany the results suggest that to promote a range of sustainable energy behaviors organizations and governments should aim to target biospheric values, environmental self-identity and personal norms. Strategies that focus people on these factors or strengthen these factors are likely to promote a range of sustainable energy behaviors. However, the results from the large survey also suggest that there is a different route to pro-environmental behavior. Policy makers and organizations can promote sustainable energy behaviors by showing that they aim to reduce their environmental impact. When people think their organization or government aims to reduce its environmental impact they are more likely to do so as well.

The large survey further showed that gas use behavior (i.e. room temperature setting) and total gas use of Dutch households is explained by building characteristics, socio demographics and psychological factors, so integrated approaches to reduce gas consumption likely to be more effective

The findings from an experiment conducted in collaboration with utility company Qurrent show that when organizations are perceived as aiming to reduce their environmental impact an environmental message is more likely to effectively promote sustainable energy behavior. However, when people think the organization does not aim to reduce its environmental impact an environmental message is less effective. In that case, a different message such as a financial message may be more effective in promoting sustainable energy behavior.

We conducted another field experiment with around 1,500 households to assess the effectiveness of games and gamified IT applications for environmental awareness and energy conservation. The key idea was to address pupils of the elementary and secondary schools (age range 10-14) and engage them and their families in playful activities designed to promote environmental values and improve awareness about

sustainable consumption. With the help of the teachers, the experiment was embedded in the existing educational programs of the schools, which devote a sensible amount of time to such topics as climate change, sustainability, and natural resource conservation. School classes were assessed before the intervention with a pre-treatment questionnaire, to capture their initial environmental values and energy-related knowledge, and then engaged in using a hybrid game conveying the value of the EU energy label and the importance of saving energy. Some classes were requested to have a passive role (only using the game in class and at home), whereas other ones had to participate more proactively, by creating original content for the digital part of the game (a mobile quiz game about energy). The experiment demonstrated that pupils were interested in playing the hybrid game approach, which integrates a traditional board game with an IT mobile app that extends the gameplay. The attention of millennials was greatly boosted by the experience with a traditional board game, which sounded as a novelty to the great majority of the involved students. At the same time, the presence of a “digital appendix” to the board game brought pupils back to their most familiar game mechanics and provided a hook for their proactive participation as contributors to the energy game content. A post-treatment assessment was conducted with the pupils and their families and the results of the questionnaires are under processing. Yet, the download history of the mobile game application shows that 68% of the involved students downloaded the app for continuing the use of the game at home, a positive result, also confirmed by feedback from the teachers.

From the experiment, several observations and policy recommendations can be derived. First of all, the experiment suggests that pupils were enthusiastic about using games and gamified applications for environmental education. Previous studies suggest that such games can promote behaviour change, specifically in the areas of natural resource and energy conservation. For the future it is important to verify the concrete impact on energy consumption of innovative educational methods in schools by monitoring the energy efficiency of schools by means of smart

meter data collection, a procedure nowadays made possible by the increasing availability of smart meters in EU countries.

## **5. Behavioral Responses in Terms of Energy Investments and Purchasing Decisions**

To understand the drivers of investments into energy efficiency, we conducted field experiments on the investments in energy efficiency, we analyzed a data set on energy efficiency investments of firms and ran a case-study in Hungarian urban municipality on the insulation of block-houses.

We conducted two field experiments on the impact of providing information regarding energy usage cost of household appliances on investments in energy efficient appliances.

In the first experiment we ran a randomized field trial with 661 households in Switzerland. We explored the role of limited knowledge about the monetary costs of energy use in the consumers' valuation of energy efficiency. Limited knowledge about energy costs might affect adoption of efficient energy-using durables in at least two ways: on the one hand, it might induce households to keep using existent energy-consuming durables even when their replacement with more energy efficient ones would decrease the total costs of producing energy services over the households' life cycle; on the other hand, conditional on the decision of purchase of a new energy-consuming durable, consumers that under-(over-)estimate the monetary costs of energy use might tend to under-(over-) invest in energy efficient technologies.

To investigate the role of limited knowledge about energy costs on the replacement of old appliances and the level of energy efficiency of the newly purchased durables, we used in-home visits, and collect information on the electricity consumption of the participants' existing home appliances and lighting in Switzerland. We then sent a report to the participants with individualized information about the potential

monetary savings from the adoption of new comparable efficient appliances and light bulbs.

While we find that the information treatment does not affect the probability for households to purchase a new home appliance, we show a substantial response of households in terms of electricity consumption of the newly purchased home appliances. In particular, the intervention induces households to purchase home appliances that consume on average 18 percent less electricity compared to those purchased by households in the control group. We also find evidence of an increase in the probability for households to purchase a new light bulb following the information treatment. Moreover, conditional on the decision of purchasing a new light bulb, the intervention increases the probability that households purchase (at least) one energy efficient light bulb by around 9 percentage points.

The second experiment was conducted in cooperation with customers of an Italian online retailer, and we measured the impact of making more salient the energy usage cost of household appliances, namely refrigerators. Customers viewing the website refrigerator pages during the study period were randomly assigned to one of the three conditions. The 1-year condition provided information on the yearly energy usage cost of each product in euros, while the 15-years condition provided information on the lifetime energy usage cost of each product, in euros. The control group presents the default product visualization of the retailer, with no information on energy usage costs, but only the standard energy class label. Theories of salience and inattention suggests that displaying products' energy costs in a salient and transparent way should spur sales of energy efficient products and discourage those of inefficient ones.

Contrary to expectations, we found that making appliances' energy need more salient leads to a shift in purchases from more to less efficient products. This effect is concentrated among clients who received information on appliances' lifetime energy cost.

Based on the joint results of these two field experiments, the researchers suggest the following policy recommendations. The provision of tailored information about the monetary savings of energy efficient appliances, compared to the existing ones, increased the adoption of energy efficient durable goods. On the contrary, information on energy usage cost of appliances decreased the adoption of energy efficient durable goods. This means that in the case of information policies, what matters is not only the content of the information program but also the way in which the information is presented. The format (monetary savings versus energy costs) is a strong moderator of the effectiveness of information policies on investments.

Regarding the analysis of firm-level behavior, we analyzed a German firm-level census data set, which includes investments into energy-using technologies. The main research question was what were the drivers and barriers of firms regarding investments into energy efficient technology. We used logit models to assess the factors that determine a firm's likelihood of investing into energy efficient technology. Large firms are far more likely to do so than small-and-medium enterprises (SME). For the latter, the data also suggest large potential for further energy efficiency improvements. We find that firm-level characteristics are significantly correlated with the take-up of investments, especially for large firms. Results also suggest substantial influence of peer firms' emissions performance and investment behavior. For SME on the contrary, firm-level characteristics are not significantly correlated with investment behavior. One exception is that the likelihood of investment activity increases for SME when peer firms show substantially better emissions performance. Thus, future policies may utilize peer pressure and networks for knowledge spillover. Back-of-the-envelope calculation also suggest longer payback periods of investments for SME. The analysis reveals that policies should consider instruments to increase the attractiveness and feasibility of investments, especially for SME.

We identified the level of efficiency in the use of electricity of European households. The used a benchmarking approach to assess the level of efficiency and found that

European households could save roughly 27-30% of their energy usage by correcting inefficiencies. The significant level of inefficiency in energy use in European households prompts policy makers to implement energy efficiency policies.

We also analyzed the impact of energy-related financial literacy on the adoption of efficient light bulbs. We wished to test the hypothesis that higher energy-related financial literacy (ERFL) affects the probability to adopt energy efficient durable goods. We found substantial lack-of energy-related financial literacy in European households and estimate an important impact of energy-related financial literacy on the adoption of energy efficient light bulbs. Increasing the level of ERFL increases the share of energy-efficient light bulbs at home by around 28.5% and reduces the probability to have “low” lighting efficiency by almost 60%. These results suggest that to increase the adoption of energy efficient durable goods, policy makers could promote educational training on energy and investment related topics and information campaigns about the potential of monetary savings coming from the adoption of energy efficient technologies.

In a different study, we analyzed the role of a bias towards the status quo in energy-related choices. We found that when the respondent exhibits a bias towards the status quo, the probability that the household owns at least one appliance that is more than 10 years old increases by 3.7 percentage points. Also the consumption of energy services increases by 5.7 percent and total electricity consumption increases by 5.7 percent. For policymakers this means that individual preferences might matter a lot and that a bias towards the status quo hinders the level of energy efficiency. These results suggest it may be important to explicitly address the tendency towards the status quo bias with separate policy tools such as scrapping incentives for old electrical appliances.

According to the case-study conducted in a Hungarian urban municipality, the insulation of block-houses are organized by a non-profit agency and driven by the aim to reduce energy costs. The non-profit energy agency has central role in building

insulation projects, energy efficiency management and in organizing the complex use of sustainable sources. The agency does not practice constructing but provide advises, mediation between all actors of insulation, energetical and solar cells projects. They draw building maintenance managers' attention to new projects, financial conditions and inform, convince and persuade of flat owners about usefulness and advantages of complex energetic restoration, building insulation and use of solar cells.

According to the conducted interviews the investment in insulation had the following main reasons to: energy-use reduction, cost reduction, renovate the block and the flat, increase the value of the flat and increase the comfort of the flat. Environmental values and environmental awareness are not among the most important motivations for insulation.

By emphasizing environmental values and energy reduction the ideas could be spread among communities of lower middle-class people thus not only living cost reduction, but also environmental values could be presented. Other initiatives, like implementing solar panels are financed by own resources, as individual actions, and prestige investment.

We also found that the local government has almost no effect on energy efficient projects, thus local political institutions' interests, impacts, attitudes and the barriers are shadowed. National governments decide about energy policy. The development agency has a leading role in implementing central decisions and managing local energy-efficiency projects: although they are a project-oriented organization, they are highly interested in developing energy efficiency projects. The organizations have a direct and strong influence on insulation projects. The agency has a leading role in insulation and solar cell projects which is based on information monopoly, networking capacity, knowledge capital, proficiency and skills. In practice, the most of energetics restoration of private property flats use state or EU projects financial sources. The actors of house restoration and installation of solar cells (flat and house proprietors, building maintenance managers even the contractors) do not have right knowledge for complex proposal writing, administrative and financial management of a project, the bureaucratic



procedures, energetics and engineering planning, announcing and organizing procurements. The contractor companies do not aspire to lead energy projects. The government finances, often from EU sources, solar panel and building insulation projects, but there is no political institution to implement them. The active contribution of formal and non-formal education to the dissemination of environmental values was not mentioned in the interviews.

We have formed the following recommendations. As in other policy arenas also in energy use subsidiarity and local interests should be taken into account. Local policy should play a much more prominent role in the dissemination of environmental values and environmental awareness, which can be promoted through the promotion of formal and non-formal education, direct political campaigns, and the support of specialized environmental and green NGOs.

## **6. Impact Assessment of Energy Efficiency Policies**

By enhancing a suite of models -including agent-based, integrated assessment and computable general equilibrium (CGE) models- we were able to incorporate the empirical findings of PENNY and explicitly take into account behavioral shortcomings in energy service consumption and residential energy use. Using the CGE model, long-term energy consumption scenarios in the presence of behavioral shortcomings and other policies were simulated. The central aim of the CGE model scenarios is to analyze the impact of misperceived energy prices in energy service consumption on the consumer demand, the associated impact on production sectors in Germany and Europe and CO<sub>2</sub> emissions.

We conclude that the impact of potential policies aimed at increasing households' energy efficiency will crucially depend on whether households actually observe prices in an unbiased fashion. The simulations further indicate that households' ability to process information and modify their expenditure structure accordingly is a decisive factor for the success of efficiency improvements in their homes.

We find that misperceived electricity prices change the way energy services are consumed but do not affect its overall consumption level by much. With respect to the rest of the economy in Germany and the EU, changes in production as well as consumption remain rather small for those goods that are only indirectly affected by the misperception of electricity prices. Confronted with the real market price, energy efficiency will increase when households perceived the electricity price to be lower than it actually is.

Providing information on electricity prices can therefore have a positive effect on electricity demand reductions if households are able to identify possible trade-offs in their energy service consumption. Households that are aware of alternative and more efficient electric appliances can reduce electricity consumption by switching to more efficient technologies.

We further demonstrate in the behavioral efficiency simulations, that improving the knowledge on how to save energy using appliances more efficiently has a greater effect in the short-run. If households are able to adjust their behavioral efficiency in energy service consumption over the long term they might refrain from buying more energy efficient technologies. As the electricity sector is mostly affected by the price misperceptions and behavioral inefficiencies of households, electricity production levels and CO<sub>2</sub> emissions are also higher if prices are perceived to be lower than they actually are.

However, when consumers perceive the electricity price to be higher than it actually is, providing actual cost information can turn out to be counterproductive in terms of energy demand reductions and CO<sub>2</sub> emissions as households might realize that they pay less than they expected. Therefore, from a private perspective households might invest too much in energy efficiency, but from an environmental point of view this over-investment could be beneficial. Potential co-benefits that result from reduced energy demand like health benefits through better air quality will have an additional effect on welfare.

Finally, the model based assessment emphasize the crucial role of promoting energy efficiency, both in terms of behavioral change than of investments and innovation. Achieving low carbon targets in a low energy demand system is much easier economically and socially: it limits the amount of investment needs, limits the increase of energy prices and bills, and also provides important economic and social co-benefits such as for increased air quality.

## **7. Conclusion**

The project covered a wide range of studies that are informative to policy makers in reducing the barriers to energy efficiency in the European Union. First, there are a number of experiments that have identified both effective and ineffective interventions. Feedback interventions on social norms have proven to be an

effective tool in reducing household energy consumption. In this context, the design of the information plays a crucial role and affects behavior the most if it resonates with household's central values. On the contrary, the experiment on energy saving goals has shown that a planning prompt nudge regarding future energy consumption may not be a scalable intervention with mobile phones. While energy saving goals might have affected subjects' consumption, demand for the energy savings app was surprisingly low. The design and promotion of such an app is therefore likely to be an ineffective and expensive policy tool.

We have also identified the role of institutions to be a factor in households energy consumption. The Dutch study has shown that whether organizations are perceived as aiming to reduce their environmental impact matters for the effectiveness of environmental and financial messages. This highlights that institutions should communicate their intentions regarding their environmental impact.

The researchers have also identified that revenue use matters for the acceptability of certain policies. Push measures that promote energy-efficient appliances and the use of renewable sources are particularly accepted by the public if the revenues are redistributed in a way that helps the environment.

Several studies have analyzed the effects of information disclosure on investments into energy efficiency. The design of information on monetary savings of household appliances may be an important determinant affecting purchase decisions. Households have shown to have a low degree of energy literacy and generally tend to underestimate its benefits. Educational campaigns could increase the level of energy literacy and thereby promote investments into energy-efficient appliances. Information disclosure also plays an important role in the scenario analysis done in the computable general equilibrium framework. The researchers have quantified the effects of low levels of energy literacy (in particular, of a misperception of electricity prices) and shown negative implications for consumer welfare and CO<sub>2</sub> emissions. Unless consumer perceive electricity prices to be too high, information provision generally increases social welfare.

In a nutshell, feedback interventions and information provision have proven to be important and effective behavioral interventions in reducing energy consumption and increasing investments into energy efficiency. Monetary incentives to replace old and inefficient appliances could be an important policy in reducing households' status-quo bias. In addition, institutions and governments should communicate their intentions to act pro-environmentally in order to affect individual behavior and social norms. Well-tailored policies in these domains have the potential to yield large welfare gains for society.