European Commission

Energy Savings at Home and Work

Behavioural interventions to tackle the energy crisis

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Behavioural interventions to tackle the energy crisis

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Abstract

Energy crises and concerns about climate change call for a decisive shift in our daily behaviour at home and work. However, the public policies enabling this change require an accurate understanding of the behavioural factors influencing energy consumption in both spheres and how people respond in different contexts. This report reviews these factors concerning residential and workplace interventions to promote energy savings. It also spotlights the conditions under which interventions targeting one context could spill over to another setting. The analysis highlights the main similarities and differences between promoting energy savings at home and work, such as differences in financial incentives, awareness, cognitive barriers, free-riding problems, and peer interactions. The report also provides recommendations for policies that aim to incorporate spillovers, such as promoting habits, a green identity, and peer influence. However, our review of the academic literature highlights the scope for more empirical studies on these topics.

1 Introduction

The European Union (EU) faces multiple complex energy challenges to achieve climate neutrality by 2050 set out by the European Green Deal. Russia's invasion of Ukraine has further complicated the transition. On the one hand, it has led to a sudden halt in natural gas imports from Russia, accelerating the shift toward renewable energy sources. On the other, the embargo on Russian fossil fuels has also generated a negative shock to the economy of many countries, which required urgent and extraordinary measures to tackle potential shortages of energy supplies and the rising energy cost for families and businesses.

The European Commission proposed several measures articulated in the RePowerEU plan to deal with the current situation.[1] The plan's two main pillars are accelerating investments to diversify the energy supply, especially renewables, and promoting energy demand reductions.

However, while the plan lists several "structural" measures to diversify the energy supply and reduce energy usage, it also recognises the need to incentivise citizens and businesses to make small behavioural changes to save energy.

This "behavioural" approach seeks to reduce energy usage while limiting negative economic impacts in the short term, especially given the limited time available to implement the necessary solutions to diversify the energy supply. By encouraging individuals and businesses to make small changes to save energy, governments can reduce the overall energy demand without curtailing energy usage or rushing investments, which could lead to adverse effects on the economy and a higher fiscal cost of the investments.

The International Energy Agency estimates that behavioural interventions to reduce gas and oil will immediately lower demand by 5% at a low cost, providing evidence of the potential effectiveness of behavioural interventions to reduce gas and oil consumption.

A breakdown of final energy consumption in the EU among different end users shows that households account for 28% and commercial/public services for 14%.[2] At the same time, statistics on energy consumption by building type show that office spaces have a 41% higher energy consumption per square meter than private households.[3]

Based on these statistics, interventions targeting office spaces could be more effective than those targeting residential buildings, despite the latter accounting for a larger share of final consumption. However, more work is needed to understand what measures can help people save energy

[1] European Union: Communication from the Commission to the European Parliament, the European Council, the European Economic and Social Committee and the Committee of the Regions, REPowerEU Plan, COM(2022) 230 final, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022DC0230 [accessed 21 December 2022].

[2] Eurostat data on energy final consumption in the EU (Eurostat code: `nrg_bal_s`).

[3] ODYSSEE database: Energy efficiency in Europe. Available at http://www.indicators.odyssee-mure.eu/ [accessed 20 November 2022].

in offices and residential buildings effectively, and how to integrate these interventions into a coherent policy.

This technical report identifies and discusses various behavioural public interventions governments can adopt or promote to encourage behavioural change in households and firms. We focus especially on a "first line of action" that governments can implement before or in addition to taking more drastic or coercive measures. But we also discuss possible long-term effects.

Perusing numerous experimental studies on behavioural interventions promoting energy conservation, we provide a roadmap identifying effective strategies to address the peculiarities of energy consumption at home and work. We also point out the difficulties in designing effective behavioural interventions and evaluating these measures' effectiveness.

Our analysis highlights that even though there are differences in how people conserve energy at home versus in the office, the behaviours in one setting can influence and spill over into the other. For example, if someone is diligent about turning off lights and unplugging electronics at home, they may be more likely to do the same at work.

Similarly, if someone sees energy-saving behaviours being encouraged or rewarded in the workplace, they may also be more likely to adopt them at home. However, these spillover effects complicate policy evaluation and are complex to integrate into policy design.

Concerning how to incorporate spillovers into policy, the report discusses a few key ideas, such as promoting habits, green identity, and peer influence, while it also calls for more empirical studies on testing the effectiveness of these interventions.

The report also examines how spillovers may complicate evaluating policies' effectiveness. For example, a policy incentivising energy savings at home may simultaneously encourage more energy waste at work, with unclear net effects on energy consumption.

This report is organized as follows. First, it discusses the academic literature and the available scientific evidence on the effectiveness of policy interventions targeting households (Section 2) and those targeting behaviours at work (Section 3). It then discusses integrating actions targeting residential or workplace behaviours into uniform policy interventions to better account for possible spillover effects between the two spheres (Section 4).

2 Saving energy at home

Two different types of policy interventions promote energy savings among households. The first approach involves encouraging individuals to change their energy consumption behaviours, like turning off lights and appliances when not used, cooking more efficiently, and reducing the use of heating and cooling systems.

The second approach involves stimulating purchases of energy-efficient technologies, such as replacing traditional incandescent bulbs with new LED ones, buying energy-efficient appliances, and installing "smart" home systems. Long-term strategies can also foster investments in home renovations, from small renovations like replacing old windows to reduce heat loss in the winter to installing photovoltaic panels.

In 2022, the European Commission combined both approaches in the "Playing My Part" information campaign, launched in response to the rising energy costs for families after Russia invaded Ukraine.[1]

This campaign urged households, first and foremost, to adopt small changes in their everyday energy consumption, such as adjusting their boiler settings, turning down heating, using less air-conditioning, and driving their cars more economically. Secondly, it also encouraged households to switch to energy-efficient technologies, such as purchasing electric heat pumps or installing programmable "smart" thermostats, while asking Member States to intensify the efforts to facilitate the process.

However, it is difficult to anticipate how information campaigns like "Playing My Part" can influence people to reduce their energy consumption during a crisis.

On the one hand, the recent increase in retail energy prices due to the surge in wholesale prices caused by the embargo on Russia's fossil fuels may cause people to be more concerned about the impact of higher energy bills. Therefore, individuals may be more inclined to change their energy usage and actively search for ways to reduce their energy consumption to lower their bills. At the same time, government interventions to calm energy prices, despite being necessary to offer relief to individuals, could weaken the incentive for households to achieve energy savings.

On the other hand, many studies have shown that, despite receiving basic information about the potential benefits of good energy conservation practices, only a minority of individuals tend to adopt such practices, even when cost-effective (Jaffe and Stavins 1994). This means that most individuals often stick to their usual energy consumption patterns or habits rather than trying to reduce their energy consumption.

Classical explanations for this Energy Paradox, as it's called, are threefold (Jaffe and Stavins 1994):

[1] Information about the Playing My Part campaign is available at: https://www.iea.org/reports/playing-my-part [accessed December 21, 2022].

- **Information barriers**. Households face multiple barriers either in accessing information or absorbing it. For example, a study, based on a survey of Dutch households, shows that only about half of respondents are aware of their monthly charges for energy consumption, and only 40% understand the correct trade-off between different investment decisions in energy equipment (Brounen, Kok, and Quigley 2013).
- **Time discounting**. Investments in energy efficiency or behavioural changes involve immediate costs (i.e., the cost of installation) and delayed rewards (i.e., lower electricity bills). However, if individuals heavily discount the future benefits they will obtain by switching to more energy-efficient actions, they would rather spend their time or money elsewhere today.
- **Heterogeneity in consumption**. Households are widely heterogeneous concerning their energy consumption patterns. Thus, even if a technology (or behaviour) is profitable on *average*, it may remain unattractive for a large portion of the population.

The above explanations assume that individuals would make optimal decisions if they had more information about costs and benefits or if the market offered them more personalized solutions to save energy. However, much psychology and behavioural economics evidence have challenged these assumptions because people do not typically make optimal decisions, if under the best conditions. On the contrary, individuals often act as if they were predictably "irrational" or biased.

Based on such evidence, other explanations for the Energy Paradox have emerged. Here, we provide two examples:

- **Time-inconsistent preferences**. People often delay or postpone action despite knowing there will be negative consequences, a form of procrastination. This phenomenon is known as inconsistent time preferences, where people make choices today that are inconsistent with their future well-being and preferences. For example, people prefer to keep their heating systems at high levels to stay warm and comfortable, but they systematically regret their decision when they receive a high energy bill. For example, a recent study based on a survey with an experimental design shows that people who exhibited time-inconsistent preferences also tended to over-consume energy at home (Werthschulte and Löschel 2021).
- **Loss aversion**. Another example is that, when making energy decisions, individuals may find it too costly to deviate from their current energy consumption patterns or "status quo" because it involves giving up their current comfortable lifestyle, which they have become accustomed to. Therefore, they may resist making changes, even if the potential rewards are significant, due to the fear of loss. This phenomenon is known as loss aversion, where people fear losses more than they seek equivalent gains. A recent study, based on a large-scale survey of EU citizens, shows that individuals who are loss averse are less likely to invest in energy-efficient appliances or retrofit measures (Schleich et al. 2019).

The reasons for the Energy Paradox remain a question still being studied, and the behavioural factors influencing households' energy decisions are still unclear. So, in this report, we take a more practical approach by exploring different interventions found to be successful in the academic literature. This will help us understand the challenges and effectiveness of other solutions.

Table 2.1 summarises the interventions discussed below.

2.1 Information nudges and energy labels

Information Nudges is a term used to describe policies sending households energy-saving tips or rules of thumb to induce desired energy consumption choices or rectify behavioural biases. These messages are typically sent via electricity bills, postcards, emails, and other media.

Extensive literature shows that Information Nudges are an effective way to promote energy savings (Craig and McCann 1978; Ruokamo et al. 2022; DellaValle and Sareen 2020; Caballero and Della Valle 2021). However, multiple factors influence the effectiveness of such measures, including the credibility of the source (Craig and McCann 1978), the delivery method, and the target groups.

At the same time, the impact on energy consumption is of modest size. A recent meta-analysis based on 52 studies between 2005 and 2020 (Buckley 2020) shows that the average effect of Information Nudges ranges between 2% and 4%. Despite the modest effect size, they are typically inexpensive and easy to deploy and the associated cost-effectiveness prompts their use.

Energy Labels are another form of information nudging as they serve to intuitively convey a technology's or commodity's energy efficiency properties. Extensive evidence has proven their effectiveness in various settings, like energy-efficient electric appliances (Dyer and Maronick 1988; DellaValle and Zubaryeva 2019) and residential buildings (Taranu and Verbeeck 2018; Brounen and Kok 2011) tend to promote investments in long-term energy savings. One common explanation for the efficacy of energy labels is that they provide easy-to-grasp information and make the long-term impact of energy expenses more salient, thus helping households to overcome time-inconsistent decision patterns.

2.2 Energy one-stop shops

One-stop shops are agencies that aim to offer integrated solutions and customer-centric services that simplify the decisional process for the renovation of residential buildings. Indeed, increasing the efficiency of residential buildings through renovations is challenging. It involves a cumbersome and lengthy process in a fragmented market that might discourage consumers. Interventions promoting one-stop shops can bridge the fragmented demand and supply of the renovation value chain. These shops guide citizens and businesses through the renovation journey, from start to finish, and help them overcome hurdles they would otherwise face alone. One-stop shops are relatively new, and so far, 63 case studies have been identified and analysed in Europe (Bertoldi et al. 2021) providing early evidence of their effectiveness.

2.3 Individual feedback and goal setting

Personalised feedback promotes energy savings by informing households of their energy consumption. There is widespread evidence of their effectiveness, as outlined in several comprehensive reviews (Abrahamse et al. 2005; Andor and Fels 2018). Personalised feedback aims to make energy consumption more "visible" to consumers. Electric companies typically send feedback via periodic email or monthly electricity bills. Sometimes, consumers can receive real-time feedback to adjust their energy consumption to price changes during the day or avoid peaks using smart

meters (Aydin, Brounen, and Kok 2018). However, as technology progresses and new ways of communication emerge, more work is needed on designing individual feedback to optimise effectiveness in a fast-changing environment.

Setting specific household energy consumption goals is another critical application of individual feedback. A recent meta-analysis of studies that combine feedback with goal settings shows that this combination consistently reduces the energy consumption of private households (Andor and Fels 2018). Yet, the effect sizes can vary considerably, suggesting that contextual factors influence the success of policy implementation.

2.4 Intrinsic motivations and social norms

In addition to providing information in an easily understandable manner to consumers, behavioural interventions can impact energy savings by targeting individuals' inner (intrinsic) motivation to save energy. For example, interventions can appeal to individuals' environmental values or willingness to adhere to well-established social norms. These interventions assume that people are intrinsically motivated to save energy and will respond to solicitations without personal benefits or financial incentives (Van der Linden 2015).

One specific example of behavioural interventions that use the power of social norms consists of providing individuals with information about how much energy is used by peers or socially approved energy consumption levels, thus supplying social comparisons and norms. Since many individuals care about conforming, this information motivates them to change their energy consumption. Extensive literature has shown the effectiveness of this approach in promoting energy savings (Allcott 2011; Caballero and Della Valle 2021).

2.5 Warnings and fact-checking

Misinformation is an obstacle to energy savings and environmentally conscious behaviours, like other informational barriers. For example, studies have shown widespread energy misinformation about politicised topics such as the causes of global climate change (Oreskes 2004; Farrell, McConnell, and Brulle 2019), and fake news underplaying the concerns about climate change can negatively influence people's perception of the problem and their willingness to invest in energy-efficient technology. Similarly, misinformation about energy use could also affect long-term policies of supply diversification, for example, by giving citizens a wrong idea of the risks of nuclear power (Ho et al. 2018, 2022; Ho and Kristiansen 2019).

Behavioural interventions, such as warnings and fact-checking, offer a promising approach to "inoculate" public attitudes against the spread of misinformation about energy policies. For example, a recent experimental survey shows that warning people about politically motivated attempts to spread misinformation is an effective way to fight the spread of misinformation on climate change (Van der Linden 2015). However, more work is needed to understand what works against misinformation.

Table 2.1: Intereventions promoting energy conservation at home

Intervention	Definition
Information nudges	Energy-saving tips or energy-efficiency information through energy labels.
One-stop shops	Agencies to guide citizens and businesses through the entire process of energy renovation.
Feedback & goals	Personalized information about energy consumption to make it more visible to consumers. Personalized feedbacks can be also used for goal setting.
Social comparisons	Providing information about energy consumption by peers to activate social norms of energy conservation.
Warnings & fact-checking	Warning people against misinformation about climate change, the risks of nuclear power, etc.

Takeaways

- Encouraging energy savings is difficult due to households' information barriers, misinformation, heavily discounted future efficiency gains, heterogeneity, and cognitive barriers in energy consumption decision-making.
- Several behavioural interventions address these problems adequately.
  - **Information barriers:** information nudges, energy labels, warnings, fact-checking
  - **Cognitive and effortful process:** information nudges, energy labels, one-stop energy shops
  - **Motivation:** feedback, goal setting, social norm interventions

3 Saving energy at work

As for households, policy interventions can either focus on reducing energy usage by changing the behaviour of employees and staff members or encourage the management to invest in energy-efficient technologies and practices.

This report focuses on interventions to motivate workers to change their energy behaviour at work. We will not discuss policies stimulating firms to invest in energy efficiency solutions or green practices because this topic has been widely discussed in previous literature (e.g., DeCanio and Watkins 1998) and public policies promoting firms' investments in energy are part of a long-term strategy, while this report focuses on first-line-of-action interventions.

The focus on interventions stimulating behavioural change at work is partly motivated by evidence showing that employee behaviour significantly impacts the energy consumption of commercial buildings (Azar and Menassa 2014). At the same time, other evidence shows that, while at work, people make fewer energy conservation actions than at home (Lin and Azar 2019).

One reason for fewer energy conservation actions at work is that employees typically have weak incentives to save energy in the workplace. People are better off in warm rather than cold offices, using air-conditioning in the summer; and they may feel less of a personal connection with energy wastes, such as forgetting to turn off the office lights or computer when leaving, than at home.

Another reason is that employees may feel they have no direct control over the energy systems, which are usually centralised. Such centralised systems have two mean implications for energy consumption. On the one hand, centralised systems may help facility managers oversee the buildings and generate energy savings. On the other, these systems could prevent energy conservation actions by the occupants, such as turning off the lights when not needed.

One possible solution is to offer rewards when staff achieves specific energy-saving goals at the individual or organisational level. For example, transportation companies often reward their drivers with cash bonuses or vouchers for consuming less fuel than predetermined levels (Schall and Mohnen 2017). However, such compensation schemes can clash with productivity goals when, for example, organisations cannot track individual energy consumption for technical or privacy reasons, and employees have the incentive to free-ride on each other.

Other solutions could involve adequate organisational support or creating new opportunities for energy conservation actions. Research based on surveys suggests that employees view the lack of financial incentives for energy savings as less of a factor than missing organisational support, limited opportunities for energy conservation, little time, or even confusion about who has the assigned responsibility to initiate energy savings (Li et al. 2019; Staddon et al. 2016).

Additionally, intrinsic motivations, such as environmental concerns or for the organisation's mission and image, and warm-glow feelings can partially compensate for the lack of incentives or organisational support. Several studies have shown that people are willing to contribute to the

workplace environment because of their intrinsic motivations, which are fundamental to leading employees to save energy in the workplace (Leygue, Ferguson, and Spence 2017).

However, the drivers of energy use in the workplace still need to be better understood, primarily because of the vast heterogeneity of organisations and behaviours within them and the consequent difficulties in conducting large-scale empirical studies on the topic. Despite this limitation, several policy interventions have been tested to change energy-use behaviour in the workplace and have been discussed in the academic literature (see, e.g., Staddon et al. 2016).

Here, we review three main categories of interventions as in Table 3.1.

3.1 Information, social norms, and peer education

As for the residential sector, several studies have investigated information nudges to inform employees of energy consumption patterns via emails and innovative ways to visualise energy data (e.g., live dashboards).

Workplace information nudges often aim to activate social norms via comparative feedback across departments or groups of colleagues. For example, Carrico and Reimer (2011) compare the effect of generic advice sent directly to office employees through postcards against the same message combined with comparative feedback at the building level. They also test "peer education" involving employees who act as a point of contact for questions on saving energy at work. The experiment involved twenty-four office buildings and 2,300 employees. The results show that feedback and peer education achieved 7% and 4% energy savings, respectively, compared to an *increase* in energy consumption associated with sending informative postcards alone. Remarkably, such comparative feedback appears effective in widely different settings, even in the industrial sector (e.g., a metallurgical company as in Siero et al. 1996), and there is evidence of long-term effects after the feedback is removed (Kamilaris et al. 2015).

Comparative feedback in the workplace can also help coordination and decision-making, such as when using air-conditioning and ventilation in shared spaces or when energy consumption requires some form of consensus among employees. For example, in one notable field experiment (Murakami et al. 2007), employees could submit their preferences on air conditioning use in real-time with an algorithm providing individual feedback on air conditioning preferences coupled with energy-saving information. The results showed that the algorithm recommendations promoted more coordination and produced significant energy savings.

Providing feedback to employees varies across many different mechanisms. Staddon et al. (2016) provide a systematic review of interventions delivered through various media (postcards, posters, leaflets, emails) and in one shot or repeated multiple times. However, there is a growing collection of innovative approaches that involve gamification combining the informative aspect of feedback with a more engaging environment for people, including video games based on actual energy use data accessed via mobile applications (Oppong-Tawiah et al. 2020).

3.2 Monetary and non-monetary rewards

Several studies have shown that non-monetary rewards, including vouchers, public social reward points (Handgraaf, De Jeude, and Appelt 2013), serious games (Orland et al. 2014) or the possibility of winning a competition can reduce energy consumption. For example, a study testing the promotion of energy saving based on points engaged about 60% of employees, leading to a substantial reduction in energy consumption (Kuntz, Shukla, and Bensch 2012).

In a serious game called "Energy Chickens", energy saving measured through plug-in sensors earned participants eggs with which they could purchase accessories in a virtual farm. The intervention led to significant energy savings; however, the effects did not seem to last beyond the game duration (Orland et al. 2014). Similarly, a large-scale competition involving small material rewards among 500 Italian bank branches also reduced energy consumption (Fanghella, D'Adda, and Tavoni 2022).

In comparison, small-sized cash rewards rarely show an effect or are only short-lived (Handgraaf, De Jeude, and Appelt 2013; Schall and Mohnen 2017). This evidence suggests that more than low-powered economic incentives are needed to achieve consistent and notable energy savings at work.

3.3 Default settings and automation

Introducing defaults and automation can significantly impact energy saving (Staddon et al. 2016). Advanced power strips which automatically switch off computer screens or non-essential circuits can save up to 20% of energy consumption (Sheppy et al. 2014). Also, automatically reducing heating at the end of a workday or before weekends is a promising technological solution to energy over-consumption. However, setting the correct temperature or reasonable defaults is challenging. In one field experiment, researchers found that lowering the default room temperature by 1 or 2 degrees in offices could increase energy consumption as the occupants are more likely to overrule the defaults (Brown et al. 2013).

Another issue is how defaults could create a differential impact among employees. In response to the current energy crisis, many local and national governments defaulted 19 degrees in public buildings to save gas consumption. However, while studies on the effectiveness of this default are rare, anecdotal evidence suggests that this decision may negatively affect workers with special needs and ignores individual perceptions of temperature and comfort.

Table 3.1: Interventions promoting energy conservation at work

Intervention	Definition
Feedback	Targeted feedback (hints, suggestions, performance, etc.) to enable individuals to reflect and adapt their own behaviour.
Explicit incentives	Increase motivation by awarding people monetary or non-monetary rewards

Intervention	Definition
Defaults & automation	Exploits the tendency of people to generally accept the default option in a certain situation.

Takeaways

- Policy interventions for energy savings at work can focus on behaviour change or investment in energy-efficient technologies.
- Lack of direct financial incentives, organisational support, and limited energy conservation opportunities influence employee energy consumption. Intrinsic motivations can partially compensate for the lack of incentives or support.
- Evidence points to effective behavioural interventions addressing these problems.
  - **Information & Feedback**: comparative feedback activates social norms and effectively encourages energy savings.
  - **Internal competitions & non-monetary rewards:** prizes promote energy savings and activate image and reputation concerns that will likely enhance social norm interventions.
  - **Defaults & automation:** Defaults can considerably impact energy consumption, but setting the appropriate default is challenging and should consider various behavioural responses, including the risk of disparities.

4 Spillovers and peer effects

Even though we have treated policies promoting energy conservation at home and work separately so far, they are strongly interlinked. The concept of "spillover" is often used to describe this connection, as it refers to the effects of policy interventions on multiple non-targeted behaviours.

Spillovers can be positive or negative depending on whether the effects on the non-targeted behaviours are in the direction of the desired change. This distinction is essential to understand the net effect of a policy. For example, a policy that positively affects the targeted behaviour may still produce a net negative result if the adverse effects on off-target behaviours offset the positive ones.

One critical step in the analysis of spillovers is to identify areas or situations where they may arise. A deep analysis of the academic literature by Nilsson and others (2017) suggests classifying spillovers into various types based on the following distinctions (see also Table 4.1):

- **Behavioural Spillovers.** This category refers to the effects of one behavioural intervention on non-targeted behaviours. For example, a policy reducing households' electricity consumption by raising individuals' environmental concerns could also affect people's inclinations towards recycling, eco-driving, and other non-targeted pro-environmental behaviours.
- **Temporal Spillovers.** These spillovers occur when the effect of one behavioural intervention at a given time also influences the same behaviour in the future. For example, educating children to save energy will affect their current behaviour, but it could also influence their behaviour later in life.
- **Contextual Spillovers**. These arise when the effect of one behavioural intervention transfers from one context to another. For example, interventions that persuade households to consume less energy at home could also stimulate energy savings at work.
- **Social Spillovers**. These refer to the influence that choices by others may have on individual choices. Unlike other spillovers, they occur between individuals. For example, an intervention informing school children about energy savings at school could also affect the information, and thus energy consumption, of their family and friends.

Multiple studies have investigated spillovers in the context of energy conservation. One such study is a meta-analysis of 22 experimental studies, which provides evidence of significant behavioural spillovers (Maki et al. 2019). One example of spillover observed is the "rebound effect," which refers to an increase in consumption after an investment in energy-efficient equipment. This may happen when the initial energy savings of the equipment may lead to increased consumption, which can ultimately negate the energy savings achieved through the investment (Aydin, Kok, and Brounen 2017).

A study by Egner and Klöckner (2021), based on a large-scale survey of Norwegian households, found evidence of temporal spillovers in energy retrofitting behaviour. Specifically, they found that households who completed energy retrofits once were more likely to retrofit their homes again three years later. These findings suggest that the initial retrofitting behaviour had a positive spillover effect, leading to continued interest and commitment to energy efficiency over time.

Yet, there is still a need for more evidence on contextual spillovers in energy consumption across home and work. However, in the context of food waste, there is evidence of positive spillovers across these contexts. A quasi-experimental study shows that efforts to reduce food waste in the workplace are associated with food-saving actions at home (Wang et al. 2021).

In the context of energy conservation, there is evidence of a strong positive association between energy consumption at home and work via surveys (Littleford, Ryley, and Firth 2014; Lin and Azar 2019). This association has been further tested in laboratory experiments, which have confirmed a positive link (Alt and Gallier 2022). However, there is still a need for more experimental evidence in the field to better understand the potential for spillovers in energy conservation across different contexts.

The evidence of social spillovers is also conspicuous. Research has shown that solar cell deployment becomes more likely if the neighbours have installed this technology on their roofs (Bale et al. 2013). This suggests that one individual or household's actions can influence others' behaviour in their social network or neighbourhood, leading to a ripple effect of energy conservation behaviour. By leveraging the power of social spillovers and designing strategies that promote visible and conspicuous displays of energy-saving behaviours, it may be possible to increase the adoption of clean energy technologies and promote sustainable behaviours more broadly.

The presence of spillovers in energy conservation has multiple implications for policy design and evaluation. On the one hand, it complicates the ex-ante cost-benefit analysis and ex-post impact assessment of energy-conservation policies, as discussed by Galizzi and others (2019). If a policy intervention generates spillovers, ignoring these spillovers puts policymakers at risk of underestimating or overestimating the actual impact of one intervention. At the same time, estimating possible spillovers in ex-ante and ex-post evaluations is generally complicated, and more research is needed to provide an easy-to-use framework for policy evaluation.

Regarding policy design, more research is needed to understand how policymakers can leverage spillovers to enhance energy-saving interventions. While the discussion continues, we examine key levers widely studied in the literature as discussed below.

4.1 Habit formation

Social psychologists define a habit as a settled routine or regular tendency triggered by exposure to the same environmental cues, for example, turning off the lights when no one is using them. It follows that once an energy-saving behaviour becomes an established habit, it does not need nor require specific incentives or motivations to be triggered, which makes habit formation a particularly appealing objective for policies, as discussed elsewhere (Broek, Walker, and Klöckner 2019).

Various studies examined interventions encouraging efficient energy-consumption habits showing evidence that policies that stimulate habit formation are effective. For example, Ito et al.

(2018) randomly assigned households to a dynamic pricing scheme encouraging good energy conservation habits. Results show that this approach produced significant energy savings, most of which were thorough habit formation as the treatment effect persisted even after the intervention had ceased. This study underscores a more general idea suggesting that habit formation could explain why one-shot behavioural interventions generate results on energy conservation that continue over time (Allcott and Rogers 2014; Jessoe and Rapson 2014).

4.2 Identity

One way to leverage contextual spillovers is through interventions encouraging people to adopt a green identity. If people consider themselves environmentalists, as this notion is part of their identity, they will show consistent pro-environmental behaviours in multiple contexts.

Although the evidence on these spillovers is limited, a survey of the UK public shows that people who self-identify as environmentalists tend to maintain pro-environmental behaviour in multiple contexts (Whitmarsh and O'Neill 2010). Moreover, some studies have tested different interventions to foster individuals' environmental identity. These studies have shown that using cues from past pro-environmental behaviour and feedback to label a person as an environmentalist can effectively stimulate a pro-environmental identity (Geng, Sarkis, and Bleischwitz 2019; Gleue et al. 2022; Fanghella, d'Adda, and Tavoni 2019).

4.3 Commitment to the cause

Committing to engage pro-environmentally can positively affect spillovers. Such a commitment can occur in the form of pledges but also in the form of actual behaviour. Inclining in costly or effortful behaviour for the environment's sake can be considered a self-signal of being committed to a pro-environmental goal. As a consequence, subsequent pro-environmental actions in other contexts become more likely. Through these self-signals, commitments are highly linked to the establishment of an environmental identity to which the respective actions positively contribute.

There exists evidence that people who gave up on their monetary income for a good cause have been less likely to seize benefits at the expense of others when having the opportunity to thereafter (**gneezy2012paying?**). This shows that commitments in pledges and actions can act as a "foot in the door", helping people to focus on a specific goal or objective.

4.4 Moral licensing

Contextual spillovers can also be harmful to energy conservation. For example, a policy that targets household energy savings may succeed in reducing energy consumption at home but inadvertently increase energy consumption at work, with an overall effect that could vary from positive to negative.

One frequent explanation for negative spillovers implicates the concept of "moral licensing," which describes a situation in which past good deeds will lower the probability of engaging in future good behaviours (Merritt, Effron, and Monin 2010). Moral licensing is part of a more general theory of moral balancing (Funder and Colvin 1991; Monin and Miller 2001), which describes how past actions could affect the probability of engaging in future behaviours, either good/moral or wrong/immoral.

Several studies have examined moral licensing in various settings to assess the magnitude of these effects. For instance, a meta-analysis of 91 state-of-the-art experiments shows the effect size of moral licensing can be considerable (Blanken, Van De Ven, and Zeelenberg 2015). However, we need more studies focused on the effects of moral licensing on energy consumption.

How moral licensing relates to policies is still a largely unexplored topic. However, using an experiment in the context of charitable donations, a recent study shows that interventions offering monetary incentives to adopt pro-environmental behaviours could backfire and amplify the adverse effects of moral licensing (Alt and Gallier 2022). One possible explanation is that a "monetary mindset" induces individuals to rationalize behaviours differently when offered cash incentives or moral suasion, as discussed in another related study (Ito, Ida, and Tanaka 2018). Combinations of monetary incentives with commitment devices or norm interventions could counteract such negative spillovers, as they foster consistency within a newly adapted behaviour, as discussed in various studies (Royer, Stehr, and Sydnor 2015; Alt and Gallier 2022).

4.5 Peer effects

Policies can influence social dynamics, such as peer effects, to trigger savings in energy consumption. For example, one intervention could target a subset of households in each neighbourhood, and the intervention's effects could spread to other households. This diffusion could happen organically, through word of mouth or there might be elements of the policies that foster spreading information, such as referral programs.

The mechanisms behind peer effects are manifold. They can be driven by a person's desire to comply with the behaviour of others, which is perceived as an implicit social norm. Social preferences, such as inequality aversion. If others act, people may feel the need to act as well. But also social learning by observing what others are doing.

The experimental literature on peer effects is vast, and the size of peer effects can vary considerably across different contexts. Recent studies have explored various approaches to promote energy savings in the work environment (Nye and Hargreaves 2010) and among households (Wolske, Gillingham, and Schultz 2020). However, integrating interventions with peer effects across different settings remains challenging, primarily because social dynamics and interactions vary substantially across different contexts (e.g., in the office and at home).

Table 4.1: Types of spillovers

Spillover	**Definition**
	Individual Spillovers

Spillover	Definition
Behavioural	Conducting behaviour A influences the probability of conducting behaviour B.
Temporal	Conducting behaviour A at time T influences the probability of conducting behaviour A at time T+1.
Contextual	Conducting behaviour A in context 1 influences the probability of conducting behaviour A in context 2.
	Social Spillovers
Peer Effects	One person conducting behaviour A influences the probability of conducting behaviour A by another person.

Takeaways

- Office and home energy consumption interventions are interlinked via "spillover," which includes policy intervention effects on non-targeted behaviours.
- Spillovers operate across different behaviours and contexts, over time, and across individuals.
- Spillovers complicate the ex-ante cost-benefit analysis and ex-post impact assessment of energy-conservation policies.
- Integrating spillovers into policy design will enhance the effectiveness of policy interventions (e.g., habit formation, peer effects).

5 Conclusion and recommendations

Behavioural interventions have great potential to support policymakers during energy crises, as they can be implemented quickly and cost-effectively while long-term structural measures are underway. However, it is essential to note that policies should not be designed for the "average" person but should consider individual differences and the specific settings in which they will be implemented.

As our report shows, while information nudging, goal setting and comparative feedback have consistently promoted energy savings, the impact of these interventions on energy consumption can be limited in some cases due to multiple factors. For example, the effectiveness of these interventions may depend on motivation, knowledge, and habits, as well as contextual factors such as the availability of energy-efficient products and services and the social norms surrounding energy use in a particular setting.

Therefore, policymakers should consider a range of behavioural interventions tailored to specific individuals and contexts to maximise their impact on energy consumption. This may include combining multiple interventions, such as providing feedback on energy use and setting energy-saving goals, to increase the likelihood of sustained behaviour change (on this topic, see, e.g., **alt2022synergies?**).

Additionally, policymakers should promote policies that generate positive policy spillovers, such as promoting habits that can be transferred from one context to another or leveraging individual social networks to foster the adoption of energy-efficient behaviours, while at the same time, it should avoid those that produce negative spillovers, like generating "rebound" effects.

Beyond the selection of the right policy mix, the conspicuous evidence of policy spillovers in energy conservation raises more than one question about the evaluation of policies. Looking back at how the effectiveness of many behavioural approaches has been assessed, our work suggests a considerable risk of underestimating the overall effect of information nudging on energy consumption.

This report focused on two critical settings, the home and workplace, which account for about half of the final energy consumption in the EU. However, we found that home settings are more studied and better understood than work settings. Homes are often more accessible and less complex for researchers to study, as they typically involve fewer people and fewer variables to control for.

Conversely, work settings usually apply more complex social and organisational structures and several barriers to data collection, making these settings more challenging to study. Therefore, more research is needed to understand what interventions work and why in this setting.

Overall, this report helps identify several needs to improve the effectiveness of energy-saving interventions. First, more research is needed to understand better the impact of behavioural interventions in the workplace setting, which needs to be better understood than those in the

residential setting. This research should identify which interventions are most effective in promoting energy savings in the workplace and why.

Secondly, there is a need for explicit testing of spillovers from energy-saving behaviours at home to the workplace and vice versa. Many employees spend a significant amount of time at work, and their energy use behaviour at home may influence their behaviour in the workplace. At the same time, the diffusion of remote working practices has transformed some of the time spent at work into work done at home, with deep implications for energy consumption spillovers that are still unclear. By understanding how these spillovers occur, policymakers can design more effective interventions that exploit these dynamics.

Finally, there is a need for a better framework for evaluating the effectiveness of energy-saving policies across different contexts. Different workplaces may have different energy-saving needs, and policies that work well in one context may need to be revised in another. A better framework for evaluating policy effectiveness should consider these contextual factors and help policymakers design more effective interventions tailored to specific contexts.

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