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Energy savings at home and work

Behavioural interventions to tackle the energy crisis

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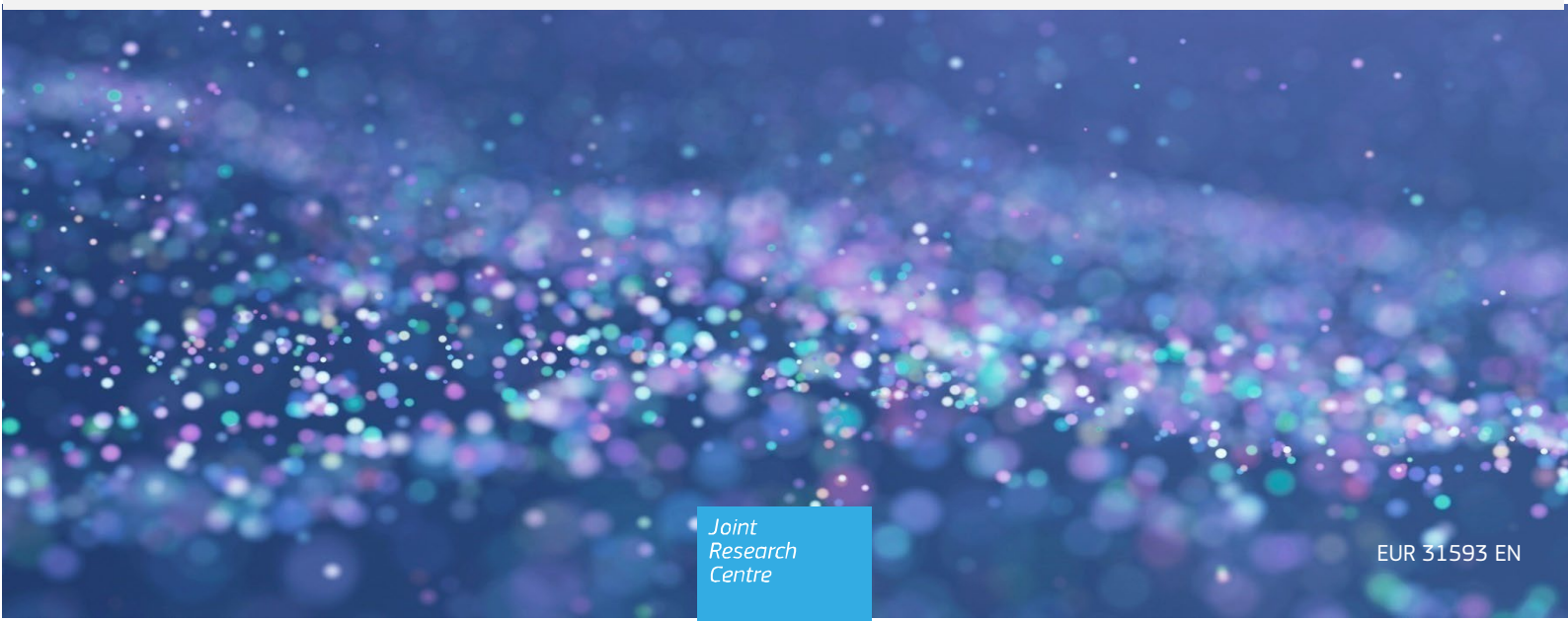

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Energy Savings at Home and Work: Behavioural Interventions to Tackle the Energy Crisis

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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, formulating public policies encouraging and facilitating this change presents considerable challenges. One such challenge is understanding the behavioural factors influencing energy consumption in residential and workplace settings and designing interventions that effectively leverage these factors across different environments. This report reviews the academic literature discussing interventions to foster energy savings and the potential to help policymakers curtail energy consumption in an energy crisis. 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. It also spotlights the conditions under which interventions targeting one context could have an impact, 'spillover', in another setting. The analysis provides recommendations for policies that encourage energy savings at home and work while offering strategies to incorporate and promote positive spillovers, such as promoting habits, a green identity, and peer influence.

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Executive summary

1. Behavioural interventions offer timely and cost-effective solutions during energy crises. They can be swiftly deployed by governments and have the potential to reduce energy consumption in the short term while promoting long-term energy-saving habits and culture.
2. The effectiveness of behavioural interventions is influenced by various factors, including intrinsic motivation, skills, habits, and contextual factors such as the availability of energy-efficient products. To maximize impact, policymakers should consider a range of tailored interventions and combine multiple strategies to address energy consumption effectively.
3. Policy spillovers play a significant role in energy conservation. Policymakers should promote policies that generate positive spillover effects, enabling energy-efficient behaviours to transfer across different contexts. They should also minimize negative spillovers, such as rebound effects, that can undermine policy effectiveness.
4. Evaluation of behavioural interventions in energy conservation requires a comprehensive framework. Current assessment methods risk underestimating the overall effect of information nudging on energy consumption. A better evaluation framework is needed to accurately measure the impact of interventions and guide policy design.
5. Further research is necessary to understand the effectiveness of behavioural interventions in the workplace setting. Work settings present more complexity and barriers to data collection compared to residential settings. Identifying the most effective strategies for promoting energy savings in the workplace will contribute to a comprehensive approach to tackling energy consumption.

Policy Recommendations

1. Tailored Behavioral Interventions: Implement a range of behavioural interventions tailored to specific individuals and contexts to maximize their impact on energy consumption.
2. Promote Positive Policy Spillovers: Foster policies that generate positive spillover effects, enabling the transfer of energy-efficient behaviours across different contexts while minimizing negative spillovers.
3. Research in Workplace Settings: Conduct further research to understand the effectiveness of behavioural interventions in workplace settings and identify the most effective strategies for promoting energy savings.
4. Improved Framework for Policy Evaluation: Develop a comprehensive framework for evaluating the effectiveness of energy-saving policies across different contexts, considering contextual factors to design targeted interventions.

1 Introduction

An increasing global energy demand, geopolitical instabilities, and the challenges of transitioning to clean energy sources may amplify the likelihood of energy crises. Energy crises are complex phenomena that demand urgent action on both *systemic* and *individual* levels. For example, the 2022 energy crisis following Russia's invasion of Ukraine urged many countries[1] to implement swift measures to lower their reliance on Russian natural gas, achieve significant energy savings quickly, and safeguard citizens and businesses from energy shortages and increased costs.

For policymakers facing an energy crisis, behavioural interventions represent an appealing solution to quickly and effectively promote significant energy savings while minimising disruptions to everyday lives. These behavioural approaches, which include information provision, non-monetary incentives, social norms, and social interactions, encourage voluntary energy savings by tapping into human behaviour, influencing individuals' and communities' choices, habits, and preferences rather than imposing unpopular and restrictive limitations.

A large body of research has found various applications of behavioural interventions to foster energy savings, from the early studies in the 1980s (Shama 1983, 1983; Coltrane, Archer, and Aronson 1986) to more recent ones (Allcott and Mullainathan 2010; Allcott and Rogers 2014; Nisa et al. 2019). However, there is little discussion of the peculiarities of using these tools during energy crises. This report aims to fill this gap by exploring the potential of behavioural interventions to mitigate the adverse effects of energy crises, examining their effectiveness, scalability, and long-term impact on energy conservation.

One key question in this report is to what extent behavioural interventions should target residential or commercial/public buildings. Estimating the potential impact of a policy that integrates both contexts can be challenging. In the EU, for example, while residential buildings account for a larger share of final energy consumption (households for 28% and commercial/public services for 14%, according to Eurostat, Simplified energy balances[2]), office spaces have a 41% higher energy consumption per square meter than private households, according to the Odyssee database on energy consumption of buildings[3]. Therefore, office space interventions could have a relatively more significant impact, even though they account for a smaller share of the total energy consumption. At the same time, the net effect will ultimately depend on how individuals will respond and internalise the benefits of energy savings at home versus in the workplace, which is unclear.

Another critical point is the possibility that the effects of one policy targeting a specific context can influence or "spill over" to another. For example, a strategy harnessing intrinsic motivations encouraging people to take energy-saving actions at home can also increase the likelihood of these individuals replicating the same environmentally-friendly actions at their workplace. Likewise, implementing a policy that cultivates a culture of energy sav-

[1] https://www.nature.com/articles/d41586-022-00969-9
[2] https://ec.europa.eu/eurostat/databrowser/view/NRG_BAL_S/default/table?lang=en
[3] http://www.indicators.odyssee-mure.eu/

ings at work can effectively translate into consistently adopting energy-saving practices at home. Despite these phenomena being frequent and a growing interest in the academic literature, policymakers do not pay proper attention to the role of spillovers, and they seldom explicitly promote positive spillovers into energy-saving policy.

This report addresses these issues by reviewing the academic literature on interventions fostering energy conservation at home and in the workplace, examining how people responded, and discussing the need for tailored approaches to maximise effectiveness in both contexts. Our analysis highlights that behavioural interventions can significantly generate energy savings at home and work despite many differences in how people consume energy in both contexts and people's tendency to internalise the benefits of energy savings better at home. It also discusses a few simple ideas to leverage spillovers, such as promoting habits, green identity, and peer influence. It further highlights the complexities that spillover effects can introduce when assessing the effectiveness of policies through ex-ante and impact evaluations. For instance, an approach that incentivises energy savings at home may inadvertently lead to increased energy waste in the workplace, resulting in unclear net effects on overall energy consumption.

This report proceeds as follows. First, it discusses the academic literature and scientific evidence on the effectiveness of policy interventions specifically targeting energy savings among households (Section 2) and those aimed at influencing behaviours within the workplace (Section 3). Subsequently, it explores possible spillover effects between the two spheres and how to integrate actions targeting residential or workplace behaviours into uniform policy interventions (Section 4). The last section concludes the report and provides several policy recommendations.

2 Saving energy at home

Behavioural interventions to promote energy conservation at home have a long history, dating back to the first global energy crisis in the 1970s (Craig and McCann 1978). These interventions encompass a wide range of targets. They can encourage households to adopt small behavioural changes, improve their homes, and invest in clean energy sources.

Figure 1 illustrates the encouraging small behavioural changes approach with the "Playing My Part" information campaign launched by the European Commission in collaboration with the International Energy Agency (IEA) to tackle the energy crisis following Russia's invasion of Ukraine. This information campaign identified nine simple steps citizens can take to "save money, reduce reliance on Russian energy, support Ukraine, and help the planet." According to IEA estimates[4], EU households could make significant savings by following these recommendations (over EUR 450 per year) while helping the EU reduce oil consumption by 220 million barrels annually and save 17 billion cubic meters of gas.

According to the Bruegel's Database of National Energy Response to the Energy Crisis[5], several EU countries launched similar information campaigns with energy-saving tips and guidelines for households, including the "One Step Lower" campaign[6] in Finland, the "I Have an Impact" in Belgium, the "Saving at Home" in Greece, and "Mission11"[7] in Austria.

To accelerate energy-efficient investments, policymakers can use fiscal incentives to make people replace old electric appliances with energy-efficient new ones, renovate their buildings, or invest in alternative energy sources, such as solar panels. However, research shows that behavioural approaches complement these interventions and that economic incentives alone are insufficient in many cases (Jaffe and Stavins 1994) to convince people to change behaviour.

An illustrative example is the "Solarize" program, which successfully leveraged social interactions and nudges to increase the adoption of photovoltaic panels in US cities[8].

It is crucial to emphasize that during an energy crisis, individuals tend to voluntarily decrease their energy consumption at home in anticipation of higher energy bills. This situation leads them to actively seek ways to modify their energy usage and seek methods to lower their energy consumption to reduce their bills. Consequently, behavioural interventions are particularly appealing in a crisis as they help lowering barriers to accessing this information. However, it's worth noting that government interventions aimed at stabilizing energy prices, while necessary to provide relief to vulnerable households, may inadvertently diminish the incentive for individuals to prioritize energy savings. Moreover, a large body of research shows that people tend to stick to their consumption patterns, despite economic gains from change, a situation also known as the Energy Paradox (Jaffe and Stavins 1994). Therefore, energy-saving tips or information campaigns alone may not

[4] https://www.iea.org/reports/playing-my-part
[5] https://www.bruegel.org/dataset/national-energy-policy-responses-energy-crisis
[6] https://www.astettaalemmas.fi
[7] https://mission11.at
[8] https://resources.environment.yale.edu/gillingham/GillinghamBollinger_SocialLearningPV.pdf

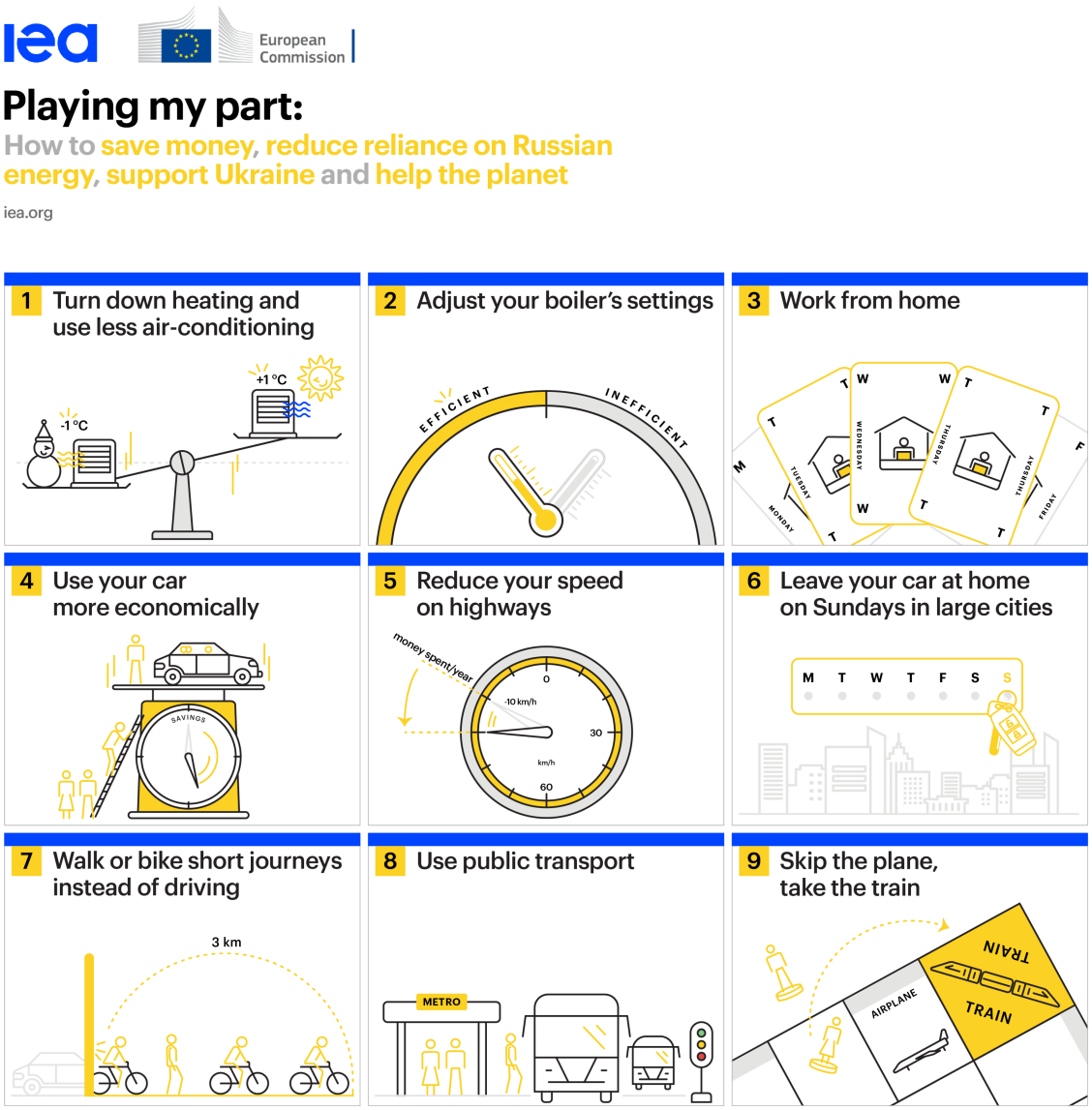

Figure 1: Infographic from the "Playing My Part" information campaign launched by the IEA and European Commission

be sufficient to achieve the socially-desired levels of energy conservation.

Box 2.1: Classical explanations for the Energy Paradox

These are the classical economic explanations of why people tend to stick to their energy consumption patterns, despite economic gains from changing behaviour, according to Jaffe and Stavins (1994).

- **Information barriers** Individuals face multiple barriers in accessing or absorbing information. For example, a representative 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 and, to some extent, significant behavioural changes involve individual costs. These costs are typically immediate (i.e., installation expenses), offering only delayed rewards (i.e., lower electricity bills). However, if households heavily discount the future, 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.

Classical explanations for this paradox (see the Box) assume that individuals would make optimal decisions if they had more information about costs and benefits or if the market offered them more personalised 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. Here, we provide two examples of such behaviours.

- **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).

2.1 Interventions to Save Energy at Home

The reasons for the Energy Paradox remain open, and the behavioural factors influencing households' energy decisions are still a topic of intense study. 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 1 summarises the interventions discussed below.

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 feedback can also be 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.

Table 1: Intereventions promoting energy conservation at home

2.1.1 Information Nudges and Energy Labels

Information Nudges is a term 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 displayed via electricity bills, postcards, emails, and other media. Extensive literature shows that Information Nudges effectively 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 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.

2.1.2 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.

2.1.3 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.

2.1.4 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).

2.1.5 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, an 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.

3 Saving energy at work

We now focus on interventions stimulating behavioural change at work. Current policies overlook the importance of human actions and potential energy savings from improved building operations in commercial or industrial settings. However, the evidence suggests a significant potential for savings. A case study on office buildings in the US shows that employee behaviour significantly impacts the energy consumption of commercial buildings and estimates a potential 21% reduction in energy use through simple changes in human operations (Azar and Menassa 2014). Another case study comparing office vs home energy consumption choices observed a strong relationship between behaviours in the two environments, with actions at home influencing actions at work and vice versa, with a tendency of people to take more energy conservation actions at home than at work (Lin and Azar 2019).

Weak incentives and limited control over energy choices are common explanations for people taking fewer energy conservation actions 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. Additionally, they may have no direct control over the building's centralised energy systems, even when motivated to save energy. The occupants' limited control over energy consumption could be desirable in an energy crisis, and such centralised systems can be a powerful tool for facility managers to oversee the buildings and generate energy savings. However, these systems may lack the flexibility to accommodate the needs of building occupants and result in suboptimal outcomes.

Personal rewards, organisational support and addressing intrinsic motivations are effective strategies to address these problems and achieve energy savings at work. Rewards are used, for example, by transportation companies that reward drivers with cash bonuses or vouchers for consuming less fuel than predetermined levels (Schall and Mohnen 2017). However, such individual compensation schemes depend on the organisation's ability to track individual energy consumption consistently and reliably. Surveys suggest that organisations can support energy savings by creating more opportunities, assigning clear responsibilities, and reserving time for energy conservation actions (Li et al. 2019). Additionally, addressing employees' intrinsic motivations to save energy, such as environmental concerns, warm-glow feelings or concerns for the organisation's mission and image, might increase employees' energy saving (Leygue, Ferguson, and Spence 2017).

Box 3.1: Key points for energy savings at work

- Policy interventions can focus on changing employee behaviour or encouraging management to invest in energy-efficient technologies.
- Employee behaviour significantly impacts energy consumption in commercial buildings, with lower energy conservation at work than at home.
- Weak incentives and lack of direct control over energy consumption contribute to lower energy conservation at work.
- Personal rewards, organisational support, and addressing intrinsic motivations can be effective strategies for achieving energy savings at work.
- Further research is needed to understand the drivers of energy use in the workplace, but various interventions have been tested.

3.1 Interventions in the Workplace

The factors influencing energy conservation in the workplace still need to be better understood. Large-scale empirical studies that account for the vast heterogeneity of organisations and behaviours are missing. Despite this limitation, several policy interventions have been tested to change energy-use behaviour in the workplace (Staddon et al. 2016). For convenience, we group these interventions into three main categories: feedback, rewards, and defaults or automation, as illustrated in Table 2. This section discusses the empirical evidence on the effectiveness of different interventions in each category. Key takeaways are in Box 3.2.

Intervention	Definition
Feedback	Targeted feedback (hints, suggestions, performance, etc.) to enable individuals to reflect and adapt their behaviour.
Rewards	Increase motivation by awarding people monetary or non-monetary rewards
Defaults & automation	Exploits the tendency of people to generally accept the default option in a specific situation.

Table 2: Interventions promoting energy conservation at work

3.1.1 Feedback

Field experiments evaluated the effectiveness of comparative feedback. For example, Carrico and Reimer (2011) show that comparative feedback on energy consumption (based on different office buildings) achieved 7% and 4% energy savings, respectively, compared to an *increase* in energy consumption associated with sending informative postcards. Remarkably, such comparative feedback appears effective in widely different settings, even in the industrial sector, a metallurgical company as in Siero et al. (1996), and there is evidence of long-term effects after removing the comparative feedback (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 coordination and produced significant energy savings.

3.1.2 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 duration of the game (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).

3.1.3 Defaults 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 caused by Russia's invasion of Ukraine, 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.

Box 3.2: Interventions in the workplace

- Factors influencing workplace energy conservation need better understanding, and large-scale empirical studies are lacking.
- Tested policy interventions for energy conservation can be categorised into **feedback**, **rewards**, and **defaults/automation**.
- Comparative feedback on energy consumption has been found effective in different settings, including the industrial sector, and can lead to long-term energy savings.
- Non-monetary rewards, such as vouchers, social reward points, or participation in competitions, have been shown to reduce energy consumption.
- Serious games with virtual rewards have also effectively promoted energy-saving behaviour.
- Introducing defaults and automation, such as advanced power strips or automatic temperature adjustments, can significantly impact energy savings.
- However, default settings may have a differential impact among employees, and considerations should be made for workers with special needs and individual perceptions of temperature and comfort.

4 Spillovers and Peer Effects

Policies promoting energy conservation at home and work are strongly interlinked, despite being often treated separately. 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. 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 formulating policies fostering energy savings is identifying areas or situations where spillovers may arise. Analysis of the academic literature by Nilsson and others (2017) suggests classifying spillovers into four categories: *behavioural*, *temporal*, *contextual*, and *social* (or peer effects). These categories are summarised in Table 3.

Behavioural Spillovers occur when one behavioural intervention affects non-targeted behaviours. For instance, a policy that reduces household electricity consumption by increasing individuals' environmental concerns may also impact their inclination towards recycling, eco-driving, and other pro-environmental behaviours. Temporal Spillovers occur when a behavioural intervention's effect at one time influences the same behaviour in the future. For example, educating children about energy conservation can impact their present behaviour and actions later in life. Contextual Spillovers arise when the effect of a behavioural intervention transfers from one context to another. For instance, interventions encourag-

ing energy savings at home may also promote energy conservation at the workplace. Finally, Social Spillovers involve the influence of others' choices on individual decisions. For instance, informing school children about the significance of energy savings at school can also impact the energy consumption of their family and friends by transmitting the information.

Individual Spillovers	
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.

Table 3: Categories of Spillovers and Peer Effects

4.1 Evidence of spillovers

Multiple studies have investigated spillovers in the context of energy conservation. A meta-analysis of 22 experimental studies 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 effect 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 large-scale survey of Norwegian households found evidence of temporal spillovers in energy retrofitting behaviour (Egner and Klöckner 2021). Specifically, households who completed energy retrofits once were more likely to retrofit their homes again three years later, even after controlling for individual demographic differences. These findings suggest that the initial retrofitting behaviour had a positive spillover effect, leading to continued interest and commitment to energy efficiency over time. This association has been further tested in laboratory experiments, which have confirmed a positive temporal spillover (Alt and Gallier 2022).

Evidence on contextual spillovers in energy consumption is lacking, although surveys found a strong positive association between energy consumption at home and work (Littleford, Ryley, and Firth 2014; Lin and Azar 2019). In the somewhat related context of food waste, 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), consistent with a positive spillover from the workplace to the household.

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 finding 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.

Overall, spillovers in energy conservation have 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.

Box 4.1: Spillovers

- Energy conservation policies at home and work are interconnected through spillovers, which refer to the effects of policy interventions on non-targeted behaviours.
- Spillovers can be positive or negative, impacting the overall effectiveness of a policy.
- Types of spillovers include behavioural, temporal, contextual, and social spillovers, each with its characteristics and implications.
- Evidence shows the existence of spillovers in energy conservation, such as rebound effects, temporal spillovers in retrofitting behaviour, contextual spillovers in food waste reduction, and social spillovers in the adoption of clean energy technologies.
- Understanding and leveraging spillovers can enhance policy design and evaluation, with strategies like promoting habit formation, fostering a green identity, encouraging commitment, addressing moral licensing, and leveraging peer effects.

4.2 Leveraging Spillovers

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.

4.2.1 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 through 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).

4.2.2 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). Consequently, these cues to people's environmental identity could be used to stimulate energy conservation behaviour at work and at home.

4.2.3 Commitment to the cause

Fostering people's commitment to pro-environmental behaviour, such as promoting pledges or specific demonstrative actions, can generate positive contextual spillovers. By inclining in costly or effortful behaviour for the environment's sake, people send a signal of being committed to a pro-environmental goal. As a consequence, subsequent pro-environmental actions in other contexts become more likely. Furthermore, individual commitments are highly linked to the establishment of an environmental identity to which the respective actions positively contribute. For example, Gneezy et al. (2012) shows that people are more likely to behave consistently with their self-perception of being prosocial when they engage in costly prosocial acts. Consequently, commitments in pledges and actions can act as a "foot in the door", helping people to focus on a specific goal or objective. This suggests a viable strategy to promote energy conservation behaviour via

pledges, whereby energy providers could encourage consumers to set a goal or make a pledge to save energy in the upcoming year.

4.2.4 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. Considering energy conservation as a moral behaviour, conservation efforts could be prone to the reasoning of moral balancing/licensing and thereby threatening the achieved energy reduction by consuming energy more in other contexts.

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).

4.3 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).

5 Conclusion and Recommendations

Behavioural interventions have great potential to support policymakers during energy crises. And the analysis of the relevant academic literature discussed in this report provides several recommendations, summarized in Box 5.1.

One key advantage is their timeliness. Unlike long-term structural measures, governments can deploy many behavioural interventions swiftly and economically. Based on our examination, information campaigns, comparative feedback, and addressing intrinsic motivations can reduce energy consumption in the short term and across various settings. They can also contribute to achieving long-term objectives by promoting habits and a culture of energy saving and efficiency. Nevertheless, the effect size of these interventions varies and is sometimes small. Therefore, these measures may be inadequate as standalone to address energy crises.

Our analysis highlights how multiple factors influence the effectiveness of behavioural interventions. Key aspects include people's intrinsic motivation, skills, current habits, and contextual factors such as the availability of energy-efficient products and services. The social norms surrounding energy use in a particular setting are also important drivers. Therefore, our analysis suggests that policymakers should consider a range of behavioural interventions. Such interventions must be tailored to specific groups of individuals and adapt to different contexts to maximise their impact on energy consumption. One way to implement this diversified approach is to combine multiple interventions, such as providing feedback on energy use and setting energy-saving goals; on this topic, see, for example, Alt et al. (2022).

Another critical aspect of this report is the role of policy spillovers. We provide compelling evidence of policy spillovers in energy conservation. Consequently, 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. At the same time, they should minimise the risk of *negative* spillovers, like generating "rebound" effects, that will harm the net impact of a policy. However, it is challenging to identify specific positive and negative spillovers due to the absence of a comprehensive framework to guide this process.

In addition, 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 environment. This research should identify which interventions are most effective in promoting energy savings in the workplace and why.

Secondly, there is a need to explicitly test spillovers from energy-saving choices at home to the workplace and vice versa. Many employees spend a significant amount of time at work, and their energy use at home may influence their choices 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 profound 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, our report identifies 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 adjusting 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.

Box 5.1: Key policy recommendations

- **Tailored Behavioral Interventions**: Consider a range of behavioral interventions tailored to specific individuals and contexts to maximize impact on energy consumption.
- **Promote Positive Policy Spillovers**: Foster policies that generate positive spillover effects, encouraging the transfer of energy-efficient behaviors across different contexts while minimizing negative spillovers.
- **Research in Workplace Settings**: Conduct further research to understand the effectiveness of behavioral interventions in workplace settings, identifying the most effective strategies for promoting energy savings.
- **Improved Framework for Policy Evaluation**: Develop a comprehensive framework for evaluating the effectiveness of energy-saving policies across different contexts, considering contextual factors to design targeted interventions.

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