User-Centred Energy Systems

Behavioural insights for demand-side energy policy and programmes

An environment scan

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Users TCP and IEA

Contents

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Executive summary

What are behavioural insights and how can they support energy policy?

At home, in the office or in public spaces, virtually all our habits and decisions affect energy consumption: adjusting the heating temperature; changing the heating system; buying a new smartphone or white good; or opting for public transport, bike sharing or private car use. Habits and decisions are driven by both personal factors, such as preferences and budget constraints, and structural ones such as infrastructure availability and energy market design. Both personal and structural factors are affected by policy interventions.

It is possible to shed light on the catalysts of habits and choices – and on the extent to which they are affected by implicit behavioural mechanisms – by studying the *behavioural insights* (BIs) gleaned through research in the behavioural sciences, neurosciences, psychology and behavioural economics. Examples of behavioural mechanisms include people's difficulties in calculating and comparing the present and future costs and benefits of investments, or the desire to align with social norms.

Through what are called *behavioural diagnostics*, BIs can help energy policy makers and professionals understand how some behavioural mechanisms can act as obstacles to more sustainable habits and energy-wise choices, and how others can be exploited to encourage positive behavioural change. Capitalising on this knowledge helps choose appropriate levers to encourage efficient and flexible energy use across sectors through *behavioural interventions* both in policy and utility programmes.

This report focuses on *behavioural interventions* designed and implemented by public institutions (e.g. ministries, government agencies and local administrations) and private businesses in the energy sector (e.g. utilities and energy service companies), often with the support of academics and other BI experts. It provides a snapshot of BI applications for demand-side energy policies and programmes that target flexible and efficient energy use, sustainable mobility choices, and investment in low-carbon and energy-efficient technologies (e.g. efficient appliances and vehicles, retrofits and renewables).

The analysis covers more than 40 case studies, spanning residential buildings and appliances; transport and mobility; and businesses and other organisations. While the case studies may not be fully representative of all behavioural interventions addressing demand-side energy policy issues, they cover a variety of implementation scales, behavioural issues, behavioural levers and institutional frameworks. The analysis therefore illustrates the range of issues that BIs can help address, and their potential for energy policy.

Findings

- Most behavioural interventions analysed in this report are aimed at individuals and households, with relatively few addressed to organisations and businesses. The numerous behavioural mechanisms that affect individual decision-making processes can be partly tempered in collective processes at the business or organisation level. Nevertheless, all policies and programmes can benefit from a behavioural diagnostic.
- Building upon existing taxonomies, we identify seven different behavioural levers that are used individually or in conjunction in behavioural interventions: simplification and framing of information; changes to product design and to the physical environment;

changes to the default policy and product specifications; social norms and comparisons; feedback mechanisms; reward schemes; and goal-setting and commitment devices.
- Behavioural insight applications appear to favour certain levers:
  - Virtually all interventions leverage information simplification and framing to make information more salient and intuitive (e.g. energy efficiency labels).
  - Feedback mechanisms are popular to provide consumers with frequent or real-time information on their energy consumption.
  - Social norms and comparisons are exploited when informing consumers on how they perform relative to peers (e.g. energy consumption patterns).
- However, interventions integrating principles of gamification and positive competition could further exploit goal-setting and commitment devices, as well as rewards. Changes to product design, to the physical environment and to policy-induced default options also remain underutilised.
- Most interventions focus on incentivising habit changes, such as making energy saving efforts at home or shifting to sustainable mobility, with few initiatives targeting energy efficiency investment. Among the latter are interventions to reframe labelling schemes for both appliances and vehicles, but few involve home retrofits or residential solar PV installations.
- Context-specific behavioural diagnostics of investment barriers could reveal the relative importance of behavioural obstacles such as perceived hassle and complexity of home retrofits, as opposed to structural barriers such as financial constraints and split incentives.

Our case study analysis has also revealed a number of key thematic insights.

Residential buildings and household appliance use

- Among interventions supporting change in energy consumption habits, utility-led demand-response and energy efficiency programmes using feedback mechanisms have been widely adopted. These interventions, which provide feedback on energy consumption and tips to become more efficient, have induced energy savings in multiple country contexts.
- Behaviourally informed energy efficiency label designs for appliances have proven effective in helping consumers understand the costs and benefits of energy efficiency improvements.
- Although the very few behavioural interventions aimed at boosting large-scale investments (such as for deep home retrofits or heating system changes) have not been found to significantly increase investment, they have helped identify complexities in retrofit incentive schemes.
- Local initiatives encouraging community-grouped investments have significantly increased the uptake of rooftop solar panels: this indicates that there is potential for behaviourally informed investment incentives that capitalise on social norms.

Transport and mobility

- Including estimates of expected fuel costs in fuel economy labels and comparing them with the costs of the most efficient vehicle in the same category can help consumers understand the benefits of opting for more fuel-efficient cars.

- Behavioural diagnostics can identify barriers specific to the uptake of electric vehicles, including costs; recharging timing and practices compared with the ease of refuelling; range anxiety; and the perceived distribution of charging stations.
- Real-time feedback on wait times and travel times for public transport can counter misperceptions of unreliability.
- Behavioural insights can inform sustainable mobility incentives such as workplace or school travel plans, information campaigns and sharing schemes. Integrating multiple “soft” mobility interventions is most effective for a large-scale shift away from car use.
- Personalised travel planning may vary in effectiveness according to available travel options and to their perceived and real convenience.
- Behavioural interventions to encourage walking and cycling are most effective in prompting habit changes during the warm season and when addressed to specific groups with targeted messaging.

Businesses and other organisations

- Simplifying and reframing information provision and communication platforms can strengthen business compliance with regulations and voluntary agreements.
- Requesting board-level signoff on mandatory energy audits can help engage top decision-makers in the audit process, raise the profile of energy efficiency and possibly encourage corporate investment to improve it.
- Changing default practices can remove the hassles that prevent employees from making more sustainable choices at their workplace.

Recommendations

While integrating BIs into the energy policy cycle has led to the development of new demand-side energy policies and programmes, encouraging evidence of their impact indicates that they deserve to be mainstreamed. Furthermore, integrating BIs into the design and implementation of “traditional” energy efficiency policy approaches such as economic incentives (e.g. retrofit grants; time-of-use electricity tariffs) and regulatory requirements (e.g. energy efficiency standards) can enhance policy impacts.

Testing pilot behavioural interventions allows policy makers and energy utilities to experiment with innovative policies and programmes. The empirical assessment of behavioural interventions through randomised controlled trials and other evaluation approaches allows to determine their effectiveness prior to large-scale implementation, enabling necessary adaptations. By accounting for confounding factors that also contribute to policy impacts, experimental and quasi-experimental evaluation methodologies are an improvement with respect to before/after studies, as they allow to identify the causal impact of policies in a more reliable way.

Over half of the interventions discussed in this report are trials or pilot projects: it is fundamental that any barriers preventing the expansion of successful behavioural interventions be removed to reap their full energy efficiency benefits. Qualitative analysis of pilot results can reveal the extent to which they are context-specific, thus informing policy makers in other jurisdictions. Continuous monitoring of behavioural interventions, in the policy context or as part of utility programmes, can indicate their long-term impact on behaviour change.

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Chapter 1. Introduction

Virtually all behaviours of individuals – within households or businesses and other organisations – affect energy consumption: from heating, cooling, lighting and electric appliance use, to driving, cycling or catching public transport for commuting and leisure trips, to opting for a certain energy source in one's electricity supply, to purchasing high- or low-efficiency devices (Figure 1).

Largest end uses by sector in selected IEA countries, 2018

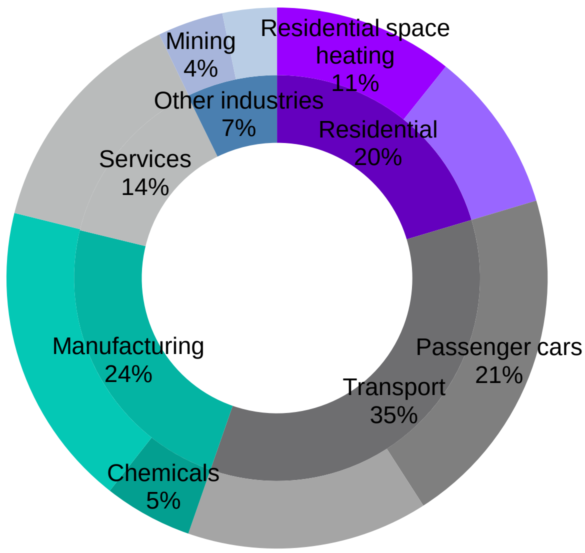

Figure 1. Largest energy end uses by sector in selected IEA countries, 2018

Notes: Statistics cover the 24 IEA countries for which data are available for most end uses: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Poland, Portugal, the Slovak Republic, Spain, Switzerland, the United Kingdom and the United States. "Other industries" covers agriculture, mining and construction. "Passenger cars" refers to cars, sport utility vehicles and personal trucks.

Source: IEA (2020d), IEA Energy Efficiency Indicators (database), https://www.iea.org/reports/energy-efficiency-indicators-2020.

The decision-making processes behind each of these behaviours, whether they be one-off or habitual decisions, are complex and depend on both personal factors (e.g. preferences, attitudes and budget constraints) and structural considerations (e.g. infrastructure availability and energy market features). Policy interventions can affect both personal and structural elements.

While standard economic theory assumes that individuals act rationally and interpret all the information available to them to achieve their preferred consumption outcome given their resources, this is in fact not the case in many circumstances – particularly when it comes to energy consumption.

While market failures and other engrained mechanisms can sometimes negate energy-savvy decision-making, at other times individuals behave somewhat irrationally and make choices that are short-sighted rather than forward-looking. Examples include forfeiting a steady stream of savings by purchasing a gas-guzzling car rather than a similar but more fuel-efficient model, or nonchalantly leaving lights and appliances on when they are not being used.[1] At the same time, individuals also respond to comparisons with their peers, for example concerning trends in household energy consumption. These are indications of what scholars have called bounded rationality (Simon, 1957), bounded willpower and bounded self-interest (Mullainathan and Thaler, 2000).

Some policies are designed to address structural issues such as market imperfections. Energy efficiency labels for appliances, fuel efficiency labels for cars, and energy performance certificates for buildings are all examples of policy tools aimed at providing information to redress the asymmetry of consumers knowing little and salespeople being well informed about products' energy consumption (i.e. asymmetric information).

Behavioural insights (BIs) can inform the design and implementation of these and other policies by explicitly acknowledging and addressing the behavioural mechanisms that steer consumers away from energy efficient decision-making. For example, behaviourally informed energy efficiency labels aim to convey information to consumers in a clear, simple, relevant and timely way.

What are BIs and what is this report about?

BIs are drawn from disciplines such as the behavioural sciences, neurosciences, psychology and behavioural economics, which aim to understand what people are doing, why they are doing it, and how policy can encourage behavioural change that is desirable from a societal perspective.

In the energy context, this amounts to understanding the behavioural drivers of energy consumption, the barriers to energy efficient habits and consumption decisions, and how public policies and programmes developed by various actors in the energy field (e.g. utilities and energy service companies [ESCOs]) can encourage energy efficient habits and consumption decisions among individuals.

This report focuses on the potential usefulness of BIs for the energy demand-side sector, relating to: residential buildings and appliances; transport and mobility; and businesses and other organisations. It aims to provide an "environment scan" illustrating the extent to which BIs have so far been used to inform the design and implementation of government policies and programmes that promote:

- Flexible and efficient energy use (i.e. changing when and how much energy is used) in households and businesses.
- Investment in energy efficient technologies (e.g. appliances and vehicles) and retrofitting efforts in residential and commercial buildings, in transport, and in business operations.
- Investment in distributed energy generation technologies.

[1] Just as economic theory labels deviations from perfect competition as "market failures," deviations from perfect rationality, willpower or self-interest are called "behavioural biases" in economics literature.

This report is not a scientific literature review, as it focuses on behaviourally motivated interventions initiated by government institutions and agencies (e.g. energy ministries, regulatory agencies and BI teams nested in public institutions) and by other actors operating in the energy field (e.g. energy utilities and ESCOs), rather than by academic and research institutions.[2] Over 40 case studies involving BI applications are discussed in three thematic chapters: residential buildings and appliances; transport and mobility; and businesses and other organisations.

The discussion of behaviourally motivated interventions distinguishes between large-scale policy interventions and programmes and small-scale pilots or experiments, highlighting possible barriers to upscaling. Analysis focuses primarily on national-level demand-side energy policies and programmes, with subnational policies and programmes examined depending on the sector and country context.

The study is based on desk research as well as on a survey that targeted energy policy makers, regulators, utilities, BI practitioners and researchers.

How can BIs support energy policy and programmes?

Taking BIs into account can be beneficial at several stages of the policymaking process:

- **Identifying behavioural issues and barriers**: BIs can be used to identify issues preventing policies from encouraging behavioural change. Issues may result from behavioural mechanisms such as biases and heuristics, or from structural factors such as market and policy features. BIs can also help identify and prevent unintended behavioural consequences of policies.
- **Designing policy interventions**: Once the target behaviours have been identified, desirable behaviour change can be incentivised through well-designed and appropriate policy interventions. These should make behaviour change: 1) Easy (e.g. through simplification or changes in default options); 2) Attractive (e.g. by attracting attention to the consequences of non-compliance with regulation); 3) Social (e.g. by leveraging social norms and the power of networks); and 4) Timely (e.g. by timing prompts when people are most receptive). This is known as the EAST approach to applying BIs to policy, designed by the London-based Behavioural Insights Team (Service et al., 2014)
- **Testing and adapting policy interventions**: Finally, BI applications have often complemented structured testing and the evaluation of policy pilots and large-scale policy initiatives (e.g. through field experiments). Gathering data to measure the impacts of innovative policy initiatives can help track whether they match expectations and objectives, and BIs can inform policy adaptation if necessary (Haynes et al., 2012).

Based on how deeply BIs are engrained in the policy process, it is possible to differentiate among policy interventions according to the typology provided by Sousa Lourenço et al. (2016):

[2] Collaborations among multiple institutions are common to develop and implement complex behavioural interventions. Chapter 2 presents the institutional setup of behavioural interventions discussed in this report.

- **Behaviourally aligned** policy initiatives are in line with evidence from the behavioural sciences, in spite of not explicitly referring to it in their design and implementation phases.
- **Behaviourally informed** policy initiatives build upon BIs derived from previous research.
- **Behaviourally tested** policy initiatives are followed by a formal evaluation and can possibly be scaled up from small pilot to full-scale programme.

While the latter two categories of policy initiatives are based upon the explicit intention to make use of BIs, behaviourally aligned interventions could result incidentally, without formally integrating BIs into the policy process. As this report aims to understand the extent to which the behavioural sciences inform the policy process, it focuses mainly on the latter two categories while still acknowledging particularly relevant behaviourally aligned initiatives.

A fourth category of BI applications is that of behavioural diagnostics: while a diagnostic precedes the development of a behavioural intervention, in some contexts it can be greatly informative in itself, allowing policy makers to identify a range of policy recommendations, including behavioural interventions as well as traditional policy initiatives such as economic incentives or regulatory action.

What behavioural mechanisms affect energy demand?

Many publications have studied the behavioural mechanisms (or biases, from an economics perspective) that affect energy consumption and investment decisions, and have identified policy levers that can be used to address them (Cabinet Office Behavioural Insights Team, Department of Energy and Climate Change and Department for Communities and Local Government, 2011; Mont, Lehner and Heiskanen, 2014; Elberg Nielsen et al., 2016; CEE, 2017; OECD, 2017b).

This section groups these mechanisms into three categories:

- **Behavioural mechanisms that prevent flexible and efficient energy use**, including those that discourage energy-savvy habits, self-motivated behaviour change and participation in demand management programmes promoting flexible and efficient energy use.
- **Behavioural mechanisms that prevent investment** in energy efficiency, renewables and storage technologies.
- **Behavioural mechanisms that prevent environmentally sustainable practices and purchases**, and that affect attitudes towards the environment or decisions that have environmental repercussions.

Behavioural mechanisms that prevent flexible and efficient energy use

A vast proportion of individual and household energy consumption is the result of well-engrained *habits*, which translate into recurring choices that are automatic rather than deliberate. Such habitual behaviour affects the way people use electronic devices and home appliances, from cell phones and computers to washing machines and toasters, as well as heating, cooling and lighting technologies. Habits also play out in mobility patterns: most regular trips, from commuting to work to grocery shopping, reflect well-honed transport routines rather than daily-optimised itineraries. At the business level, habits are reflected in established work practices, from the use of machinery to the choice of freight options.

These habits may depart from efficient energy use because of personal preferences and constraints: for example, some people might not wish to reschedule their household chores for a time when energy is more affordable, or they may not have the flexibility to reschedule their commute. Additionally, some market imperfections make energy prices rather opaque for end consumers, hampering the usefulness of flexible demand-response systems. One example of such a market imperfection is low billing frequency: by aggregating information on energy consumption on only a monthly or bimonthly basis, bills do not enable consumers to understand the energy intensity of their various appliances and practices (OECD, 2017b).

These attitudinal and structural barriers, together with unconscious behavioural mechanisms such as the status quo bias, cognitive dissonance and the impact of social norms, can impede behaviour change towards more flexible and efficient energy use practices.

The *status quo bias* is a phenomenon in which alternative scenarios or options are assessed relative to the current situation: because humans tend to perceive losses more poignantly than equally large gains (a mechanism called *loss aversion*), change is shunned for the sake of maintaining the status quo (Kahneman, 2003). Sticking with the default option is also easiest, as it does not require effort.

This mechanism can affect energy consumption at the margins: for example, energy consumers might maintain the default setting on their heating thermostat even on slightly warmer days, despite knowing that tweaking it could yield an energy bill reduction. Similarly, when people are used to regularly using home appliances such as washing machines and dishwashers at the same time, they might not be keen to exploit the flexibility of time-varying energy tariffs. Due to the status quo bias and the perceived hassle, replanning home tasks could seem like too great an effort for the potential benefits (i.e. lower energy consumption and less costly bills).

Inertia can affect mobility decisions for habitual trips, as individuals rarely choose to re-optimise their commute on a daily basis according to factors such as fuel prices, traffic conditions and air pollution levels. Inertia in mobility habits is also connected to a combination of limited information availability and cognitive ability: the full cost of driving includes fuel costs, but also parking fees, fixed costs for insurance and maintenance, possible distance-based or congestion charges, and the cost of time spent stuck in traffic. Some of these costs are spread over a long period of time and numerous trips, requiring considerable computational effort to obtain cost estimates that can be compared with the expense of other transport options.

Additionally, transport decisions are affected by *social norms*, as different means of transportation have certain social status associations that vary depending on geographical area and population group. Therefore, although one may choose to travel by car, bicycle or public transport for personal comfort and convenience, it may also be to publicly display “membership” in a certain social group.

Because of *lack of awareness*, some individuals might not understand how their daily choices affect their energy consumption patterns. Furthermore, some people exhibit inconsistencies between their beliefs and their behaviours – a phenomenon called *cognitive dissonance* (Carlsson and Johansson-Stenman, 2012). Even if individuals strive for efficient energy consumption for environmental or economic reasons, they might not translate this abstract intention into daily action.

Behavioural mechanisms that prevent investment in energy efficiency, renewables and storage technologies

Retrofitting a dwelling or purchasing a new car or home appliance are infrequent investments, based on a decision-making process different from daily energy consumption habits.

Along with the status quo bias, other behavioural mechanisms such as *choice overload* and the *sunk cost fallacy* might contribute to *inertia*, slowing or even hindering investments in energy efficiency. Sunk costs are unavoidable, in that they have already been incurred because of past decisions, and therefore cannot be reimbursed or recovered. Because of the sunk cost fallacy, individuals are wary of relinquishing goods they have invested in even when their high maintenance costs outweigh their benefits (Gifford, 2011). For example, while the benefits of upgrading home insulation or appliances can quickly compensate for the cost, the deceptive perception of sunk costs might prevent consumers from committing to such energy efficiency investments because they consider them a waste of still-valuable assets, such as still-functional appliances (OECD, 2017b).

Choice overload can paralyse consumers faced with complex decisions and multiple options, each characterised by different costs and benefits (CEE, 2017). This can occur during appliance purchases, which require consumers to choose from among a variety of outlets, brands, models, costs, energy efficiency standards, sizes and more. Investing in building retrofitting also requires owners to choose from among numerous options, with the additional complexity that structural changes can appear even more daunting than appliance replacements. Choice paralysis is also related to the perceived hassle or inconvenience associated with certain investments (de Vries, Rietkerk and Kooger, 2020). In the case of home retrofits, for example, the complexity of navigating procurement, credit requests and possibly incentive eligibility all contribute to the hassle factor.

Both types of investment decisions are complicated by their intertemporal nature, given that they entail short-term costs (which can be sizeable) and a stream of future benefits in terms of increased comfort and energy savings. Because of *time inconsistency*, consumers tend to misestimate and strongly discount future benefits, and loss aversion contributes to making upfront costs seem disproportionately high.

The perceived feasibility of investments and behavioural practices relative to one’s constraints and abilities (*self-efficacy*) can also act as a barrier to change if deemed too daunting or inappropriate. At the same time, optimistic overconfidence can produce the same result but for opposite reasons: when people are overly optimistic about their energy consumption, they may not perceive the need to invest in energy efficiency themselves (CEE, 2017).

Behavioural mechanisms that prevent environmentally sustainable practices and purchases

While not necessarily specific to energy consumption and energy efficiency investments, a range of behavioural mechanisms can hinder or even prevent environmentally sustainable practices and purchases.

If *social norms* establish energy-intensive goods consumption and habits as status symbols, energy-savvy practices may not be popular. The difficulties posed by *cognitive dissonance* and *knowledge-attitude-behaviour gaps* affect environmentally sensitive behaviours at large: for example, if climate change is perceived as irrelevant to one's specific context or community, engaging in environmentally conscious practices is unlikely to happen.

Conversely, even when consumers are environmentally motivated and prone to take action to reduce their energy consumption, the *single-action bias* might translate into symbolic acts rather than a complete review of energy-relevant practices and purchases. For example, some people who drive electric vehicles (EVs) might consider they have done their part for energy efficiency and disregard the benefits of replacing their current home appliances with energy efficient models. Further, due to the *moral licensing* effect, some individuals reduce their sustainability efforts in one area when they increase their action in another.

More generally, some behavioural mechanisms play out in virtually all purchases and negotiations. For example, consumers tend to be *averse to extreme options* and opt for the middle ground – or choose between two similar options when the third is radically different – to simplify the choice set when faced with too many complex options. If an energy efficient appliance is much more expensive or deviates from the "average" appliance in some other way, it might be excluded even though it could deliver net benefits to the unaware consumer.

In psychology literature, inaction with respect to environmental or climate issues has been associated with three barriers that arise consecutively: ignorance of issues; psychological mechanisms that prevent one from taking action to address the issue once one is aware; and insufficient or short-lasting efforts once one does take action (Gifford, 2011). More specifically, the macro categories of psychological barriers to climate change mitigation and adaptation, identified by Gifford (2011) as "dragons", are: limited cognition (e.g. uncertainty and ignorance); ideologies (e.g. techno-optimism); comparisons with others; sunk costs; discredence (e.g. mistrust and denial); perceived risks; and limited behaviour (e.g. rebound effect).

What policy levers can help address such behavioural barriers?

Using BIs to inform the design and implementation of appropriate policy levers can help address the above mechanisms as well as market imperfections. According to the policy and jurisdictional context, behaviourally motivated policy interventions can be used to either counter behavioural mechanisms that hinder desirable actions (e.g. investment in energy efficiency) or capitalise on mechanisms that can encourage their uptake (e.g. social norms).

This report is based on the typologies of behavioural levers provided by the OECD (2017b) and Mont, Lehner and Heiskanen (2014), presented in the table below.[3]

Behavioural lever	Definition
Simplification and framing of information	Individuals respond differently to information depending on how it is framed. For this reason, simplifying information provision and framing information in a clear and prominent way can attract the attention of consumers and improve their understanding of it. Additionally, information framing can make use of some well-known behavioural mechanisms and rules of thumb individuals use in daily decision-making. For example, because of loss aversion, consumers are more likely to consider purchasing an energy efficient appliance if told how much more they would pay with a low-efficiency option rather than how much they would save with a top-efficiency good. Framing information using meaningful time frames and metrics that are easy to understand can help (Yoeli et al., 2017). The same information can be perceived as more or less reliable according to its messenger, hence the importance of using trusted spokespeople in public information campaigns (de Vries, 2020).
Changes to product design and to the physical environment	Changes to product design and to the physical environment can steer consumers towards energy efficient practices, since many energy-relevant decisions are based on routine rather than on deliberate choice. For example, simply and clearly designed smart energy meters, placed in convenient locations and connected to apps or web platforms, can increase consumer understanding of their energy use.
Changes to the default policy or product specifications	Changing the default policy or product specifications can take advantage of the status quo bias by making energy efficient options the default. Although consumers can still choose a different option, making energy efficiency the automatic default can help overcome the barrier of inertia.
Social norms and comparisons	Exploiting social norms and comparisons can make consumers aware of how their energy consumption compares with that of their peers, prompting positive competitive efforts. For example, home energy reports have now become popular means to inform consumers of their energy consumption patterns, comparing them with similar households in the area. Likewise, making EV license plates a different colour can make the public more aware of the number of EVs and create the sense of a community of EV drivers.
Feedback mechanisms	The use of feedback mechanisms can help consumers visualise the energy implications of their day-to-day consumption, e.g. through phone apps or in-home displays connected to smart energy meters to monitor energy consumption. Timely prompts can also be a useful form of feedback.
Reward schemes	Reward schemes with in-kind or financial compensation can motivate the uptake of best practices for energy efficiency or investments. They should be designed and implemented to avoid crowding-out, which may happen if desired behaviours are already happening on a voluntary basis and consumers shun their remuneration. Rewards can also be part of gamification schemes or lotteries.
Goal setting and commitment devices	Goal setting and commitment devices can help individuals identify concrete efforts they are willing and able to make to achieve energy savings, together with a timeline and a set of milestones to achieve them. Commitment devices, particularly if connected to a group of peers or the entire public, can provide additional motivation to persevere.

[3] Osbaldiston and Schott (2012) and Schubert (2017) present additional typologies of behavioural levers used in environmental and energy policies and programmes.

Multiple levers can be integrated into a behaviourally motivated intervention (or, more synthetically, a behavioural intervention) and can also be used to support the deployment of traditional policy tools such as regulations, information provision and market-based policies. For example, addressing the barriers that time inconsistency and loss aversion can pose for energy efficiency investments, a behaviourally informed incentive scheme could incorporate low-interest loans that distribute upfront costs over a longer period to balance them with the benefits of energy savings.

Chapter 2. Applying behavioural insights to energy issues: Where do we stand?

Geography and governance of energy-related behavioural insight applications

This section discusses the geographical distribution and governance structure of the behavioural insight (BI) applications discussed in the next three thematic chapters. This assessment is based on case studies we have been able to gather information about, hence it does not claim to be exhaustive: more behavioural interventions may have taken place without being publicly documented.

The BI applications we analyse are concentrated in English-speaking countries: most are in the United Kingdom and Canada, followed by the United States, Australia, the Netherlands and Japan (Figure 2).

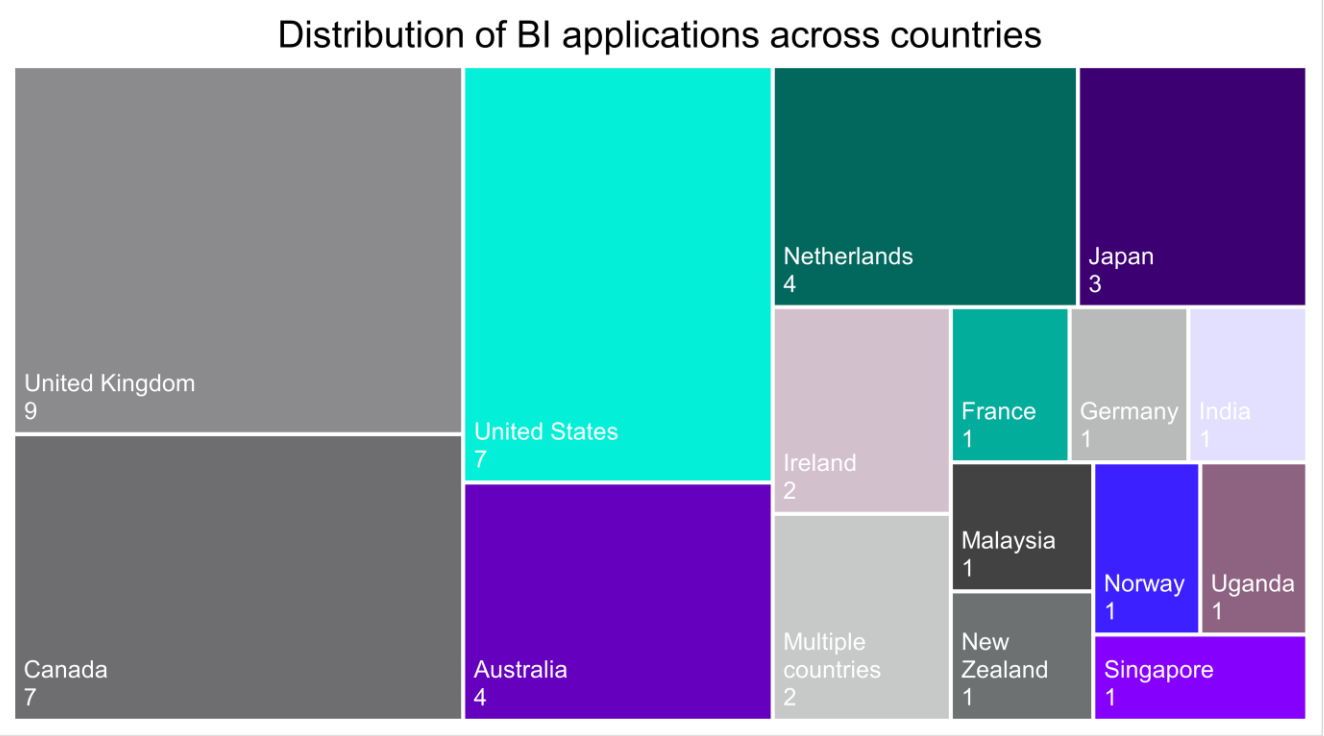

Figure 2. Country distribution of behavioural insight applications discussed in this report

Many of the countries in which the behavioural interventions were implemented host a BI team based in a public institution in various formats:

- In the office of the head of state, such as the Behavioural Economics Team of the Australian Government within the Department of the Prime Minister and Cabinet.
- Nested within a ministry, such as in Japan's Ministry of Environment and Ministry of Economy, Trade and Industry or in the Netherlands' Ministry of Economic Affairs.

- Nested within a regulatory authority, such as BI teams in the Sustainable Energy Authority of Ireland and in the Office of Gas and Electricity Markets in the United Kingdom.

The presence of a formal BI team in an institution participating in the energy policy process certainly helps integrate BIs into policymaking (OECD, 2017a; 2017b). At the same time, this is not the only driver of or possible institutional setup for energy-related BI applications: the governance of behavioural interventions varies across sectors (energy efficiency in households, businesses and transport) and according to the given country's institutional and policy context. Figure 3 illustrates the institutions in charge of BI applications discussed in this report.

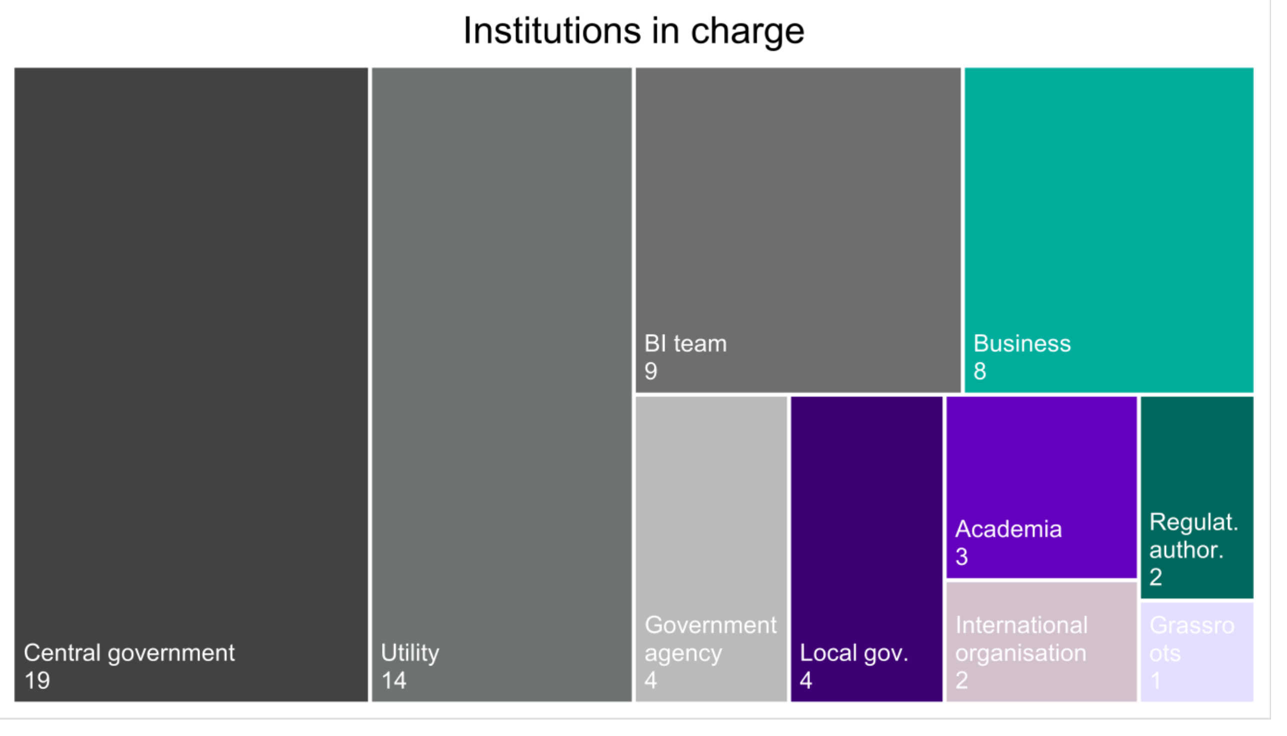

Figure 3. Institutions in charge of behavioural insights applications discussed in this report

Partnerships between energy utilities and businesses specialising in BI applications for customer engagement characterise most behavioural interventions deployed in the United States to support energy saving efforts. This is because utility-led energy efficiency programmes are key in the US context.

In the transport sector, behavioural interventions to prompt sustainable mobility have generally been put forward more often by local governments than by central ones. Collaborations with local transport utilities are common.

Expert support to realise behavioural diagnostics and to design and implement empirical impact assessments, including through randomised controlled trials, is generally provided by BI teams or academics.

Over half of the interventions discussed in the thematic chapters have been implemented at national scale, and about one-quarter are at the state, provincial or local level (Figure 4).

More than half have been trials or pilots to test the impact of certain behavioural levers on a small sample of participants, to gauge their effectiveness and upscaling potential. While we present only 4 examples of full-scale behaviourally motivated national policies, we discuss 13 full-scale programmes (a “full-scale” programme is an initiative that has been institutionalised rather than just trialled as a pilot experiment, i.e. programmes led by government institutions at different levels of jurisdictions, or by utilities or businesses).

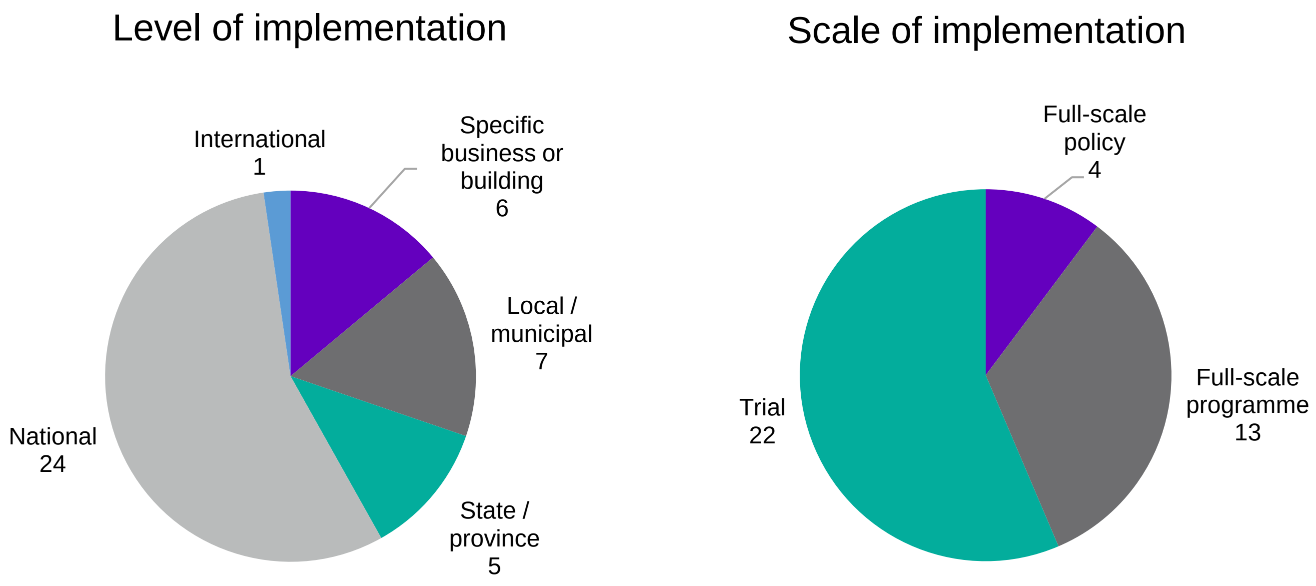

Figure 4. Jurisdictional level of implementation and scale of behavioural insights applications discussed in this report

More specifically, the full-scale programmes we have analysed include city-level initiatives to support sustainable mobility, business-level initiatives to reduce energy consumption associated with operations, utility-led energy efficiency programmes open to their whole customer base (generally at state or national level), and programmes developed by regulatory authorities.

Most trials are implemented at the national level so that government institutions can test innovative policy initiatives, often with the guidance of BI teams.

	Full-scale policy	Full-scale programme	Pilot or trial	Diagnostic
Specific business or building	0	5	1	0
Local or municipal	0	2	4	1
State or province	0	3	2	0
National	4	3	14	3
International	0	0	1	0

Key insights from the environment scan

This chapter summarises some key lessons from the application of BIs to recent energy and transport policy efforts. Behaviourally informed policy interventions and programmes have been designed to encourage households and businesses to curb their energy consumption, to prompt investment in energy efficient building retrofits and renewable energy, and to encourage a shift to sustainable transport.

Interventions focus on households and individuals, with few targeting businesses and organisations

Most interventions reviewed in this report are aimed at *individuals* and *households*, with only a minority exploring the potential of BIs to influence *organisation* and *business* behaviours.

This is logical, as cognitive restrictions and other behavioural mechanisms are numerous in individual decision-making while they can be partly tempered through collective decision-making in organisations. At the same time, even when acting as employees or managers, individuals can be affected in their workplace behaviour by their tendency to rely on shortcuts and heuristics. Any policy or programme can benefit from behaviourally informed framing to ensure that unduly complex and convoluted information provision and procedural requirements do not stifle behavioural change.

The toolkit of behavioural levers has not yet been exploited to its fullest

Information simplification and framing, which is employed in almost all the interventions discussed, is by far the most popular behavioural lever embedded in policy interventions and programmes to encourage efficient and sustainable behaviour change (Figure 5). This is unsurprising: addressing information asymmetries is critical given that energy consumption is invisible and the benefits of investing in energy efficiency efforts are difficult to calculate.

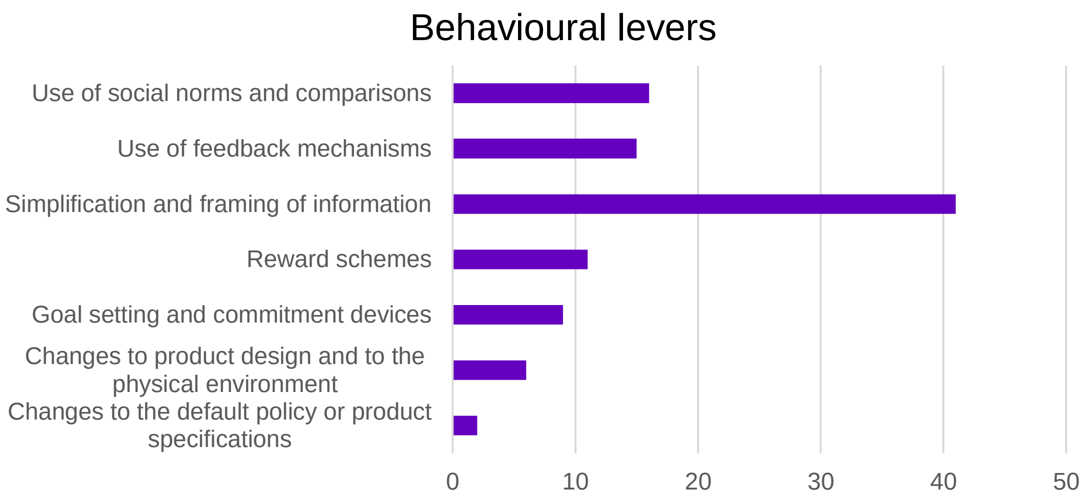

Figure 5. Behavioural levers used in the policy interventions and programmes discussed in this report

The high deployment of information simplification and framing indicates that one of the key BI messages is well understood: individuals respond to information differently depending on how it is framed and presented. Minor tweaks and design changes can have a substantial impact on how well consumers understand the multiple benefits of energy efficiency and their level of engagement with energy saving efforts. For example, these insights have been applied to the design of energy efficiency labels, or in the way energy consumption data is presented in energy bills.

The second-most-exploited behavioural levers are feedback mechanisms and social norms and comparisons. Feedback mechanisms are connected to information provision, in that they inform consumers about the evolution of their consumption patterns. Feedback can also be provided relative to the consumption patterns of peers, exploiting the influence of social norms and comparisons. Social comparisons are often used as benchmarks in information provision, to give recipients a sense of their position or performance relative to their peers. Social norms are also leveraged as part of competitions and community-wide schemes.

For example, home energy reports (HERs) rely on the combined application of these three levers to increase consumer awareness of their energy consumption patterns, and to prompt them to reduce their energy use. HERs simplify and frame energy consumption information in a compelling way, so that consumers can visualise what their energy bills really translate into. Feedback on historical energy consumption allows consumers to track the evolution of their own energy use and see how it relates to specific appliances. Social comparisons are leveraged in benchmarking one's energy consumption against that of similar households.

Goal setting and commitment devices are useful to encourage deliberate changes in practices and habits. Some energy utilities have relied on them to achieve short-term, immediate goals, such as curtailing peak energy consumption on hot days or during extreme weather events. Local transport authorities have leveraged goal setting and commitment devices to encourage a shift to sustainable mobility options, such as cycling, by helping individuals set realistic goals and devise a plan for gradual and durable behaviour change. Reward schemes are often implemented alongside commitment devices: utility and business initiatives encouraging energy consumers or employees to adopt energy saving practices have included rewards such as vouchers for affiliated stores and company-wide recognition.

Although it is clear that exploiting the entire set of behavioural levers to its fullest is the best way to address behavioural barriers to greater energy efficiency, changes to product design, to the physical environment and to policy-induced default options remain underutilised. In the policy sphere, BIs could inform the continuous evolution of minimum efficiency standards for appliances and electronic products. At the micro level, businesses and other organisations can take BIs into consideration when designing products to increase product efficiency and simplify the customer experience, as well as to boost sustainability efforts in the workplace.

Empirically assessing the impacts of BI applications can shed light on their effectiveness

One of the merits of the wave of interest in BIs is that implementation of behaviourally motivated policy measures and programmes has often been accompanied by rigorous impact assessments that elucidate their concrete impacts. Of the over 40 interventions discussed in this report, more than 20 have been empirically assessed (i.e. they are behaviourally tested interventions) (Figure 6). To the best of our knowledge, one-quarter of the interventions were not explicitly informed by behavioural sciences but were afterwards aligned with BIs (i.e. they are behaviourally aligned interventions). We have identified four behaviourally informed interventions built upon previous evidence from relevant initiatives.

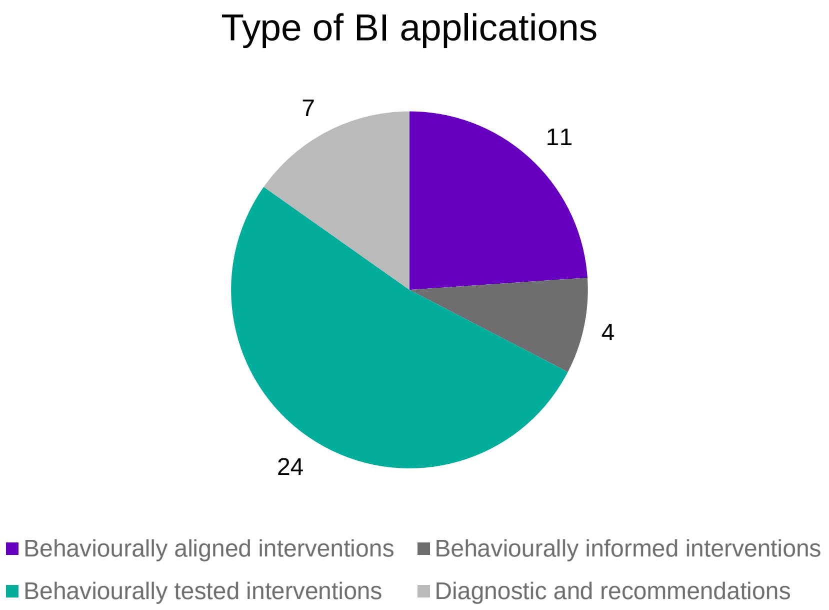

Figure 6. Types of behavioural insight applications discussed in this report

When empirically assessing a behavioural intervention, it is important to understand the extent to which its impacts might be context-specific. While the effects of the same intervention might differ according to policy, geographical or cultural context, the lessons from applications and assessments of behavioural interventions are informative for all policy makers and practitioners.

Some interventions have been replicated in different contexts with success, indicating that they might be ready to be implemented more broadly with policy support. For instance, HERs, which are inexpensive to deliver and provide helpful insights to consumers, have already led to energy savings in the United States, Japan and Malaysia. The cross-country evidence base for the impacts of digital feedback tools is also growing, encompassing smart meters, smart thermostats, in-home displays, mobile applications and web-based portals.

Finally, it is encouraging to witness the use of behavioural diagnostics as a tool to assess how behavioural barriers drive specific policy issues. Diagnostics are a necessary prerequisite for designing behavioural interventions: having a clear sense of how behavioural mechanisms influence the context under analysis is fundamental to choose the appropriate behavioural levers for policy and programme development. Furthermore, behavioural diagnostics can also inform the design and implementation of economic incentives and regulatory restrictions. Behavioural diagnostics should therefore be viewed as the groundwork necessary for policy development whenever individuals, households and businesses are the policy subjects.

Most behaviourally motivated interventions have focused on incentivising energy saving habits, with few initiatives targeting energy efficiency investment

Most interventions discussed in this report focus on incentivising energy savings through daily-habit changes and small-scale investments such as appliance replacements.

Conversely, few behaviourally motivated initiatives aim to encourage larger investments in upgrades such as home retrofits, efficient heating systems, and renewable energy systems.

Considering context specificities, diagnosing the relative importance of financial, behavioural and technical obstacles to energy efficiency investments is necessary so that appropriate policy solutions can be chosen to unlock investment potential. The relative scarcity of BI applications to boost investment in energy efficiency and renewables may be partly due to budget constraints that limit investment potential and require specific policy solutions. BIs can contribute to the design of ad-hoc economic incentives and programmes (e.g. low-interest loans) and to communications effort to increase consumer awareness and uptake.

For example, providing behaviourally informed information on the costs and benefits of energy efficiency improvements (e.g. through appliance labels, home audits and building certificates) is fundamental to help consumers choose viable solutions to improve their thermal comfort and optimise energy procurement.

Behaviourally tested pilot programmes allow policy makers and energy utilities to experiment with innovative policy approaches

As illustrated in Figure 4, over half of the behavioural interventions discussed in this report are trials or pilot projects – i.e. small-scale testing of specific policy designs or new utility-based programmes. Large-scale, institutionalised policy interventions that integrate BIs to achieve energy savings and investment in efficient and clean energy and transport systems are rare. However, some utilities, particularly in North America, have long embedded BIs in their customer programmes to encourage households to reduce their energy consumption, often in exchange for small reductions on their energy bills and other benefits, allowing utilities to meet regulatory objectives for energy efficiency.

Examples of large-scale approved policy reforms based on BIs include the redesign of energy efficiency labels in the European Union and India’s introduction of a green default on set-point temperature settings for air conditioners. New EU energy efficiency labels are behaviourally tested in that they have been developed through extensive testing of alternative designs in trials with consumers in several countries, with the aim of finding a label design that is easily understood by consumers and can thus effectively inform their appliance purchases. The new regulation on air conditioners in India is behaviourally aligned, as it employs default control by requiring manufacturers to fix the onset temperature at a level that balances comfort with energy savings, while still allowing consumers to alter the operating temperature according to their preferences.

Both policy reforms demonstrate how BIs can inform the design of traditional policies such as energy efficiency labels and product specifications and standards, based on specifically designed pilot trials and scientific evidence from previous research. Testing behavioural interventions on small samples, either through field experiments or online platforms (e.g. to simulate purchase decisions) can help policy makers understand possible behavioural responses to new policies and programmes before investing in full-scale implementation. Based on the costs and benefits of tested behavioural interventions, upscaling may or may not be cost-effective.

While some of the tested behavioural interventions discussed in this report have not led to statistically significant impacts (e.g. interventions to prompt retrofit investments), most aimed at household energy savings in residential buildings have been effective, with the magnitude of their effects varying by intervention.

Successful pilot projects should be mainstreamed into large-scale policies and programmes

What limits the upscaling of successful behavioural interventions that have been tested through randomised controlled trials and other pilot projects? Feasibility and political or business interest to implement such interventions at scale can vary depending on the behavioural levers at play. For example, behavioural levers such as changes to product design or to the physical environment (urban spaces, public buildings, schools, etc.) may require more granular decisions than large-scale policies (e.g. decisions at the business, building or government agency level). Changing policies through “green” default options can prompt adaptations in product design choices and in widely adopted business practices.

Behavioural levers such as goal setting, commitment devices and reward schemes might be best implemented in contexts in which monitoring and repetitive prompts are easily set up, to follow participants in their progress and provide reminders and suggestions for successful goal achievement. This could be the case for programmes managed by energy utilities, which have an established communication channel with their customers, or initiatives launched by government agencies targeting specific groups (e.g. categories of households or businesses with specific characteristics). At the same time, policy makers could promote the use of such behavioural levers to create a favourable policy framework. For example, launching voluntary agreements could boost business initiatives to achieve agreed goals.

Supporting both behavioural and structural approaches enhances energy efficiency

A transition to clean energy requires behaviour change in many areas, and evidence from the behavioural sciences can inform a range of policy efforts. Policy measures should rely on the rich toolkit of behavioural levers in its entirety – from simple tweaks to existing communication tools (e.g. better-designed energy and fuel efficiency labels) and inexpensive interventions (e.g. HERs), to digital solutions (e.g. apps and in-home displays), to more sophisticated programmes to help travellers shift to sustainable mobility, urban planners to design infrastructural solutions, and households and businesses to invest in structural thermal quality improvements of their homes and offices.

Integrating BIs into demand-side energy policies and programmes can complement and amplify the impact of large-scale programmes to encourage structural improvements in energy efficiency, delivering concrete benefits in terms of lower greenhouse gas (GHG) emissions. There is evidence that behavioural interventions that prompt energy efficient consumption can deliver energy savings and curb related GHG emissions more quickly than structural programmes aimed at building retrofits and appliance upgrades – at one-fifth the cost (Hibbard et al., 2020).

Although this estimate of cost-effectiveness is based on a set of utility programmes implemented in the United States and should be validated with a larger set of interventions, it appears reasonable, as simple interventions can be implemented quickly, leading to lower energy consumption in the near term. In contrast, designing and rolling out retrofit incentives is more complex, and investment decisions may be hindered by numerous other barriers.

Incentive schemes for structural energy efficiency improvements and behavioural interventions to support the adoption of energy saving habits should not be seen as alternatives but rather as complementary measures to achieve the ambitious goal of transitioning to an energy efficient, low-carbon economy. In fact, policy efforts should continue to identify and address behavioural barriers to energy efficiency investment, and to ensure that behavioural interventions translate into long-lasting changes in habits.

BI applications can enhance the impacts of traditional policies, including pricing tools and regulations

Clear information-framing can support all public communication and information provision efforts, addressing both households and businesses. For example, carefully designed energy and fuel efficiency labels are easier to understand and have a stronger impact.

Behavioural levers can also be introduced in regulatory approaches: for example, changes in policy-induced default options can help reshape product specifications and standards, hard-wiring energy efficiency features into product design.

At the same time, BIs can increase the impact and acceptability of pricing tools. For example, BIs can inform the design of urban congestion pricing, and help shape related communications to ensure they are well understood and accepted by inhabitants and commuters alike. BIs can also enhance the design of dynamic energy pricing schemes by making them conspicuous and easier to adjust to, increasing behavioural responses and the ensuing energy savings.

Continuous monitoring can shed light on the long-term impacts of behavioural interventions

A persistent challenge to upscaling the use of BIs in policy action is the limited evidence on their long-term impacts. Most documentation on the effects of behavioural interventions relates to short-term behavioural responses – both to policies and to programmes developed by utilities or businesses. As most interventions discussed in this report are time-bound pilot projects, impact assessment and monitoring generally stop when the intervention is over.

Smart meter data and other digitally generated information can provide relatively easy access to long-term energy consumption trends, facilitating impact assessments for behavioural interventions aimed at reducing household energy use. Conversely, monitoring the impacts of ongoing interventions in the travel sector requires deliberate and sustained data collection and analysis on medium- and long-term behavioural responses (e.g. through travel surveys and anonymised or aggregate data from smart travel cards). Regardless of the nature of the data, continuous monitoring can indicate the duration and frequency of interventions required to prompt habit changes, and whether the changes last over time.

Other challenges relate to uncertainty in areas in which behavioural interventions have been limited or evidence is inconclusive, such as interventions to support sustainable mobility and large-scale energy efficiency investments. In these areas, behavioural barriers to action are compounded by structural obstacles (e.g. split incentives in building renovation and transport infrastructure limitations in certain places) and financial hurdles (e.g. budget and credit constraints). Applying BIs in these areas is necessary to diagnose the relative importance of such barriers in different contexts, and to identify appropriate policy responses.

BOX 1: KEY THEMATIC INSIGHTS

Residential buildings and appliances

Behavioural interventions in the context of residential buildings and appliances can be divided into two categories: those aimed at changing energy consumption habits and those to increase investments in energy efficiency and renewable energy.

In the first realm, energy utilities have been applying BIs to their demand-response and energy efficiency programmes for the past ten years. For example, households can access real-time information on their energy consumption using digital tools such as smart meters and connected in-home displays. Through home energy reports, adopted widely from the United States to Japan, they can benchmark their own consumption against that of similar households and track its evolution over time and across seasons, identifying corners that can be cut. Furthermore, US-based utilities have been developing web-based marketplaces for consumers to easily compare and shop for appliances based on their energy efficiency ratings and the energy savings and lower bills they can deliver.

Evidence from e.g. Australia, Canada and the United Kingdom indicates that feedback mechanisms, goal setting and commitment can prompt household energy savings as part of consumer engagement initiatives, also leveraging gamification. The magnitude of these impacts varies according to the intervention and context: while interventions targeting critical peak demand management can prompt significant behavioural responses, the ensuing energy savings are by definition time-limited to a few hours or days, in the context of extreme weather events. Conversely, while long-lived interventions such as feedback mechanisms generally deliver smaller proportional responses, maintaining them in the long term can result in substantial aggregate energy savings.

Behaviourally informed energy efficiency label designs for appliances have been shown to improve consumer understanding of the costs and benefits of energy efficiency improvements. Trials from Australia and from the EU indicate that simple, well-framed labels can steer consumers towards purchasing more efficient appliances. As such, information simplification and effective framing can indirectly raise investments in small-scale energy efficiency improvements (e.g. appliances and lighting).

However, few interventions have been aimed at boosting large-scale investments in projects such as deep home retrofits or heating system changes. Interventions implemented in Ireland employed personal communications, events with trusted messengers (e.g. friends and relatives), and free energy audits to encourage the uptake of retrofits and heat pumps. While consumer requests for additional information on incentives available for such investments rose slightly, neither intervention had a large-scale impact on investment.

In the sphere of small-scale renewable energy systems, a local-level initiative promoting community-grouped investments significantly boosted the uptake of rooftop solar panels in Seattle (United States). It also stimulated broader initiatives, indicating that there is potential for behaviourally informed investment incentives in this area.

Transport and mobility

In the transport sector, BIs have been used to support fuel-efficient vehicle purchases, including electric vehicles (EVs), and to encourage walking, cycling and public transport use while limiting travel by private motorised vehicles.

Behavioural interventions to support the purchase of fuel-efficient, low-carbon vehicles have leveraged simplification and framing of fuel economy labels (e.g. in Canada) to convey information on the costs and benefits of more efficient vehicles in a clearer and more prominent format. Interventions aimed specifically at encouraging EV uptake have included the introduction of special number plates in the United Kingdom, to highlight the growing presence of EVs on the road and the shift in social norms favouring low-carbon vehicles. These interventions have been implemented at the national level.

Conversely, behavioural interventions to support walking, cycling and public transport use have generally been implemented on a local rather than national scale. While some barriers to sustainable mobility in urban environments are well known and general (e.g. crowded public transport during rush hour, limited bike lane coverage and inexpensive car parking), some might be specific to each city (e.g. infrequent public transport service, perceived unreliability, and social norms surrounding bicycle use). For this reason, local-level behavioural diagnostics are fundamental to identify the relative importance of structural versus behavioural – and local versus broader – barriers to sustainable mobility.

Sustainable mobility incentives have included interventions targeting the whole population, or specific groups identified through their characteristics or circumstances. For example, personalised travel planning initiatives have been tested in UK and US cities to encourage active mobility and reduce reliance on single-occupancy car trips. Tailored solutions include school travel planning and group-oriented activities for schoolchildren, trialled in Australian cities to encourage active mobility as a commuting option. Finally, time-specific interventions can address individuals changing jobs, schools or residences.

Evidence that travel planning and gamification in Australia and the UK have encouraged a modal shift from car use to active mobility options is encouraging. However, while tailored interventions can maximise effectiveness, their impact is likely to be context-specific.

Businesses and other organisations

BIs have also informed interventions to expand energy efficient practices and technology adoption by businesses and other organisations (e.g. public administrations and universities), and by their employees.

Evidence from the Netherlands indicates that business-oriented messaging on energy efficiency (e.g. energy audits) can be made more relevant and appealing to companies by including indications of how energy efficiency improvements can positively affect other key performance indicators. Because key performance indicators reflect core operations, they may differ by sector, firm structure and size: behavioural diagnostics can therefore be useful to define relevant indicators and design sector-specific interventions to encourage energy efficiency investments.

Sustainable workplace behaviours can be encouraged by cultivating a sense of belonging and positive competition among different branches or departments, and by channelling communication through trusted messengers.

Chapter 3. Residential buildings and household appliance use

Introduction

The residential sector accounted for 20% of final energy consumption in IEA countries in 2018. While specific end-use characteristics vary by country and region, household energy consumption patterns indicate three major end-use types (Figure 7): 57% space heating and cooling (53% and 4% respectively); appliance use (19%); and water heating (16%). Cooking and lighting combined account for 6% of residential energy use (IEA, 2020d).

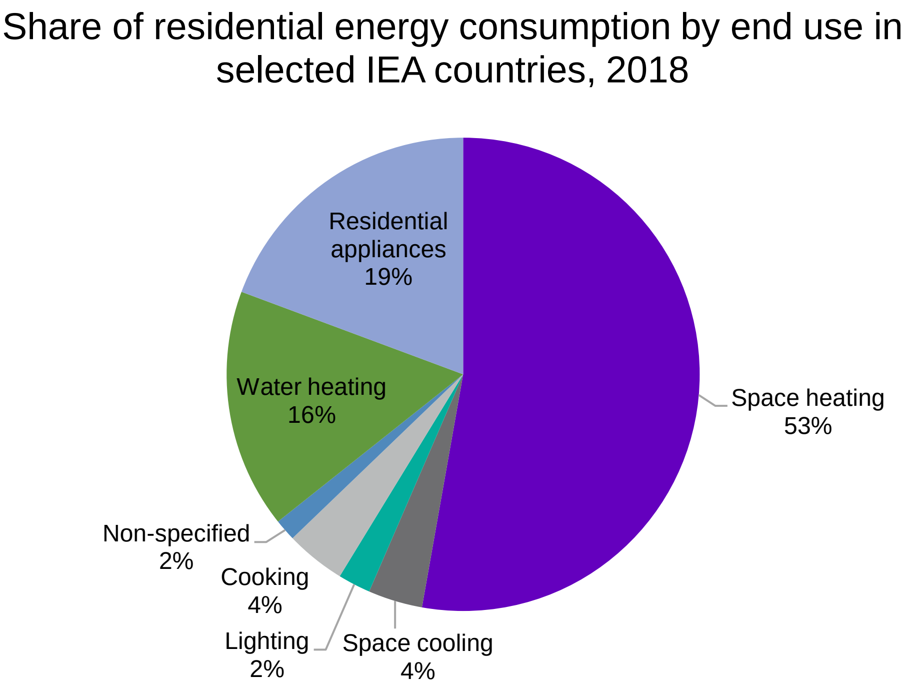

Figure 7. Shares of residential energy consumption by end use in selected IEA countries, 2017

Note: Statistics cover the 24 IEA countries for which data are available for most end uses: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Poland, Portugal, the Slovak Republic, Spain, Switzerland, the United Kingdom and the United States.
Source: IEA (2020d), IEA Energy Efficiency Indicators (database), https://www.iea.org/reports/energy-efficiency-indicators-2020.

This breakdown illustrates the variety of behaviours that drive energy consumption at home – from deliberate acts such as cooking and taking a warm shower, to automatic, habitual gestures such as turning on the lights or the TV. Taking action on the specifics of such deliberate acts (e.g. adjusting the temperature of the oven, washing machine and shower, as well as heater and air conditioner thermostat set points) is a way for consumers to control their power consumption in everyday life.

Paying attention to energy efficiency when making structural decisions that concern one's home and appliances is a way of ensuring that durable investments – from home renovations to purchasing or upgrading appliances – translate into long-term energy consumption reductions. Apart from some appliances that are relatively expensive for the average consumer to refurbish or replace (e.g. refrigerators and washing machines), various other technologies can be inexpensively upgraded to deliver the same service more efficiently (e.g. shifting from incandescent to LED light bulbs). At the same time, some energy consumption and investment decisions are bound by structural factors, such as whether the consumer is a tenant or owns the home.

This chapter discusses the structural and behavioural motivations of decisions that affect energy consumption in residential environments, and it indicates how behavioural insights (BIs) are informing policy developments to raise residential energy efficiency.

What drives energy consumption and investment decisions in the residential sector?

Energy consumption patterns and energy efficiency investment decisions are dictated by personal characteristics such as budget constraints and preferences, which in turn are affected by cultural and social factors. For example, showering frequency could be influenced by cultural and social norms on cleanliness and comfort, as well as by climate. Generously warm or cool indoor temperatures might be instrumental to create a comfortable, welcoming space for guests.

At the same time, macro factors such as energy policy and power market design, and micro factors such as the technical specifics of electric appliances, are structural elements that act as additional drivers and constraints for household energy use and investment decisions. For example, in markets where energy utilities are required to achieve energy efficiency objectives, consumer engagement strategies such as demand-response efforts during extreme weather events are well established and thus provide households and other energy consumers with concrete incentives for energy-savvy behaviour.

Utilities' operational choices also have important consequences for energy consumption: for instance, electric utilities often bill consumers a fixed amount based on key household features and account for the surplus or deficit in charges annually when the meter is read, making the connection between energy consumption and pricing opaque. Billing infrequency creates a further disconnect between energy usage and cost. When utilities charge consumers on a monthly or quarterly basis, it can affect how consumers perceive their consumption habits and the control they wish to exert over energy use.

The technical features of electric home appliances, as well as heating and cooling controls, directly affect how consumers understand their functioning and associated energy consumption. Complexity or non-transparency can lead to involuntary high energy consumption. Default features of appliances, such as standby lights and thermostat set points, can also affect energy use significantly, as consumers may not be able to alter them.

Finally, broader economic conditions are important in determining the extent to which consumers can control their energy consumption. Being a homeowner versus a tenant can prompt very different purchasing decisions on everything from lightbulbs to energy efficient appliances – especially if the tenant is a short-term resident. Further, structural improvements such as roof and wall insulation are often out of reach for renters.

While the consequences of some macro structural features are relatively straightforward (e.g. limited manoeuvrability for tenants), appliances' technical and design features can have unexpected impacts on different consumer categories. BIs can be used to identify the effects of such structural features and support behaviourally robust design processes that can then lead to higher appliance efficiency and lower energy bills.

More broadly, BIs can be integrated into policies to facilitate both long-term investments (to structurally improve the energy efficiency of residential buildings by boosting retrofitting and energy efficient appliance purchases) and the uptake of more energy efficient consumption practices in everyday life.

In fact, energy consumption is often not a studied decision but is induced by the habitual use of basic services such as heating, cooling and lighting, and by deliberate activities such as using digital entertainment. As such, it is affected by a range of behavioural biases such as inertia due to the status quo bias and the attitude-behaviour gap (OECD, 2017b).

Conversely, investment decisions aimed at improving the energy performance of one's home are deliberate acts requiring somewhat complex calculations and trade-offs, involving comparisons of immediate investment costs with future energy savings. They are vulnerable to various behavioural mechanisms, such as faulty or incomplete awareness and understanding of energy consumption, and short-sighted decision-making (OECD, 2017b).

Precisely because of their habitual nature, everyday consumption patterns affecting energy use are greatly influenced by inertia, which can sometimes trump intrinsic motivations such as environmental concerns. For example, individuals wishing to save energy to lower their spending and help reduce greenhouse gas emissions may fail to do so because of the *status quo bias* that ties them to well-established habits, or because of *unawareness* of their own energy footprint.

Inertia may also prevent consumers from converting to a renewables-based energy contract, as switching energy providers requires physical and cognitive effort. Consumers must scrutinise all available electricity plans and utility providers, choose one that meets their needs by weighing the costs and benefits of paying a "green" tariff, and then follow through with the paperwork to request a change from their utility provider.

Coupled with the *attitude-behaviour gap,* inertia and an incomplete understanding of one's appliances and one's energy footprint might inhibit simple behavioural changes that, at scale, could generate important energy savings – from low-temperature machine washing and line-drying in appropriate climates, to avoiding appliance standby and turning-off lights.

Both small- and large-scale investments in energy efficient improvements for one's home can also be impeded by inertia and a limited understanding of their costs and benefits. It requires effort to find and comprehend information on the savings potential of updating white goods and windows. Additionally, trying to choose a service provider for retrofitting work can result in information overload and choice paralysis.

Plus, the intertemporal nature of energy efficiency investments makes calculating the costs and benefits even more complex. Because intertemporal decisions are susceptible to short-sightedness, people tend to pay more attention to immediate investment costs than to future savings that can derive from purchasing a (possibly) more expensive but more efficient appliance. While a low-efficiency choice might translate into a more affordable investment in the short term, it negates longer-term energy and financial savings. A faulty perception of the sunk costs of existing appliances and home infrastructure can also delay or prevent energy efficiency improvements.

BOX 2: KEY IMPACTS OF THE COVID-19 PANDEMIC ON HOUSEHOLD ENERGY CONSUMPTION

The movement restrictions and social distancing measures instigated by the Covid-19 pandemic in the first half of 2020 have profoundly affected household energy use. With non-essential workers being encouraged to work from home or furloughed, the types, times and frequency of energy-using activities have changed as many previously office-based activities have been increasingly shifted to the home.

Teleworking is adding to household energy use by changing the frequency of energy-consuming activities, as people are not only using electricity for their home offices but also spending more time cooking and cleaning. Smart meter data from the Netherlands during the lockdown showed a 10-15% increase in the use of white goods, kitchen appliances, dishwashers, lighting and home entertainment, while EV charging dropped 5-10%. Recent IEA analysis reveals that teleworking could cause household energy consumption to rise 7-23% on average, depending on the size of the home, heating and cooling needs, and appliance efficiency (IEA, 2020c).

For some households, higher energy expenditures may draw attention to the urgent need to improve the efficiency of their building and appliances, provoking upgrades and behavioural changes. However, whether consumers notice the difference and respond to higher energy use and expenditures will depend on a range of factors, including consumers' exposure to flexible energy prices, meter-reading frequency and the presence (or absence) of feedback loops.

Electricity meter data from several countries also indicate that people tend to change their morning routines in the absence of their morning commute, causing morning peaks in electricity use to occur later. Data also suggest that people are adjusting their habits by, for example, taking showers at different times of the day (Wilson et al., 2020).

The flexibility that increased teleworking introduces into people's schedules suggests that they may now be more open to changing how and – importantly – *when* they use energy. This is intriguing for policy makers interested in better aligning energy use with low-carbon energy availability, a goal that has been difficult to achieve given the rigidity of habitual energy patterns. Supported by the growing penetration of digital devices linked to smart meters and new business models, now might be an opportune moment for policy makers to take advantage of behaviour changes triggered by Covid-19 to expand flexible demand resources in the household sector.

How can BIs support energy efficient behaviour in residential buildings?

Using BI applications can help achieve multiple policy objectives related to residential energy use, including by promoting investment in energy efficient retrofits and appliances, lowering energy consumption through efficient energy practices, and increasing the uptake of small-scale renewable energy installations.

The next section discusses case studies of policy interventions and programmes that have pursued energy objectives with the help of BIs. These interventions and programmes are anchored to the following well-known behavioural levers:

- *Simplification and framing of information*, which can clarify some of the complex and opaque aspects of energy consumption, supporting both energy efficient everyday practices and infrequent but durable investments. This strategy can be applied to many information vectors that aim to influence energy-related decisions – from energy efficiency labels for electric appliances and energy audits of buildings to home energy reports (HERs) and electricity bills.
- *Feedback mechanisms*, which can help reduce the opacity of energy consumption information that is usually limited to energy bills by improving consumer understanding of their consumption patterns and empowering them to make informed energy saving decisions. HERs (possibly provided with energy bills) are a means of offering feedback based on disaggregated data on energy consumption patterns. Additionally, digital devices can be employed to provide consumers with personalised, real-time information in a clear, prominent and timely way through in-home displays (IHDs) connected to smart meters, or via websites and apps.
- *Changes to the physical environment*, e.g. by installing feedback devices in the home, can increase the visibility of energy consumption patterns and facilitate consumer access to data. The same philosophy can apply to *changing product specifications* with BIs in mind, to eliminate energy-intensive features that do not necessarily add value to the consumer experience (e.g. standby lights).
- *Changes to the default policy or to default product specifications*, which can exploit the status quo bias and ensuing consumer inertia by making the most energy efficient option the default rather than the by-product of a choice requiring consumer effort. For example, changing a thermostat's default set point can result in important energy savings.
- *Goal setting and commitment devices*, which can support individual efforts by helping consumers match their aspirations to reduce residential energy consumption with concrete actions. *Reward schemes* can also be designed to provide in-kind or financial rewards for energy saving efforts. Rewards could range from gifting a free LED lightbulb to participants in specific programmes to providing discounts through apps that promote energy saving efforts through gamification.
- *Social norms and comparisons*, which can be built into information provision tools or into commitment devices and reward schemes, can prompt householders to step up efforts to reduce their residential energy consumption to be better aligned with their peers.

The next section offers examples of how these behavioural levers have been implemented thus far in policies and programmes that address residential energy use.

Case studies

This section discusses case studies of behavioural interventions designed to encourage household energy saving practices and investments. The table below outlines case studies indicating the country where the intervention took place, the institutions in charge, the jurisdictional level of implementation and the scale at which it was deployed (trial or pilot project; full-scale policy or programme; or behavioural diagnostic). Finally, it specifies the behavioural levers used in each intervention.

Country	Institutions	Case study	Level	Scale	Behavioural levers
Promoting investment in energy efficient appliances					
Australia	BI team	Designing clear energy efficiency labels	National	Trial	Simplification and framing of information
United States	Business; utility	Utility-branded marketplaces for efficient appliances	State / province	Full-scale programme	Simplification and framing of information
Japan	Central government	Information framing to support the shift to LED lighting	National	Trial	Simplification and framing of information; changes to the default policy or product specifications; social norms and comparisons
Promoting investment in energy efficient home retrofits					
Ireland	Regulatory authority	Information framing to increase heat pump intake	National	Full-scale programme	Simplification and framing of information
Ireland	Regulatory authority	Leveraging peer effects to foster home retrofits	National	Trial	Social norms and comparisons; feedback mechanisms
Promoting lower energy consumption in residential buildings					
Japan	Central government; utility	Providing HERs to residential consumers	National	Trial	Social norms and comparisons; Simplification and framing of information; feedback mech.
Malaysia	Central government; utility		National	Trial	Social norms and comparisons; simplification and framing of information; feedback mech.
United States	Utility; business		State / province	Full-scale programme	Social norms and comparisons; simplification and framing of information; feedback mech.
Norway	Utility; business		National	Trial	Simplification and framing of information; feedback mech.
Australia	Utility; local government; academia	Reducing peak demand stress	Local / municipal	Trial	Reward schemes; feedback mechanisms; goal setting and commitment devices
Australia	Utility; BI team	Reducing peak demand stress (Powershop)	State / province	Trial	Reward schemes; social norms and comparisons

Country	Institutions	Case study	Level	Scale	Behavioural levers
Germany	Utility; business	Supporting the use of smart appliances at times of peak energy demand	Local / Municipal	Trial	Changes to product design and to the physical environment
India	Ministry	Applying green defaults to baseline temperature settings of air conditioners	National	Full-scale policy	Changes to the default policy or product specifications
United Kingdom	Utility; BI team	Providing feedback through IHDs and other devices	National	Trial	Simplification and framing of information; social norms and comparisons; feedback mechanisms; changes to product design and to the physical environment
Multiple countries	Utility; academia	Providing feedback through IHDs and other devices	International	Trial	Feedback mechanisms; social norms and comparisons; simplification and framing of information
Netherlands	Central government; BI team	Encouraging energy savings and energy efficient purchases through web-based information campaigns	National	Full-scale programme	Simplification and framing of information
Canada	Utility	Leveraging rewards and gamification in utility programmes	State / province	Full-scale programme	Simplification and framing of information; social norms and comparisons; feedback mechanisms; reward schemes; goal setting and commitment devices
Promoting efficient heating practices at home					
France	Central government	Discouraging non-essential wood heating	National	Trial	Simplification and framing of information; feedback mechanisms; social norms and comparisons
United Kingdom	BI team; business	Facilitating efficient use of heating	National	Trial	Feedback mechanisms; simplification and framing of information; changes to product design and to the physical environment
Uganda	International organisation	Identifying barriers to efficient cookstove uptake in Uganda	National	Diagnostic	Simplification and framing of information; social norms and comparisons
Increasing the uptake of renewable energy for residential users					
United States	Grassroots	Promoting investment in renewable energy	Local / municipal	Trial	Simplification and framing of information; social norms and comparisons

Promoting investment in energy efficient appliances

DESIGNING CLEAR ENERGY EFFICIENCY LABELS

BIs have informed the revision of EU energy efficiency labels. In 2015, the European Commission conducted a cross-country study aimed at testing several behaviourally informed label designs (London Economics and IPSOS, 2014). The study comprised experiments both online and in physical stores in nine EU countries. Insights gained from the study led to the revision of the energy efficiency labels, involving a shift from the A+++ to G scale to a new alphabetic scale ranging from A to G. The new scale was found to be easier for consumers to understand, resulting in more energy efficient purchases. This indicates how simplification and framing of information can act as a lever for behavioural change using a range of policy mechanisms – from information provision through awareness campaigns to mandatory certification schemes. A summary of the cross-country experiment underpinning the reform can be found in OECD (2017b).

In 2017, the Behavioural Economics Team of the Australian Government (BETA) investigated the effect of energy labels on consumer decisions in online appliance purchases.[4] Labels were designed to help consumers understand the value associated with higher-energy-efficiency appliances compared with lower-efficiency ones and make them more appealing. The intervention aimed to assess the impact of these labels across three key outcomes: customer engagement; customer intent to purchase; and actual customer purchases (BETA, 2018). The intervention's success relied on overcoming customer myopia in intertemporal choices, the attitude-behaviour gap and the status quo bias.

The effectiveness of this intervention was tested with the help of a randomised controlled trial on an online interface, with consumers randomly assigned to one of three groups over a one-month period. Participants belonging to the control group did not see any energy labels, whereas those in the two treatment groups were exposed to two energy label variations – one mentioning savings in kWh per year, the other specifying financial savings (in AUD) over the product's lifecycle.

Compared with no energy label, both increased the likelihood of consumers purchasing energy efficient appliances by 20%, with no significant differences between the two. While the results are not statistically significant, they suggest increased interest in energy efficient appliances that have an energy label (BETA, 2018).

This study has not yet affected any policy reform, but it seems to have confirmed the belief that energy-rating labels also help consumers make good choices when buying online (BETA, 2018).

UTILITY-BRANDED MARKETPLACES FOR EFFICIENT APPLIANCES

Utility companies can benefit from consumers using energy efficient products, as it reduces stress on the grid while helping utilities meet their energy efficiency goals. For this reason, software-as-a-service companies such as Enervee, based in the United States, provide services such as online utility-branded marketplaces.[5] These platforms allow utilities to showcase the most energy efficient products to their customer base, directly nudging them

[4] While energy rating labels are required for appliances sold in stores, they are not obligatory for online platforms.
[5] https://www.enervee.com/.

towards energy-saving purchases. Utility companies such as AEP Ohio, Con Edison NYC, and the Pacific Gas and Electric Company have established branded marketplaces.

In terms of consumer benefits, this type of platform addresses two sets of barriers: confusion about energy efficiency, which it compiles into a simple indicator and translates into possible financial savings, and the overwhelming variety of products available on the market, which it makes accessible and comparable through one single website. This can help consumers overcome the choice-overload obstacle associated with the plethora of products available on the market while focusing on energy efficiency.

Enervee has been offering an e-commerce-based platform for electric appliances since 2010. It highlights each product's energy efficiency rating, enabling consumers to make energy efficient purchases from the product range available from leading appliance retailers. It also points to possible savings associated to with certain products relative to less efficient counterparts and allows consumers to immediately see whether products are eligible for a utility rebate (Arquit Niederberger and Champniss, 2018).

Simplifying and framing energy efficiency information – for example by incorporating an appliance's initial investment as well as its lifecycle energy costs into one indicator – can help consumers overcome the loss aversion bias, cognitive dissonance and myopia that affect their intertemporal decision-making.

A recent assessment of the impacts of AEP Ohio's marketplace indicates that about 150 000 unique active visitors (out of a residential customer base of 1.2 million) accessed the platform from January 2018 to March 2019, resulting in over 42 000 purchases. Marketplace-related purchases will therefore deliver over 92 000 MWh in estimated gross lifetime savings (Opinion Dynamics, 2020). About half of the respondents indicated that the marketplace had affected their purchase decisions (Opinion Dynamics, 2020).

Similar online platforms exist in Europe, although they are not directly associated with energy utilities. The Topten programme presents all electric appliances available on the market in one portal, allowing consumers to easily find the most efficient option with a single click.[6] The portal then links to the product's page on the retailer's website or other online marketplace through which the consumer can complete the purchase.

INFORMATION FRAMING TO SUPPORT THE SHIFT TO LED LIGHTING

Through a randomised controlled trial, Japan's Ministry of Economy, Trade and Industry has recently tested alternative messages to encourage consumers to switch from high-energy-consuming compact fluorescent lamps (CFLs) to efficient LED lightbulbs:[7]

1. A comparison of CFLs with LED lighting, indicating that LEDs consume nearly half as much electricity as CFLs while offering the same brightness.
2. Alongside message 1, a message exploiting people's desire to conform with social norms, indicating that one in two households uses LED lights.
3. A message including information on the lifetime economic value of lamps, indicating that an LED lamp lasts six times as long as a CFL.

[6] www.topten.eu.

[7] Information gathered through direct communication with Japan's Ministry of Economy, Trade and Industry, and https://www.enecho.meti.go.jp/about/special/johoteikyo/shoene_nudge.html

4. Alongside the consumption comparison of message 1, a message changing the default choice from between CFLs and LEDs to two types of LEDs. Consumers were encouraged to choose between Bluetooth-operated LEDs, which can be switched on via smartphone, and automatic ceiling lights, for which the crime prevention potential had been highlighted.

These messages were tested on roughly 4 000 participants in the context of a virtual web-based store. In the control group receiving no message, 65% opted for LED lighting while in the groups that received one of the four messages 72-74.2% purchased LED lights. The highest and most robust impact was associated with the fourth message, which included both information on LED economic benefits and the default presenting LEDs as the ideal choice, highlighting their connectivity and safety features. The fourth message also encouraged consumers to purchase more expensive LED lights.

Promoting investment in energy efficient home retrofits

INFORMATION FRAMING TO INCREASE HEAT PUMP UPTAKE

The uptake of heat pumps is hindered by some common behavioural mechanisms such as inertia and hassle factors, by biases against upfront costs and a tendency to more heavily discount savings accruing in the distant future. Some behavioural issues are specific to the context of renovation decisions, as the costs of installing existing systems (in this case, boilers) are used as a frame of reference, making heat pumps appear expensive. Finally, some barriers are structural, such as limited information with respect to relatively new technologies such as heat pumps, and a lack of financing options.

In 2019, the Sustainable Energy Authority of Ireland (SEAI) carried out a national communications campaign, leveraging BIs to examine whether simplified, personalised and targeted messaging could encourage households eligible for grants to install heat pumps.[8]

To achieve this objective, roughly 32 000 homes were identified from the National Building Energy Rating Database of Ireland as having low-level heat losses. These buildings were denoted as “heat-pump-ready” and then randomly assigned to either a control group or one of seven treatment groups. The treatment groups received letters highlighting various benefits associated with installing heat pumps, such as comfort, cost savings and health/air quality improvements. Different letters built on different behavioural levers, from message simplification to social norms to exclusivity. Some households received letters in an envelope reiterating the same message.

The variously framed communications were not found to have a statistically significant effect on actual heat pump installations. This result was in line with the expectations of the project team, which considered that a single mailing might not be enough to motivate such a considerable undertaking as heat pump installation. However, messages highlighting exclusivity (“You have been selected as being eligible for a heat pump grant”) were the most effective at generating responses from households, who reached out to SEAI’s contact centre for further information on installation grants. This type of message evoked a response rate of 1.76%, compared with 0.05% from the control group. This was unexpected, as health and comfort framings are often considered the most important motivators for homeowners to undertake energy efficiency upgrades.

[8] According to SEAI responses to the Users TCP survey.

LEVERAGING PEER EFFECTS TO FOSTER HOME RETROFITS

The uptake of home energy upgrades is hindered by a range of behavioural barriers, from the low visibility of heat loss implications to information overload for consumers sifting through all the options to improve home thermal quality.

Between 2018 and 2019, the SEAI conducted a behavioural barrier analysis to identify key obstacles, and a trial to assess how peer effects can encourage consumers to install energy efficient products in their households, overcoming some of these barriers (SEAI, 2020).

The trial's goal was to encourage households to purchase and install energy efficient products such as loft insulation by capitalising on the influence of social norms in combination with a communications campaign and the offer of personalised building energy ratings (BERs) of their homes. A home energy event was designed, modelled on similar initiatives conducted in the United States but tailored to the Irish context.

Event hosts were recruited through SEAI's Sustainable Energy Communities (community groups with an active interest in taking climate action) and from a large outdoor festival. In exchange for signing up to host an energy event, participants received a free BER assessment. The event involved a professional home assessor explaining the reasons and procedures for home upgrades, involving the hosts' neighbours, family and friends. Attendees were also eligible for free BERs of their own homes. Following the assessment, homeowners were provided with a simplified one-page report on the best upgrades for their home and were offered the opportunity to be put in contact with a one-stop shop to help them complete their upgrades if they wished.

This type of event exposes participants to information on home renovations in a friendly environment, through a trusted messenger – a friend or relative. The combination of in-person event and BER assessment provides a good mixture of behavioural levers, including games and visual cues such as thermal imaging, which can highlight the losses associated with missed renovation opportunities.

Overall, the entire programme received positive participant feedback, with the majority claiming they would recommend the event to a friend. However, of the 82 households (event hosts and guests) who received free BERs, only 3 eventually proceeded to complete the energy efficiency upgrades. This suggests that financial barriers to this type of investment and the hassle factor (e.g. lack of time and perceived complexity) persist. Nonetheless, the participant feedback helped improve the overall quality of the programme: for example, it was suggested that some of the complex messages contained in the BER report be simplified (SEAI, 2020).

Promoting energy-saving practices in residential buildings

PROVIDING HOME ENERGY REPORTS TO RESIDENTIAL CONSUMERS

In 2017, Japan's Ministry of Environment commissioned Oracle Utilities Opower to work with four major utilities across Japan to reduce household energy consumption. Oracle collaborated with companies to send quarterly HERs containing personalised energy use information and efficiency advice to 60 000 households in each of the five utility territories, for a total of 300 000 households.

HERs frame energy consumption information in a clear and prominent manner, and they provide targeted messages that are specific to each customer. They are usually two pages long, including information and graphs that illustrate historic energy consumption compared with that of similar neighbouring households, with insights on specific consumption items such as cooling. They also provide a personal energy tracker to compare energy consumption from one year to the next and across seasons, including insights on average daily peak usage (Oracle, 2017).

Comparing a household's energy consumption with that of its neighbours – even if done in an aggregate and anonymised way – induces social comparisons that can motivate high-energy-consumers to reduce their power consumption to align with "the norm". In addition, emphasising approval for energy saving efforts can help circumvent the "boomerang effect", whereby households learning that they consume less than their peers might be tempted to increase their energy usage.

In April 2018, Japan's Ministry of Environment reported that households receiving HERs used 2% less energy on average than those not receiving the communications. If all Japanese households achieved these savings throughout the year, it would be the equivalent of replacing 26 million refrigerators (at a cost of roughly JPY 3 trillion) or placing rooftop solar panels on 800 000 homes (at a cost of JPY 1.4 trillion) (Oracle News Connect, 2019).

Although not specific to this project in Japan, a previous detailed study of three similar OPower projects was conducted in the United States to test the persistency of the effects of HERs (Allcott and Rogers, 2014). Economic theory suggests that when consumers are presented with new information, they should adapt their beliefs and behaviour accordingly and in a permanent way; in the context of HERs, they would be expected to respond by adjusting and optimising their energy consumption. This is not, however, the case in practice: energy consumption slides back to previous patterns when consumers stop receiving HERs, perhaps because HERs are perceived as a cue and are promptly forgotten. Nevertheless, regularly receiving HERs can ultimately effect behavioural change by engraining energy saving habits through persistent reminders.

HERs were also tested in Malaysia in 2015, launched by the national utility Tenaga Nasional Berhad in collaboration with the Ministry of Energy, Green Technology and Water. In this first such programme in the Association of Southeast Asian Nations (ASEAN) region, HERs were sent to a total of 450 000 consumers: report recipients achieved energy savings of 1-3% relative to control group members, or about 50 000 MWh (Sachar et al., 2019). A similar HER trial is ongoing in Delhi, India, involving over 200 000 customers (Sachar et al., 2019).

Opower has recently been assessing and revising HERs (Oracle, 2020). As part of their general redesign, new HERs aim to provide more personalised reports for all types of consumers, and to facilitate their further engagement by guiding them towards complementary online tools (e.g. home energy assessments and high-bill alerts). Most importantly, alongside social comparisons (one's energy consumption compared with that of similar neighbours), revised HERs now also include an "efficiency zone" comparison to provide a compelling benchmark target, as well as an historical comparison with one's own energy consumption.

Building upon specific household features enables the provision of tailored insights according to season and appliances owned, and minor hurdles such as log-in requirements are minimised to facilitate access to personalised information and tips. Additionally, Opower's assessment of their longstanding HER programme has yielded insights on consumer motivation and perceived barriers to saving energy. For example, energy saving opportunities are perceived to be more limited in summer than in the winter.

Uplight, a software-as-a-service company helping energy utilities achieve their energy efficiency goals, points to a range of challenges and opportunities for HERs in the near future (Uplight, 2019). Disaggregated data gathered through smart meters should feed into more personalised reports and enable tailored demand-response requests. Personalised energy consumption information can be particularly helpful for consumers subject to time-of-use pricing.

Furthermore, smart home products (e.g. thermostats, lights, irrigation systems and electric vehicles) offer additional opportunities to optimise energy consumption through automation or prompts conveyed by apps or smart voice assistants, potentially in real time. All these elements could be integrated into HERs, both to gain a better understanding of energy consumption patterns and to provide tips for more effective energy savings.

An additional innovation in the field of HERs is the transition from the standard paper-based report to a system that combines digital platforms and machine learning to offer detailed insights via mobile applications, which can then be supplemented by paper reports. Digital reports have the double advantage of increasing consumer engagement and reducing programme costs for utilities, allowing them to be deployed to a larger set of consumers rather than high-energy-users only (Bidgely, 2020b).

By exploiting machine learning and data mining, software-as-a-service company Bidgely has constructed a more detailed picture of energy consumer behaviour to devise more personalised support and insights for consumers through "second-generation" digital HERs (Bidgely, 2020b). Greater personalisation allows better targeting of specific consumer categories with tailored, relevant messages (e.g. budget-conscious, eco-friendly, tech-savvy, etc.). In a partnership with SoCalGas, the leading utility provider in Southern California (serving 21.8 million customers), Bidgely's digital HERs delivered 286 000 therms of energy savings in three months (Bidgely, 2020a).

A similar technological solution is employed by Eliq, a Swedish company developing mobile applications for energy utilities: their mobile app exploits data analytics to simplify insights for consumers by splitting information between heating and other categories, and sending customers alerts about unusual consumption or power cuts (Eliq, 2020). An assessment of energy-use patterns of about 1 100 households in Norway indicates that electricity consumption decreased 6.8% on average after consumers started using the app (Eliq, 2020).

REDUCING PEAK-DEMAND STRESS

Extreme weather events such as heatwaves can put exceptional pressure on the power grid as swathes of consumers switch on the air conditioning. Keeping energy consumption down during such peak-demand events can ease pressure on the grid, avoiding planned blackouts and reducing dependence on backup energy sources.

In 2017, the Jemena Electricity Network, an Australian energy utility company, tested a demand-response intervention informed by BIs to reduce household energy consumption, especially during peak-demand periods on hot days. This was part of a collaboration with the Department of Environment, Land, Water and Planning of the state of Victoria and with BehaviourWorks Australia, a BI research team at Monash University (Jemena, 2019).

The primary aim of this intervention was to reduce stress on Jemena's electricity distribution network during times of peak demand, when households use three times more electricity than usual. To achieve this objective, the trial used competitions, goal setting and incentives to shift customers' perceptions of social norms.

The voluntary demand-response programme involved 613 households in six selected Victorian suburbs. Calls for Demand Response (DR) Challenges were sent throughout the summer with 48 hours' notice. Upon signing up for a DR Challenge, participants would be allocated an energy consumption target for a three-hour period, with the objective of reducing their normal usage. If they met their target, they earned points. Households were assigned to one of two treatment groups according their home's location, with earned points leading to *personal rewards* that could be converted into gift cards or *community rewards* that could be donated to local schools and community organisations.

In addition, households could participate in other educational challenges designed to inform participants about the electricity market and to provide tips to manage their electricity usage and bills through quizzes and videos. Feedback was supplied through smartphone apps and web portals, enabling consumers to monitor their progress in meeting energy saving objectives. While the variable cost to achieve peak-demand reductions from this particular trial was higher than the typical cost of demand response from large business customers, fixed set-up costs could be minimised by scaling up the programme and making it permanent.

In groups earning personal rewards, average energy consumption reductions during the six rounds ranged from 26% to 42% during the three-hour DR Challenge windows. The groups exposed to community rewards achieved statistically significant savings of 33-35% in only two of the six rounds, with non-statistically significant variations in energy consumption in the other four DR Challenges (Jemena, 2019). Apparently, community rewards are a weaker motivation than personal rewards for temporary energy saving efforts.

Awareness of grid stress issues was found to be high: 76% of respondents considered that residential customers should take steps to reduce stress on the grid if it can help avoid huge investments in infrastructure – thus building on the concept of social norms in communities.

Furthermore, 85% of participants reported that the intervention increased their awareness of energy conservation and motivated them to reduce their electricity usage and bills. Motivations mentioned by consumers for taking part in demand-response programmes included earning personal rewards, saving money on their electricity bill, learning how to reduce household electricity consumption, donating to a local charity (or their community) and reducing stress on the grid (Jemena, 2019).

Between 2018 and 2019, a behavioural intervention with the same objective was implemented in Australia's state of Victoria, by energy utility Powershop in consultation with the Behavioural Insights Team (BI Team). More specifically, the intervention aimed to understand what motivates people to participate in behavioural demand-response programmes, and what the drivers of energy savings are at times of peak demand (Behavioural Insights Team, 2019a).

Powershop's Curb Your Power demand-response programme involved volunteer households equipped with a smart meter. Ahead of an extreme weather event and related power demand peaks, these households were notified by SMS and invited to reduce their energy consumption. Consumer responses were solicited from a few hours to seven days prior to the extreme event, generally for a time window of one to four hours. Consumers were given a personalised energy saving target calculated based on their energy consumption history, and were rewarded with a AUD 10 discount on their next electricity bill.

While its reliance on rewards makes Curb Your Power a classic economic incentive, the trialled intervention also made use of BIs to increase participation and ensure higher energy savings. More specifically, it leveraged social norms in two ways: in one treatment group, it allowed users who had already volunteered for the demand-response programme to choose whether to keep their reward or donate it to a community charity (similar to the Jemena programme). In a second treatment group, messaging was anchored to group belonging, highlighting the influence of like-minded volunteers opting to reduce their power consumption during extreme weather events. Another group was exposed to a lottery, being given the chance to win prizes worth up to AUD 5 000 each time they engaged in demand-response efforts. Finally, a fourth group received spontaneous invitations to take part in the demand-response exercises ("Surprise! We need your help") without having previously signed up.

Although recipients of the lottery-related message used 6% less energy on average than standard-message receivers, the impacts of the messages leveraging social norms and rewards were not statistically significant. Conversely, defaulting utility customers into the programme had an important effect: sending spontaneous messages to all utility consumers led to three times the average individual energy savings, indicating a potential 2-3 MWh reduction in energy usage per demand-response event (compared with the business-as-usual scenario).

This points to the importance of reducing friction by not requiring customers to explicitly sign up, but to rather send invitations to the entire population to take part in energy saving efforts ahead of critical demand peaks. Furthermore, volunteer households that did sign up to receive invitations to reduce peak energy usage generally had lower baseline energy consumption already, and a higher chance of relying on solar power. Expanding the pool of customers invited to join a demand-response effort, which can be done easily by generalising messaging to all, can thus lead to larger savings.

SUPPORTING THE USE OF SMART APPLIANCES AT PEAK HOURS

As intermittent energy sources such as wind and solar are integrated into the power market, time-of-use electricity tariffs can make it easier for consumers to use their appliances during periods when the power supply is abundant and generated from renewable energy sources, while also reducing their energy bills. At the same time, however, inflexible daily schedules may not allow consumers to freely adjust their appliance use: smart appliances can help reduce the burden of planning and automatically power up when energy tariffs are most advantageous. This type of feature can counteract consumer inertia and encourage a shift in the timing of energy-intensive activities – washing, drying, ironing and dishwashing – to periods when wind and solar power are more abundant and energy prices are lower.

In 2011, a field trial supported by energy utility RWE and appliance manufacturer Miele was conducted among 41 households in Essen and Wesel, Germany. The study tested whether smart appliances can enhance energy demand flexibility by analysing their impact on behaviour when consumers were faced with time-varying prices due to intermittent availability of renewable energy (Stamminger and Anstett, 2013).

To achieve this objective, the trial leveraged changes in the home environment and in the features of standard appliances by providing consumers with smart appliances (washing machines, dishwashers, dryers and irons) connected to smart meters. The appliances were programmed to start only when price signals were low, and consumers would need to shift their own personal behaviours and practices to match the triggered start of the appliance.

The study showed that potential energy and financial savings were the main motivators for programme participation. Between November 2011 and July 2012, the aggregate costs of powering the smart appliances were estimated at EUR 105, with flexible tariff use enabling average savings of 28% of that amount (Stamminger and Anstett, 2013). Considering washing machines, tumble-dryers and dishwashers as the main appliances for which operations can be shifted, a maximum shift of 10% of residential electricity consumption is possible: this pilot shows that smart appliances can enable this shift under flexible tariffs.

It may be particularly useful to consider changes in appliances' technical features when addressing problems associated with peak demand response in general. For instance, the study highlights that most pilots test the automation of air conditioners or electric heating thermostats to turn down (or off) during peak periods of electricity demand. Such devices, aside from being "smartly automated", also do not require any human intervention compared with devices such as washing machines and dishwashers, which need someone to introduce and remove clothes and dishes. Therefore, if all new air conditioners were – at minimum – planned to be "smart" by default (to operate according to price signals from the grid), considerable energy savings could be achieved without radical behavioural changes.

BOX 3: BEHAVIOURAL BARRIERS TO TIME-OF-USE ELECTRICITY PRICING

With time-of-use (ToU) tariffs, different electricity prices are charged at different times of day, providing price signals to consumers to shift usage from peak to off-peak times. Loss aversion, risk aversion and status quo biases can inhibit ToU tariff demand; opt-in policies can also reduce the uptake of such tariffs (Belton and Lunn, 2020).

Through a trial supported by the Irish Commission for Regulation of Utilities, consumers were faced with the simulated choice of getting a smart meter and being billed at either a flat or ToU tariff, while being exposed to different information frames. Overall, the trial findings indicate a high degree of smart-meter acceptance, with slightly more people responding positively to messages highlighting environmental benefits (80.6%) compared with monetary benefits (72.6%). Complex ToU tariffs were met with higher aversion, as consumers respond more positively to familiar flat tariffs (Belton and Lunn, 2020).

Asking consumers to estimate their personal consumption through personalised calculation tools had a substantially more positive effect on the quality of decision-making compared with tools that only gave costs based on the average user. While this is important to encourage the successful adoption of ToU tariffs, the more practical applications include encouraging consumers to shift their consumption to peak renewable energy production periods or, alternatively, discouraging energy consumption during peak demand periods on hot days.

APPLYING GREEN DEFAULTS TO BASELINE TEMPERATURE SETTINGS OF AIR CONDITIONERS

In India, the share of space cooling in peak electricity load is projected to rise sharply – from 10% today to 45% in 2050 (IEA, 2018). To address this rise in demand, the Government of India, in collaboration with the Bureau of Energy Efficiency (BEE), has mandated that all new room air conditioners manufactured, commercially purchased or sold in India as of January 2020 have a default set-point temperature of 24°C (Ministry of Power, 2020).

When new room air conditioners are switched on, they will start running at 24°C but will not prevent consumers from lowering the set-point temperature if desired. The policy is based on evidence that many consumers tended to set the temperature lower (18-20°C) and never change it again – so much so that it became the norm. In resetting the default each time the appliance is switched on, this policy aims to address consumer inertia and the status quo bias by obligating users to think about the cost implications of lower baseline temperature set points when they must choose to reduce the temperature every time. Moreover, this new default setting requires cognitive effort by the consumer if a lower temperature is desired, which should help limit temperature resets. It additionally signals to the consumer that 24°C is the best choice, serving as a healthy recommendation.

The 24°C default was chosen based on previous research by the Indian Institute of Technology at Kharagpur, and on studies by the American Society of Heating, Refrigerating and Air Conditioning Engineers (Ministry of Power, 2020). BEE held a meeting with air conditioner manufacturers to explore the technical feasibility of setting the default temperature at 24°C (Ministry of Power, 2020), and the positive results of the technical feasibility study enabled BEE and the government to advance the mandate. The implementation cost is minimal for the government, and the mandate does not require complex technical adaptation from the manufacturers. If applied to all air conditioning units, this policy could save 20 billion kWh of electricity in one year (CSE, 2018).

PROVIDING FEEDBACK THROUGH IN-HOME DISPLAYS AND OTHER DEVICES

The United Kingdom aims to install smart meters in every home and small business by the end of 2024. As part of this initiative, free in-home displays are being provided to households as feedback tools to deliver real-time information on their energy consumption. The nationwide rollout of IHDs has been motivated by evidence from multiple studies, including the 2015 Smart Metering Early Learning Project, which demonstrated that consumers with smart meters and IHDs used 1.5% less gas and 2.2% less electricity in 2011 than those with standard meters and no IHDs (Behavioural Insights Team, 2019b).

Alternative and more recent energy feedback technologies such as smartphone apps may, however, have different impacts from IHDs. Hence, in 2016 the UK Department for Business, Energy and Industrial Strategy (BEIS) allowed energy suppliers to offer customers alternatives to IHDs, such as smartphone apps, to test how they compare with IHDs in terms of energy savings (Behavioural Insights Team, 2019b).

Two energy suppliers have conducted trials to compare the effects of IHDs and phone apps on energy consumption. Broadly, the tested IHDs and apps provided the same core information (real-time and historical consumption), with apps offering additional services such as energy saving tips and push notifications.

The interest in testing the impact of flexible feedback mechanisms such as phone apps is that they can be easily tweaked to integrate multiple behaviourally informed levers (social norms and comparisons; framing of energy consumption information leveraging loss aversion; and broader personalisation and gamification) along with feedback provision. Further, phone apps have the important advantage of allowing users to consult their energy consumption data while away from home.

The trials indicated that engagement levels differed between IHD and app users: not all households offered the app downloaded it, but nearly all that were proposed a free IHD accepted its installation. This indicates that small hassles can create important friction, reducing coverage of the feedback device. However, one of the trials indicated that app users who downloaded and exploited the app showed greater engagement and were more likely to recommend it.

In its analysis of the trials run by energy suppliers, the BI Team concluded that apps were likely to lead to slightly higher energy consumption on average than IHDs (0.2-2.6% higher), although some statistical uncertainty was acknowledged (Behavioural Insights Team, 2019b).

Follow-up surveys and interviews indicated some explanation for the marginally superior performance of IHDs: they can appeal to a larger population, whereas apps suit more proactive users looking for additional features that allow more in-depth assessment of their energy consumption. For example, push notifications were found to be beneficial for prompting consumers to monitor their energy consumption.

The study concluded that the two technologies (IHDs and phone apps) are not direct substitutes but rather leverage different behavioural mechanisms. However, despite the versatility of the app as a platform to exploit social comparisons, tailored advice, gamification, etc., IHDs were still found to be slightly more effective to reduce customers' energy consumption.

Under the impetus of Japan's national Behavioural Sciences Team (BEST), the Ministry of Environment of Japan also benefits from digital technologies to collect and analyse data on household energy use (electricity, gas and automotive fuels), sending personalised prompts to individuals and households via smartphone apps and assessing how such prompts affect energy use (BEST, 2019). This initiative is ongoing.

An app connected to smart meters has also been tested as part of the PEAKapp project, which involves a large cross-country consortium of research institutions and energy utilities in Austria, Latvia, Estonia and Sweden. While the app provided customers with feedback on their energy consumption (similar to those described above), it also informed them of evolutions in the dynamic electricity prices to which they were subject (Reichl et al., 2019). This proved to be effective for prompting consumer response, but energy consumption variations differed from morning to afternoon, reflecting variable demand-response potential over the course of the day.

The app also included games to provide insights into one's own electricity consumption in absolute terms and relative to similar households, integrating social comparisons. The advantage of including social comparisons in an app rather than in HERs is that it allows information providers to know whether consumers have accessed the information tools. However, as consumer interaction with mail and smartphones varies, different media could be used for different consumer categories.

ENHANCING CONSUMER ENERGY SAVING AND ENERGY EFFICIENT PURCHASES THROUGH WEB-BASED INFORMATION CAMPAIGNS

In the Netherlands, the Ministry of Economic Affairs and Climate Policy, with support from expert panels, the internal BI team and other ministries, tested and implemented a behaviourally informed, web-based communication campaign aimed at encouraging behaviour change for environmental sustainability.[9]

The campaign, launched in 2019 and still ongoing, has the double objective of enhancing consumer participation in energy saving measures and enabling consumers to make efficient energy choices. To achieve these goals, the campaign presents simply framed information on various consumer options to save energy in different areas of daily life and consumption: energy, food, transport, and waste recycling and reuse. For instance, the campaign includes information on insulation and possible measures one might apply; it also provides links to possible subsidies and institutions that can help execute these measures. In addition, it exploits the use of social norms by showcasing success stories of people who, for instance, installed roof insulation in their home.

LEVERAGING REWARDS AND GAMIFICATION IN UTILITY PROGRAMMES

Gamification strategies are being increasingly used by energy utilities to engage consumers in pro-environmental behaviours. Such strategies aim to maximise participants' cognitive, emotional and behavioural engagement through gaming features that prompt feelings

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[9] Information in this section based on responses to the Users TCP survey. The campaign website is https://www.iedereendoetwat.nl/.

associated with meaning, ownership, social influence and accomplishment (Ouariachi, Li and Elving, 2020).

Since 2008, BC Hydro, an electricity utility in Canada's province of British Columbia, has been running a voluntary customer loyalty programme called Team Power Smart, inviting consumers to participate in an energy saving challenge to earn rewards (Kassirer, Korteland and Pedersen, 2014).

The programme's goal is to encourage customers to reduce their energy consumption by exploiting multiple behavioural levers (social norms; goals and commitments; and rewards and incentives) to address barriers to energy efficient behaviour. Obstacles range from the fact that energy efficiency may not be a high priority in everyday life, to misconceptions that savings are negligible or even impossible if one considers oneself to already be an exemplarily efficient consumer.

Voluntary participants in the energy saving challenge are invited to achieve 10% energy savings over the course of one year: meeting this goal earns them CAD 50. Team Power Smart members also have the opportunity to join exclusive contests (e.g. seasonal challenges with specific tasks) and receive dedicated communications, special offers and vouchers for partner stores and member events.[10] The programme leverages social norms by sharing success stories from other team members to maintain motivation.

The programme aims to increase participant engagement through three dimensions: enjoyment, affiliation and resonance (Kassirer, Korteland and Pedersen, 2014). Rewards such as cash bonuses increase the enjoyment factor of the challenges, while a positive perception of affiliation with the programme is stimulated by using gadgets with the programme logo (e.g. clothes pegs to encourage line-drying as an energy efficient practice). Voluntary signup for the programme and commitment to a specific goal aim to boost resonance (Kassirer, Korteland and Pedersen, 2014).

Active membership has increased since 2008. More customers accept the challenge every year, and a growing proportion of participants have reduced their energy consumption by 10% or more. However, programme assessment also indicates that participants who completed the challenge but then did not sign up for another one have subsequently slipped back slightly: this might be due to the absence of a fixed goal and associated financial reward, together with fatigue from the year-long challenge (Kassirer, Korteland and Pedersen, 2014). The next step would be to leverage BIs to establish challenge-driven energy efficient practices into daily routines to ensure durable savings.

Promoting efficient heating practices at home

DISCOURAGING NON-ESSENTIAL WOOD HEATING

Although wood heating is associated with images of cosiness and warmth, it is an important source of indoor air pollution. In the Paris region, for example, it generates roughly one-third of particulate matter (PM) emissions – as much as private motor vehicles (DITP, 2020a). At the same time, it also has some relative benefits: CO_2 emissions from wood heating are relatively low in France thanks to careful forest management and wood sourcing, and it is one of the most affordable heating options, thus helpful in combating energy poverty. The complexity of this situation requires that a behaviourally motivated approach be used to

[10] https://www.bchydro.com/powersmart/residential/team-power-smart.html.

identify groups of users who do not rely entirely on wood heating to reduce its use in non-essential contexts.

For this reason, France's BI team (nested within the DITP, the inter-ministerial department for the transformation of public institutions), in co-operation with the regional environment and energy department (DRIEE), developed a behavioural diagnostic to identify the barriers to mainstreaming a realistic perception of wood heating (DITP, 2020a). A field intervention was subsequently implemented during the winter of 2019-20 to reduce the use of non-essential wood heating in the Paris region (DITP, 2020b).

The field intervention relied on letters framing information on the air pollution emissions associated with wood heating in a simple way, highlighting the importance of prevention to avoid negative health impacts. The letters exploited the trusted-messenger effect, citing scientist and doctor expertise, as well as the pressure to conform with social norms, reporting comparisons with neighbours. The impacts of such targeted messaging were assessed by measuring indoor air pollution variations through specific sensors, and by surveying participants to gauge their understanding of the implications of wood heating.

Participating households were randomised into different groups to test the impact of letters providing (1) only general information (information on the health implications of fine particulate emissions), or (2) both general and specific information (adding data on the specific indoor air pollution levels measured in one's household, ranked relative to that of neighbours), as opposed to the control group.

Letters with both generic and personal information were found to catalyse a change in attitude for recipients, who indicated greater awareness of the health impacts of wood heating and the intention to use it less in the future. However, findings indicate that letters containing general information on health impacts alone were not sufficient to drive a change in behaviour, so pre-existing levels of wood heating and related indoor air pollution were maintained. Letters encompassing the health impacts as well as personalised air pollution ratings and social comparisons reduced PM2.5 levels by 20%.

FACILITATING EFFICIENT HEATING

Different individuals have different preferences for heating their homes and adjust the timing and temperature of their heating systems accordingly. These decisions can be influenced or hindered by the complexity or opacity of heating controls and by behavioural inertia, leading to unnecessarily high energy consumption or low thermal comfort.

Informing households of how to best use their heating controls to ensure efficient heating and optimal comfort is complex (see DECC [2014] and OECD [2017b] for an example of information-framing that leverages the trusted-messenger effect).

Digital technologies can be employed to simplify this task for consumers. For example, smart heating controls such as Nest learn from heating patterns and thermal performance to deliver automatically high thermal comfort in an energy efficient way. This still allows consumers to adjust temperature settings manually using the thermostat or an app. Prompted by smart thermostat manufacturer Nest, the BI Team implemented a range of field studies between 2014 and 2017 to assess the impact of smart thermostats on energy consumption, relative to other modern heating controls such as programmable timers, room thermostats and radiator valves (Behavioural Insights Team, 2017).

The intervention effectively amounted to testing the impact of a connected device that differs from standard thermostats in design, associated with simplified and intuitively framed information on energy consumption. Information was transmitted to consumers through HERs, the thermostat itself and a connected app.

The studies indicated that the Nest Learning Thermostat (NLT) saved, on average, 6-7% of the gas consumption of central heating systems, which translates into 4.5-5% lower total annual household gas consumption. Additionally, these energy savings did not reduce thermal comfort. Savings could be larger if the NLT were introduced in households that rely on thermostats without timers or on-off switches on radiators.

One trial tested the impact of Nest's opt-in Seasonal Savings algorithm, which aims to achieve energy savings in winter by "reducing temperatures by fractions of a degree overnight and at other moments the user is deemed unlikely to notice" (Behavioural Insights Team, 2017). The trial indicated that Seasonal Savings achieved additional average savings of around 4.5% of heating system gas use among users who opted to activate this Nest thermostat feature. Overall aggregate savings could be substantial if this NLT feature were mainstreamed to all users – making it the default rather than an opt-in feature.

Increasing renewable energy uptake by residential users

Household-level investment in solar photovoltaic (PV) panels is hindered by behavioural barriers such as consumer inertia and by market barriers associated with the scale of projects (i.e. their high upfront costs and complexity). Installing solar panels involves addressing numerous technical issues, and choosing a contractor can feel overwhelming.

The first Solarize campaign began as a grassroots initiative among residents in Portland, Oregon (United States), wanting to install solar panels. Joining forces in a community project therefore simplified the decision-making and investment processes. Thanks to support from the US Department of Energy, this small-scale initiative has grown into the Solarize programme, and lessons from community investments over the years have been gathered into a guidebook (Irvine, Sawyer and Grove, 2012).

The objective of the Solarize programme is to increase the uptake of renewable energy systems within communities by leveraging the influence of social norms; information simplification and framing; and goals and commitments. More specifically, community-led outreach has benefited from the engagement of trusted messengers. Contractors were selected through competitions managed by community volunteers to simplify the process for householders, who could then interact with a preselected, trusted contractor. Limited-time offers encouraged commitment and created a sense of urgency.

The programme has been highly successful: in 2010, it prompted 400 installations in Portland – a more than 400% increase from the previous year. While the number of Solarize installations fell in 2011, overall PV installation rates in Portland remained very high, with the number of independent installations on the rise. The project has demonstrated that community-oriented targeting can definitely fuel an increase in renewable energy installations. Moreover, the upsurge in independent installations in 2011 suggests that the initial large-scale installation was critical to lay an infrastructural foundation and to simplify the process to make independent installations easier.

BOX 4: EFFECTIVE BEHAVIOURAL DIAGNOSTICS: IDENTIFYING BARRIERS TO THE UPTAKE OF EFFICIENT COOKSTOVES IN UGANDA

BIs can inform assessments of both the structural and behavioural barriers to the uptake of energy efficient behaviours and assets. For example, the World Bank's Energy Sector Management Assistance Program (ESMAP) has built on research in the behavioural sciences to systematically identify barriers to the spread of efficient cookstoves in Uganda (ESMAP, 2019). The project involved desk research, interviews and focus groups with consumers as well as other key stakeholders along the value chain (e.g. cookstove manufactures and distributors).

The analysis identified numerous barriers and potential solutions to address them that will need to be tested in the field.

Barriers	Potential solutions
High costs: Improved cookstoves are perceived as luxury items because of their higher upfront price, even though they deliver savings throughout their lifetime.	With appropriate reframing considering both investment and use costs, standard stoves would appear as the "luxury" option.
Low trust in institutions: Consumers and distributors have little confidence in savings organisations and credit co-operatives.	Identifying trusted credit institutions and involving them in efforts to promote efficient cookstoves would help raise confidence.
Limited access: Few shops provide efficient cookstoves, which limits consumer awareness as well as demand.	Centralised retail points where consumers can not only purchase but also test efficient cookstoves and ask questions about their benefits, as well as learn about credit options, would be useful. Public demonstrations and information campaigns can also help raise awareness.
Limited word-of-mouth despite general satisfaction with efficient cookstoves.	Referral programmes leveraging the influence of social norms could be established.
Low awareness of the limitations of traditional cookstoves (health and financial implications).	Focus could be drawn to the concrete benefits of efficient cookstoves (financial savings) rather than seemingly abstract concepts (health impacts). Framing of such messages is extremely important: storytelling based on first-hand experiences can help.
Rare public demonstrations of efficient cookstoves.	Developing standardised public demonstrations that can be easily executed with little training could be beneficial.
Gender barriers: Women are the key stove users, but they need to convince male household heads to purchase new efficient cookstoves.	Marketing campaigns should acknowledge gender barriers and provide messages that women can use to convince household decision makers to purchase efficient cookstoves.
Few credit options for low- and mid-priced cookstoves are available.	Partnering with alternative credit providers could be effective: telecom companies might be able to offer automatic layaways towards a "cookstove fund".
Low durability and lack of confidence in warranties: Efficient cookstoves are generally less sturdy than traditional options, and consumers do not trust warranty claims.	Manufacturers should be convinced to invest in durable designs as well as repair services and spare parts to offer a complete product package.

BOX 5: THE CONSORTIUM FOR ENERGY EFFICIENCY'S WORK ON BEHAVIOUR

The Consortium for Energy Efficiency (CEE) brings together nearly 100 gas and electricity energy efficiency programme administrators in the United States and Canada. CEE has over 25 years of experience working to accelerate the uptake of efficient products and services in residential, commercial and industrial markets. Its behaviour-related work addresses the growing interest in applying lessons from the behavioural sciences to energy efficiency and demand-response programmes, and the expanding role of digitalisation in homes and businesses. Projects range from deep investigations into specific aspects of behavioural energy efficiency programmes – such as the persistence of their effects (Ashby et al., 2017) and the regulatory treatment of behaviour change – to detailed descriptions of the features and impacts of behavioural programmes implemented by CEE member organisations.

In recent years, CEE has collected and analysed evidence on how BIs are being leveraged in energy efficiency programmes that include digital technologies. Each year, CEE releases a report detailing behavioural programme examples from the United States and Canada (CEE, 2017). This report discusses the BIs and technological tools incorporated into the programmes, as well as the specifics of the evaluation processes and programme impacts.

The table below lists key features of many of the programmes and pilots, which are described in detail in the report available online. Additional programmes are discussed in the 2019 programme overview.

Key features of the programmes and titles discussed in CEE (2017)

Geographical scope	Institution(s) in charge, programme or pilot title	Objective	Sectors	Technology, tools deployed	Behavioural levers
California, United States	Pacific Gas and Electric: *Home and Business Area Network (HAN)* [Pilot]	Help customers exposed to time-of-use pricing monitor their energy use and costs in real time to support energy savings	Residential customers, small and medium businesses	IHDs, apps, web-based portal	Simplification and framing of information; use of feedback mechanisms
San Diego, California, United States	San Diego Gas and Electric: *Manage-Act-Save* [Pilot and programme]	Help consumers visualise and understand their energy use in more detail through insights reports (both paper and e-mail)	Residential customers	Smart meters, insights reports	Simplification and framing of information; social norms and comparisons; reward schemes
Communities in Wisconsin, United States	Focus on Energy and Wisconsin Public Service: *iCanConserve* [Pilot]	Determine customer acceptance, cost-effectiveness, and transferability of large-scale pilots including power tariff designs, customer education, information and tools, and energy efficiency initiatives	Residential and commercial customers	Smart thermostats, IHDs, home energy management systems	Simplification and framing of information; goal setting and commitment devices; reward schemes
Maryland, United States	Baltimore Gas & Electric Company: *Smart Energy Rewards®* [Programme]	Reduce peak summer energy demand by engaging consumers in a rewards programme	Residential customers	Smart meters, prompts by e-mail, text message, phone	Simplification and framing of information; goal setting and commitment devices; reward schemes
Maryland, United States	Baltimore Gas & Electric Company: *Smart Energy Manager®* [Programme]	Help customers monitor their energy use and costs in real time through online tools and HERs	Residential customers	HERs; smart meter; IHDs	Simplification and framing of information; social norms and comparisons; feedback mechanisms

Oregon, United States	Energy Trust of Oregon: *Nest Thermostat Heat Pump Control Pilot*	Encourage energy savings by controlling heat pumps through Nest smart thermostats	Residential customers	Nest smart thermostat; related app and online portal	Changes to the physical environment; feedback mechanisms; changes to the product's default specifications (learning from occupants' behaviour)
Sacramento, California, United States	Sacramento Municipal Utility District: *IHD Checkout Pilot*	Help customers monitor their energy use and costs in real time to encourage energy savings	Residential customers	IHDs	Feedback mechanisms
Sacramento, California, United States	Sacramento Municipal Utility District: *SmartPricing Options* [Pilot]	Encourage energy conservation by offering IHDs to customers with time-based pricing plans	Residential customers	IHDs	Simplification and framing of information; feedback mechanisms
California, United States	Pacific Gas and Electric: *Smart Thermostat Pilot*	Facilitate energy savings for heating and cooling through the use of smart thermostats	Residential customers	Smart thermostat	Changes to the physical environment; simplification and framing of information; feedback mechanisms
Cape Cod, Massachusetts, United States	Cape Light Compact: *Smart Home Energy Monitoring Pilot*	Help customers monitor their energy use and costs in real time to support energy savings	Residential customers	IHDs; web interface	Feedback mechanisms; goal setting and commitment devices; reward schemes
Michigan, United States	DTE Energy: *DTE Insight Smartphone App* [Programme]	Develop smartphone apps that provide access to energy use	Residential customers	Smartphone application	Feedback mechanisms; goal setting and commitment devices
California, United States	Southern California Edison: *Save Power Day* [Pilot]	Encourage customers to save energy on specific event days through peak-time rebates enabled by smart thermostats	Residential customers	Smart thermostats	Feedback mechanisms; reward schemes; goal setting and commitment devices
Vermont, United States	Efficiency Vermont: *Continuous Energy Improvement* [Pilot]	Improve energy efficiency of large commercial and industrial customers through comprehensive energy management prompting structural upgrades and behaviour change	Commercial and industrial customers	Energy tracking tools	Feedback mechanisms; goal setting and commitment devices; social norms and comparisons

Main insights from case studies

Energy utilities have been the most active category of institution in designing and implementing behavioural interventions to support energy efficiency in residential buildings (Figure 8). Their efforts have revolved mainly around demand-response programmes to alleviate grid pressure, as well as continuous efforts to engage customers in best practices to achieve energy savings.

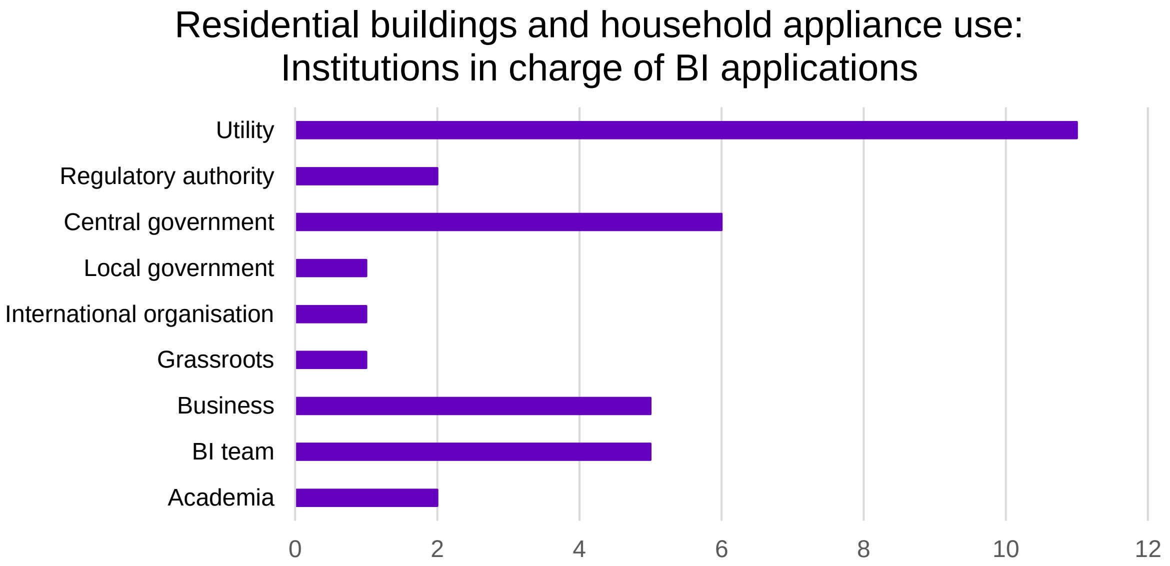

Figure 8. Institutions in charge of BI applications for policies and programmes addressing residential buildings and household appliance use

Of the 21 behavioural interventions analysed in this policy area, 16 leverage simplification and framing of information, either through energy efficiency labels for appliances and information campaigns to guide investment decisions, or as part of feedback mechanisms (Figure 9).

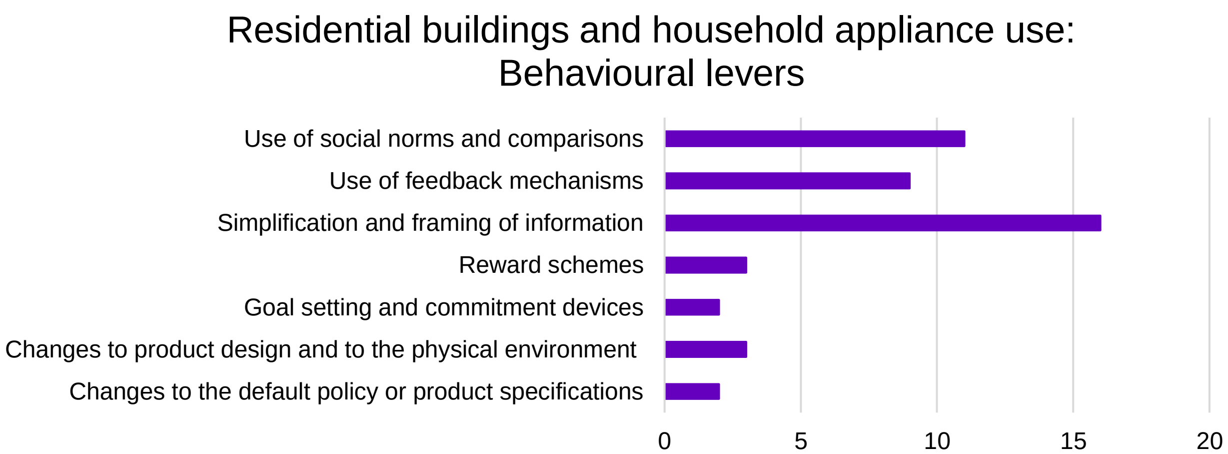

Figure 9. Behavioural levers used in interventions addressing residential buildings and household appliance use

Feedback mechanisms that help households understand and track the evolution of their energy consumption practices have been deployed through many communication channels: letters and e-mails for HERs, and digital tools such as IHDs and mobile phone apps for continuous real-time feedback.

Social norms and comparisons have often been employed in conjunction with feedback mechanisms to portray a household's energy consumption relative to that of similar households in the same neighbourhood. They have also motivated the design of group or community-based incentives for the uptake of energy efficient and renewable energy technologies.

Over half of the interventions addressing residential energy consumption and household appliance use (mainly trials and pilot programmes) have been implemented at the national level (Figure 10). Full-scale programmes have been developed and implemented by energy utilities at the state level in the United States, and at the national level elsewhere. Finally, over three-quarters of interventions in this area are behaviourally tested.

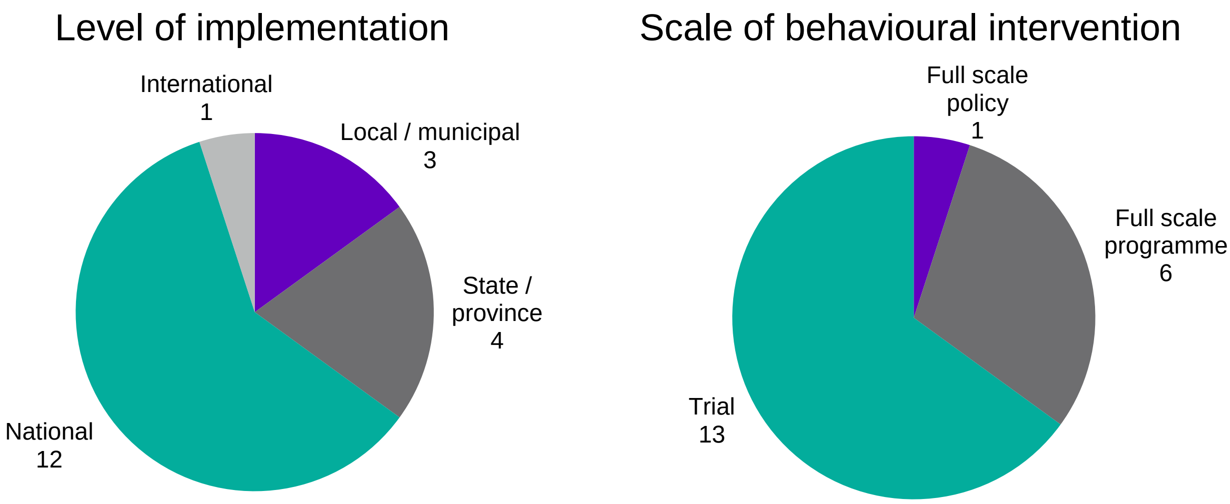

Figure 10. Jurisdictional level of implementation and scale of BI applications addressing residential buildings and household appliance use

BI-informed information provision at the point of sale through labels effectively promotes investments in low-cost energy efficiency improvements such as appliances

While energy efficiency labels for appliances are a cornerstone of energy efficiency policy, their design can benefit from the application of BIs. Simplifying the information contained in labels, and framing it to make the energy and financial savings associated with energy efficiency more obvious, can guide consumers towards purchasing more efficient appliances.

Where energy efficiency labels are not mandatory, online utility platforms (or "marketplaces") have proven effective in providing information on appliance energy efficiency, aiding consumers in their consumption decisions. This type of platform might more generally help consumers connect the observation and payment of their energy bills with efficiency considerations, to possibly reduce the effects of inertia and hassle factors and prompt them to purchase more efficient appliances.

Online utility platforms ultimately simplify the connection between energy consumption and energy savings investments. An additional advantage of connecting energy utility billing platforms to marketplaces is the possibility to flag and rebate any utility discounts for energy efficient appliance or lightbulb purchases at the source. Such interventions also display the positive effects of co-operation between energy utilities and companies providing services such as utility-branded marketplaces.

Known applications of BIs to the design of initiatives supporting energy efficiency investments have not been successful thus far, indicating outstanding investment barriers

Investing in energy efficient retrofits and appliances generally entails substantial upfront costs with the promise of future savings. Because of the intertemporal nature of the costs and benefits associated with such consumption decisions, informing consumers of the expected lifetime costs and benefits of various appliances (e.g. through labels) can lead to better-informed and more efficient investments.

The two interventions aimed at promoting investment in home retrofit measures therefore leveraged information provision through targeted messaging, highlighting eligibility for heat pump incentives, in-person events to discuss the benefits of home retrofits, and free home energy audits to deliver targeted assessments. Nevertheless, neither intervention significantly boosted retrofit uptake, possibly because the required investments may be considerable (or perceived as such), depending on the state of the building.

Energy saving efforts can be encouraged by providing feedback through HERs that capitalise on social comparisons, and through in-home displays and smart meters

HERs have been popularised by companies such as Opower, which specialises in BI application to translate the energy consumption information usually buried in energy bills into crisp, compelling documents for consumers. Alongside consumption information, a key feature of HERs has been the inclusion of social comparisons, allowing consumers to visualise how their own power consumption fares relative to that of similar, neighbouring households. These reports have proven effective in prompting energy saving efforts in many regions (e.g. the United States, Japan and Malaysia). Persistence of energy conscious behaviours can be encouraged through sustained reporting.

Further, alternative modes of communication can be tested and leveraged to provide feedback to residential energy consumers – from smartphone apps to IHDs. Different tools can be used depending on feedback frequency and its objective: for example, IHDs can be paired with smart meters to inform consumers of general consumption trends. Alternately, timely prompts alerting consumers to time-varying energy prices might be best delivered through a smartphone, given that it is generally at hand. Smart appliances provide additional opportunities to optimise energy consumption in a relatively hands-off way for consumers.

Targeted campaigns can help raise awareness about peak-time energy consumption and motivate consumers to reduce their power usage at critical times. Utilities can assist by inviting consumers to set an energy saving goal and incentivise its achievement through small discounts or in-kind rewards (e.g. membership programmes in affiliated businesses).

Gamification and social norms can also be exploited in such membership programmes to connect entertaining group activities with energy saving commitments.

Changes to the physical environment inside homes, such as through smart meter and IHD installations, can alter the choice architecture increasing the visibility of their energy consumption and prompting them to make energy saving efforts. Similarly, changing certain product design features (e.g. the set-point temperature of thermostats and air conditioners) is a way to make appliances more efficient by default.

While some behaviourally informed initiatives prompt consumers to reduce their residential energy consumption as a whole, feedback and information provision can also be useful to address particularly energy-intensive practices, such as wood heating.

Tapping into people's desire to conform with social norms is boosting distributed renewable energy uptake

Social norms can be leveraged in dedicated campaigns to foster community-level investment in renewable energy installations, overcoming the barriers – from the sheer complexity to the high costs – that hinder single households from investing. Programmes such as Solarize, implemented in the United States and inspired by grassroots efforts from Portland, Oregon residents, can help overcome hurdles associated with installing rooftop solar panels. In this programme, community-led outreach through trusted local messengers raised interest in collective solar PV installations, gathering sufficient participants to contract service providers under better conditions than individual households might have been able to negotiate. Through collective procurement, selecting and following up with contractors can be handled by community co-ordinators, simplifying the process for participating households.

This type of collective outreach and agreement could be tested more broadly, as being able to rely on shared services within the community (procurement, monitoring and information exchange) appears to motivate households to consider large, complex investments such as solar panels and home retrofits.

Chapter 4. Transport and mobility

Introduction

Transport accounted for 35% of final energy consumption in selected IEA countries in 2018: passenger cars alone consume roughly about the same amount of energy as the entire residential subsector, with respectively 21% and 20% of final energy consumption (IEA, 2020d – see Figure 1, Chapter 1).

Individuals, households and businesses regularly make transport-related decisions that have important energy implications. Such decisions can involve one-time but durable investments with long-term implications, such as obtaining a driver's licence or buying a car, or can be short-term but possibly recurring choices, such as the timing, routes and means of commuting (Garcia-Sierra, van den Bergh and Miralles-Guasch, 2015). Residence decisions also affect transport and mobility patterns, as whether one lives and/or works in an urban, suburban or rural area will give access to different transportation networks.

Many interconnected factors affect transport-related decisions. Some are structural, including availability, accessibility and location of infrastructure, while others are personal and reflect preferences and budget constraints as well as attitudes, habits, and underlying behavioural mechanisms (Department for Transport, 2010).

This chapter discusses the drivers of mobility and transport decisions, and points to how behavioural insights (BIs) can inform policy efforts to increase energy efficiency in transport, through technological investments and through a modal shift towards low-carbon mobility options and practices.

What motivates mobility and transport decisions?

The *structural drivers* are external conditions such as the availability, accessibility and location of public transport and of walking and cycling infrastructure, as well as the user costs of different transport options and, consequently, their affordability. These aspects are affected by transport and mobility policies, including vehicle registration fees, distance-based taxes, congestion prices and parking fees. Travellers can generally take these factors as a given.

Mobility and transport decisions are also affected by *personal factors* such as individual preferences for different transport options and budget constraints, as well as by more subtle behavioural mechanisms. The latter shape perceptions of the costs and risks associated with the various transport modes, as well as the perception of one's ability to use them safely. For example, overly optimistic drivers tend to systematically overestimate their driving ability, thus downplaying the risks (known as "optimism bias"). This is just one of several implicit behavioural mechanisms that can affect transport mode decisions.

Multiple behavioural mechanisms can cause transport habits and purchases to deviate from the established norms of perfect rationality, self-interest and willpower.

Social and cultural norms strongly influence decisions – from choosing one's home location to obtaining a driver's licence to commuting by car, bicycle or public transport. Each of these choices in fact provides the possibility to adhere to the norms of a certain social group.

Mobility habits tend to be characterised by *inertia*, as people rarely reconsider their commuting route. Inertia also plays out in the long-term choice of one's default transport option, and the *status quo bias* as well as the *endowment effect* may lead consumers to overvalue the flexibility of owning a personal vehicle compared with using a shared-mobility scheme (Pankratz et al., 2017). Because of *loss aversion*, consumers may hesitate to relinquish vehicle ownership, fearful of not having the option to use their own car whenever they wish. Additionally, even though the purchase cost of one's vehicle is sunk, consumers might feel compelled to maximise its use to justify the investment, thus shunning alternative mobility options even when they would be both more convenient and less costly.

Travellers' knowledge and awareness of the features and availability of different transport options also affect their perception of relative convenience. For example, because of *time inconsistency*, people tend to undervalue the benefits of seemingly small improvements in vehicle fuel efficiency at the point of purchase: this is because initial investment costs loom large, while it is difficult to estimate the reduced lifetime costs of a more fuel-efficient vehicle. Confusing framing of fuel efficiency indicators and labels can reinforce the time inconsistency factor by misguiding consumers.

Furthermore, there is evidence that consumers underestimate the costs of owning and using a vehicle by up to 50%: while they tend to correctly estimate fuel costs, expenditures associated with repairs, insurance, depreciation and taxes are undervalued (Andor et al., 2020). There is a structural reason for this: insurance and maintenance expenses are generally infrequent (e.g. paid annually), whereas fuel costs are incurred regularly and are therefore much more prominent. *Misestimation* of this kind and magnitude can substantially tilt investment decisions towards private motorised vehicles and away from public transport passes or memberships in shared mobility schemes.

Finally, because of *aversion to uncertainty*, travellers tend to dislike variability in travel time more than duration unpredictability (Garcia-Sierra, van den Bergh and Miralles-Guasch, 2015). Because travel times tend to be systematically overestimated, public transport can be perceived as unreliable in systems characterised by high variability.

These structural and behavioural factors combined can hinder the uptake of fuel-efficient vehicles and the use of soft mobility options such as public transport and bicycles. Next, we discuss how insights from the behavioural sciences can help policy makers and transport programme managers address obstacles.

BOX 6: THE IMPACT OF THE COVID-19 PANDEMIC ON TRANSPORT AND MOBILITY BEHAVIOUR

One of the primary impacts of the Covid-19 pandemic on the energy sector has been the sharp reduction in passenger transport use.

In addition to border closures and lockdowns, behavioural factors have also spurred lower transport use during and following lockdown periods. For many people, a fear of crowded mass transport modes, where the perceived risk of contracting the virus is higher, has been a strong driver in their decision-making. Behavioural scientists refer to this as “dread behaviour”.

In cities, commuters are shifting away from public transport, with smartphone data suggesting a 40% cut in public transport use in many cities. Urban commuters appear to be opting for private cars (when available) or active transport such as walking or cycling. Long-distance trips are also changing, with travellers opting to drive rather than fly (IEA, 2020b).

While it is still too early to tell whether such behavioural changes will result in long-term changes in transport demand and energy use, experience from previous crises suggests that well-designed policies will be crucial to incentivise mobility choices that get people “from A to B” while also maximising positive health, environmental and economic outcomes for society. Applying BIs can further boost policy efficacy.

For example, research has shown that people perceive danger differently depending on factors such as gender. Policies that raise perceptions of safety for sustainable modes of transport such as cycling – by building dedicated infrastructure or reducing motor vehicle speed limits, for example – could help ensure the maintenance of cycling rates, which have risen rapidly since the pandemic began.

Incorporating BIs into the design of active transport infrastructure can also boost its effectiveness. The City of Paris’s new cycling network includes electronic information boards along several routes, providing live data on the number of cyclists that have used the route over the current day and year. These tap into the power of feedback loops, which have been proven effective in cementing new behaviours by both helping individuals see how their actions are contributing to larger societal change and making their actions tangible.

Policies promoting sustainable transport should also address dread behaviour and the strong desire of some people to travel in what they perceive to be the relative safety of their cars. Policy makers seeking to counteract such tendencies could consider communicating the risks and benefits of different transport choices. For example, while car travel may appear safer because it avoids human contact during a pandemic, it carries its own risks – from road fatalities to the long-term health impacts of air pollution.

How can BIs support energy efficient transport behaviour?

Using BIs to identify the structural and behavioural factors supporting or hindering specific travel choices can result in better transport policymaking and programme development. Identifying these factors is necessary to correctly define the policy problems that need to be addressed as well as their scope (whether general or pertaining to specific social groups), and to map possible policy solutions.

Structural barriers pertaining to infrastructure and mobility policy require structural policy interventions: BIs can help policy makers understand the critical shortcomings perceived by users, and better communicate the policy and infrastructure changes implemented to address them (Department for Transport, 2011).

Behavioural policy levers can help address the behavioural obstacles to the use of soft mobility options and to the uptake of fuel-efficient vehicles (Department for Transport, 2010; 2011; Behavioural Insights Team and Alta Planning + Design, 2017).

Framing and simplifying information is critical when designing information tools geared towards investment as well as regular mobility choices. For example, to overcome the short-sighted preferences that hinder fuel-efficient vehicle purchases, fuel efficiency labels could include the estimated driving costs of the most efficient vehicle in the class, as well as use costs not based on distance travelled (i.e. insurance, maintenance and repairs).

Similarly, travel planning and mapping tools could leverage loss aversion and compare the full, standardised costs of various travel options (private car, shared car, bicycle and public transport). In the same way as smart energy meters and in-home displays can provide a real-time picture of energy consumption patterns in the home, similar devices could help drivers visualise fuel consumption when they use their motorised vehicle.

Additionally, translating fuel consumption information into financial costs and environmental impacts can simplify estimation for consumers, directly linking their mobility patterns to their expenditures and making the connection more visible (Franckx, 2017).

Information can be perceived differently according to how the content is framed, but also depending on how the message is conveyed – whether through a brochure, a letter, an SMS or a large-scale information campaign. Identifying trusted messengers to channel information is important to ensure that consumers perceive the information as credible.

Providing feedback to travellers on their mobility patterns, as well as in comparison with those of their peers, can help raise awareness of individual and collective habits, and of the associated expenditures and environmental impacts. Data sources can include local travel surveys and big data from smart cards used to access public transport and shared mobility services.

Real-time feedback could be provided through travel planning tools and apps indicating the cost of driving one's specific car over a certain route relative to the most efficient vehicle in the same class, as well as the associated CO_2 emissions.

Both general information and personalised feedback are most useful when delivered in a timely manner at opportune moments, such as when individuals are experiencing a major change – be it a change in job, home or family situation – and may thus be particularly inclined to alter their habits (Department for Transport, 2011). This is an example of a specific context in which targeted communications and prompts could be particularly effective.

Green defaults can support sustainable travel choices. For example, travel planning tools could propose public transport, the train or cycling as the default option, depending on the distance involved (Avineri, 2012).

Because mobility decisions are strongly affected by *social norms*, a modal shift towards low-carbon transport modes amounts to a shift in social norms associated with the use of cars and alternative transportation. Supporting modal shifts therefore requires that policy makers have a good understanding of what the prevailing social norms are in order to design policy interventions tailored to context specificities.

Setting up workplace and school ride-sharing and collective commuting groups, as well as information-sharing spaces, can create a sense of community and of accountability for individuals keen to shift from private motorised vehicles to cycling or public transport. This can help reinforce *commitment* towards such individual objectives, and possibly avoid backsliding (Department for Transport, 2011).

As travellers do shift towards low-carbon mobility options, making this change conspicuous (for example by allocating differently coloured number plates to electric vehicles) can draw public attention to the change in social norms. At the same time, given the current price differential between electric and conventional vehicles, such an indicator could also be perceived as a status symbol.

The next section provides examples of how these behavioural levers have been concretely adopted in the context of transport policies and programmes thus far.

Case studies

This section discusses behavioural interventions to encourage the purchase of energy efficient vehicles, including EVs, and to support the uptake of sustainable mobility options (cycling, walking and public transport use) while reducing the use of private motorised vehicles. As in the previous chapter, the table below outlines the case studies under discussion.

Country	Institutions	Case study	Level	Scale	Behavioural levers
Supporting purchases of energy efficient vehicles					
Canada	Central government	Identifying the behavioural drivers of car purchases	National	Diagnostic	Simplification and framing of information
Canada	Central government	Simplification and framing of fuel efficiency vehicle labels	National	Trial	Simplification and framing of information
United Kingdom	Central government	Making EVs more prominent	National	Full-scale policy	Simplification and framing of information; social norms and comparisons; changes to product design and to the physical environment

Country	Institutions	Case study	Level	Scale	Behavioural levers
New Zealand	Central government	Identifying barriers to the adoption of EVs in New Zealand	National	Diagnostic	Simplification and framing of information
United Kingdom	Central government; BI Team	Identifying barriers to the adoption of EVs in the United Kingdom	National	Diagnostic	Simplification and framing of information; reward schemes
Encouraging public transport use					
Canada	Utility; BI team	Identifying barriers to public transport use	Local / Municipal	Diagnostic	Simplification and framing of information; feedback mechanisms
Encouraging walking and cycling					
United States	Local government	Increasing bike-sharing use	Local / municipal	Trial	Simplification and framing of information
Australia	Government agency	Gamification to encourage walking as a commute option	State / province	Trial	Simplification and framing of information; reward schemes
United Kingdom	Business	Encouraging cycling	National	Trial	Simplification and framing of information; reward schemes; goal setting and commitment devices
Limiting the use of private motorized vehicles					
United Kingdom	Local government; central government	Supporting modal shift away from cars	Local / municipal	Full-scale programme	Simplification and framing of information; goal setting and commitment devices
United Kingdom	Central government; BI Team	Encouraging sustainable commuting practices	Specific business	Trial	Simplification and framing of information; social norms and comparisons
United States	Local government; academia	Reduce single-occupancy car use	Local / municipal	Trial	Simplification and framing of information; social norms and comparisons; reward schemes
Japan	Central government	Encouraging eco-driving practices	National	Trial	Simplification and framing of information; Feedback mechanisms
Singapore	Central government	Using BIs to support congestion pricing	National	Full-scale policy	Simplification and framing of information; feedback mechanisms

Supporting energy efficient vehicle purchases

IDENTIFYING THE BEHAVIOURAL DRIVERS OF CAR PURCHASES

To encourage the uptake of fuel-efficient vehicles and support the transition to a low-carbon transport sector, it is necessary to understand which behavioural drivers influence consumer vehicle selection and purchases.

With this in mind, Natural Resources Canada and Environment and Climate Change Canada undertook a study including both a literature review and a series of in-person interviews and focus groups to “understand the motivations, behaviours, and contextual influences within the [vehicle] purchasing experience” (Natural Resources Canada and Environment and Climate Change Canada, 2020). These insights will inform the design and testing of a behavioural intervention to encourage the purchase of fuel-efficient vehicles.

Interviews and focus groups involved 38 consumers who had just purchased a vehicle. Participant recruitment took numerous criteria into account to ensure sample representativeness, including personal factors (e.g. gender, age, education and income) and transport-specific factors such as geographic location and vehicle type.

Findings indicated that the vehicle research and purchase process is likely to be very different for each individual consumer, as it is influenced by their past experiences, present needs and concerns, and the information sources they tap into. Thus, a policy intervention aimed at encouraging fuel-efficient purchases should be as customisable as possible in order to accommodate consumer diversity.

Buyers seek trusted interactions with acquaintances, networks, online resources and directly with salespeople during vehicle searches and purchases. Because vehicles have many features and the market presents numerous makes and models, the search can be complex: consumers therefore tend to narrow down a few characteristics they deem fundamental given their needs and preferences. Information provision tools allowing consumers to compare vehicles across preferred features can help them identify relevant options more quickly.

To reach a final decision, consumers must often make trade-offs among the various vehicle features. For consumers to prioritise fuel efficiency, it is important to make it both prominent and relevant. Because cost is a key criterion, framing fuel efficiency information in terms of financial impacts can encourage fuel-efficient purchases.

This case study provides just one example of how BIs can inform exploratory work to identify the key drivers and bottlenecks affecting transportation-related behaviours.

SIMPLIFICATION AND FRAMING OF VEHICLE FUEL EFFICIENCY LABELS

Fuel efficiency labels include several indicators common to many countries. In IEA economies, most labels contain information on vehicle technology and fuel type, and indicators of fuel consumption and CO_2 emissions.

The EnerGuide[11] for vehicle labels presents model-specific fuel consumption information for new light-duty vehicles available for sale in Canada. In addition to the vehicle’s fuel consumption rating, the label also indicates the best and worst within-class fuel consumption ratings, an estimate of annual fuel costs, and ratings for the vehicle’s tailpipe CO_2 and smog-forming pollutant emissions.

In the United States, fuel economy labels include both a miles-per-gallon (MPG) index that differentiates between city and highway consumption and a gallons-per-100-miles index that was added when the label was redesigned in 2011. This addition was based on evidence from the behavioural sciences indicating that MPG is a misleading indicator of fuel economy

[11] https://www.nrcan.gc.ca/energy-efficiency/energuide-canada/energuide-vehicles/21010.

(Larrick and Soll, 2008). Alongside annual fuel costs, the US label also provides estimated fuel cost savings or extra costs compared with the average new vehicle.[12]

In 2018, Natural Resources Canada undertook an experiment to test different fuel consumption label formats with a group of participants asked to choose a vehicle in a simulated purchase decision (Dulcimer Labs and Natural Resources Canada, 2018). The various labels leveraged different BI techniques to emphasise either the financial savings or the environmental benefits associated with the vehicle. Participants were also surveyed to evaluate their comprehension of the information contained on the labels, as well as their background and attitudes concerning transportation, fuel efficiency labels and the environment more generally.

Study results indicate that labels clearly focused on the environmental benefits of fuel efficiency, as well as those displaying a comparatively more conspicuous visual depiction of the vehicle's fuel consumption rating, led to more fuel-efficient choices. Findings also suggested that depicting fuel consumption in both absolute terms and relative to the vehicle's class increased participant comprehension and led to greener vehicle selection.

While not yet translated into policy adjustments, a series of recommendations to reform and improve fuel consumption labels was formulated based on the experiment's results: labels should be simplified (e.g. by removing MPG information) and should leverage clear colour coding of information on environmental impacts, which has been shown to prompt more efficient purchase intentions. Bundling information on CO_2 and air pollution emissions in a composite "environmental impact" index could also increase comprehension, and labels could leverage social norms by indicating the percentage of Canadians concerned about the environmental impacts of transportation.

These policy recommendations have not yet been implemented in Canada. More generally, fuel efficiency labels in most other IEA countries (e.g. EU countries and Japan) do not translate fuel consumption information into fuel expenditures, even though this type of framing could help consumers estimate the savings possible with more efficient vehicles.

MAKING ELECTRIC VEHICLES MORE PROMINENT

The global EV market share has grown exponentially in the past ten years, from 0.1% in 2011 to 2.5% in 2019 (IEA, 2020b). However, the public might not have a clear perception of the share of EVs in the total private vehicle fleet.

Making EVs more prominent through the use of special number plates could make people more aware of their diffusion and also help shift social norms, encouraging EV uptake through "green virtue signalling".[13] It could also facilitate the tasks of public authorities, for example when verifying eligibility for EV benefits (e.g. lower parking fees and entry into low-emission or limited-congestion zones). In June 2020, the United Kingdom adopted this approach, announcing that zero-emission vehicles will be identifiable through number plates with a green flash as of autumn 2020.[14]

This type of behaviourally aligned policy intervention leverages a change in the physical environment (i.e. altering the design of vehicle number plates to draw attention to the uptake

[12] https://www.epa.gov/greenvehicles/learn-about-fuel-economy-label.
[13] https://www.bi.team/blogs/how-new-number-plates-could-green-britains-roads/.
[14] https://www.gov.uk/government/news/green-number-plates-get-the-green-light-for-a-zero-emission-future.

of low-carbon transport modes). At the same time, however, green virtue signalling could prompt moral licensing, whereby EV owners, knowing their sustainable transport efforts are being publicly recognised, may relax their sustainability efforts in other areas. It is also important to consider the potential distributional impacts of preferential treatment associated with EV ownership (e.g. lower parking fees).

PROMOTING ELECTRIC VEHICLE ADOPTION

Identifying barriers to EV adoption in New Zealand

While global EV sales are rising, several behavioural barriers still hinder their uptake. In 2018, New Zealand's Ministry for the Environment conducted a study to identify such obstacles and proposed solutions from the perspective of the government, dealerships and buyers (Ministry for the Environment, 2018). The key behavioural barriers identified in the study relate to purchase costs, driving range and charging infrastructure.

Because EVs are sold at substantially higher average prices than similar conventional vehicles with internal combustion engines (ICEs), the purchase price is a major hurdle for consumers. However, similar to other fuel-efficient vehicles, a comparison of total ownership expenses – including running costs – of an EV and an ICE vehicle shows that EVs quickly reach price parity and outperform their counterparts.

Labels and dedicated websites should convey clear information on purchase and running costs, as well as potential government incentives for EV purchase. This could help overcome myopic preferences, which cause present investment costs to outweigh future savings associated with EVs.

Another barrier to EV uptake is driving-range anxiety – the stress that users can experience when driving an EV model with a short range that requires frequent recharging. This issue has become considerably less important with EV evolution, which has led to a near-doubling of EV range in the past ten years, from 127 km in 2010 to 336 km in 2019 (IEA, 2020a). Considering that 90% of daily vehicle use in New Zealand covers 90 km or less (Ministry for the Environment, 2018), driving range should not be a limiting factor for most consumers.

Presenting consumers with clearly framed information on vehicle range and average commute length can help them both during the search process (e.g. through informational websites on fuel efficiency) and at the point of purchase (e.g. through labels).

Car dealers can ask buyers prompting questions to correctly assess their driving habits and range needs. They can also suggest car rental as a valid option for longer but infrequent trips, citing New Zealand's Ministry for the Environment's economic evidence that "purchasing an EV over an equivalent ICE vehicle equates to roughly 18 to 36 car rental days a year through reduced fuel costs" (2018).

Finally, the perceived scarcity of charging stations may contribute to range anxiety. This could be due to the status quo bias, as consumers used to ICE vehicles will tend to compare the diffusion of recharging stations with that of refuelling stations, and charging time with refuelling time. Information on the convenience of home charging, both in terms of comfort and cost, could prompt consumers to reassess this aspect of EV use. Financial incentives such as discounted rates for overnight charging at home could also help drivers adopt overnight, off-peak charging.

In exploring behavioural interventions to support EV purchases, a study by the University of Toronto recommends including maps with charging points on informational websites. Users could use this tool to calculate their regular trips, as it would help them visualise convenient charging stations and consider what range they need (Bin Latheef, Rooney and Soman, 2018).

Identifying barriers to EV adoption in the United Kingdom

The UK Department for Transport has commissioned the BI Team and the consulting company Transport Research Laboratory to conduct a study to identify the barriers to EV adoption in the United Kingdom (Reiner et al., 2020).

The study targeted five intermediate objectives leading to EV adoption, whose achievement is hampered by different behavioural and structural barriers:

- increasing EV awareness and expanding consumers' knowledge about them
- helping consumers understand the financial benefits of EVs in terms of total ownership costs
- improving consumer perceptions and making them aware of the reality of charging infrastructure availability
- addressing consumer concerns about EV features such as range and battery life
- promoting positive consumer attitudes towards EVs, both regarding their value and practical features.

After identifying possible policy options and behavioural interventions, a subset was validated by expert stakeholders in industry, the public sector, consumer bodies and academia. About half were tested with individual consumers through online surveys and focus groups and with vehicle fleet operators via phone interviews (Reiner et al., 2020). The whole process – from diagnostic to survey and interviews – resulted in numerous recommendations for the interventions likely to be the most effective in addressing the five objectives outlined above. Achieving large-scale EV adoption will require all the objectives to be met, calling for comprehensive policy packages and simultaneous behavioural interventions.

To outline just a few, information simplification and framing could be leveraged to develop personalised tools: for example, a web-based portal could help consumers calculate running-cost estimates and long-term cost savings for EVs and standard vehicles, based on their annual commuting mileage and on clear information on government grants for EV uptake. Changing default regulations, fuelling stations could be required to provide EV charging facilities. As perceptions about EV costs and charging infrastructure are as important as the reality, addressing misperceptions through behaviourally informed interventions might be quicker and more cost-effective than, for example, implementing infrastructural solutions.

Policy recommendations also include traditional policy measures such as economic incentives (e.g. different VAT rates, free parking for EVs and feebates for car registration based on emissions or powertrain type) and regulatory standards and constraints (e.g. updated labelling standards that include information on long-term costs of vehicle use).

Encouraging public transport use

The use of private motorised vehicles can be reduced in favour of public transport by targeting social groups keen to try out this mobility option but hesitant for various reasons. Such groups include those who use public transport extremely rarely but are interested in using it more often; infrequent users who need some encouragement and tips on how to make it a habit; and regular users who rely on public transport for specific cases only (e.g. commuting) and have never considered it on other occasions.

The public transport agency of the City of Vancouver, Canada, has commissioned the UK-based BI Team to carry out a behavioural analysis to identify barriers to public transport use in such groups and offer possible behaviourally informed solutions (Behavioural Insights Team and Alta Planning + Design, 2017).

A behavioural obstacle for very infrequent users of public transport is the cognitive effort required to plan a trip by public transport compared with by car. Further, the preference for car use results from both behavioural barriers to sustainable mobility use (such as the status quo bias) and from structural impediments (such as service and infrastructure limitations associated with the “first-mile/last-mile problem”). A “try before you buy” incentive, such as a one-off free bus ticket or weekly pass, could overcome the status quo bias and associated misconceptions and prejudices concerning public transport for first-time or infrequent users. A streamlined payment process, together with clear ticket fares, could also reduce the burden of planning a trip and comparing the costs of public transport with car use.

Because of ambiguity aversion, people prefer to face known risks, such as regular weekday car traffic, to unknown risks such as delays caused by technical issues in the subway network (Behavioural Insights Team and Alta Planning + Design, 2017).

Perceiving public transport as unreliable may translate into wrongful assumptions of longer travel time. Timely information-framing and feedback can redress perceptions of unreliability, for example through real-time tracking of arrival information at public transport stops and via trip planning tools. Evidence from the US city of Seattle indicates that wait times are perceived as longer for travellers without access to information than for those who can monitor it in real time (Behavioural Insights Team and Alta Planning + Design, 2017).

Highlighting the positive aspects of public transport use, such as independence, comfort and convenience (e.g. avoiding the cost and hassle of a car trip in a congested area, the search for parking, and restrictions such as pedestrian-only streets), as well as the environmental impact, can also help reverse negative misconceptions and encourage more travellers to adopt it. Changes in the physical environment, such as dedicated lanes for buses and streetcars, can also encourage their use and reduce travel time. An example is the recent adoption of streetcar priority over private vehicles on King Street in Toronto, Canada, following a successful trial period.[15]

Encouraging walking and cycling

Of the transport-related policy interventions and programmes reviewed in this report, those supporting fuel efficiency investments have generally been implemented at the national level. Conversely, interventions encouraging the uptake of soft mobility options such as

[15] https://www.toronto.ca/city-government/planning-development/planning-studies-initiatives/king-street-pilot/.

walking and cycling have been deployed at local or regional level, reflecting the distribution of policy responsibility across different jurisdictional levels.

In contexts where cars are the predominant mobility option (Canada and the United States in the case studies), behavioural interventions generally focus on the importance of reducing car use, with particular attention to single-occupancy cars. In contexts where soft mobility options are not as marginal, the framing used to further incentivise their adoption revolves around the personal health benefits and convenience of walking and cycling, as well as the broader social benefits of reduced air pollution and congestion.

ENCOURAGING THE USE OF BIKE SHARING

In 2016, the US city of Portland, Oregon, deployed a behavioural intervention to prompt bicycle sharing. The intervention exploited various messages targeting specific groups of potential users, such as people who had recently moved close to a bike-sharing station and those whose neighbourhoods had just benefited from an expansion in bike sharing (Kirkman, 2019). The city's Bureau of Transportation designed the intervention and collaborated with the UK-based BI Team to assess its impact.

Two types of messages were sent to participants, each accompanied by a coupon for a free bike-sharing ride: the first message highlighted the nil price of the free ride, while the second mentioned the discount it translated into with respect to a full-priced ride. This type of messaging builds upon evidence that consumers are more attracted and responsive to free products than to the same products presented at an equivalent discount.

People who have recently experienced transport-related changes, either because they have changed their place of residence or owing to the availability of new infrastructure, are likely to be in a good position to reconsider their travel habits: this makes them a meaningful group to target through this type of initiative. This was confirmed in the trial results, as people who had recently moved were found to be significantly more responsive to the offer, redeeming their free ride four times more often than letter recipients already living in the proximity of a newly installed bike-sharing station. While the two types of messages were generally equally effective, users living close to new stations were more responsive to the offer when it highlighted the ride being "free".

Based on the findings of this field experiment, which involved sending messages to a total of 10 500 households, the city decided to continue targeting newly relocated people and to opt for the "free bike-sharing ride" framing. While the results are encouraging, overall only 0.59% of the sample group redeemed the offer of a free bike-sharing ride received by mail (Kirkman, 2019). Although this study did not specifically assess the role of infrastructure conditions in restricting bike-sharing use, the limited impact of free-ride vouchers underscores the stickiness of mobility behaviour, which is affected by a range of factors and not only by cost considerations. Because a variety of structural barriers (including the actual and perceived availability of bike lane infrastructure, the actual and perceived safety of cycling, the availability of bike parking, and seasonal effects) can limit the uptake of soft mobility options, their importance needs to be understood in each local context.

ENCOURAGING SUSTAINABLE COMMUTING

In 2018, the Victorian Health Promotion Foundation (in the Australian state of Victoria) funded the development of a programme to incentivise walking among specific target audiences such as schoolchildren and train commuters (Woodruff, 2018). Schoolkids are an interesting target group because implanting the habit of active mobility at a young age can have positive reverberations later in life. Train commuters have been incentivised to walk to the train station, with the walk being presented as an opportunity for exercise, highlighting the convenience, health and happiness benefits of walking instead of driving.

The intervention targeting train commuters employed multiple behavioural levers, combining posters in train stations with a website to support trip planning and small rewards for travellers walking to the station. Implemented at three stations in the suburbs of Melbourne, it did not lead to a significant overall increase in walking. Differing results across stations indicate that targeting those where parking is more difficult could be more effective.

The intervention's overall lack of impact may also result from the season in which the programme was implemented: survey responses point to the lower temperatures of early winter as the main factor discouraging walking. Planning for different, mutually reinforcing interventions in different seasons could therefore convince travellers to start walking during warm weather and encourage them to maintain the habit at the beginning of winter.

The programme involving primary schoolchildren was built around clear maps of local footpaths and worksheets for parents to plan the daily trip to school, as well as a set of games to track opportunities and rewards for children and schools. It triggered a 34% increase in active mobility (including walking, cycling and riding scooters), with particularly strong effects among the youngest children. Survey responses indicate that interventions such as school gate signs, receiving a badge or stickers and seeing the footpath decals motivated the children to walk.

This Australia-based intervention again highlights the importance of choosing audience-appropriate behavioural levers (gamification for school kids and rewards for train commuters). It also underscores how important the season is in defining mobility patterns: for this reason, interventions aimed at altering mobility behaviour should be implemented at the most favourable moment for behaviour modification and should adapt messaging across seasons to sustain the habit change.

ENCOURAGING CYCLING

Non-governmental organisations (NGOs) and sector associations in direct contact with civil society can also develop behavioural interventions for target audiences to prompt desired behavioural changes such as the uptake of soft mobility options.

In 2017, British Cycling, the United Kingdom's largest cycling organisation and the national governing body for cycle sport, commissioned multiple behavioural field interventions to prompt cycling. Two focused on encouraging newcomers and infrequent cyclists to attend a cycling event, while a third instead sought to inspire cyclists to maintain their cycling habit once begun (Hale, 2017).

The first intervention involved sending out 70 000 e-mails leveraging three different behavioural insights:

- *Motivational messages* highlighting the fun associated with cycling, the health benefits and the nostalgia of past trips, alternating frames or combining them. Fun- and nostalgia-focused messages were most effective, prompting signup rates 15% higher than for other motivations to attend.

- *Tangible information* outlining how exactly a cycling event organised by British Cycling unfolds increased event registration by 75%.
- *Planning and reminders* inviting e-mail recipients to sign up and mark the date in their calendar almost doubled signup rates.

The second intervention, implemented at two workplaces, involved exposing participants to a virtual reality experience about cycling (treatment group) or to a YouTube video about cycling (control group). Participants exposed to the virtual reality experience were 39% more likely to cycle again than the control group.

Finally, the third intervention aimed to encourage former participants of British Cycling events to develop new cycling habits, either through leisure trips or by commuting. Recruited volunteers were invited to set their own cycling goals and a plan to achieve them using a leaflet provided for the purpose. Another group was simply encouraged to seek support from a peer to stick to their plan and objectives. The first set of volunteers cycled 20% more than those who did not make a plan in the month following the intervention.

This shows how deliberate planning and goal setting, together with commitment backed by social pressure and support by peers, can effectively stimulate the creation of a new, somewhat lasting cycling habit.

Limiting the use of private motorised vehicles

Local and national authorities may wish to reduce the use of private motorised vehicles and encourage eco-driving practices to limit air pollution and CO_2 emissions, noise and congestion. “Soft” transport policy measures are initiatives that aim to achieve these goals by providing better information on – and opportunities for – sustainable travel, including workplace and school travel plans, personalised travel planning, awareness and information campaigns on sustainable travel and public transport, car clubs and carsharing schemes, teleworking, teleconferencing and online shopping (Cairns et al., 2004).

REDUCING CAR USE

The Sustainable Travel Towns programme ran between 2004 and 2009 in Darlington, Peterborough and Worcester, three medium-sized towns in England very concerned about traffic growth, with the aim of reducing car use through a set of soft transport policy measures (Sloman et al., 2010). The programme was specifically financed by the UK Department of Transport, and the three towns allocated most funding to personalised travel planning, followed by awareness campaigns, promotion of walking and cycling, and public transport marketing, whereas smaller budgets were dedicated to workplace and school travel planning.

The impacts of these initiatives were first assessed in a 2010 publication based on data gathered between 2004 and 2008, including from household, school and workplace surveys, as well as observational data from automatic and/or manual counts of pedestrians, cyclists, bus passengers and vehicles (Sloman et al., 2010):

- Household survey results indicated that car driver trips fell by 9% per person, and distance by 5-7% on average. Consequently, on-street traffic volumes dropped 2%, and up to 8% in inner urban areas.
- Bus trips per person increased 10-22% at the same time as they fell slightly nationwide in similar-sized towns.

- Cycling trips per person rose 26-30% in all towns, and walking trips per person increased 10-13%. These trends contrasted with nationwide patterns for similar-sized towns, where both cycling and walking trips decreased.

In 2014, a follow-up analysis was commissioned to gauge the medium- to long-term impacts of the programme, while acknowledging the inherent challenges in measurement and attribution due to the impact of the 2008-09 economic crisis and of additional transport policy measures implemented after 2009 (Cairns and Jones, 2016):

- Cycling and walking gains persisted or, at worst, plateaued.
- While traffic miles per capita were still lower in 2012 than in 2004, it was difficult to ascertain the different impacts of the policy programme and of the altered economic situation.
- In the medium term, bus trips declined in the three towns, both because of reduced bus services due to funding cuts and because of reduced information activities.

Overall, the Sustainable Travel Towns programme induced substantial behavioural change and significant differences in travel patterns in similar but untreated towns. The first report also discusses specific behaviour changes underlying aggregate trends (e.g. variations in leisure, work and shopping trips) as well as city-specific trends (Sloman et al., 2010).

ENCOURAGING SUSTAINABLE COMMUTING PRACTICES

The UK Department for Transport commissioned the BI Team to design, test and evaluate measures supporting sustainable commuting transport options by partnering with Heathrow Airport, the largest single-site employer in the United Kingdom, with 76 000 staff members across 350 companies (Behavioural Insights Team, 2017).

The table below summarises the various interventions implemented to increase carsharing and public transport use while decreasing single-occupancy-vehicle use. The interventions, tested through six randomised controlled trials, were built around multiple behavioural levers, including simplification and framing of information, and social norms and comparisons.

Objective	Intervention	Findings
Increase registration in the carsharing scheme dedicated to airport staff	Testing differently framed letters: 1. Standard letter explaining registration procedure. 2. Clear call to action inviting employees to register on the website. 3. Testimonials from other employees who have been using the carsharing system for years.	While letters did encourage more carsharing registrations than no prompt at all, registration rates were still very low: less than 1% of overall trial participants (about 55 000 employees) registered for the carsharing scheme following the intervention. Different framings led to minimal variations in impacts.
Increase active users among the members registered in the carsharing scheme	Testing differently framed e-mails: 1. Standard letter inviting members to become more active. 2. Message suggesting potential matches of colleagues following a similar route to work. 3. Message calling attention to the opportunity cost of driving alone.	The messages had no impact on the number of active members taking part in the carsharing scheme.

Increase public transport use	Testing differently framed letters: 1. Information about bus service. 2. Free one-week travel card to use on bus coach to and from Heathrow.	The different messages did not have any statistically significant impact on the travel activity of users who received them (as measured by travel card use) compared with users in the control group – throughout the different groups, only about 2.2% of employees registered for travel cards.
Increase active participation among recipients of the free travel card	Registered members who did not use the free one-week travel card were sent a "reminder" letter highlighting the missed opportunity.	The reminder letter did not have a statistically significant impact on travel card use or purchases, as equally small numbers of users signed up for the free trial with and without receiving the reminder.
Decrease the use of single-occupancy vehicles through personalised commuting plans	E-mail with a personalised travel plan and information on the costs of various travel options, encouraging employees to sign up for one-on-one sessions to further discuss their personalised commuting plans.	With a 2.7% take-up rate for one-on-one in-person sessions, the personalised travel plan did not have a significant effect on commuting behaviour.
Decrease the use of single-occupancy vehicles through one-on-one travel planning sessions	One-on-one personalised travel planning sessions with employees who signed up for them (after receiving the e-mail mentioned above) to discuss their commuting plans.	No statistically significant impacts on commuting behaviour were detected because of the small sample size.

Nearly all the interventions tested did not have any significant impacts, and the magnitude of effects was minimal throughout all trials. Carsharing intervention results indicated a substantial difference between stated preferences and actual travel choices: while 61% of Heathrow employees driving to work declared in a 2013 survey that they would consider carsharing as an alternative commuting option, the intervention prompted only minimal uptake. Informing employees of their residential proximity and similar shift timing with other employees was insufficient to convert intention into action: this may suggest other underlying psychological barriers to carsharing, such as apprehension of co-sharers. Further, the impact of free temporary travel cards offered through interventions to support public transport was very low, indicating that subsidisation may not be enough to encourage longer-term bus use (Behavioural Insights Team, 2017).

These results point to the importance of assessing impacts with robust empirical evaluations, and to follow up with qualitative assessments to understand why some interventions work and others do not – for instance, whether it is the perceived inconvenience or safety issues that make commuters wary of carsharing. This study recommends testing more targeted behavioural interventions and considering economic incentives, stringent constraints and improvements in infrastructure and service provision along with behavioural interventions. In the context of workplace commuting, for example, economic incentives and targeted services could involve imposing paying (rather than free) parking and organising vanpools if carsharing is unappealing. Finally, the timeliness of travel-related interventions is crucial, as employees might reconsider their commuting options at specific turning points (e.g. changes in jobs or residence) (Behavioural Insights Team, 2017).

REDUCING SINGLE-OCCUPANCY CAR USE

Aiming to reduce single-occupancy car use, the US city of Durham, North Carolina, co-operated with multiple employers and with Duke University to address 1 500 workers during 2018. The behavioural interventions involved a planning tool and a lottery to promote alternatives to commuting by car (Bliss, 2018; Gardner, 2019).

First, the planning tool presented participants with personalised maps of their home-workplace commute with alternatives to cars, including walking, cycling and using public transport (City of Durham, 2018). This intervention also leveraged social norms to frame car commuting as outdated and highlighted the benefits associated with active mobility modes such as walking and cycling (e.g. financial savings on avoided gas consumption, shorter commute times and better health). This type of framing aims to address the attitude-behaviour gap, showing individuals the concrete steps they would have to take to alter their behaviour and highlighting the benefits involved.

Participants in the other intervention were invited to join a lottery by opting for public transport (City of Durham, 2018). The promise of a possible financial reward proved to be an incentive to join the programme and try out an alternative commuting mode.

According to self-reported information from pilot programme participants, the planning tool motivated 12% more employees to opt for alternatives to cars upon receiving their personalised maps, and the lottery inspired 19% more. The project's success was rewarded with a USD 1-million grant from Bloomberg Philanthropies, which the City of Durham plans to devote to mainstreaming these behavioural interventions to further reduce the use of single-occupancy cars.

ENCOURAGING ECO-DRIVING PRACTICES

To encourage eco-driving practices, Japan's Ministry of Environment has developed a mobile application with integrated GPS positioning (BEST, 2019). The app provides fuel consumption estimates based on acceleration patterns, driving times and distances. Driving at a constant speed is considered ideal and generates higher points, as does gradual acceleration and deceleration. Conversely, sharp acceleration and deceleration are considered less efficient and receive fewer points.

This information is synthesised as an eco-driving score that enables comparisons with other app users. Feedback is provided through smiley icons, with the aim of preventing drivers with a relatively high eco-driving score to increase their fuel consumption (the boomerang effect). The app also provides eco-driving tips that exploit loss aversion (e.g. "By not accelerating gradually, you increase gas consumption by 7%"). Initial pilot results indicate that the app reduced fuel consumption (measured in litres per 100 km) among its users by more than 8% relative to the control group, but these preliminary findings are not statistically significant and the experiment is ongoing.[16]

[16] http://www.env.go.jp/earth/ondanka/nudge/BI-Tech.pdf.

APPLYING BEHAVIOURAL INSIGHTS TO THE DESIGN OF CONGESTION CHARGES

Congestion charges and distance-based travel fees are market-based incentives designed to target the congestion and pollution externalities associated with road transport. Because they can disproportionately affect lower-income travellers, it is important to pair them with other measures (e.g. enhancing public transport coverage and frequency) to ensure that alternative, affordable transport modes are available.

Charges and taxes use individuals' "rational" responses to increased prices to advantage by integrating the broader social costs associated with their actions, reflecting the "polluter-pays" principle. BIs can inform the design and implementation of these policy tools to account for the behavioural mechanisms associated with the perception of financial incentives. The introduction and evolution of congestion pricing in Singapore provides a good example of how BIs can be used to design and implement economic incentives to reduce energy consumption and pollution from private transport options.

Congestion pricing has been in place in Singapore's central business district since 1975, when it was decided that drivers could access the area only by paying a fixed daily fee. In 1998, the pricing scheme evolved into congestion fees varying by time and location, a sophistication enabled by electronic entry systems. This evolution permitted more granular pricing, matching the social costs of congestion more precisely with time and space circumstances, and it took several BIs into consideration (Lew and Ang, 2009).

First, vehicle registration fees were gradually reduced in the transition to a distance-based, pay-per-use tariff structure to enter the central business district. Because car purchases and daily fees to enter a restricted area are sunk costs, travellers have a greater incentive to maximise car use when their investment in daily registration fees is high. Conversely, distance-based tariffs provide a continuous incentive to assess whether a certain trip is necessary, and whether its benefits outweigh its costs. Second, congestion pricing was made more prominent through large electronic displays showing real-time payments for entry into the central business district.

Main insights from case studies

In the transport sector, BIs have been applied to increase efficiency by supporting purchases of energy efficient vehicles, including EVs; encouraging walking, cycling and the use of public transport; and limiting the use of private motorised vehicles.

Most BI applications promoted by central governments in the transport sector have focused on encouraging fuel-efficient and low-carbon vehicle *purchases*, through measures such as label design and targeted incentives for EV adoption (Figure 11).

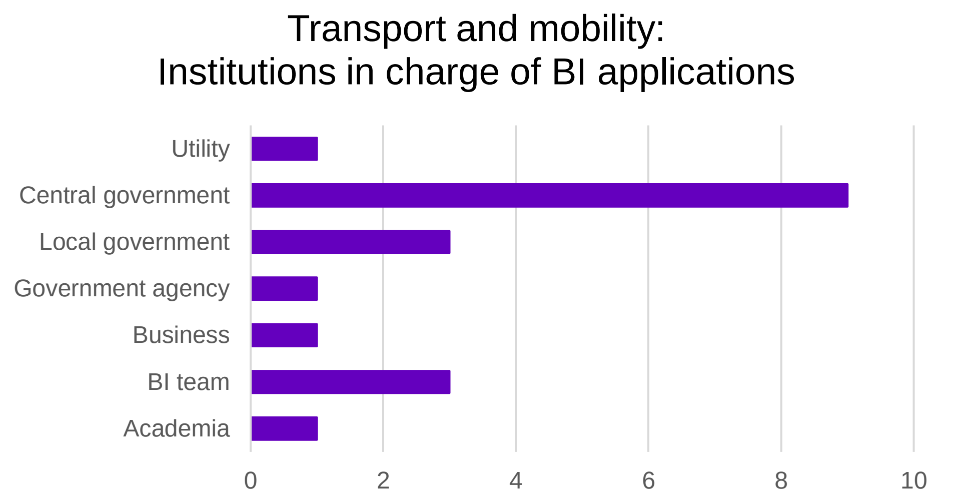

Figure 11. Institutions in charge of applying BIs to policies and programmes addressing transport and mobility decisions

Conversely, BI applications promoted by local government institutions have focused on changing mobility *habits*, providing incentives to support soft mobility options and discourage private vehicle use, with particular attention to single-occupancy cars.

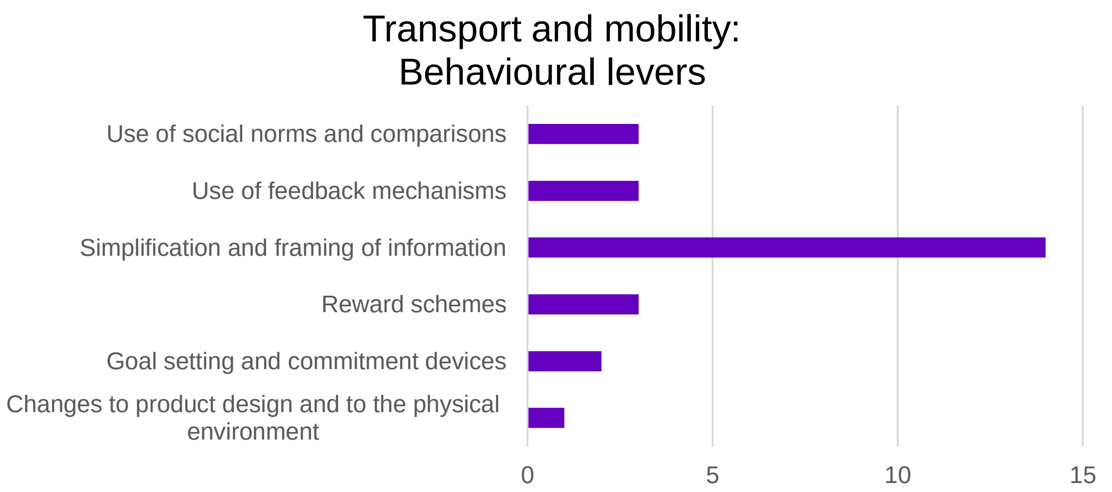

Figure 12. Behavioural levers used in interventions addressing transport and mobility decisions

Information simplification and framing is the most common behavioural lever employed in the transport-related interventions analysed in this report (Figure 12). Most relate to personalised transport planning initiatives that offer travellers tailored information and advice in person or through web portals or e-mails.

Reward schemes have been applied to sustainable mobility initiatives through gamification, to involve schoolchildren in group efforts for sustainable commuting to school, and through lotteries for new public transport users.

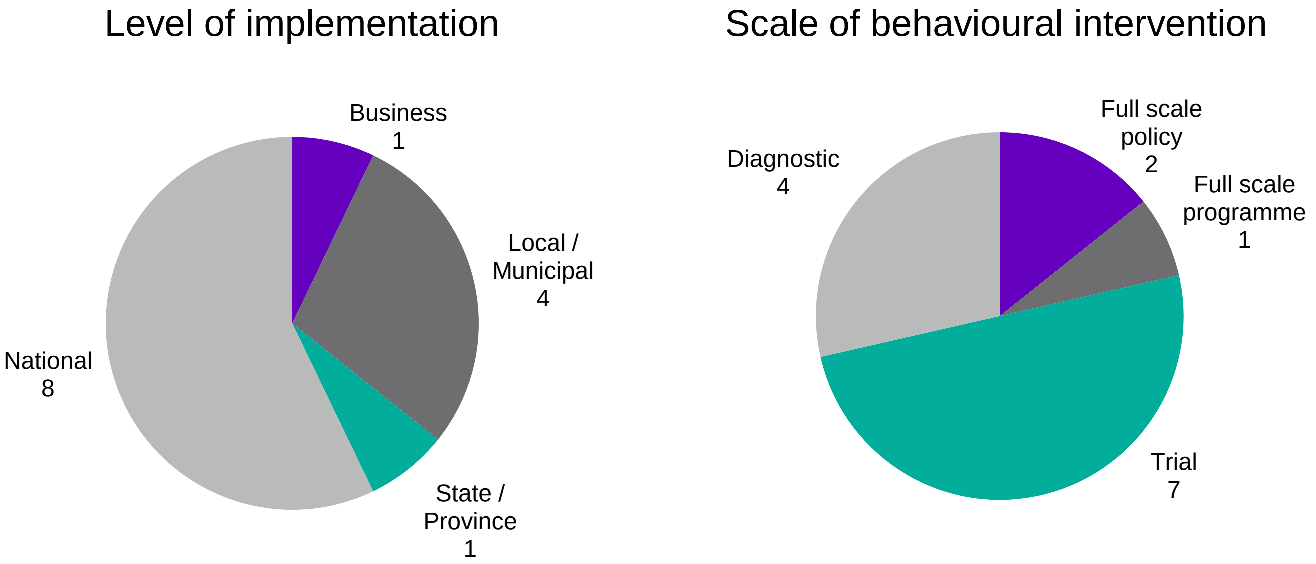

Figure 13. Jurisdictional level of implementation and scale of BI applications addressing transport and mobility

Over half of the 14 transport-related case studies are trials or pilot projects, and 4 are behavioural diagnostics: diagnostic studies are relatively more numerous in this policy area, possibly because travel habits are affected in a complex way by preferences and cultural norms, local context, infrastructural availability, cost considerations, and other factors (Figure 13). Plus, a greater proportion of behavioural interventions implemented at the local, municipal and state levels, likely due to the importance of local-level drivers of (and constraints on) transport choices.

A general consideration valid for all transport- and mobility-related BI applications is that in the absence of adequate, accessible and affordable infrastructure and services to facilitate soft mobility (from public transport to bicycle lanes), behaviourally informed incentives might be structurally limited in their impact.

Including estimates of fuel costs in fuel economy labels can help consumers understand the benefits of opting for more fuel-efficient cars

Purchase-oriented interventions to steer consumers towards fuel-efficient vehicles rely mainly on framing and simplifying information on the costs and benefits of different vehicles, e.g. through fuel economy labels.

Analysis of behaviourally informed interventions for fuel economy labels suggests that the most successful labels are simple to interpret. Simplifying fuel economy labels, removing misleading information (e.g. MPG indicators) and instead presenting data on environmental impacts in an attention-grabbing way (e.g. through colour coding) can prompt more efficient purchase intentions. Bundling information on CO_2 and air pollution emissions in a composite "environmental impact" index could also facilitate consumer understanding. Labels could also exploit the influence of social norms by indicating the percentage of fellow travellers in one's community or country concerned about transport-related environmental impacts.

Behavioural diagnostics can identify specific barriers to investing in and using specific low-carbon transport options such as EVs, such as the cost differential; recharging timing and practices compared with refuelling; range anxiety; and the perception of low charging-station distribution. Incentivising EV uptake therefore involves educating people about EV features and financial benefits in terms of total ownership costs, as well as addressing perceived and actual concerns about EVs, from charging station availability to range and battery life.

Behaviourally informed interventions such as changes to the physical environment can draw travellers' attention to the growing number of EVs on the road. For example, colour-coded number plates for EVs in the United Kingdom will be a visual indicator of shifting social norms as EVs become more widespread, aiming to encourage their uptake.

Real-time feedback on public transport wait and travel times could counter misperceptions of unreliability

Identifying subgroups of potential public transport users and the bottlenecks and uncertainties they face can help pin down policy strategies to boost public transport use. A study of behaviourally informed policy strategies to raise public transport use in Vancouver, Canada, points to the development and mainstreaming of travel planning tools to help people identify convenient public transport routes. Receiving real-time feedback on wait times for buses can reassure travellers and counter misperceptions of unreliability.

Finally, in-kind incentives such as free public transport tickets or weekly passes could function as an introduction, enabling uncertain travellers to test public transport and determine how it can suit their mobility needs. Prompts should follow in-kind subsidies to encourage repeated use.

Incentives for walking and cycling are most effective when offered in an appropriate season, addressed to specific groups with targeted messaging

Using BIs can help policy makers identify the behavioural barriers to walking and cycling and their relative importance with respect to structural barriers (e.g. infrastructural deficits). As factors influencing transport decisions vary across social groups and contexts, behavioural diagnostics can be used to gain an understanding of group-specific behavioural obstacles, and to identify social groups that may be more easily convinced to walk or cycle for part or all of their regular trips through the appropriate behavioural levers.

An intervention involving games and schoolwide rewards and activities proved effective to incentivise children to walk to school in targeted communities in Australia's state of Victoria. Conversely, an information campaign and set of rewards to encourage train commuters did not significantly increase walking rates. This highlights the extent to which seasonal variations in outdoor temperature and weather affect mobility patterns, a crucial factor that should be embedded in policy interventions aimed at incentivising active mobility.

With the aim of boosting bikesharing, the US city of Portland, Oregon, targeted long-time residents as well as recent newcomers in areas where bike sharing had just expanded. Offering a free ride proved to be effective in encouraging uptake, but the number of message recipients who took advantage of their free coupon was very small. This indicates that structural barriers to cycling may be at play, and overcoming them may require specific BI-informed infrastructural solutions.

Finally, interventions in the United Kingdom successfully incentivised leisure cycling by highlighting its entertainment dimension and by sending prompts and reminders to sign up for amateur cycling events. Goal setting can also help riders stick to a cycling routine, particularly when supported by planning and reinforced by peer support, which exploits people’s desire to conform with social norms.

Combining several soft mobility interventions is most effective for a large-scale shift away from car use

To distinguish them from “hard” (i.e. infrastructural) measures and from standard policy tools such as market-based instruments and regulatory restrictions, interventions involving information provision are sometimes labelled “soft” transport policy measures. They include personalised, workplace or school travel planning; information campaigns and sharing schemes; and interventions to reduce travel needs, such as teleworking and remote shopping.

In 2010, the five-year Sustainable Travel Towns programme involving multiple integrated soft measures in three English towns was found to substantially affect mobility patterns by reducing car trips, with the largest alternative-mode increase in cycling, followed by bus trips and walking. Follow-up assessments of the medium-term impacts of the programme indicated persistent cycling and walking improvements, whereas bus use had been compromised by service reductions. While these results are context-specific, they point to the potential importance of soft policy measures and co-ordinated policy action. At the same time, the fall in bus use indicates that structural cuts to public transport provision – such as reduced frequency or geographical coverage – can jeopardise gains achieved through soft policy measures and exclude some traveller categories from the network.

Personalised travel planning may vary in effectiveness depending on the travel options available and their real and perceived convenience

Contrary to the previous example, a UK-based travel planning intervention addressing the employees of a large single-place employer, London Heathrow airport, was found to have no significant effects on transport choice. At least two factors could be the source of this difference in impacts.

First, evaluation approaches differed in the two cases, with randomised controlled trials leading to more precise and rigorous results than before/after comparisons of mobility trends and mobility survey responses. Second, contextual conditions are of great importance, as cycling might be more convenient in a medium-sized town than between an urban area and an airport. Although employees may profess vague interest in carsharing with colleagues, in practice it depends on perceived safety. And again, structural and financial conditions can be powerful obstacles to behaviour change: free workplace parking for employees is a great disincentive to use alternative transport options.

Making driving costs more prominent can help reduce car use

Some local jurisdictions aim to disincentivise the use of single-occupancy cars to limit congestion and pollution. The US city of Durham, North Carolina, successfully reduced single-occupancy car use by promoting planning tools to help travellers visualise alternative commuting options and by offering participation in a lottery for public transport users. These are additional examples of how information provision (through a tool that can provide precise commuting information) and rewards (potential lottery prizes) can be used as behavioural levers.

BIs can also inform the implementation and development of pricing schemes aimed at limiting congestion: Singapore shifted from flat congestion prices (charged to car drivers daily for access to the city centre) to distance-based fees to make driving costs more prominent and reduce the incentive to maximise car use once the daily fee had been paid.

Chapter 5. Businesses and other organisations

Introduction

Manufacturing accounts for 24% of IEA countries' final energy consumption (IEA, 2020d – see Chapter 1, Figure 1). At the global level, the metal, chemical, and non-metallic minerals industries are the three most energy-intensive manufacturing subsectors (Figure 14). Different business activities and industries are subject to varying regulatory requirements for reporting on and curbing their pollution emissions, including those associated with energy consumption.

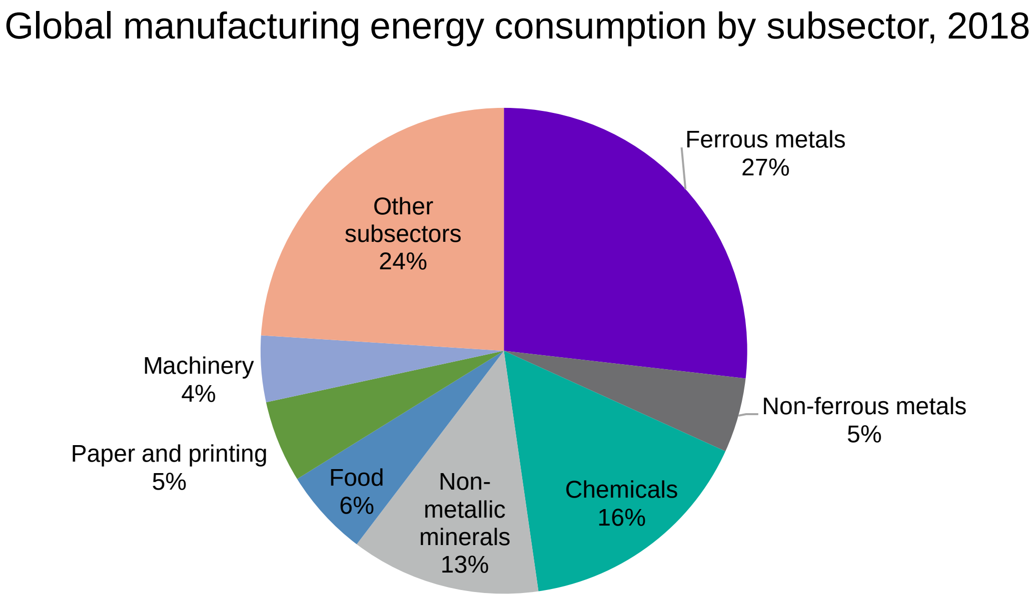

Figure 14. Global manufacturing energy consumption by subsector, 2018

Notes: Manufacturing includes the International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4 Divisions 10 to 18 and 20 to 32. Manufacture of coke and refined petroleum products [ISIC Division 19] is excluded from Manufacturing. Ferrous metals [ISIC class 2410+2431] also includes energy demand related to blast furnaces and coke ovens, as opposed to the IEA World energy balances treatment.[17]
"Other subsectors" includes all remaining manufacturing subsectors beyond the top seven (ferrous and non-ferrous metals, chemicals, non-metallic minerals, food, paper and printing, machinery).
Source: IEA (2020e), IEA World Energy Balances (database), https://www.iea.org/reports/world-energy-balances-overview

As the main items of energy spending differ among large manufacturing plants and service sector businesses and small and medium-sized enterprises (SMEs) from one country to the next, the extent to which employees can alter their behaviour or businesses can make

[17] For more information, please refer to the section on Geographical coverage in the IEA World Energy Balances Database Documentation (IEA, 2020f).

structural energy efficiency improvements to curb aggregate energy consumption is also variable.

Like for households, improvements enabling energy savings and a transition to more sustainable practices can easily be perceived as low-priority by companies and other organisations (e.g. public administrations, schools and hospitals), as energy is an invisible input that enables business but is not directly perceived as a core business element.

The remainder of this section lays out the structural and behavioural (cognitive, social and cultural) drivers that affect the energy consumption and investment decisions of organisations, including businesses, as well as the behavioural levers that policy makers can exploit to steer decisions towards greater energy efficiency and sustainability.

This is somewhat more complex than influencing household and individual behaviour because organisations encompass small manufacturing firms, large service multinationals, and institutions such as public administrations, schools and hospitals. Furthermore, some behavioural interventions target an organisation as a whole whereas others address community members or employees that have specific functions (e.g. front office staff or salespeople).

Nonetheless, some of the behavioural driver and case study findings presented in the second part of this chapter are valid across all sectors of the economy and for all organisations in general.

What are the energy consumption and investment drivers for businesses and other organisations?

Organisational decision-making, including decisions on energy consumption and investment by businesses, is complex and the drivers are different from those that affect individuals and households.

Such drivers can be grouped into:

- *structural factors*, which are not solely related to the decision under consideration;
- *cognitive drivers*, which relate to the constraints affecting individual decision makers within an organisation (e.g. their level of information, amount of time and cognitive ability);
- *social drivers*, which relate to how decision makers within an organisation interact with others;
- *cultural drivers*, which relate to organisational culture (Wilson, S., Sonderegger S., and Buzzeo J., 2016).

Although these groupings were defined with general (as opposed to energy-related) decision-making in mind, it is easy to see how they can have energy consumption repercussions.

Structural factors affecting organisational behaviour include organisational size and structure (the number of hierarchical layers and their interconnections), which affect the decision-making organ (whether it be a group such as a board in a large firm or an individual in an SME). In companies, another structural factor is the business focus, which can be single or multi-sectoral. Different business models monitor their overall energy consumption differently (depending whether it is related to manufacturing, transport, services or commercial activities) and some small businesses may not undertake detailed monitoring at all.

The various business archetypes can be defined according to structural differences in their decision-making procedures and behaviours: listed multinational corporations and financial institutions versus co-operatives, family businesses, innovative (technology-based) start-ups, SMEs or self-employed entrepreneurs (PwC, 2018).

While activity focus, hierarchy and decision-making procedures are *internal* structural determinants of organisational behaviour, a range of *external* structural factors also affect organisational behaviour, such as the laws and regulations governing the business's operating environment and its network of relationships with suppliers, customers and shareholders (HM Government, 2016).

From a cognitive perspective, complex organisational procedures involving numerous people slow down decision-making in organisations and can temper individual behavioural biases. At the same time, in contexts in which a single individual holds considerable decision-making power, all behavioural mechanisms that affect individual thought processes and decisions are important. Furthermore, informational and time constraints that lead individuals to rely upon rules of thumb and heuristics do persist in organisations.

Social interactions and norms can affect decision-making in organisations, causing teamwork-related decisions to be deliberated differently from those related to individual task work. Cultural drivers of business decision-making include organisational culture, which might be, for example, more competitive than co-operative.

How can behavioural insights be used to support energy efficient behaviour in businesses and other organisations?

Policy makers can support energy efficient organisational behaviours in several ways: by enhancing compliance with existing "hard" regulations on energy consumption and related pollution emissions, energy efficiency, and mobility; by supporting the uptake of voluntary "soft" initiatives aimed at fostering energy saving, at the level of both the organisation and individual employees and community members; and by discouraging energy-intensive, unnecessary practices.

Behavioural insights (BIs) can inform policy interventions to meet these objectives by helping policy makers diagnose which factors of organisational behaviour are at play, what type of business or institution should be addressed by a specific policy or programme, and which behavioural levers are appropriate for the policy's design.

At the diagnostic stage, several guiding questions can help identify the behavioural mechanisms and actors to be addressed by behaviourally informed policies and programmes (PwC, 2018):

- What type of decision-making unit should be targeted to affect the behaviour in question? Are we talking about a group (e.g. executive board) or an individual (e.g. energy manager or head of an SME)? How many employees are involved?
- Is the behaviour connected to a one-off or recurring decision? Does this decision relate to a business strategy or its implementation?
- Is the behaviour related to regulatory compliance or is it a voluntary effort? Does it align with existing skills or does it require new skills to be acquired?

- What is the organisation's readiness for behaviour change, including both its willingness and ability?
- What is the company's position in the business lifecycle: is it just starting out, or is it well established?

Different behavioural levers can be employed in organisation-oriented policy interventions and programmes. For example, *simplifying and framing information* about existing regulations can encourage compliance by streamlining procedures. Recruiting trusted messengers for information provision can also raise awareness of regulations and of compliance requirements.

Feedback mechanisms and *prompts* can also increase compliance, as non-compliance or late reporting might be due simply to delays and misunderstandings rather than intentional refusal. For example, prompts to comply with reporting obligations may be more effective if they include *social comparisons* with reporting rates of similar-sized same-sector businesses.

The uptake of voluntary actions could also be encouraged through *reward schemes*, which in the case of businesses might be intangible (e.g. good publicity citing the business as exceeding its requirements to reduce its energy-related emissions and fuel consumption). Conversely, businesses lagging behind in their energy efficiency efforts or not meeting industry standards might be sensitive to the threat of negative publicity.

Collective voluntary agreements that gather multiple same-sector businesses or institutions to jointly commit to common goals leverage both social norms and comparisons as well as *goal setting and public commitments*.

Case studies

This section discusses behavioural interventions to encourage entire businesses and organisations to reduce their energy consumption, and to prompt sustainable behaviours by specific stakeholders – from employees to commercial tenants.

Country	Institutions	Case study	Level	Scale	Behavioural levers
Encouraging businesses and organisations to reduce their energy consumption					
Netherlands	Government agency	Increasing adherence to a voluntary agreement to reduce energy consumption	National	Trial	Simplification and framing of information; social norms and comparisons
United Kingdom	Central government	Giving higher visibility to energy audits by involving top company decision makers	National	Full-scale policy	Changes to the default policy or product specifications; simplification and framing of information
Netherlands	Central government	Training energy managers to better communicate the benefits of energy efficiency	National	Full-scale programme	Simplification and framing of information

Country	Institutions	Case study	Level	Scale	Behavioural levers
Netherlands	Central government	Recognising the specific energy consumption patterns for businesses in different sectors	National	Diagnostic	Simplification and framing of information; goal setting and commitment devices
United Kingdom	Central government	Leveraging digital innovation for companies' energy management	National	Trial	Simplification and framing of information; feedback mechanisms; reward schemes
Encouraging employees to make their workplace behaviour more sustainable					
Canada	Utility	Encouraging employees of an energy utility to save energy at work	Specific business or building	Full-scale programme	Simplification and framing of information; goal setting and commitment devices; reward schemes
Canada	Utility; central government	Encouraging employees of a public building to save energy at work	Specific business or building	Full-scale programme	Simplification and framing of information; goal setting and commitment devices; reward schemes
Canada	Business	Encouraging employees of a hospital to save energy at work	Specific business or building	Full-scale programme	Simplification and framing of information; goal setting and commitment devices; reward schemes
United States	Central government	Encouraging employees of a public building to make their workplace behaviour more sustainable	Specific business or building	Full-scale programme	Simplification and framing of information; goal setting and commitment devices
Encouraging tenants of commercial spaces to conserve energy					
United States	Business	Encouraging tenants in commercial buildings to reduce their energy consumption	Specific business or building	Full-scale programme	Simplification and framing of information; feedback mechanisms
Encouraging community members to make their behaviour in common spaces more sustainable					
Multiple countries	BI team; international organisation	Encourage university campus members to make their behaviour in common spaces more sustainable	Local / municipal	Diagnostic	Feedback mechanisms; social norms and comparisons; simplification and framing of information

Encouraging businesses and organisations to reduce their energy consumption

INCREASING ADHERENCE TO A VOLUNTARY AGREEMENT TO SAVE ENERGY

To help the Netherlands meet its national energy efficiency targets between 2005 and 2020, 1 100 companies differing in size, production focus, energy consumption and energy efficiency performance signed a voluntary agreement with the Dutch government to achieve 8% greater energy efficiency over 4 years (Rosenkranz et al., 2017; PwC, 2018).

The agreement requires companies to provide data on energy consumption and other parameters on a yearly basis to the Netherlands Enterprise Agency, a Dutch government agency. The agency analyses the data and provides each company with a report that contains detailed feedback on the company's energy performance and how it compares with other same-sector companies, capitalising on the influential force of social comparisons.

However, the report is provided through a password-protected website, and this seemingly small obstacle resulted in only 14% of participating companies downloading it. This phenomenon of inertia provoked by small hassle factors (also known as "friction") motivated a redesign of the feedback process. Through a randomized controlled trial, e-mails conveying the feedback report were reformulated to raise the report download rate (messages were personalised as well as made shorter and clearer). Crucially, access to the report was simplified to shorten the slightly time-consuming login procedure.

These simplification and reframing efforts boosted the download rate from 14% to 46%. Furthermore, including an element of social comparison in the report notification e-mail (i.e. mentioning how comparable businesses were responding) increased the download rate even more, to 51% (Rosenkranz et al., 2017).

While not directly related to energy consumption, this business-oriented intervention indicates how the effectiveness of policy programmes to prompt energy efficiency, such as the voluntary agreement and the associated feedback report, could be considerably improved by simply tweaking the way public authorities communicate about the programme.

Interviews with the businesses involved in the trial indicated that they were keener to read the feedback reports and consider energy efficiency improvement measures after downloading them.

GIVING HIGHER VISIBILITY TO ENERGY AUDITS BY INVOLVING TOP COMPANY DECISION MAKERS

How much energy audits affect behavioural change in businesses depends on the extent to which their insights reach top management to inform high-level investment decisions to structurally improve company energy efficiency.

To ensure that energy audit information became embedded in organisational procedures and culture, the UK Energy Saving Opportunity Scheme (ESOS) requires that audit signoff be performed by two board-level directors. This requirement was designed to raise the profile of energy consumption information and the potential of energy saving measures (HM Government, 2016).

Assessment of its early impacts, based on a survey of ESOS compliers, indicates that the average priority placed on energy efficiency at the board level rose from 5.31/10 in 2016 to 6.37/10 in 2018 following implementation of this requirement. While board-level engagement has not been meaningful for all businesses involved in ESOS, in some cases the increased interest has translated into the implementation of concrete measures to improve business energy efficiency (e.g. installing LED lights) (BEIS, 2020).

TRAINING ENERGY MANAGERS TO BETTER COMMUNICATE THE BENEFITS OF ENERGY EFFICIENCY INVESTMENTS

Contrary to tangible sector-specific inputs, energy is an intangible ancillary input to the production process and the activities of businesses and organisations. For this reason, top management might not be aware of the benefits of energy efficiency, and energy managers bear the burden of making the case for investing in it.

To support the efforts of technical energy experts in non-energy businesses, in 2017 the Netherlands Enterprise Agency organised a workshop that included a simulation game for 35 experts. Its purpose was to train participants in sales communication and it included guidelines on how to calculate, present and communicate the non-energy benefits of energy efficiency measures in terms of companies' key performance indicators (KPIs; e.g. profits, product quality and operational maintenance).

Participants reported important changes in their work practices and in the way they began to communicate and collaborate with top management, incorporating KPIs into their narrative and looking beyond the basic savings and technical feasibility of energy efficiency improvements. Some even indicated that this communication evolution prompted actual investments in structural energy efficiency improvements (PwC, 2018).[18]

RECOGNISING THE SPECIFIC ENERGY CONSUMPTION PATTERNS OF BUSINESSES IN DIFFERENT SECTORS

The previous case study points to key performance indicators as parameters through which the impact of energy efficiency improvements on business activities can be measured and better appreciated.

At the same time, because activities differ from one production sector to another, communication relating to energy efficiency should be adapted accordingly, building upon relevant KPIs and highlighting the main co-benefits to inform behavioural interventions to encourage more energy efficient business behaviours.

In 2014-15, the Netherlands Enterprise Agency conducted a project to identify possible behavioural interventions to enhance energy savings, involving firms in three different industries: paper; coffee and tea; and carpet and textiles.[19]

Factory visits and discussions with experts were performed to identify the most promising processes for saving energy, for example machine-setting optimisation and waste prevention in the paper industry, and the development of sustainable packaging in the coffee and tea subsector. The most important insight from the firm visits was that, while in certain industries (e.g. paper) energy savings were not a critical KPI for production before the study, measuring the energy requirements of machinery prompted increased interest in energy efficiency as a tool to improve operations.

This indicates the importance of connecting energy efficiency messaging to goals that are important to businesses, such as cost reductions and smooth production operations, while framing energy savings as a co-benefit.

[18] Case study data based on responses to the Users TCP survey and PwC (2018).
[19] Case study data based on responses to the Users TCP survey.

LEVERAGING DIGITAL INNOVATION FOR COMPANY ENERGY MANAGEMENT

In parallel with the rollout of smart meters to households and businesses, the UK Government launched an innovation competition building on smart meter data to provide small non-domestic users in selected sectors (retail, hospitality and schools) with personalised feedback on their energy consumption and actionable insights to pursue energy savings (BEIS, 2019).

Seven competition partners tested their innovations in a real-world setting between February 2019 and January 2020, so the next phase will involve assessing their impacts. Solutions range from phone apps to websites to activities with schoolchildren, and they target organisations of different sizes (small retailers, chains and shopping centres) as well as various decision makers (general staff, managers and front-office workers).

The early application of various engagement technologies can provide some preliminary insights into how to exploit smart meter data to garner interest in energy management technologies and practices (BEIS, 2019):

- Effective messaging highlights how, thanks to feedback technologies, users can better control their energy consumption and related costs, simplifying their operations and realising financial savings. This makes organisations both more eco-friendly and more resilient. Messages can be fine-tuned to appeal to specific organisations: in schools, for example, it helps to indicate that energy efficiency measures raise classroom comfort.
- Initiatives to engage non-domestic users in energy monitoring should be well timed: as summer is likely to be preparation season for schools, it is an appropriate time to plan for energy optimisation. Retail and hospitality businesses could be approached when they are being established or during energy contract renewals.
- Successfully engaging an organisation requires capturing the attention of both the top decision makers (such as store managers, head teachers and business owners) and the internal employees (such as customer service staff and caretakers) who can influence behaviour change even though they are not decision makers.
- Energy management solutions should motivate users to take action to reduce their energy consumption in a timely way. Effective prompts to date include energy consumption feedback, expressed in financial terms and disaggregated over time and by business function or zone (e.g. a hotel's restaurant versus its rooms), as well as comparisons with similar businesses. High-consumption alerts and energy saving tips are also effective.

Encouraging employees to make their workplace behaviour more sustainable

Because office workers do not pay for their workplace energy consumption, incentivising energy-saving at work requires different behavioural levers than for the residential environment. For instance, competition among floors in an office or commercial building can exploit the effect of reward mechanisms by offering tangible compensation or public recognition for the most successful participants.

Alternately, goal setting and commitment strategies can be leveraged by providing employees with energy saving tips and inviting them to pledge to a specific energy saving target. "Floor captains" can act as competition leaders and trusted messengers, providing energy saving tips, while trained staff can visit building occupants to help them identify opportunities to save energy and guide them in reconfiguring their office spaces. Moreover, posters and banners that present simple, well-framed messages supporting energy savings (e.g. reminders to turn off computers at the end of the workday) can be useful prompts.

These behavioural levers have been applied in three Canadian pilot programmes designed to reduce energy consumption in the workplace by changing the behaviour of building occupants (Bin, 2012):

- Conservation Action!, implemented in 2006-07 at the offices of the BC Hydro and Power Authority, British Columbia's largest electricity utility
- a 2008 behavioural campaign deployed in the main building of the Ministry of Energy, Mines and Petroleum Resources of British Columbia
- Thermostats, Lights and Controls – Care to Conserve, implemented in 2007-10 at the University Health Network medical centre affiliated with the University of Toronto.

With management strongly supporting the behavioural measures, these programmes created a culture of workplace energy conservation, engaging and empowering volunteers and employees to participate in the common effort. This combination of factors resulted in energy savings of 5% in one year for the first project, 12% in one week for the second and 4.2% in two years for the third (Bin, 2012).

In 2007, the US House of Representatives launched a similar initiative, Green the Capitol, which included goals such as becoming carbon-neutral within 18 months and reducing energy use by 50% in 10 years. This large-scale project involved purchasing renewable power to meet electricity demand; operating the Capitol Power Plant on natural gas; reducing energy consumption at the Capitol Power Plant; relighting the Capitol Dome; and purchasing carbon offsets, among many other measures.

Leveraging the use of BIs, a web-based online tool was developed to promote behaviour-changing activities such as carpooling, commuting by bicycle and recycling among the staff and occupants of the participating offices. This online tool, called My Green Office, was launched in 2009 by the office of the Chief Administrative Officer (CAO).

The website collected information from visitors (e.g. House staff and employees) about behavioural choices that could reduce energy use, carbon emissions, landfill waste and energy expenditures (Bin, 2012). Participants could then track their performance against 15 "core greening activities", along with 6 stretch actions for offices aspiring to go above and beyond the basic suggestions. More than 100 trained CAO and Architect of the Capitol employees provided consultations and follow-up technical services for staff, helping volunteers to chart their office's progress and keep the CAO office updated.

By defining specific activities, the programme leveraged the use of goal setting and commitment devices to encourage participants to focus on specific energy saving objectives. One of the Green the Capitol's successes was the voluntary participation of district offices that were not part of the initial target audience (Bin, 2012).

Encouraging tenants of commercial spaces to conserve energy

In 2009, the owner of New York's Empire State Building, in co-operation with expert advisors, launched a retrofit programme to reduce energy use (Bin, 2012). The initiative assessed the costs and benefits of a wide range of energy efficiency-improving measures, then honed in on eight economically viable projects, including a behaviourally aligned energy management programme targeting energy conservation among workspace tenants. Other projects involved structural changes such as digital control of tenant lighting, daylighting and plug loads, variable-air-volume air handling units, and improved windows.

The energy management programme incorporated several behavioural levers. Introducing submetering for each tenant enabled feedback provision, allowing tenants to monitor their individual energy use and modify it if necessary. Based on tenant suggestions, key building staff were identified as trusted messengers and designated to act as contact persons for the programme (Bin, 2012). A web-based tool was launched for tenants to access and benchmark their energy consumption information online, providing them with real-time recommendations for energy savings (FMlink, n.d.).

After the first year of operations, the entire retrofit programme had reduced energy use by 38% and delivered financial savings of about USD 4.4 million, while the tenant energy management programme alone reduced energy spending by an estimated 3.3% (more than USD 380 000) (Jones Lang LaSalle et al., n.d.; Vaughn, 2012). This initiative is a valuable demonstration of how BIs can support structural upgrades to increase overall energy savings.

Encouraging community members to make their behaviour in common spaces more sustainable

When designing behavioural interventions, planning their implementation for a time that fits well with an organisation's business cycle is fundamental to maximise their impact.

Lockdown and shelter-in-place measures to deter Covid-19 contagion have forced large portions of the mobility-restricted population to work from home, demonstrating the rapid impact that behavioural changes (in this case, forced) can have on energy consumption and on related environmental emissions.

While the pandemic caused educational institutions around the world to close their physical premises and shift to online teaching in spring 2020, students in some regions returned to campus in autumn 2020. This novel situation required a host of behavioural changes, including physical distancing and mask use.

In partnership with the UK-based Behavioural Insights Team, the United Nations Environment Programme (UNEP) has developed a guidebook for university leaders, campus sustainability managers and higher-education students to incorporate "nudges" based on BIs into their efforts to support sustainable behaviours on campus (UNEP, GRID-Arendal and Behavioural Insights Team, 2020). The report provides recommendations for behavioural interventions and advertises nudges that have already been implemented on campuses across the world.

Many of the behavioural interventions suggested to prompt energy savings are among those discussed earlier in this study. They include providing feedback on energy consumption and associated costs through visible displays in common campus spaces and sharing information about positive trends to highlight changes in social norms leading to energy savings. Publicising energy consumption data disaggregated by building to prompt interdepartmental and inter-dorm competition to achieve energy savings is another way to capitalise on the influence of social comparisons. These nudges provide building managers and energy managers with useful tools to engage students and university employees alike – and many of them can be applied to community and work environments outside of higher education.

Green defaults can facilitate behaviour change by overcoming inertia and friction: at Portland Community College in the United States, for example, all employee computers are set to shut down overnight by default. This has proven more effective than sending prompts to employees or informing them of aggregate energy consumption due to idle computers, and it has led to estimated energy savings of several thousand kWh per year.

In Canada, the University of British Columbia has opted for a large-scale information campaign calling on campus staff to perform a seasonal shutdown, switching off and unplugging all electronic devices before leaving campus for the winter break, as per the checklist provided.

In the context of sustainable mobility and transport behaviour, digital technologies can be exploited to make online streaming and remote dial-in the normal and default options for meetings and events – both on campus and for events staff are invited to. Additionally, departmental rules for business travel can be set to make public transport, train use and carpooling the norm, as opposed to flying.

For daily commutes, cycling can be supported and encouraged by a programme to automatically enrol newcomers – students and staff – in local bike-sharing schemes, simplifying their use by eliminating signup hassles. As small, cumulative behavioural changes can lead to long-term habit evolution, encouraging students to increase their number of cycling trips to campus over several semesters could promote a steady change in habits.

Private car use can be discouraged by requiring drivers to sign up for parking permits on a daily or weekly basis to increase friction, even where parking is provided for free. Along with offering free or subsidised public transport passes, providing interest-free loans or subsidies for students and staff to buy seasonal passes that spread payments across a longer period of time could help them overcome short-term financial constraints and encourage the lock-in of public transport use by making it a daily habit.

Main insights from case studies

Most interventions encouraging businesses and other organisations (e.g. public administrations and schools) to adopt energy efficient behaviours have been spearheaded by government ministries or implementation agencies (e.g. the Netherlands Enterprise Agency). Interventions that instead address employees or business stakeholders such as commercial tenants have been initiated by businesses themselves, sometimes in co-operation with utilities (Figure 15).

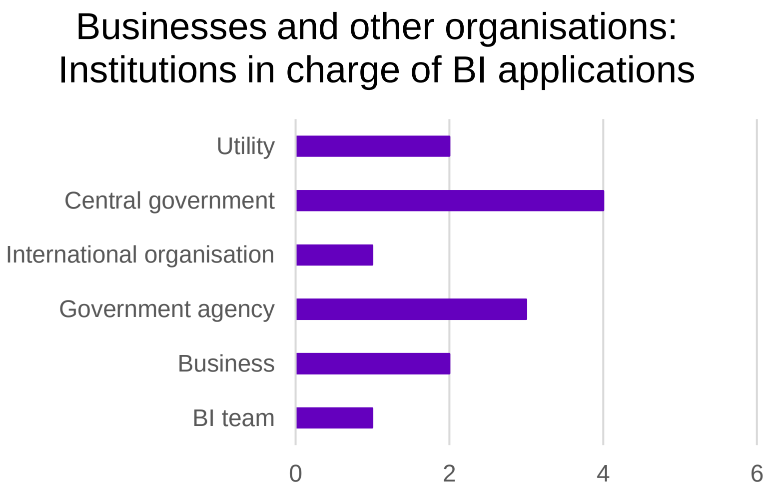

Figure 15. Institutions in charge of BI applications to shape energy consumption decisions of businesses and organisations

Information simplification and framing has motivated the redesign of a platform to monitor regulatory compliance as well as efforts to improve communication on the benefits of energy efficiency investments through relevant business KPIs. Meanwhile, reward schemes have been designed to award teams of employees collective prizes for achieving the largest energy savings following dedicated information campaigns and competitions (Figure 16).

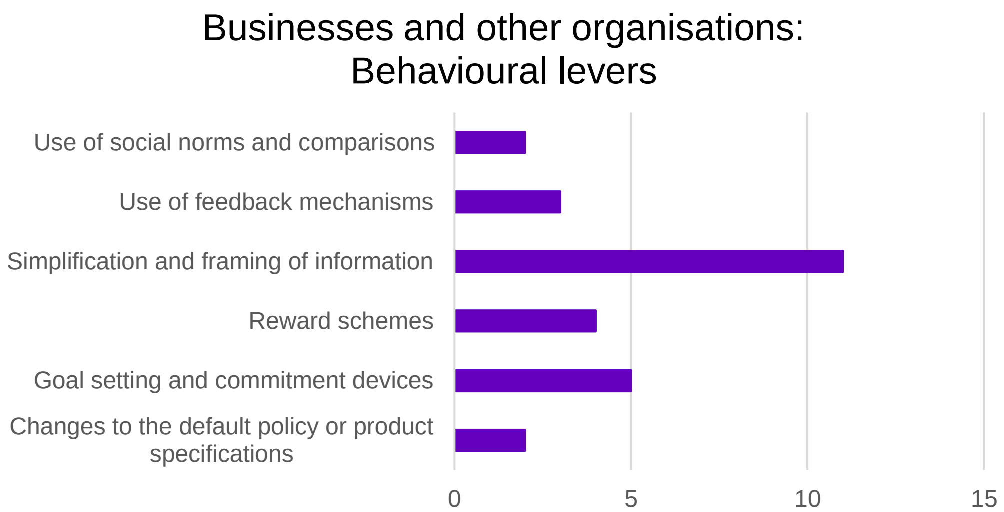

Figure 16. Behavioural levers used in interventions for business and organisational decisions on energy consumption and efficiency investments

Most interventions addressing business energy consumption and efficiency investments are full-scale programmes – some have been implemented nation-wide, while the majority apply to a specific business or even administrative building (Figure 17).

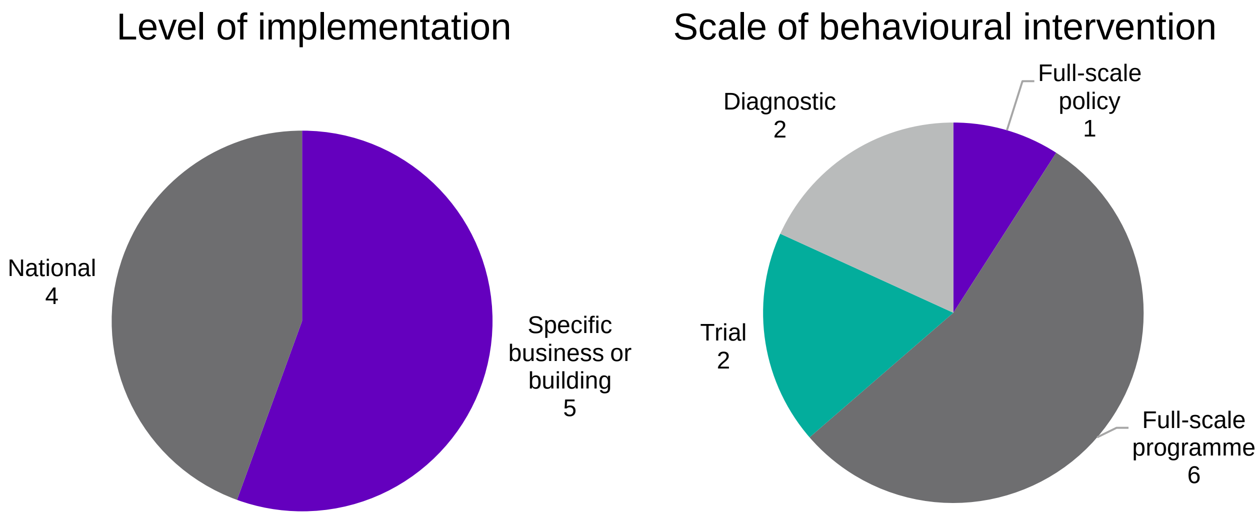

Figure 17. Jurisdictional level of implementation and scale of BI applications addressing business and organisational decisions on energy consumption and efficiency investments

Simplifying and reframing information provision and communication platforms can enhance compliance with regulations and voluntary agreements

Seemingly small hassle factors, such as the complexity of platforms businesses need to use to report compliance information and data, can disproportionately reduce compliance with both regulatory obligations and voluntary agreements. Simplifying and reframing processes and information provision can therefore eliminate unnecessary hassle and the ensuing friction.

The effectiveness of this strategy was proven in the Netherlands. The redesigning of prompts inviting businesses to download free energy audits they could benefit from through a voluntary agreement increased their engagement with the report, resulting in greater engagement with the proposed energy efficiency solutions.

Engaging key decision makers within organisations is critical to raise the profile of energy efficiency and encourage investment in it

Making energy consumption conspicuous and relevant is necessary to engage organisations in energy efficiency investment. Feedback devices should be adapted to each organisation's needs, and should provide applicable indicators: for example, hotels will be interested in disentangling energy used for room heating from consumption for restaurant activities. Digital innovations that manipulate smart meter data are being piloted in the United Kingdom, with a focus on applications pertinent to schools and the retail and hospitality sectors.

Translating energy consumption information gathered through smart meters and energy audits into relevant KPIs is critical to help business decision makers understand how energy efficiency measures can improve their operations.

Furthermore, requiring board-level signoff on energy audits ensures that high-level decision makers within the company are aware of the latest energy trends, increasing their sensitivity to the benefits of initiatives that can jointly boost their business's energy performance and its operational efficiency.

Green defaults can be leveraged to remove the hassles preventing employees from making more sustainable workplace choices

Members of any organisation – from company employees to members of a university campus – may not realise how their behaviour in the workplace or in common spaces affects organisational energy consumption because they ultimately do not pay the bills. However, organisation-wide initiatives urging individuals to engage in sustainable behaviours can be designed to nurture a sense of belonging as well as positive competition among different branches and departments.

Online tools that enable employees to set and commit to behaviour change goals are most effective if they incorporate a follow-up function that allows users to track their progress, read about tips and contact specialists to help them troubleshoot.

Green defaults can facilitate behaviour change by overriding natural inertia and friction barriers. For example, setting workplace computers to shut down after office hours can deliver energy savings without requiring any employee effort.

Finally, automatically enrolling business and educational institution newcomers in local bike-sharing schemes can help them bypass signup hassles. This would simplify their adoption of a new habit at a time when they are already adopting a set of novel routines associated with a workplace or school change.

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