Rialtas na hÉireann
Government of Ireland

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

2024

Gap Analysis on Behavioural Research Related to Climate Policy and Interventions

Authors: Leonhard K. Lades, and Cara Augustenborg

Behavioural Insights Series: No. 2

Behavioural Insights Series: No. 2

GAP ANALYSIS ON BEHAVIOURAL RESEARCH RELATED TO CLIMATE POLICY AND INTERVENTIONS

ENVIRONMENTAL PROTECTION AGENCY
An Ghníomhaireacht um Chaomhnú Comhshaoil
PO Box 3000, Johnstown Castle, Co. Wexford, Ireland
Telephone: +353 53 9160600 Fax: +353 53 9160699
Email: info@epa.ie Website: www.epa.ie
Lo Call 1890 33 55 99

Disclaimer

Acknowledgements

The authors would like to thank researchers Emma Flannery, Julion Gallagher, and Warnakulasooriya Umesh Ashen Lowe for their assistance. The authors would like to thank Andrew O'Callaghan, Hannah Julienne, and Shane Timmons for their valuable comments. The authors would also like to acknowledge the contribution of the steering committee, namely Robert Mooney (Department of the Environment, Climate and Communications), Desmond O'Mahony (EPA), and Conor Quinlan (EPA).

ISBN: 978-1-80009-213-6

Project Partners:

Professor Leonhard K. Lades

Economics and Behavioural Science Centre

University of Stirling

Stirling, FK9 4LA, UK.

l.k.lades@stir.ac.uk

Environmental Policy (Visiting Professor).

University College Dublin

Dr. Cara Augustenborg
Assistant Professor in Environmental Policy

University College Dublin

Cara.augustenborg@ucd.ie

Contents

List of Figures

List of Tables

Executive Summary

Behavioural insights are used all over the world to inform policy decisions. Ireland is at the forefront of this still novel and emerging movement, with several Irish public institutions already applying behavioural insights. However, the true potential of behavioural insights to better understand and change behaviour at scale, as well as the limitations of the approach, are not yet well-known.

Climate change, biodiversity loss, and other environmental threats are directly tied to human behaviour. Hence, the importance of insights from behavioural science to shape environmental policy making has never been greater, and it is essential for decision makers to understand how behavioural insights can inform policy decisions that address these global challenges.

This report summarises how behavioural science is being applied both internationally and in Ireland to help achieve climate action targets mainly using "green nudges." These green nudges use behavioural insights to change people's behaviour in more environmentally friendly directions.

The report provides an introduction to behavioural science and behavioural public policy (in Part 1). After having read this part, the reader will have a solid grounding in the most important behavioural concepts and theories, and how these are used to change environmental behaviour. The reader will also be introduced to more advanced topics about, for example, the effectiveness and the ethics of behavioural interventions.

The report then summarises how behavioural insights are used internationally and in Ireland in various sectors (in Part 2). A key result of this analysis is that, while there is scope in many sectors in Ireland to improve the design and implementation of environmental policies, the application of behavioural insights is more advanced in some sectors than in others.

- Behavioural insights are already frequently applied in the **energy and buildings sectors** to encourage energy efficiency investments and change the way energy is used in our daily lives. Ireland is amongst the leading countries worldwide in these sectors.

- In contrast, applications of behavioural insights in the Irish transport, agriculture, and marine sectors are less common. The international literature suggests that this is **not surprising in the transport sector**, because the potential for effective travel behaviour change interventions is limited.
- A **substantial gap** exists, however, between international best practices and Ireland's use of behavioural science **in the agriculture, land use, and forestry sectors**. Internationally, effective behavioural interventions that could change farmer and land manager decisions have been identified, but green nudges are underutilised in Ireland in these sectors.
- International insights on **nudges in the marine sector are limited** and more research is needed to identify gaps.

The report also identifies the most effective and promising green nudges, such as:

- **Changes regarding default settings.**
- **Simplification**.
- **Social norm messaging**.

However, the effectiveness of these nudges depends on the context and specific behavioural barriers and drivers. Therefore, a thorough **behavioural analysis** of the target behaviour is essential before designing interventions.

Part 3 of the report provides insights for environmental policy making based on this analysis. It suggests an important role for behavioural insights in environmental policymaking. Ignoring green nudges would leave the potential for environmental behavioural change untapped, which we cannot afford given the threats posed by climate change and related environmental crises.

At the same time, relying on green nudges alone will not be sufficient to achieve environmental targets. It is unrealistic to expect massive behavioural effects from small nudge-type interventions. Green nudges are not a silver bullet and traditional policy solutions, such as education, incentives, and regulation, are sometimes required.

Looking ahead, the next generation of behavioural research should focus on enhancing the effectiveness of traditional environmental policies through diagnostic studies, behavioural auditing, and the integration of behavioural insights with traditional policymaking. This integrated approach viewing environmental policymaking through a behavioural lens will be vital to achieving environmental targets in the face of climate change and other ecological crises linked to human behaviour.

Part 1: Behavioural Public Policy

Introduction

This report summarises how behavioural science is used internationally and in Ireland to help achieve climate action targets mainly through "green nudges". A nudge is "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2021, p. 8), and a "green nudge" aims to make behaviour more environmentally friendly. The label "behavioural science" is used here to describe the discipline that has recently emerged at the edge of economics and psychology and often aims to design and test behavioural change interventions such as nudges.[1]

In the last decade, research in the behavioural sciences has made a lot of progress in better understanding the potential, and the limitations, of behaviourally informed policy interventions as potential means to change behaviour (OECD, 2017a). As a result, behavioural insights are used all over the world to inform policy decisions (see Figure 1). Ireland is at the forefront of this still novel and emerging movement and provides an example for many other countries worldwide showcasing the effective use of behavioural insights in many sectors. Irish public institutions already using behavioural insights include the ESRI, the SEAI, the Central Bank, and the EPA, amongst others. However, the true potential of behavioural insights to change behaviour at scale in Ireland and internationally to tackle the most important issues, as well as the limitations of the approach, are not yet well-known.

A significant degree of behavioural change is needed to mitigate climate change, biodiversity loss, and other environmental threats. Thus, the significance of insights from behavioural science in shaping environmental policies has never been more pronounced (IPCC Climate Change, 2023; Linden et al., 2021). It is particularly important to change the

[1] While many other approaches could be called behavioural science as well because they use the scientific method to improve our understanding of behaviour or attempt to change it, this report uses the narrower definition of behavioural science often linked to nudging.

most impactful behaviours and to focus attention on high-emission sectors (Nielsen, Cologna, et al., 2021). Relying on behavioural insights can help Ireland to achieve the behavioural changes needed to achieve national environmental targets. Not applying behavioural insights would be an unnecessarily missed opportunity to change behaviours in environmentally friendly ways.

Behavioural change can be achieved through "top-down" system-level policies, such as infrastructure investments, regulations, and carbon taxes. However, "bottom-up" individual-level policies, such as information campaigns and changes of the choice architecture, can also lead to desired behavioural changes (Vlasceanu et al., 2024). While this report focuses on individual-level policies, behavioural insights can also inform more systemic changes. For example, behavioural insights about individual responses to how taxes are named can improve carbon pricing policies or improve the support for system-level changes (Gravert & Shreedhar, 2022).

The report is organised in three parts:

Part 1 introduces the report and explains what behavioural science is and how behavioural insights can be used to inform public policy making. First, it situates behavioural policies beside more commonly used traditional policy tools. Second, it summarises important behavioural insights (e.g. related to present bias, loss aversion, and the endowment effect) to motivate why behavioural public policies have become so influential over the last decades. Third, it provides examples of frequently used green nudges (such as green default settings, green social norm messages, and simplification). Fourth, it introduces some other behavioural policy instruments such as "boosts", "sludge-reduction", and the regulation of the misuse of behavioural insights by the private sector. Fifth and sixth, it summarises recent debates on the effectiveness and the ethics of nudging. Seventh, it presents the discussion about whether the focus on individual-level interventions can crowd out motivation to work on system-level policies. Eighth, it summarises a common framework that helps behavioural practitioners to design and test behavioural interventions. Finally, it provides a short overview of the institutions that use behavioural science in Ireland with a focus on work related to the environment.

Part 2 presents the core of the report. Chapters 3 to 7 deal with the following sectors, respectively: Electricity; Buildings; Transport; Agriculture, Land Use, Land Use Change and Forestry; and Marine. For each sector, these chapters begin by identifying the most important behaviours. Second, each chapter presents examples of international evidence about the use of behavioural insights to change these behaviours. These examples will be organised in a list of green nudges. Third, each chapter provides an overview of how behavioural insights have been applied in the respective sectors in Ireland. The final section in each of these chapters then provides a summary and recommendations about how to fill gaps between what is known from the international literature and how behavioural insights are applied in Ireland. Moreover, further reading material is suggested.

Part 3 provides a high-level summary of the potential and limitations of applying behavioural insights to change environmentally relevant behaviour in Ireland in chapter 8. Chapter 9 provides a list of specific recommendations for Irish environmental policymaking from a behavioural perspective. It is argued that the focus on nudging in behavioural public policy helped grow the field but that the same focus is now limiting further behavioural policy implementation progress. The behavioural policy toolkit is larger than nudging, thus additional works should focus on a broader behavioural agenda. Chapter 10 concludes the report with recommendations for future research. A methodological appendix provides details about how the information for the report was gathered.

Behavioural Science and Policy

Situating Behavioural Instruments in the Policy Toolbox

Many traditional environmental policies are informed by economic thinking. A key assumption in economics is that human behaviour is best described by rational utility-maximising decision-making. This assumption is sufficient to analyse and recommend traditional policy instruments. The effects of incentives, regulations, education, and information provision on behaviour, for example, can be well predicted when assuming than people make fully rational decisions.

However, not all human behaviour is the outcome of a hyper rational decision-making process, and it is uncommon to find people arguing that full rationality is the best way to describe human behaviour outside the economics profession (Mullainathan & Thaler, 2001). Instead, people sometimes rely on decision-making heuristics and make fast decisions without much deliberation (Kahneman, 2011). Fast decision-making that relies on heuristics is often efficient and can lead to good outcomes. However, sometimes such decision-making is influenced by the contexts in which decisions are made in ways that harm the decision-maker (Dolan et al., 2012). Our decisions (both fast and slow) are sometimes influenced by "supposedly irrelevant factors" such as frames or default settings (Thaler, 2015). Traditional policymaking has ignored such behavioural factors, as traditional policies have been designed for "Econs" (artificial beings that exist only in economic textbooks) but not for "Humans" who exist in the real world (Thaler, 2015).

Once we acknowledge that humans do not always make the decisions that maximise their welfare, and that context matters for our decisions, our policy toolbox does not need to be restricted to traditional policies such as incentives, regulations, education, and information provision. Instead, we can also consider more creative "behavioural" interventions such as nudges (Thaler & Sunstein, 2021).

This report deals with these behavioural interventions. Table 1 situates this novel behavioural policy tool within the wider policy toolbox using an intervention ladder adapted from the Nuffield Council on Bioethics (2007). In this ladder, lower levels describe policies

with little policy interference in individual freedom (e.g. doing nothing or providing information) and higher levels describe policies with stronger interference in people's lives (e.g. bans and taxes). Behavioural interventions appear at level 4 in this ladder. Their interference in people's lives is not very strong, they are often relatively cheap to design and implement, they can be effective, and sometimes it is simply impossible to rely on other policy instruments.

One key aim of this report is to highlight that behavioural interventions might well be the best (or even the only) policy option at a policymaker's disposal. At the same time, the report also highlights the limits of behavioural interventions and stresses that stronger interventions are required when the evidence suggests that behavioural interventions are not sufficient to achieve climate targets.

Table 1 The intervention ladder adapted from the Nuffield Council on Bioethics (2007). The higher the level, the stronger is the interference of the government in individual responsibility.

Level	Policy	Example
8	Eliminate choice	Banning the use of single use plastic containers.
7	Restrict choice	Removing environmentally-harmful ingredients from products.
6	Guide choice through disincentives	Increasing taxes on carbon or congestion charging in inner cities.
5	Guide choices through incentives	Offering tax-breaks or subsidies for the purchase of heat pumps or bicycles.
4*	Guide choices through setting defaults and other nudges	Setting green electricity defaults, communicating green information through labels, simplifying green grant application processes, etc.
3	Enable choice	Building infrastructure such as public transport or cycle lanes.
2	Provide information	Inform and educate the public as part of campaigns to encourage people to walk more.
1	Nothing	Do nothing or simply monitor the current situation.

Some Behavioural Insights

To illustrate that people do not always act in rational ways to maximise their well-being, this subsection presents some of the most influential and well-tested insights from behavioural economics. We selected these specific insights because of their potential applicability to policy. Readers who are already familiar with concepts such as loss aversion, present bias, and social norms can skip this section or read only a few select paragraphs.

Hyperbolic discounting: Hyperbolic discounting describes how people choose between outcomes that vary in size and delay. It suggests that people prefer smaller, sooner rewards over larger, later ones more than they should if they were calculating the future value of these rewards in a traditional, exponential manner (Ainslie, 1975). The term "hyperbolic" refers to the mathematical shape of the discounting curve that illustrates this preference: it shows a steep decline in the value of future rewards as they move from the immediate to the near future, but then the decline flattens out for rewards in the more distant future. For example, hyperbolically discounting people might plan to buy energy efficient appliances in the future. However, when the time of the purchase comes closer, they begin to overvalue the sooner costs, to undervalue the future cost savings, and decide against the energy efficient appliances that come at a higher up-front cost.

Present bias: A variant of the dynamic inconsistency described by hyperbolic discounting is present bias which is the human tendency to assign greater importance to present events over future ones (Laibson, 1997). When people are not aware of their present bias, it can lead to procrastination (O'Donoghue & Rabin, 1999). For example, people may decide to postpone taking financially and environmentally beneficial actions that require effort in the present to the future under the assumption that they will actually take these actions in the future. If this assumption is incorrect, such procrastination can reduce take up rates of, for example, home retrofits and heat pump installations (Lades et al., 2021).

Limited attention: People do not always consider all relevant aspects of a decision. Instead, we sometimes overlook or disregard certain factors, especially if those factors are not immediately obvious or salient (Gabaix, 2019). For example, people might focus too much

on the upfront costs of adopting environmentally friendly practices, such as purchasing energy efficient investments, while overlooking the less salient long-term savings in terms of reduced energy bills (Allcott & Knittel, 2019). Moreover, people might overlook non-monetary benefits of environmentally friendly behaviours, such as improved air quality, reduced noise pollution, or enhanced well-being.

Cognitive scarcity: When people feel that they are lacking a resource such as money or time, they may become occupied with thoughts related to having too little, and these thoughts occupy cognitive resources and thus influence choices and behaviours. This preoccupation with scarcity can impede cognitive functions (Mullainathan & Shafir, 2013). When individuals are preoccupied with concerns, such as financial difficulties or time constraints, they may allocate fewer cognitive resources to considering and acting on environmentally friendly options. Cognitive scarcity can lead to cognitive overload, making it more challenging for individuals to engage in thoughtful, well-considered decisions about environmentally significant behaviour.

Status quo bias: The status-quo bias describes our tendency to prefer the status quo over any change (Samuelson & Zeckhauser, 1988). It has also been called the *"yeah-whatever heuristic"* (Thaler & Sunstein, 2021). People have a natural inclination to conserve mental resources, especially when faced with complex or unfamiliar choices and they sometimes prefer choices and decisions that require less mental exertion or thinking. For example, people may be more likely to stick with default choices or the status quo (Madrian & Shea, 2001). The status quo bias might prevent people from adopting new environmentally friendly behaviours or technologies because they are comfortable with their current habits and routines. For example, people may opt for convenient but less sustainable options (e.g. single-use products) over more sustainable but potentially less convenient alternatives.

Reference-dependent preferences, loss aversion, and the endowment effect: Rather than evaluating outcomes in absolute terms, we often assess them as gains or losses relative to a reference point or a baseline (Kahneman & Tversky, 1979). This reference point can be a previous state, an expected outcome, or a social norm. When evaluating outcomes in

comparison with a reference point, the outcomes can be understood as gains or losses, and seminal work by Kahneman and Tversky (1979) shows that people tend to be more sensitive to losses than to gains. For example, if people expect a 20% reduction of energy costs after a deep retrofit but only achieve a 10% reduction, they might perceive this as a loss and be rather unhappy about it, even though they are still saving money. The related endowment effect describes people's tendency to place a higher value on an object they already own compared to the value they would place on acquiring the same object if they did not own it (Kahneman et al., 1991). In other words, people often ascribe a higher value to items they possess simply because they possess them. This can explain differences in willingness to pay for and willingness to accept environmental policy measures.

Projection bias: Projection bias occurs when people overestimate the degree to which their current preferences, beliefs, and attitudes will remain consistent over time. In other words, they tend to project their current state of mind onto their future selves, assuming that what they value and desire now will be the same in the future (Loewenstein et al., 2003; Read & Van Leeuwen, 1998). For example, if someone is currently very interested in environmental issues and is highly motivated to take actions to reduce their carbon footprint, they may erroneously assume that this level of interest and motivation will persist indefinitely. However, their level of concern and motivation may decrease over time due to changing circumstances, priorities, or influences.

The representativeness heuristic: The representativeness heuristic is a mental shortcut or rule of thumb that people use to make judgments or decisions based on how similar or "representative" something is to a known category or prototype (Kahneman & Tversky, 1972). People tend to judge the likelihood of an event based on how closely it resembles a familiar example. For example, people might assess the viability and benefits of new, environmentally friendly technologies based on how closely they resemble existing technologies, potentially overlooking more effective but less conventional solutions.

Anchoring heuristic: The anchoring heuristic describes the tendency of people to rely heavily on the first piece of information they receive when making decisions (Tversky &

Kahneman, 1974). This initial piece of information, or the "anchor," serves as a reference point against which subsequent information is compared. For example, the first information people see about environmental initiatives or policies can shape their attitudes and beliefs, influencing their subsequent support or opposition.

Availability heuristic: The availability heuristic suggests that people rely on readily available information or examples that come to mind easily when making judgments or decisions (Tversky & Kahneman, 1973). This mental shortcut often leads people to give more weight to information that is easily accessible or memorable, rather than considering a more comprehensive and accurate assessment. For example, images related to environmental issues that are frequently covered in the media may become more salient and influence people's perceptions and judgments about the severity of those issues more than issues less frequently discussed in the media.

Emotions and visceral states: Emotions and visceral states such as hunger and anger can influence behaviour but are rarely considered in the standard economic model of decision-making. For example, emotions can influence how much people tip in restaurants, hunger influences consumption decisions, and arousal influences the probability of engaging in morally questionable behaviour (Lerner et al., 2015; Loewenstein, 2000). Anticipatory emotions such as anticipated regret can also influence our decisions (Zeelenberg, 1999). For example, guilt about one's ecological footprint can drive individuals to adopt more sustainable practices, such as reducing energy consumption or choosing eco-friendly products. Fear of environmental consequences of environmental degradation can influence support for policies and individual actions aimed at mitigating those consequences.

Social norms: Especially when the right choice is not obvious, people often act in ways they consider normal (Nolan et al., 2008). In other words, they follow a descriptive social norm that represents the prevailing behaviours or actions observed and accepted by the majority within a specific group or community. For example, if people observe that most of their peers engage in environmentally friendly actions (e.g. recycling or using reusable items), they are more likely to adopt similar behaviours. Injunctive social norms refer to people's

perceptions of what is approved or disapproved of in a particular social context. Unlike descriptive social norms, which focus on what is commonly done, injunctive social norms convey a sense of what is socially sanctioned or accepted within a specific community or social group (Cialdini et al., 1990). For example, if a community expresses approval for recycling or reducing energy consumption, individuals are more likely to adopt these behaviours to align with social expectations. Moreover, people sometimes act in ways they believe are becoming more common over time. That is, they follow a dynamic social norm (Sparkman & Walton, 2017). For example, people might observe that more and more others are changing their dietary habits which can be a motivator to join this trend and change one's eating patterns as well.

Caring for status and image concerns: One important driver of human behaviour is the desire to be successful relative to other people and to signal one's status to others for example through conspicuous consumption (Frank, 1985). In the context of the environment, "conspicuous conservation" has been used to describe consumption that signals pro-environmental values and generates observable green status with the idea of being green to be seen (Brick et al., 2017; Sexton, 2011).

Nudging and Green Nudging

The most popular policy instrument inspired by behavioural insights as reviewed above is nudging (Thaler & Sunstein, 2021). Nudges are aspects of the choice environment that influence the behaviour of humans in a predictable way without limiting freedom of choice or changing incentives. Nudges and other behavioural public policy instruments are used all over the world (see Figure 1).

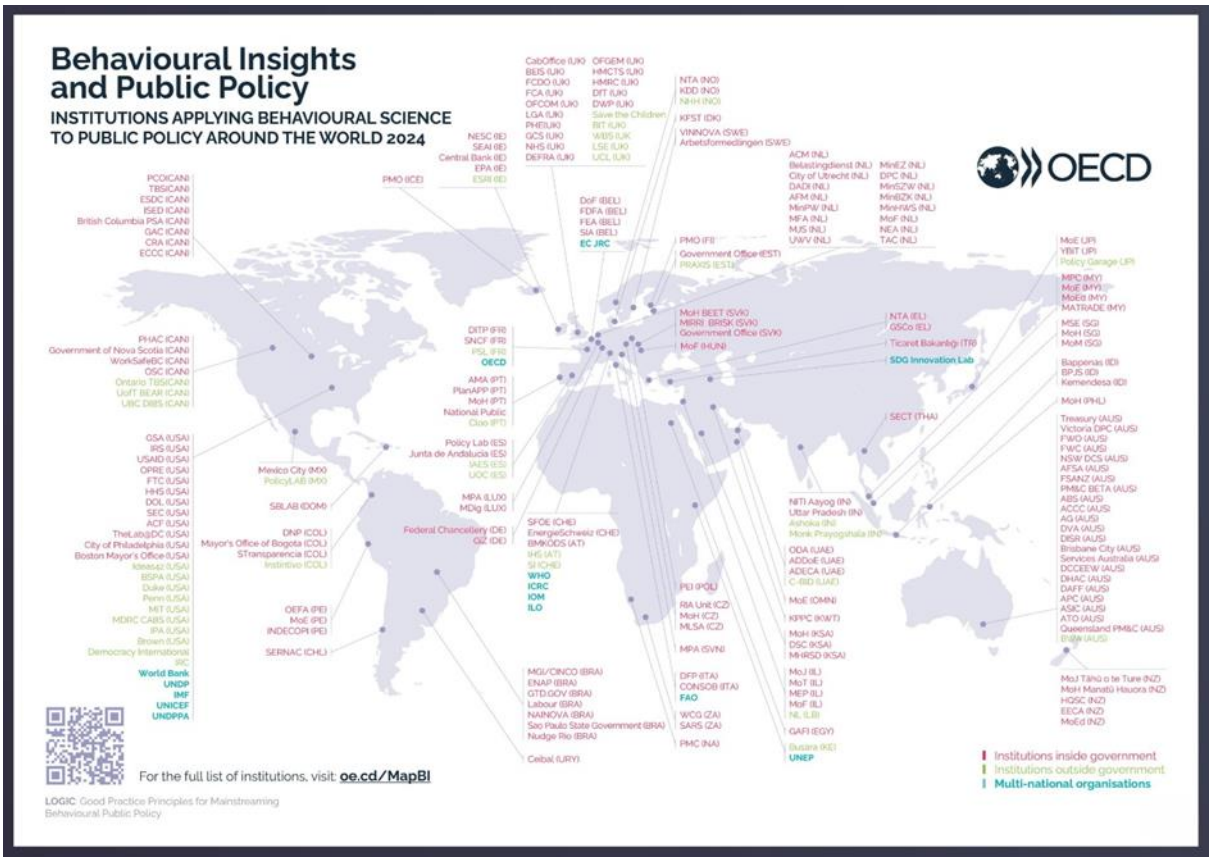

Figure 1: Over 200 institutions applying behavioural insights in governments around the world. See here for a dynamic map. Source: (OECD, 2024).

The UK Behavioural Insights team was the first government institution to apply nudges systematically as a policy instrument. This team has established the EAST framework to introduce the idea of nudging (The Behavioural Insights Team, 2014). This framework groups behavioural interventions into four ways behaviour can be changed. It suggests making behaviour:

- **Easy** by removing frictions, making messages clear, using defaults, etc.
- **Attractive** and thus guide attention to where it is most helpful.
- **Social** and use the fact that humans influence one another, and that people are more likely to engage in a behaviour if others are doing so as well.
- **Timely** by making sure that interventions come at the time when people are most receptive.

The East framework is a helpful guide to quickly identify some potential applications of nudges. The behavioural science literature, however, goes beyond that.
Nudges can be *architectural* or *educational* (Reisch & Sunstein, 2021). Architectural nudges emphasise how choices are presented (e.g. defaults, simplification, mandated choice requirements, or the order or placement of options). Architectural nudges often work because they do not rely on making people actively deliberate on which option to choose. They often rely on the idea of making the right action the easy action and work with what Kahneman called “System 1”, which describes fast and intuitive decision making. Educational nudges, on the other hand, often encourage people to reflect and make active decisions using their “System 2” by providing information in psychologically-informed ways (e.g. labels, signage, disclosures, warnings, or reminders). When nudges aim to encourage environmentally friendly behaviour, they have been named “green nudges” (Carlsson et al., 2021; OECD, 2017b; Schubert, 2017).

The remainder of this subsection summarises some architectural and educational green nudges. The chapters in Part 2 below select the most relevant green nudges presented here and show how they have been used in various environmental policy sectors.

Architectural Green Nudges

Architectural green nudges can influence environmentally relevant behaviours through changes of the choice architecture on, for example, websites, contracts, labels, policy forms, reminder messages, or physical environments.

Setting green defaults: Defaults determine what happens when people do not make an active choice. They are arguably the most effective behavioural intervention (Jachimowicz et al., 2019). Especially when people do not have a strong preference for one option over the other, defaults can increase the likelihood of the pre-selected option being chosen (de Ridder et al., 2022). Defaults can have strong effects in domains such as pension participation (Beshears et al., 2009), energy provider choice (Kaiser et al., 2020), printing (Egebark & Ekström, 2016), and meat consumption (Meier et al., 2022; Reisch & Sunstein, 2021), among others. Reasons for the effectiveness of defaults include the status quo bias and inertia, satisficing behaviour, the endowment effect, and the interpretation of the default as an endorsement (Kaiser et al., 2020).

Simplification: Richard Thaler, co-author on the book "Nudge", has a mantra: *"If you want to encourage someone to do something, make it easy"* (Thaler & Sunstein, 2021). The other co-author of *Nudge* refers to *"plate, not pyramid"* as another mantra that he used when working in the US Obama administration, referring to the change from a complex food pyramid to a simple plate to communicate healthy eating options to the public (Sunstein, 2013). Both mantras suggest using simplification to increase ease and convenience of the desired behaviours. Simplification can mean that similar information is described in simpler terms. It is possible to increase the salience (the attention-grabbing potential) of important aspects of choices by simplifying and focusing on what matters most. Since humans have limited attention, simplification can help us devote that attention to the most relevant aspects of the decisions we face. For example, energy performance certificates and building energy ratings have been simplified worldwide to make it easier for buyers and homeowners to understand and compare energy-efficiency investments. Eco-labelling and fuel energy labels are ways to orient consumers' attention to the environmental relevance of purchases while saving money (Allcott & Sunstein, 2015). Letters can be written in plain

English and simply including web-links to online forms or pre-populating forms can be effective (Halpern, 2015).

Sludge reduction: Sludge reduction is a specific type of simplification. Behavioural scientists use the term sludge to describe excessive or unjustified frictions that make it harder for people to do what they wish, similar to transaction costs in standard economic models (Shahab & Lades, 2022; Sunstein, 2021c; Thaler, 2018). Sludge is the "dark cousin" of nudge, or "nudging for evil" (Thaler, 2018). Sludge makes it more difficult for people to navigate through their everyday lives (Sunstein, 2019). For example, required paperwork can be unnecessarily complicated, the procedures to cancel memberships might be burdensome, forms need to be populated although the relevant information is already provided, websites might be designed in ways that make it difficult to identify the final price of a product, fine print of contracts might be long and confusing, defaults might be set unfavourably, messages might induce psychological costs, and so on (Soman, 2020; Sunstein, 2021c). Sludge can cost time and money. It can also lead to frustration, stigma, and humiliation. Sludge can make it difficult for people to find relevant information, to evaluate this information once found, and to implement decisions (Shahab & Lades, 2022). Sludge is particularly harmful for people who are present biased, have limited attention, and are overoptimistic. To identify sludge, public and private institutions can conduct "sludge audits" in which sludge is catalogued and assessed. After a sludge audit, informed decisions can be made about whether and how to reduce sludge. Periodic lookbacks at existing sludge could be organised to test whether the current stock of sludge can be justified or should be reduced (Mills et al., 2023; Sunstein, 2022). Sludge reduction can support the implementation of climate action policies. For example, reducing the sludge related to afforestation or access to retrofit grants can increase uptake of these measures (Bertoldi et al., 2021; Lades et al., 2021).

Real-time feedback: People often ignore information if it is presented at the wrong time, even if the information is relevant. Real-time feedback can address this issue. For instance, Tiefenbeck et al. (2018) implemented real-time feedback in university students' showers using a device that activated during each shower, displaying water and energy consumption

in real time. This approach led to a significant 22 percent reduction in the average shower time.

Changes to the physical environment: Changes to the physical environment can influence behaviour. Like the layout of a building affects how we move around, the setup of a decision-making situation can impact the choices we make. For example, the design of cafeterias, plate size, restaurant menus, recycling bins, and websites etc. influence our behaviour (Akbulut-Yuksel & Boulatoff, 2021; Kurz, 2018).

Providing opportunities to demonstrate "green credentials": Since people are sometimes motivated to show off, and environmental values are increasingly what is being signalled to others, providing opportunities to signal that one is an environmentally conscious person or institution can change behaviour. People might behave pro-environmentally to obtain social reputation and status and be "green to be seen" (Sexton, 2011). For example, the Toyota Prius was one of the first popularly marketed hybrid cars. It was bought frequently arguably because the buyers used it to make a statement about themselves. Green license plates for electric cars are another potential way to allow people signal their green status.

Educational Green Nudges

Educational nudges can influence environmentally relevant behaviours through various channels such as letters, emails, phone messages, personalised reports, signages, labels, and websites.

Communicating social norms: Effectively communicating "descriptive" social norms involves informing individuals about the behaviours of others, thereby establishing a sense of what is considered "normal" (Cialdini et al., 1990). This information becomes particularly influential when people are uncertain about the appropriate behaviour. For example, providing households with information about how much energy their neighbours are consuming can change energy use (Allcott, 2011).

People's behaviour can also be influenced by communicating what people believe is considered the appropriate behaviour (Cialdini et al., 1990). These beliefs are known as "injunctive" social norms. They convey whether a specific behaviour is socially approved. Communicating both descriptive norms (how others behave, see above) and injunctive norms (through smileys) can be done at the same time. Such information can, for example, reduce water and electricity consumption (Allcott, 2011).

Introducing "dynamic" social norms becomes relevant when a new environmentally friendly norm has not been firmly established (Sparkman & Walton, 2017). Dynamic social norms capture emerging trends in behaviour. For instance, in the context of coffee consumption, people can be informed that an increasing number of customers are choosing to bring their own reusable coffee mugs. This information has the potential to discourage the use of single-use plastic cups, illustrating the power of dynamic social norms (Loschelder et al., 2019).

Psychologically informed labels: Psychologically informed labels can convey key information in an easily understandable manner. These labels are widely used to communicate aspects such as the energy efficiency, fairness, or organic nature of products. Whether voluntary (like the US Energy Star Label) or mandatory (such as the EU Energy Label), labels can be effective because they direct people's attention to important product characteristics and reduce the time needed to gather such information (Lohmann et al., 2022; Schuitema et al., 2020; Sunstein, 2021a). Moreover, they contribute to updating consumers' beliefs, such as potential savings (Allcott & Sunstein, 2015). Labels providing financial and lifespan-related details can also boost the sales of energy-efficient appliances (Stadelmann & Schubert, 2018). However, it is worth noting that the effectiveness of labels can vary, and some studies suggest that they may not always achieve the desired impact (Allcott & Knittel, 2019; Bar-Gill, 2023).

Goal setting and precommitment: Encouraging people to set goals and commit to these can change environmentally relevant behaviour. Providing commitment devices can help individuals lock themselves into desired future behaviours. These devices include personal

or public pledges or promises to, for example, reduce energy consumption (Allcott & Mullainathan, 2010).

Reminders: Reminders can be effective in increasing attention to decisions and reducing forgetfulness. However, they can also carry moral costs by drawing attention to decisions individuals may prefer to avoid (Damgaard & Gravert, 2018). Reminders can increase participation rates in contexts such as voluntary land conservation programs (Wallander et al., 2017), reduce electricity consumption (Gilbert & Zivin, 2014), and promote fuel-efficient travel (Gosnell et al., 2020).

Beyond Green Nudging: Other Behavioural Policy Instruments

While nudging is the most popular behavioural public policy instrument, there are other behavioural policy instruments available that can change environmentally relevant behaviour (Nova & Lades, 2022). This subsection presents behavioural interventions that have emerged as alternatives or complements to nudging in the literature on behavioural public policy.

Agency-enhancing behavioural policies: "Boosts" aim to enhance people's competencies by improving their skills and knowledge and by facilitating the achievement of their objectives (Grüne-Yanoff & Hertwig, 2016). This approach operates on the belief that people's competencies can be elevated either by expanding their repertoire of skills and decision tools or by restructuring the environment to better leverage existing skills and tools. Boost policies target and rectify deficiencies in skills and knowledge, particularly in domains where decision-making plays a crucial role. For example, fast-and-frugal decision trees can be used. These trees involve a series of yes/no questions to efficiently guide decision-making. They can improve decisions in the context of energy consumption (Caballero & Ploner, 2022) or medical decision-making (Hafenbrädl et al., 2016). Another boost is the provision of energy-saving tips at the right moments through stickers with QR codes on appliances such as microwaves, showers, or fridges (Paunov & Grüne-Yanoff, 2023).

Another agency-enhancing behavioural policy is called "nudge plus" (Banerjee & John, 2021). This variant of nudging suggests that nudges can be coupled with a form of reflection about their preferences and about the nudge itself. For example, before or after defaulting people into meat-free meals, choice architects can provide information about the purpose and the design of the default, or they can ask people to think about signing a pledge to eat sustainably (Banerjee et al., 2023). This combination of the default and the encouragement to reflect can lead to higher intentions for greener dietary options compared to the nudge alone.

Budging: Behavioural insights are also used by the private sector to make profit and increase market shares. At times this business practice is manipulative and deceptive and harms consumers or other organisations. Regulating such misuse of behavioural science has been labelled "budging" (Oliver, 2013). The government can, for example, disallow harmful behaviourally informed practices or mandate that business must use behaviourally informed interventions that are expected to be beneficial to customers. Such budging reduces negative externalities that arise through the misuse of behavioural insights. An important role of research on behavioural insights is to identify how private organisations use behavioural insights, such as loss aversion, present bias, and the status quo bias, to increase profits. Once knowledge about such misuse is available, the government can legitimise behaviourally informed regulations that reduce the freedom of private organisations to increase the welfare of consumers.

Shoves: People sometimes behave in ways that are harmful to themselves. For example, due to behavioural factors such as present bias and overoptimism, we eat too much and save too little. Behaviour that does not maximise welfare has been labelled "behavioural market failures" that can lead to "internalities" (Allcott & Sunstein, 2015). While negative externalities describe the effects of a behaviour on a third party (e.g. when a company pollutes a river and people can't swim downstream), internalities describe the effects of a behaviour on oneself (e.g. when a person lives an unhealthy lifestyle and suffers from ill health in old age). Shoves aim to regulate internalities. They are paternalistic interventions that use hard regulation (such as bans and mandates) to enforce or prevent behaviours that would harm the individual who is engaging in this behaviour (Conly, 2012). Regulation through bans and mandates is seen as the least costly approach to prevent harm to people. For example, fuel economy standards that mandate car manufacturers to produce more efficient cars are largely motivated by the desire to help people to save money to overcome an "internality" (Allcott & Sunstein, 2015; Sunstein, 2021b).

Table 2. The most common behavioural public policy instruments with definitions. See Nova and Lades (2022) for more details.

Behavioural Policy Instrument	Definition
Nudge	Any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives (Thaler & Sunstein, 2021)
Sludge-reduction	Sludge is understood as frictions that separate people from what they want to get. Sludge can involve waiting times, reporting burdens, dreary or duplicative application requirements (Sunstein, 2021c). The reduction of sludge could be understood as a nudge as well.
Boost	Boosts aim to enhance people's competencies by improving their skills and knowledge and facilitating the achievement of their objectives (Grüne-Yanoff & Hertwig, 2016).
Self-nudge	Self-nudges enable people to design and structure their own decision environments to make better everyday choices (Reijula & Hertwig, 2022).
Nudge plus	An intervention that incorporates an element of reflection – the plus – into the design of a nudge (Banerjee & John, 2021).
Budge	Government regulations against behaviourally informed activities performed by the private sector that harm other individuals or organisations (Oliver, 2013).
Shove	Paternalistic interventions motivated by behavioural insights about costly mistakes people make that use hard regulation (such as bans and mandates) to enforce certain behaviours (Conly, 2012).

Effectiveness and Cost-Effectiveness

Recent meta analyses suggest that modest effect sizes of nudges are a realistic expectation on average (DellaVigna & Linos, 2022; Mertens et al., 2022; Szaszi et al., 2022). Some nudges are very effective, and others lead to null effects or can even backfire. Overall, one should not expect massive effects from small interventions. This is particularly true in the context of environmentally significant behaviours as these behaviours are often costly, habitual, closely tied to people's identities, and strengthened by cultural, social, economic, and physical contexts. Hence, these behaviours are difficult to change.

But even small effects can be worthwhile when the intervention is very cheap to administer. Nudges have been shown to be a cost-effective means to change behaviour in many situations (Benartzi et al., 2017). If a very cheap nudge leads to some reduction in environmental harm, the nudge should arguably be employed even if the reduction of environmental harm is not of a huge scale. Moreover, studies that analyse whether nudges are effective tend to investigate one nudge at a time. In the real world, nudges come in bundles and repeatedly over time. It might well be the case that such repeated and multiplied nudging changes behaviour despite the absence of evidence for such effects.

The effectiveness and cost-effectiveness of nudges is usually tested using randomised controlled trials. In these trials, participants are randomly allocated to a nudge condition and behavioural outcomes are compared across a control condition. An introduction to experimentation is beyond the scope of this report. It is, however, important to understand that the focus on experimentation and measurement in the nudge literature has meant that most nudges have been designed in contexts that allow a clean evaluation of the nudge effectiveness. This has, to some extent, limited the growth of the behavioural science literature in other areas (Hallsworth, 2023).

It is also important to distinguish between different types of interventions when evaluating the effectiveness of behavioural interventions. For example, the effectiveness of a default rule can be very different from that of a social norm intervention. Each behavioural intervention should be assessed on its own merit and should not be evaluated as they are part of the larger category "nudge". Considering the average effect size of many different

nudges is not very meaningful. Similarly, comparisons between the general categories of behavioural policies (e.g. comparing *nudges* and *boosts*) is of limited value as each category of behavioural interventions itself is very diverse.

The Ethics of Behavioural Influence

Behavioural change interventions have been criticised for being unethical. Critics suggest, for example, that nudges are manipulative and prevent people from using their agency. However, a general discussion about the ethical acceptability of nudges is not helpful because the universe of nudges is large, and nudges are very diverse. Instead, it is important to reflect on whether any specific behavioural change intervention is ethical on a case-by-case basis.

To facilitate case-by-case assessments of the ethical legitimacy of nudges, the FORGOOD ethics framework can be used (Lades & Delaney, 2022). This framework suggests that applied behavioural scientists should consider seven ethical domains when designing behavioural interventions: **F**airness, **O**penness, **R**espect, **G**oals, other **O**ptions, **O**pinions, and **D**elegation, as shown in table 3.

Green nudges are nudges as well, and it is important to reflect on whether they are ethically legitimate. It is true that green nudges often have an ethically legitimate goal: to reduce the negative impact of people's behaviour on the environment. And this is captured in the Goals dimension of the FORGOOD framework. But ethical reflection should not stop there. For example, a nudge might be unfair as it might put undue burdens on the already most vulnerable in society (Fairness). Nudges might also be manipulative (Openness) or disrespectful (Respect). Ethical nudges are transparent and respect people's freedom of choice, agency, their ability to make decisions for themselves, and the right to privacy. It is also possible that there are much more effective or less infringing policy alternatives (Options). If so, the use of nudges can be seen as unethical. If many people express their dislike for a given nudge (Opinions), this should be a warning signal indicating that there might be ethically problematic elements of it. Finally, nudgers should reflect on whether they can and should use the power that was delegated to them (Delegation).

A key question concerns the trade-off across different ethical dimensions. For example, climate action is imperative to protect people. But it is also difficult to achieve due to its transformational nature and climate action will likely involve some loss of or reduction in individual freedom when harder policies such as taxes or bans are used. It is not straightforward to determine whether nudges can prevent harm from climate change without reducing freedom of choice. With the help of the FORGOOD framework, policymakers can reflect on whether they are implicitly making trade-offs across these dimensions.

Table 3. The Nudge FORGOOD ethics framework by Lades and Delaney (2022).

Dimension	Example questions
Fairness	Does the behavioural policy have undesired redistributive effects?
Openness	Is the behavioural policy open or hidden and manipulative?
Respect	Does the policy respect people's autonomy, dignity, freedom of choice and privacy?
Goals	Does the behavioural policy serve good and legitimate goals?
Options	Do people accept the means and the ends of the behavioural policy?
Opinions	Do better policies exist and are they warranted?
Delegation	Do the policy-makers have the right and the ability to nudge using the power delegated to them?

Individual-Level Interventions vs. System-Level Interventions

This report focuses on individual-level behavioural interventions that aim to change people's behaviour. Much of the previous applied behavioural science literature as designed and tested these interventions. However, behavioural science has much to say about system-level policies as well, and leading figures in behavioural science call for more research on the relevance of behavioural insights for system level changes (Chater & Loewenstein, 2023; Hallsworth, 2023).

Behavioural science acknowledges that individual-level interventions (such as nudges) should not crowed out political attention to more system-level interventions (such as regulations or incentives). This crowding-out effect is a frequently mentioned worry (Hagmann et al., 2019). However, no robust evidence exists about it actually taking place in a policy context.

It is also widely acknowledged that individual-level insights from the behavioural sciences can complement harder system changes such as taxes, bans, mandates, and other forms of regulation (Gravert & Shreedhar, 2022). However, there is a lack of studies that test how behavioural insights can improve system-level changes.

Often the dichotomy between individual-level interventions and system-level interventions is not helpful. Individual behaviour can influence systems and systematic change influences behaviour. Individual and system-level change are interlinked. For example, individual actions can send signals to powerful actors to change systems. And vice-versa, system level changes are often the best way to change individual behaviour.

And even when appreciating that system-level interventions are more effective, it is often the case that behavioural interventions are *the only* way a given group of policy makers can influence behaviour. It might be impossible to change systems in the shorter run and it is very possible that individual level change creates a momentum for system changes in the longer run.

Applying Behavioural Insights: BASIC

While it is helpful for the behavioural science practitioner to know about behavioural interventions such as nudges, it is arguably much more important to understand when and how to use them. Having a particular nudge in mind (e.g. a change of the default setting), and looking for settings where it can be applied, is bound to fail. A more promising strategy that is highly recommended is to follow one of the step-by-step guides to design behavioural interventions. One of the most popular and helpful behavioural frameworks is the BASIC toolkit (OECD, 2019), which suggests a five-step approach to applying behavioural insights (see figure 2).

Behaviour: The first step in a behavioural science project in the environmental context is to identify the behaviour that has environmental consequences and should be changed. This step relies on the expertise of key stakeholders and policymakers. For example, one might rely on Climate Action Plans and expert knowledge to identify a subset of behaviours.

Analysis: Once key behaviours have been identified, it is time to analyse which behavioural barriers and enablers are most relevant. This can be achieved through a behaviourally informed problem diagnosis or a behavioural audit. Knowledge about behavioural insights (some of them summarised in section 2.2) is helpful to recognise behavioural patterns and diagnose behavioural biases that lead to environmental harm. This is a crucial step in the policy design process as a deep understanding of the cognitive, emotional, and behavioural mechanisms can help identify the most appropriate interventions at a later stage.

Strategy: When identifying potential strategies to change behaviour, policymakers can rely on examples of policies that have been shown to be helpful in the past as summarised in section 2.3. At this stage, it is important to have a large repertoire of potential strategies in one's toolbox, and broad knowledge of behavioural interventions is helpful. It can be useful to combine different behavioural interventions and view them as building blocks of a wider policy agenda. Once several potential behavioural interventions have been identified, they can be ranked according to whether they are feasible and impactful.

Intervention: Designing and testing behavioural interventions is an important step to evaluate whether the intervention that was picked is effective (see section 2.5). The implications of behavioural insights are often tested using the scientific method with pre-registered hypotheses that are tested in experiments with pre-specified measurable outcomes. This is the gold standard for evidence-based policymaking. However, it should be noted that experiments are not always feasible or warranted.

Change: The last step is to develop plans to change behaviour and the structures that influence behaviour at scale and sustainably.

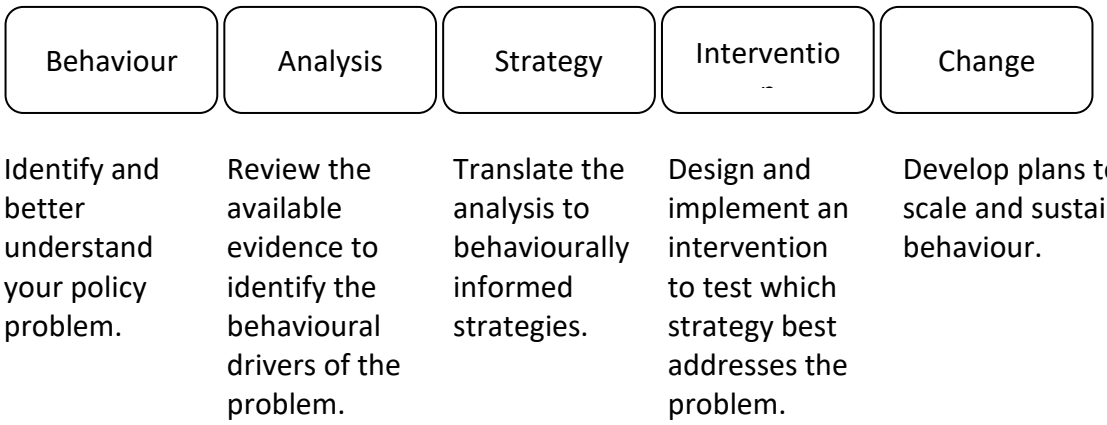

Figure 2. The structure of the BASIC framework that is often used in applied behavioural science work. Source: OECD (2019).

This framework provides an excellent structure to guide stakeholders in design workshops to design effective behavioural solutions. Behavioural scientists with a broad knowledge of barriers and enablers, who are aware of many potential intervention strategies, and who can design experimental studies to test whether interventions are effective can be consulted to help at all five steps.

Behavioural Science in Ireland

Irish organisations that rely on behavioural insights to inform environmental policies include the following:

EPA: The Environmental Protection Agency (EPA) supports behavioural science research and applications to support the development and implementation of climate policies. An

example project from the EPA is Climate Change in the Irish Mind (CCIM), which is conducted by the EPA and Yale University's Programme on Climate Change Communications and aims to improve our understanding of public climate change knowledge, attitudes, policy preferences, and behaviours. CCIM is a nationally representative telephone survey carried out every two years. Data on the Irish population is collected via telephone interviews. The EPA also hosts the Behavioural Insights programme which provides evidence to inform policy and informs behavioural change interventions and awareness campaigns. The EPA contracted Behaviour & Attitudes (B&A) to carry out quantitative research in a number of subject areas including Textiles, Repair, Food Waste, Reuse, and Plastics.

SEAI: The Sustainable Energy Authority of Ireland hosts a Behavioural Economics Unit which aims to encourage measurable changes to energy behaviour, using the latest evidence from behavioural science and economics. The Unit conducts evidence reviews, surveys and experiments, and designs innovative behaviourally-informed interventions to better understand and change energy related behaviour. Some relevant work of the Unit includes a behavioural energy and travel tracker which provides information on how energy is used in Ireland in everyday life, primary work on heat pump adoption, a field trial describing the effects of home energy events, and evidence reviews on promoting retrofitting, communicating to encourage energy conservation, encouraging heat pump adoption, and many more.

BRU/ESRI: The Behavioural Research Unit at the Economic and Social Research Institute (ESRI) conducts behavioural science research in many environmental areas. This is an active research programme funded by various stakeholders. Topics include improving household waste management, efficiency of household hot water use, perceptions of environmental risks, greenwashing and consumer choice, eco-labelling, youth knowledge and perceptions of climate mitigation, everyday barriers to climate mitigation behaviours, public perceptions of active travel initiatives, and behaviour change and active travel.

NESC: The National Economic and Social Council (NESC) has produced work that uses behavioural insights to inform environmental policy making. For example, a 2012 NESC report on "Social and Behavioural Aspects of Climate Change" provides a broad review of

the state of behavioural change research across energy efficiency, social acceptance of energy infrastructure, travel behaviour, and farming practice (Moore, 2012). A follow-up paper by on "The Framing of Climate Action in Ireland: Strategic Considerations" identifies how irrationality, ideology, interests, and institutions influence climate action policy as understood by policymakers and decision-makers (FitzGerald, 2019).

The Teagasc Signpost Programme uses behavioural science in agriculture to engage farmers and support them to move towards more sustainable farming systems.

Other areas: Irish public organisations that rely on behavioural insights to inform policies in other areas include the Department of Health which hosted the National Public Health Emergency Team (NPHET) COVID-19 Subgroup – Behavioural Change and provided recommendations on health communications, alterations to physical choice architecture, and understanding of public behaviours during the Covid-19 pandemic (Department of Health, 2020). The Department of Health also engages in international collaborations with the WHO's European regional action framework for behavioural and cultural insights for health, 2022–2027.

The Central Bank of Ireland conducts behavioural science research on topics such as communications with mortgage borrowers, mortgage refinancing, and insurance switching. The Office of the Revenue Commissioners also works in the area. The National Economic and Social Council (NESC) has published reports on Covid-19 and Behavioural Change, the Foundations of Behavioural Insights, and the Framing of Climate Action in Ireland.

Some of these institutions, as well as Irish academics, are part of the Irish Behavioural Science and Policy Network (ISBPN) which has hosted several seminars and networking events. UCD hosts the Behavioural Science and Policy Group which has organised many behavioural science events for academic and the wider public.

Part 2: Applications

Part 2 of this report presents the results of rapid scoping reviews on how behavioural science can inform and support climate policy in the following sectors: Electricity; Buildings; Transport; Agriculture and Land Use, Land Use Change and Forestry; and Marine.

Given the breath of this report, and its intention to inform and inspire readers not yet familiar with behavioural science, Part 2 does not present a complete overview of all potential behavioural policies. Instead, it presents a subset of behavioural insights to provide examples that can inspire the design of behaviourally informed policies and a new approach to environmental policy making.

For each sector, four subsections will be presented:

First, we describe **relevant behaviours that could be changed** in each sector to achieve Ireland's climate action targets. The identification of these behaviours relied on the Irish 2023 Climate Action Plan, the expertise of policy stakeholders, as well as the literature on existing behavioural change interventions.

Second, we present examples of **nudges that have been used to change these behaviours**. This section relies on academic evidence from the international behavioural science literature. To identify relevant academic work in each sector, we used rapid semi-systematic scoping reviews with pre-specified search terms, inclusion criteria, and exclusion criteria. We also relied on forward and backward searches, artificial intelligence search engines, and our existing expertise and knowledge in the area to find relevant work. More methodological details are presented in the Appendix.

Third, we summarise **how behavioural insights have been applied in Ireland to change these behaviours.** This analysis relied on the grey literature, policy documents, and our existing knowledge of the work done by Irish behavioural scientists. We also reached out to Irish behavioural scientist colleagues and asked for examples of applied behavioural insights in the environmental domain.

Finally, we present a **summary and reflections about gaps and further reading material** for each sector.

When reading the proceeding chapters, it is helpful to keep a few principles in mind:

- Not all human decisions are the result of rational deliberation. Instead, decisions are sometimes influenced by context factors that a hyper rational decision maker would consider irrelevant. Modifying contexts through nudges can change behaviour in ways economic thinking has long ignored.
- It is behavioural change, rather than change in knowledge, opinions, or attitudes, that is required to achieve climate action targets.
- While behavioural interventions can be cost-effective, they are not a silver bullet. Behavioural interventions alone are unlikely to be effective enough to achieve climate action targets. This, however, is not a reason to ignore behavioural interventions. They can help.
- Behavioural policy making does not start with a nudge. Instead, it is recommended to first identify the behaviour that needs to be changed and then analyse what the most relevant barriers and enablers are. These are steps 1 and 2 in the BASIC toolkit.

What this report excludes:

This report focuses on behavioural science interventions such as nudges (e.g. social norm messages, defaults, labels, simplification, ...). There is a wider literature that can also be called behavioural science that relies on related but different behavioural change approaches such as the COM-B model and the Behavioural Change Wheel. We do not refer to this literature on this report. Moreover, studies that test the effects of interventions on intentions (rather than behaviour) and that focus on attitudes, values, opinions, etc. are excluded from this report. While such studies can inform behavioural interventions, they do not test them, and behaviour is what we ultimate care about from a climate perspective.

The Electricity Sector

Key Behaviours in the Electricity Sector

This section focuses on three types of behaviours that can be the object of behavioural change interventions. These three types of behaviours can be linked to the avoid, shift, and improve framework (Composto & Weber, 2022). The focus here is on curtailment behaviours and factors that influence the everyday use of electricity. The next section on Buildings focuses more on larger investments in energy-efficient technology.

Reducing electricity consumption: Reductions in energy consumption happen when people reduce heating, limit dishwasher use, or turn off the lights more frequently. This behaviour is typically based on routines and happens automatically and is not the result of cognitive deliberation.

Shifting electricity consumption to more sustainable times of the day: Shifting of electricity consumption to off-peak hours and those hours of the day when renewable energy generation is high (for example, wind at night or solar PV during the day) is facilitated by the installation of smart meters in line with the National Smart Metering Programme, which aims to replace over 2.4 million electricity meters by the end of 2024. Smart meter customers are now able to avail of time of use tariffs.

Increasing the take-up of green electricity tariffs: Switching energy providers is an effortful behaviour and frequently subject to procrastination. Switching to a green energy tariff requires people to search for alternatives, evaluate these alternatives to find the tariff they prefer, and then take all the required steps to subscribe to it.

Behavioural Interventions in the Electricity Sector

Reducing Energy Consumption

Communicating social norms: Communicating social norms to reduce people's energy consumption is the most popular green nudge in the academic literature. Seminal studies by Allcott conducted in collaboration with the US electricity company Opower tested the effects of behaviourally informed home energy reports that included social norm message

on electricity consumption (Allcott, 2011, 2015; Allcott & Kessler, 2019). These home energy reports showed how much energy one's neighbours are consuming and compared this with the household's own energy use (see figure 3). US data shows that these social norm messages in home energy report can reduce energy consumption by 1 to 3 percentage points on average. However, the potential of these interventions is lower in Europe where the housing stock is better and the social norms related to air conditioning different (Andor et al., 2020; Andor & Fels, 2018). Another potential problem is the boomerang effect, where people increase their energy consumption after having obtained a message about their low energy use (Byrne et al., 2018). Using smileys that communicate an injunctive norm describing the morally correct behaviour (see the figure 3 on the right) can alleviate this effect (Schultz et al., 2007).

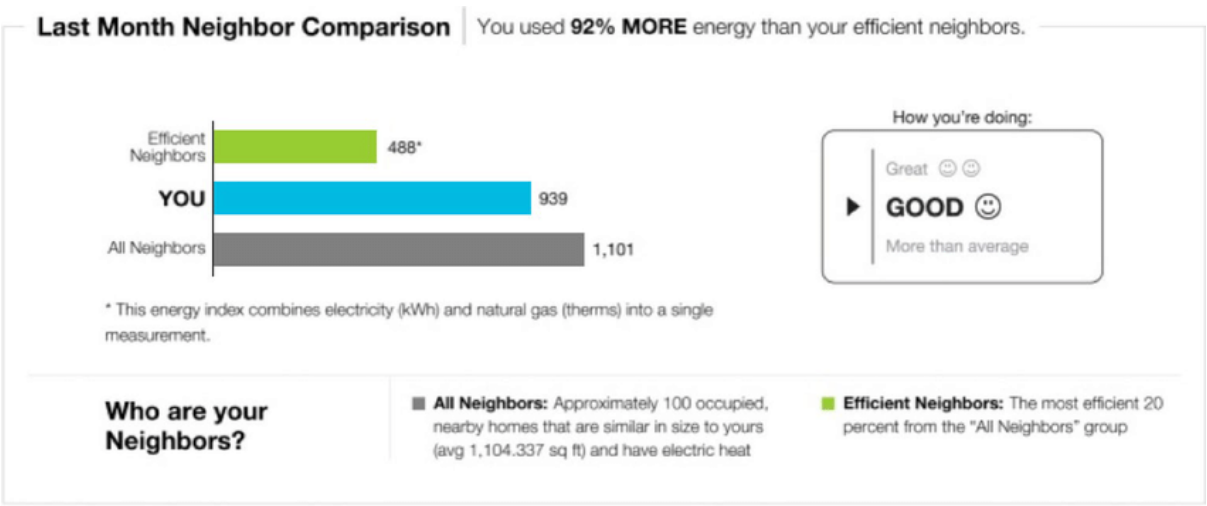

Figure 3. The most popular green nudge: Social norm messages sent by the US electricity company Opower that reduce electricity consumption by 1 to 2 percent. Source: Allcott (2011)

Simplifying energy consumption feedback: When presenting feedback on how much energy people have been using, potential monetary savings and the potential of emissions reductions can be highlighted in simple and easy-to-understand ways (Cappa et al., 2020). For example, complex energy-use data that is usually provided in units such as kilowatts can be problematic (Brandsma & Blasch, 2019). This information can be transformed into formats that are easier to understand such as money that can be saved. Simplification can be used in various communications including energy efficiency labels, energy audits, home energy reports, smartphone apps, and electricity bills.

Providing real-time energy consumption feedback: It is also possible to provide energy use feedback in real time when the energy is used. For example, in-home displays can be used to help people monitor their energy usage in real time (Schultz et al., 2015). While many types of feedback messages can be communicated using the in-home displays, including social norm feedback and providing financial information seems to be the most effective type of feedback. A report by Users TCP and IEA (2020) discusses many future directions for the application of behavioural insights using in-home displays. Another study suggests that providing real-time feedback under the shower can reduce energy and water consumption by up to 22% (Tiefenbeck et al., 2018).

Defaults: Defaults can also be used to reduce energy consumption. For example, the baseline temperature settings of air conditioners and heating systems can be set to moderate levels. This has been applied in India, where the government regulated that all new air conditioners that are commercially purchased or sold as of January 2020 need to have a default temperature of 24°C. Whenever the system is switched off and on again, the temperature needs to be set at 24°C again (Users TCP and IEA, 2020).

Shifting Energy Consumption Over Time

Not much is known about which behavioural interventions can shift energy consumption to off-peak times of the day. However, a 2024 report from Users TCP and the Behaviouralist provides behaviourally-informed guidelines for using behavioural insights to encourage demand flexibility and shifts of electricity consumption across times of the day (Kacha et al., 2024). This report differentiates between behavioural interventions that can change energy consumption habits, that can increase the uptake of demand-response technologies, and that promote consumers' enrolment and participation in demand-response programmes.

Providing rewards: Electricity consumption is a habitual behaviour that does not involve a lot of reflection. Reminders and feedback provided at the appropriate point for example via in-home displays or smart phones can encourage such reflection. Rewards can be financial (e.g. discounts for customers who avoid electricity use at peak times), but they can also be social (e.g. providing ways to signal to others that one is shifting energy use) or symbolic

(e.g. a simple letter that recognises homeowners as “energy-efficient neighbours”) (Kacha et al., 2024).

Providing feedback and reminders: Some studies test whether feedback and reminder notifications can shift people’s energy consumption from peak demand periods to off-peak times of the day. For example, Jorgensen et al. (2021) show that peak energy demand can be reduced by feedback and timely reminder notifications in university residences. Reminders can come in various forms such as reminder letters, notifications, or added signage. When creating reminders, it is important to make them appear at appropriate moments (e.g. using time- on location-based triggers). One can also encourage customers to set their own reminders and provide the technology necessary for that (Kacha et al., 2024).

Simplification and automation: Adopting the habit of avoiding electricity use at peak times is hard. To simplify this process, communications can provide simple step-by-step instructions on how to set thermostats differently. The user journey can be streamlined, and simple language can be used. To design these instructions, it is advisable to consult users including homeowners who are not particularly interested in technology and energy and to test different versions of these instructions in experiments. It is also suggested to collaborate with home appliance manufacturers and ask them to incorporate simple peak spreading mechanisms into their products and to set demand flexibility defaults to settings that avoid the use of electricity during peak times (Kacha et al., 2024). Simplification can also help in the context of time-of-use tariffs. These tariffs are more complex and less known than flat tariffs and consumers prefer the simpler versions (Belton & Lunn, 2020; Parrish et al., 2020). As such, communicating time-of-use tariffs in simple ways and designing them more intuitive (e.g. by distinguishing only between two pricing tiers) might be a way to increase acceptance.

Defaulting people into time-of-use tariffs: Since defaults are usually a very effective tool to change behaviour, one might suggest that automatically enrolling people into time-of-use tariffs is effective (Schneider & Sunstein, 2017). However, the available evidence suggests that people do not respond to time-of-use tariff structures (Burns & Mountain, 2021) and that defaults do not seem to be an effective policy to reduce or shift energy consumption.

Increasing the Take-up of Green Electricity

Defaulting people into green electricity tariffs: Automatically enrolling people in renewable energy sources can significantly increase green electricity consumption. For example, Ebeling and Lotz (2015) show that ticking the box for green energy can increase the uptake of green energy from 7.2% of purchased contracts in the opt-in treatment to 69.1% in the opt-out treatment. Similarly, Kaiser et al. (2020) show that defaults can be very powerful in the energy sector and lead to lasting changes, especially among people who care about climate change (see also Liebe et al., 2021). These effect sizes are amongst the larges that can be found in the behavioural science literature.

Decision support tools: Belton and Lunn (2020) use behaviourally informed experiments to test how good people are when choosing time-of-use tariffs. They show that people find it difficult to match tariffs to usage accurately and that people dislike time-of-use tariffs. A decision support tool in the form of a price comparison site, can improve these decisions.

Behavioural Insights in the Irish Electricity Sector

The "Behavioural Energy and Travel Tracker" developed by the SEAI Behavioural Economics Unit (2023) measures everyday energy behaviours and helps better understand people's current energy behaviours and the factors that underlie them. The Tracker is a monthly online survey that gathers granular data about the everyday energy behaviours of people living in Ireland. It suggests, for example, that the most common high-energy consumption behaviours are setting heating thermostats too high, using tumble dryers frequently, and heating unoccupied rooms. Such insights have were fed into the government's Reduce Your Use campaign (see also here and here) that provides practical advice on how to reduce energy costs and stay warm.

Psychologically informed communication to reduce energy consumption: The **SEAI's Behavioural Economics Unit** has also developed a policy guide aimed at anyone communicating with citizens to encourage energy conservation (Sajan, 2023). The guide outlines 14 recommendations for the best ways of communicating with people about how

they can conserve energy. Recommendations include not overwhelming people with too many **energy saving tips; communicating social norms; appealing to people's sense of social identity; and using relevant and timely reminders.**

Smart meters and in-home displays: The installation of smart metres and in-home displays provides opportunities to apply behavioural insights to help people reduce and shift their energy use. A study that analysed the electricity usage of 5000 Irish residential consumers in response to the introduction of a time-of-use tariff showed feedback from in-home displays can reduce energy use in Ireland (Cosmo & O'Hora, 2017). However, smart meters without in-home displays, as currently in place in most Irish homes, do not provide such opportunities for real time feedback.

Summary, Recommendations, and Further Reading

The strongest behavioural intervention in the electricity sector in the international behavioural science literature is to default customers into green electricity tariffs. Studies demonstrate the uptake of green electricity tariffs can be increased from below 10 percent to almost 70 percent by automatically ticking the relevant box and still allowing customers to untick the box to opt out (Ebeling & Lotz, 2015; Kaiser et al., 2020; Liebe et al., 2021). However, while the direct behavioural effects of these defaults are very strong, such a shift in energy demand to renewables has system-level consequences that need to be considered as there is not yet enough renewable energy available. It is worth exploring whether green electricity defaults can change the energy mix in Ireland as well.

A lot of behavioural science research in the electricity sector highlights the potential of real-time reminders, feedback, and warnings. Smart meters with in-home displays provide the optimal touchpoint through which such behavioural interventions can be administered. Smart meters without in-home displays or other ways to provide real-time feedback, however, are less helpful (Behavioural Insights Team, 2019). Rolling out smart meters without in-home displays is a missed opportunity to create behavioural change, and it should be a priority to equip homes with ways to view their energy use in real time.

Overall, Ireland is at the forefront of applied behavioural science in the electricity sector, largely due to the work by the Behavioural Economics Unit at the SEAI. As such, much of the suggested further reading below is produced by the SEAI.

Selected further reading:

- The SEAI Behavioural Insights portal provides an overview of the work by their Behavioural Economics Unit including current projects and publications.
- A 2022 SEAI policy guide on "Communication strategies to encourage energy conservation: Recommendations based on a rapid review of behavioural science literature" to support communications with citizens to encourage energy conservation (SEAI, 2022a).
- The SEAI Behavioural Economics Unit (2019) has produced a report on Changing energy behaviour – what works?
- The SEAI Behavioural Economics Unit has co-commissioned a report on the Users TCP Behavioural Insights Platform about "Applying behavioural insights to unlock residential demand flexibility: Guidebook for practitioners" (Kacha et al., 2024).
- The International Energy Agency produced a report on "The Potential of Behavioural Interventions for Optimising Energy Use at Home" (Cornago, 2021).
- Users TCP and the IEA (2020) produced a report on "Behavioural insights for demand-side energy policy and programmes. An environment scan".
- An academic review paper on "Effectiveness of behavioural interventions to reduce household energy demand: a scoping review" by Composto and Weber (2022).
- An academic review paper on "Behavioral Economics and Energy Conservation – A Systematic Review of Non-price Interventions and Their Causal Effects" by Andor and Fels (2018).
- An academic review paper by "Psychology and energy conservation: Contributions from theory and practice" by (Abrahamse & Schuitema, 2020)

Buildings

Key Behaviours in the Buildings Sector

This section focuses on energy efficiency improvements in the residential buildings sector. Investing in energy efficiency improvements is a relatively infrequent behaviour for most households. But compared to interventions that aim to change how people use their existing appliances and infrastructure in everyday life, encouraging energy-efficiency investments has a stronger potential to reduce environmental harms (Gardner & Stern, 2008). Such investments are complicated as people must make complex trade-offs between immediate costs and future benefits of the investments, and awareness of many efficient solutions is low as is the confidence in them. Moreover, administrative burdens and sludge related to these investments can be high. Behavioural barriers to retrofitting are hyperbolic discounting, inertia, the hassle associated with these investments, information overload for consumers, salient upfront costs and hidden benefits that only arise on the long term, and the low visibility of heat loss implications (Users TCP and IEA, 2020). The behavioural interventions that can influence such investment decisions are thus different to those discussed above in the context of everyday behaviours that consume electricity.

The first key behaviour that will be considered is to **retrofit homes and buildings**. The Irish 2023 Climate Action Plan specifies targets of 500,000 existing homes retrofitted to BER B2 or equivalent by 2030, which is very ambitious. Retrofits improve the material used in people's homes by, for example, upgrading or installing insulation, double or triple glazing windows, or improving ventilation and air flow.

Another important behaviour that needs to be encouraged is the **installation of heat pumps and rooftop solar PV** on buildings with useful floor areas and sufficient roof space, respectively.

Behavioural Interventions in the Buildings Sector

Simplification: It is commonly acknowledged that the retrofit process can be uncertain, cumbersome, and stressful for homeowners. In other words, obtaining a retrofit is a sludgy process. There are various opportunities for simplification. For example, the loan and grant

systems can be simplified through decision-tree tools that show which types of grants are available for whom, and by making it easier for homeowners to access financial solutions. Moreover, the One Stop Shop scheme aims to reduce administrative barriers towards retrofitting and further streamlining this process can be helpful as discussed in a 2023 SEAI report (SEAI, 2023). The same report recommends further improving the One Stop Scheme and potentially extending its scope also to, for example, heat pumps or solar panels.

Information provision through targeted messaging: Providing information through targeted messages can highlight the long-term financial gains versus the upfront costs of energy-efficient investments. These messages can counteract the human tendency to focus more on immediate costs than future benefits. Messages can also include information about what the social norms are (e.g. “the vast majority of people in your neighbourhood have installed an energy efficient heat pump”). Or both environmental and financial benefits can be communicated which can increase people’s intentions to buy energy efficient products (Hafner et al., 2019). Messages can also highlight eligibility for incentives like heat pump or solar panel grants. A SEAI (2020) study tested whether targeted letters that included elements of simplification and social norms could increase the uptake of heat pump grants. However, these interventions did not increase uptake. This illustrates a general finding that a single and small interventions may be insufficient to motivate significant investments. Investing in energy-efficient technologies is a complex decision and isolated informational interventions are unlikely to be a key influence. However, repeated messaging might well have the desires effects (Users TCP and IEA, 2020).

Energy labels and other ways to make retrofits visible: Energy labels can help reduce energy consumption by influencing purchasing decisions, affecting sales prices, and increasing the willingness to pay for more efficient appliances (Andor & Fels, 2018). When shown saliently on property listings and open home events, these labels can help signalling that retrofits are common and normal (Users TCP and IEA, 2020). Going beyond BER ratings and additionally displaying salient labels on property listings and putting clear signage outside homes during works organised through One Stop Shops might also be effective (SEAI, 2023). However, the effectiveness of labels can vary, as demonstrated by mixed

results in influencing the purchase of energy-saving light bulbs (Allcott & Taubinsky, 2015). Comerford et al. (2018) show that requiring energy labels for dwellings can nudge investments in energy efficiency such as retrofits. This is one of the examples of a behaviourally informed regulation such as the EU-wide regulation that requires energy performance certificates when buildings are constructed, sold, or rented.

Peer effects: The decision to invest in solar panels is influenced by social norms, i.e. by whether one believes that it is normal to have solar panels on one's roof. That peer influence and social norm information can increase solar panel adoption was shown in US contexts. These studies highlight the role of peer visibility and word of mouth in fostering social comparisons and learning (Bollinger & Gillingham, 2012; Gillingham & Bollinger, 2021), showing that visible solar panel installations by neighbours can increase adoption rates. Given the importance of peer influence and visibility in solar panel adoption, policymakers may want to explore ways to increase the visibility of other energy-efficient technologies such as heat pumps as well.

Behavioural insights in the Irish building sector

Simplification and one-stop shops: The SEAI is aware of the hassle factor that can reduce uptake of their retrofitting grants (SEAI, 2023). Irish research also showed that homeowners start the retrofitting process but do not finish it, and that abandonment rates are high (Collins & Curtis, 2017; Pillai et al., 2021) possibly because of the administrative burden linked to the retrofit process (Brown, 2018; Lades et al., 2021; Reaños et al., 2024; Wilson et al., 2015). Partly motivated by this behavioural insight, One-Stop-Shops have been established to alleviate most of the administrative burden for householders during the 'Set Up' stage in Ireland. This follows a European trend where One Stop Shops are becoming increasingly prevalent (Bertoldi et al., 2021). Policy in Ireland has hence responded to two major barriers to retrofitting, through enhanced grant availability and an increasing number of One Stop Shops.

Simplification of the BER design: The SEAI Behavioural Economics Unit has also improved the design of the BER Advisory Report. The previous version was excessively complex and verbose, so the SEAI Behavioural Economics Unit suggested to make essential information

and benefits of a potential retrofit more salient. This involved contributing to a working group for the update of the Home Energy Upgrade Advisory Report.

Decision support tools: The SEAI also offers several decision support tools on their website. For example, energy efficiency calculators to give more tailored advice, clearly presented guidance about grant and funding options, and a tool for tracking existing BER ratings for properties.

Energy Events: The SEAI (2020c) tested if peer influence could encourage households to install energy-saving measures, including loft insulation. This experiment featured a marketing campaign, provision of tailored Building Energy Ratings, and the organization of domestic energy events, taking inspiration from American models tailored to Irish contexts. These events were organised by leaders from SEAI's Sustainable Energy Communities. They provided complimentary Building Energy Ratings evaluations and informed attendees about energy improvement options via respected community figures. The strategy blended face-to-face interactions and Building Energy Ratings evaluations with compelling activities and visual tools such as thermal imaging to highlight the advantages of household renovations. Despite receiving favourable feedback and high recommendation levels from participants, only a small fraction, 3 out of 82 households, acted on the suggested energy efficiency improvements, pointing to economic and logistical hurdles.

Summary, Recommendations, and Further Reading

Key behaviours in the building sector are retrofitting homes, installing heat pumps, and installing solar panels. Promising behavioural interventions to encourage these behavioural changes are to simplify the investment procedures, using energy labels and other ways to signal to others that these investments have been made. These behavioural interventions can make harder (and more costly) interventions, such as grants, more effective.

Ireland is at the forefront of applying behavioural science in the building sector. The international literature refers frequently to Irish case studies (e.g. Users TCP and IEA, 2020), which is mainly due to the work conducted by the Behavioural Economics Unit at the SEAI. One noteworthy document published by this team is an evidence review and policy recommendations on "Promoting retrofitting among homeowners in Ireland through a

behavioural lens" (SEAI, 2023). The document lists 22 behaviourally informed strategies to encourage retrofitting. The four main types of solutions are to (1) address financial barriers, (2) reduce hassle, (3) raise awareness, and (4) upstream solutions that focus on the functioning of institutions, businesses and markets. However, as also acknowledged in the report, studies testing these solutions with robust causal designs are often lacking. Future research in this sector should provide causal evidence on which behavioural solutions can encourage retrofits, and fill gaps in the literature related to public understanding, perceptions of policy initiatives, and consumer interaction with administrative burden when investing in energy-efficient technologies in the buildings. Research on the behavioural barriers that prevent the energy-efficiency investments of rented properties also has potential to complement economic arguments related to the split-incentives problem between landlords and tenants. Future work should audit the existing loan/grant landscape and identify what green financing solutions can support customers pay the high up-front costs of retrofits. A better understanding of the behavioural factors at all stages of the customer journey towards retrofitting is also needed. Different behavioural factors will influence different customers and the analysis of this heterogeneity, for example in segmentation analyses, is important to develop targeted and personalised interventions.

Selected further reading:

- A SEAI commissioned report on "Promoting retrofitting among homeowners in Ireland through a behavioural lens: Evidence review and policy recommendations" (Behavioural Insights Team, UK, 2023).
- A 2019 SEAI Evidence Review on "Changing energy behaviour – what works?" which presents international evidence on what works for encouraging sustainable energy behaviours and recommends a number of behaviour change programmes that should be trialled in Ireland (SEAI, 2019).
- A 2017 SEAI Evidence Review on "Behavioural insights on energy efficiency in the residential sector" (SEAI, 2017).

- Several SEAI studies on heat pump adoption such as a 2022 survey and online experiment on "Consumers' ability to operate heat pumps and their controls: Insights from a survey and online experiment" (SEAI, 2022b), a 2024 survey and online experiment on "Insights from a homeowner survey and willingness to pay experiment" (SEAI, 2024a), and an interview study on "Insights from structured interviews with heat pump installers" (SEAI, 2024b).
- A 2020 SEAI Evidence Review on "Encouraging heat pump installations in Ireland: Strategies to maximise heat pump installation and the savings produced" (SEAI, 2020b).
- A 2020 report on "Behavioural insights for demand-side energy policy and programmes. An environment scan" (Users TCP and IEA, 2020).
- A report on "Applying behavioural insights to unlock residential demand flexibility: Guidebook for practitioners" (Kacha et al., 2024).
- A report from the Joint Research Centre (European Commission) on "Mobilising citizens to invest in energy efficiency: an overview of concepts and approaches for encouraging decisions to invest in energy efficiency" (Bertoldi & Della Valle, 2021)

Transport

Key Behaviours in the Transport Sector

Infrastructure improvements (e.g. high-quality cycle lanes, growing bus fleets, or integrated mobility solutions) are essential to reduce transport-related emissions. However, the effectiveness of these investments may be increased with behavioural insights. The Irish 2023 Climate Action Plan distinguishes between avoiding the need to travel, shifting travel towards more sustainable options, and improving the efficiency of vehicles, and there are important behaviours to be considered in these three categories. Behavioural insights might be able to support behavioural change in these areas.

This section provides an overview of behavioural interventions that might be effective to change travel-related behaviours. Following Sussman et al. (2020), three different types of behaviours can be distinguished.

Interventions can aim to encourage travellers to **choose more efficient modes of transportation** (such as active travel or public transport) or to travel less frequently or shorter distances.

People can be encouraged to **purchase more efficient vehicles**. The purchase of a motor vehicle is – like the purchase of any other durable good – an infrequent event from the household's perspective. Hence, it is subject to all the biases characterising investments in energy efficiency improvements such as myopia and inertia induced by perceptions of sunk costs.

Behavioural interventions can also encourage people to **use their chosen transportation options more efficiently** (e.g. accelerating and braking more smoothly.
Since the frequency of these types of behaviours differ from daily to once every few years, different behavioural interventions should be considered.

Behavioural interventions in the transport sector

Switching to sustainable modes of transport

Communicating social norms: Several academic studies test whether social norm messages (e.g. "many people in this area cycle to work") lead to more environmentally friendly travel (Gravert & Collentine, 2021; Kormos et al., 2015; Mundaca et al., 2022). The findings of these studies are contradictory. For example, Kormos et al. (2015) shows that over-reporting how many others have switched to sustainable transportation increased how likely people are to switch to sustainable transportation as well. The study by Giubergia et al. (2023) showed that an injunctive social norm message can increase intentions to reduce car use. Other studies do not find any significant effects of a social norm intervention (Gravert & Collentine, 2021).

Framing costs and benefits: The costs and benefits associated with various modes of travel can be presented in different frames thus highlighting different aspects of the travel modes. For example, the costs of driving are not only limited to the private expenses borne by drivers but also encompass broader societal impacts, including environmental degradation due to emissions, health issues stemming from air pollution, and the collective time lost to increased traffic congestion. Highlighting the annual time wasted in congestion, as opposed to daily, and emphasizing the extensive use of land for parking can help underline the significant drawbacks of driving. Conversely, the advantages of active travel and public transport are also multifaceted. Emphasizing the benefits of public transport, such as enhanced independence, affordability, the convenience of not having to find parking, and its positive environmental impact, sheds light on its value from various angles (Users TCP and IEA, 2020).

Asking people to commit to sustainable travel: Some studies suggest that asking people to make visible personal commitments to sustainable travel can lead to travel mode shifts. This is most effective when people are in the middle of a life change as habits less sticky at these points in time (Kirkman, 2019; Verplanken et al., 2008; Verplanken & Orbell, 2022). Travel

mode choices are very habitual, and people stick to their habits even though other travel mode choices might be better financially and lead to less time spent travelling.

Providing real-time information: People dislike ambiguity. Not knowing how long one must wait for a bus is very stressful. Subjective waiting times are also perceived to be longer when no information about the objective waiting time is available (Watkins et al., 2011). Hence, providing reliable real-time information at the bus stops or via a well-designed mobile phone app can increase public transport use.

Make the ride social: It is sometimes suggested that public transport use, especially in more rural areas, can be more social than driving (Alta Planning + Design & Behavioural Insights Team, 2017). Surveys on feelings during travel suggest that people feel better when interacting with others during the trip (Ettema et al., 2012).

Simplification: Simplifying the payment process can reduce the burden of planning public transport trips. For example, if it is possible to use one's existing credit cards rather than cash (without change given) or the leap card, travelling on public transport becomes more accessible.

Encouraging EV purchases over Diesel and Petrol Alternatives

Provide vehicle comparison tools: Vehicle comparison tools can provide information to overcome the barriers to EV adoption (SEAI, 2020c). These tools contain information such as upfront cost, available purchase incentives such as grants and tax relief, estimated annual electricity/fuel costs, battery range, available charging infrastructure, and so on and provide an easy way to compare different vehicles. When designed appropriately, information about the lifetime costs of EVs or the total cost of ownership compared to other cars can attenuate the effects of hyperbolic discounting which causes people to overvalue immediate costs compared to future cost savings (T. Wu et al., 2016). Highlighting the total cost of ownership (rather focusing on the purchase price) of a car can help reduce the perception that EV are much more expensive than petrol and diesel alternatives in a lifetime assessment of the car's costs (SEAI, 2020a; Sussman et al., 2020). EVs in the most popular Irish car segments

cost on average 26% and 42% less than equivalent petrol and diesel alternatives over a 4-year ownership term (Guo et al., 2022).

Providing fuel efficiency information: It is often argued that providing fuel efficiency information should encourage consumers to buy more efficient cars. However, Allcott & Knittel (2019) run two experiments in the field and online with US customers and do not find significant effects of information about individually tailored annual and lifetime fuel cost information. Information provision alone might not be sufficient to change behaviour. It might be important to also increase the salience of this information and making sure that it receives sufficient attention. This can be done through vehicle economy labels that highlight environmental aspects of cars, such as greenhouse emissions. For example, environmentally conscious customers can be encouraged to buy fuel efficient vehicles when their environmental benefits, rather than their cost savings, are highlighted (Ungemach et al., 2018). Fuel efficiency information can influence what cars people buy (Long et al., 2021; Ní Choisdealbha et al., 2020). Another study shows that making future cost savings salient can increase the chances of EV purchases. However, this effect was only present for a subset of study participants who had preferences for large vehicles, who valued future benefits, and who regarded themselves as pro-environmental, indicating substantial heterogeneity in the effectiveness of nudges (DellaValle & Zubaryeva, 2019).

Free or discounted trials: A positive direct experience with a certain travel mode may be more influential for encouraging vehicle purchases or adopting a new travel mode as it can reduce the anxiety associated with that travel mode (Sussman et al., 2020). Studies have shown that direct experience can reduce the range anxiety associated with battery-electric vehicles. A study conducted by the Behavioural Economics Unit at SEAI found that Irish car owners who had prior experience with EVs were more inclined towards purchasing an EV in their next vehicle purchase. Therefore, encouraging Irish dealerships to always have EVs ready for test drives would probably result in higher EV adoption (SEAI, 2020a).

Providing opportunities to demonstrate "green credentials": Green license plates have been introduced in places such as Canada, Hungary, China, and Norway and can serve as a

means to signal green credentials to others (SEAI, 2020a). These green licence plates create a visible signal that can be used to "show off" and also highlight that an increasing number of vehicles are electric on the road (Sexton & Sexton, 2014).

Encouraging more efficient driving

Road markings and speed display signs: Some of the earlier examples of nudges that were used to explain the new policy tool tried to encourage more efficient driving through physical changes in roadway painting and related nudges (Thaler & Sunstein, 2008). For example, road markings that create an optical illusion suggesting that drivers are faster than they actually are can reduce driving speed (Charlton et al., 2018). Dynamic speed display signs can that measure and display the speed of approaching vehicles with a smiley or and "thank you" message can reduce speeding (Gehlert et al., 2012). Also road signs depicting children's book illustrations can reduce speed on urban roads at least temporarily (Vlakveld et al., 2022).

Real-time onboard feedback: Onboard driver assistance devices can provide information such as optimal speeds for certain areas of roads and traffic conditions, and how to avoid traffic. Effectiveness of these devices could range from 5-37% of fuel saving with eco driving (Sussman et al., 2020).

Behavioural Interventions in the Irish Transport Sector

Disclosure through vehicle comparison tools: Informed by behavioural insights (SEAI, 2020a), the SEAI improves the Irish EV purchase experience by changing the way information is presented on the SEAI's websites. These websites reduce behavioural barriers by reduces learning costs associated with the need to browse through many sources of information and simplifies the decision-making process. For example, the SEAI Behavioural Economics Unit has fed into the development of an EV comparison tool that can compare EV running costs. The Unit ran an RCT to test the impact different cost comparisons versus the previous tool and then worked with the SEAI EV team during the tool redesign to incorporate those features (SEAI, 2020a).

Free or discounted trials: Free E-bikes are also becoming a popular alternative in Irish mobility. Fingal County Council reports a trial project where local businesses were given the opportunity to trial e-Cargo bikes for a 12-month period [FCC, 2022] in the hope to allow the local businesses to experience the benefits of e-bikes which eventually lead them to adoption. The Bike Library is lending e-bikes to families in Dublin to cycle for a limited amount of time. This project aims to democratise cycling and finding new ways to give people access to sustainable mobility options.

EV dealership awards: Recommendations from the SEAI EV adoption evidence review (SEAI, 2020a) around a need for dealer incentives to promote EVs led to the creation of the EV dealership awards. These awards recognise and reward excellence in the promotion and sales of electric vehicles in Ireland and provide an opportunity to signal green credentials to customers through, for example, a certificate and wall plaque and a digital banner for the website.

The NTA Smarter Travel Programme: As mentioned in a 2023 Oireachtas debate, a comprehensive programme of infrastructure development and behavioural change initiatives has been put in place since 2020, with €290 million allocated to the NTA's Active Travel Infrastructure Programme in 2023 alone. The National Transport Authority's Smarter Travel Programme is a voluntary behaviour change programme that supports employers and third level institutions to implement voluntary travel plans. It includes interventions such as:

- Smarter Travel Workplaces and Campuses.
- Step Challenges such as the Marchathon.
- Cycle Challenges such as the Ready, Set, Cycle Programme, which provides a toolkit and resources for Smarter Travel Partner organisations to encourage and support staff and students to begin, continue or increase cycling on their commute and beyond.
- The Light Up your Life initiative which promotes the use of bike lights and focuses on the time of the year when days get shorter.

- Smarter Travel Student Awards which invite students to develop a project that supports, facilitates and/or enables sustainable and/or active travel modes to, from, and on campus that is relevant to their field of study and interest.
- The Smarter Travel Mark from the National Transport Authority is a way for organisations to signal their green credentials. It is a three tier certification (gold, silver, and bronze) that recognises and celebrates organisations that support active and sustainable travel.

Implementing active travel infrastructure: A working paper by the ESRI Behavioural Research Unit on "Using Behavioural Science to Design and Implement Active Travel Infrastructure: A Narrative Review of Evidence" (Timmons et al., 2023) led to a number of policy changes for the Cycle Design Manual - National Transport and also fed into a number of Communication & Engagement Campaigns that are being developed by the department. The Behavioural Research Unit of the ESRI will work on Behaviour Change and Active Travel.

More behaviourally informed programmes: Although not nudges or being directly informed by behavioural insights as defined in this report, the following programmes have been informed by multidisciplinary research.

- **Safety campaigns:** Fingal County Council reports that safety campaigns targeting poor driving behaviour are capable of encouraging people to swap to active travel [FCC, 2022]. Therefore, the county's strategic plan to improve active travel includes conducting safety campaigns disclosing safe active travel information.
- **Cycle to work scheme:** The cycle to work scheme offloads the effort to get a grant to the state or the employer. Obtaining this grant is relatively easy.
- In line with Action TR/23/6 of the 2023 Climate Action Plan, **several programmes** are developed by the Department of Transport's Climate Engagement and Governance Division to address non-structural barriers based on behavioural insights such as identity, beliefs, social norms, skills, memory, attention, decision processes, motivation, status quo bias etc. No public reports have been published on this yet.

Summary, Recommendations, and Further Reading

The effectiveness of nudges to change behaviour in the transport sector is limited. Compared to other sectors, only a few studies show evidence for effective transport changes. Even detailed reviews on policies to change travel behaviour (Sussman et al., 2020) do not explicitly include nudges. Moreover, some studies show null results. These studies suggest that nudges are not an effective policy instrument to encourage sustainable travel behaviour. For example, Kristal and Whillans (2020) found in a large field experiments that behaviourally-informed letters and emails, non-cash incentives, and personalised travel plans did not increase carpooling. A systematic review of the efficacy of behavioural interventions for transport behaviour change finds no evidence for the efficacy of existing behavioural interventions to reduce car trips (Arnott et al., 2014). Such null effects are likely due to the very sticky and habitual nature of travel behaviour.

The value of behavioural science in the transport sector is likely highest to support the design of infrastructure changes. For example, Timmons et al. (2023) review the relevance of behavioural insights in the transport sector and suggest that connectivity, proximity, and safety are key factors that influence whether people start cycling. The subjectively perceived quality of a route might well depend on the worst part of that route (e.g. the most dangerous section). They recommend infrastructures such as segregated and one-way cycle lanes and dedicated priority lights at intersections for cyclists. Another important role in the transport sector for behavioural science research is to better understand the factors that explain whether people perceive transport policies to be effective and acceptable (Timmons et al., 2023). For example, the public acceptability of transport policies such as congestion charges have been shown to be much higher after the policy has been implemented (Schuitema et al., 2010). Status quo bias might be one reason for this difference (Andersson et al., 2023).

Selected further reading:

- The SEAI (2020a) report "Driving Purchases of Electric Vehicles in Ireland: A Behavioural Economics Perspective" led to several programmes of work being commenced to remove the barriers identified including the development of vehicle comparison tools and total cost of ownership, EV Dealership Awards Programme, free test drive events and multiple new programmes to fund EV Charging Infrastructure.
- Researchers from the ESRI Behavioural Research Unit wrote a report on "Using Behavioural Science to Design and Implement Active Travel Infrastructure: A Narrative Review of Evidence" (Timmons et al., 2023).
- A 2020 report on "Behavioural insights for demand-side energy policy and programmes. An environment scan" from has good material on the transport sector (Users TCP and IEA, 2020).
- A report by and the UK Behavioural Insights Team on "Driving and accelerating the adoption of electric vehicles in the UK" (Reiner et al., 2020)
- A report by Alta Planning + Design and the Behavioural Insights Team (2017) on "Applying Behavioural Insights to Transportation Demand Management".
- An academic review paper on "How Cities Can Apply Behavioral Science to Promote Public Transportation use" by (Kormos et al., 2021).

Agriculture and LULUCF

Key behaviours in the Agriculture and LULUCF sectors

The key decisions in the agriculture and land use and land-use change and forestry sectors are made by farmers and foresters and divided in the 2023 Climate Action Plan with regards to forestry, croplands, grasslands, and wetlands. Key behavioural changes related to **forestry** include afforestation, moving towards sustainable forest management and climate-smart forestry, increasing carbon sinks and stores, creating recreational areas, and addressing issues with the licensing backlog and streamline the licensing process for the future. Key behaviours related to **croplands** include maintaining a green cover over the winter period, incorporating straw into the soil, and increasing capital investment in low impact tillage equipment. Key behaviours related to **grasslands** include improved management of grasslands on mineral soils for carbon sequestration, reducing the management intensity of drained, agricultural, managed carbon-rich soils, supporting farmers for measures supporting soil carbon sequestration, and supporting capital investments in grassland management equipment. Key behaviours related to **wetlands** include reduce management intensity of peatlands, continue to restore and rehabilitate former peatland production lands, and seeking opportunities for the public and private funding of peatland rehabilitation.

Behavioural interventions in the LULUCF and agricultural sectors

Using defaults: Agri-environmental programs have been plagued by low adoption rates because of complexity associated with completing paperwork and navigating the enrolment requirements of federal programs. Farmer cooperatives could use defaults to change farmer practices without mandating them. For example, Ferraro et al. (2022) found that changing default enrolment increased farmers' investments in the programs. It is also possible to set pest-resistant seeds as the default input when recommending practices (Institute for Prospective Technological Studies, Joint Research Centre et al., 2015). Another application of the default is to auto-enrol farmers into agri-environmental programs to mitigate a lack of attention presented to the farmers (Palm-Forster & Messer, 2021). Making programs salient and simple is key.

Using labels to guide attention: Salient and specific labels can be used to increase the uptake of subsidies such as agri-environmental schemes. For example, Ocean and Howley (2021) found that farmers' spending intentions changed depending on the name of the subsidy label. Generic farm subsidies could be called "*simple payment scheme*" to highlight the ease of signing up. Other schemes could be called "*agricultural payment scheme*" to create a mental account to induce expenditure related to agriculture. The label "*environmental protection scheme*" could signal that a higher proportion of the subsidy expenditure should be allocated to environmental management (Ocean & Howley, 2021). Given that mental accounts are created based on scheme labels, it is evident for policy makers to first understand which aspect of the farmers expenditure would create the greatest social and environmental welfare when designing the scheme labels (Bao & Robinson, 2022). Moreover, outreach efforts should highlight program benefits rather than costs (Dessart et al., 2019).

Simplification and sludge reduction: Sludge reduction can be used to encourage farmers to apply for agri-environmental schemes. For example, application processes can be streamlined and simplified (OIRA, 2023). Such simplification is particularly important given that expected bureaucracy is one of the most important reasons farmers state to discourage adoption of agri-environmental schemes (Massfeller et al., 2022). For example, integrating any application costs into the subsidy itself may increase subsidy uptake. Bao and Robinson (2022) find that, when exchanging money for reduced application time, farmers are willing to sacrifice substantially more of their subsidy for a time reduction than they are willing to pay in a separate transaction. Campaigns that provide information that is simple, readily understandable, and relatable can also change farmer decisions (Dessart et al., 2019).

Reminders: Wallander et al. (2017) tested whether reminder letters could increase willingness to participate in voluntary land conservation programmes. In a large-scale field experiment, they found that reminder letters were effective only for well-informed groups and for farmers whose contracts were expiring.

Communicating descriptive social norms: Farmers are more likely to participate in a program when they are given information about social norms suggesting that other farmers are participating in the program as well (Le Coent et al., 2017; Palm-Forster & Messer, 2021). Kuhfuss et al. (2016) and Wu et al. (2021) found that, in programs in which participation was already high, producers responded to nudges informing them about other farmers who had already adopted climate-smart practices, and Wu et al. (2021) found that the messenger who delivers an injunctive norm matters. Producers were more likely to act when they received positive information from individuals they viewed as like themselves. Providing farmers with information about descriptive social norms, for example relating to the participation of other farmers in pro-environmental activities (e.g. "Many farmers have demonstrated how much they value the natural environment by taking part in similar activities in the past"), can increase farmers' intentions to engage in this activity (Howley & Ocean, 2021). Information about what others do can also be provided more often to increase results. For example, Chabé-Ferret et al. (2019) show that farmers who received weekly information on individual and group water consumption over four months reduced water consumption of farmers with previously high levels of consumption. However, Le Coent et al. (2021) showed that social-norm strategies could backfire when only a small number of farmers have already adopted desired practices. Their study further showed that combining injunctive norms with descriptive norms increased retention in the climate-smart program through the contract terms.

Communicating injunctive social norms: Providing information about injunctive social norms (i.e. what people think farmers *ought* to do) can influence landowner behaviour. Enlisting influential messengers (e.g. respected farmers in the community) to communicate an injunctive norm about desired actions can be particularly effective. People are most likely to act when they receive positive information from individuals they view as similar to themselves in some way and from individuals they like and trust (S. Wu et al., 2021).

Communicating dynamic social norms: Policy makers can consider communicating information about how other people's behaviour is changing over time (i.e. dynamic social norms). For example, messages can inform farmers that more and more other farmers are

taking up agri-environmental schemes. Such dynamic descriptive social norms have been shown to be effective in other areas. For example, information about how others are changing their eating behaviour over time can motivate individuals to change their own food selection and consumption (Çoker et al., 2022). Farmers are more likely to adopt sustainable practices when most neighbouring farmers have done so, when they follow the opinion of social referents who support adoption, and when they are willing to gain social status (Dessart et al., 2019).

Facilitating conditional cooperation: Kuhfuss, Préget, Thoyer, and Hanley (2016) show that the introduction of a conditional collective bonus in an agri-environmental scheme can improve farmers' participation and increase land enrolment for lower overall budgetary costs. The results show that it contributes to increased expectations of farmers on others' participation, therefore changing the pro-environmental social norm and initiating group dynamics towards the adoption of less pesticide- intensive farming practices over time.

Providing opportunities to demonstrate "green credentials": One way to encourage sustainable farming policies is to encourage farmers to make sustainable farming practices visible to the public, for example, through signage (Howley & Ocean, 2021). Providing farmers with a mechanism to demonstrate their green credentials could encourage conservation farm practices, especially because some of these practices may otherwise be invisible or misunderstood by the general public (Dessart et al., 2019). Participation in green certification and verification programs are an effective way for farmers to showcase their green credentials, and the social and community aspects of such programs can encourage pro-environmental behaviour as they tap into elements of ego and the power of social norms (Palm-Forster & Messer, 2021).

Changing the timing of payments and subsidies: Program administrators can make programs more attractive to farmers and rural landowners by reducing the perceived risk of participating, establishing regular payment schedules farmers can count on and making some payments upfront. It is possible to potentially increase enrolment or reduce costs by changing the timing of payments to better reflect farmer preferences. Farmers choose

smaller, immediate rewards rather than larger, later rewards. In an experiment by Duquette et al. (2012), farmers in the experiment were offered a choice between a “now” payment of roughly $400 and a higher “later” payment that varied across subjects. The farmers in this experiment were estimated to apply a discount rate of at least 28%. Other options for policy makers to increase farmers' environmental conservation practices is by offering insurance options, and promoting cost-free trial periods (Pannell et al., 2006).

Use appropriate messengers: Responses to an intervention can be strongly influenced by the messenger delivering the information (Palm-Forster et al., 2019). Behavioural science can shed light on how to improve existing efforts to enhance capability. For example, increasing numbers of female instructors in a farmer outreach scheme in Mozambique significantly increased uptake of sustainable land management techniques (Kondylis et al., 2016). It is important for policy makers to understand the effects of trusted messengers on capability-building efforts and increasing scheme uptake (Balmford et al., 2021).

Framing: Policy makers must take great care to appropriately frame costs and benefits. For example, framing the benefits of participating in agri-environmental schemes in terms of environmental conservation (e.g. protection of biodiversity and groundwater) yields higher participation rates than framing these as a compensation for environmental damage (Broch & Vedel, 2012; Le Coent et al., 2017). Even simply changing the name of a payment may have an impact on whether farmers adopt sustainable practices (Hermann et al., 2017). Framing may have different effects on adopters and non-adopters (Andrews et al., 2013). Moreover, negative (related to risk) vs positive (related to benefits) framing can increase farmers’ responsiveness to policy interventions (Thomas et al., 2019). When faced with such framing and offered incentive payments to compensate opportunity costs, farmers are more responsive to such a policy compared to the case of a positive framing. For example, if the impact on farm income is kept constant, punishing farmers for using fertilisers is more effective than rewarding them for reducing fertiliser use (Moser & Mußhoff, 2016). A similarly stronger effect of punishment (vs. reward) has been shown to incentivise the cultivation of flowering cover crops (Holst et al., 2014).

Allude to moral concerns: Compared with conventional farmers, organic farmers are significantly more concerned about doing 'the right thing'. Farmers are not only driven by monetary considerations but also change their behaviour in reaction to moral and social ones (Mzoughi, 2011). Dessart et al. (2019) shed a light on the effects of moral concerns of farmers. Farmers who show relatively high concern for others and score highly on empathy–sympathy are more likely to adopt conservation tillage practices (Sheeder & Lynne, 2011) or to participate in voluntary forest preservation or wetland restoration (Johansson et al., 2013). Moral concerns affect other farmers' behaviours, such as adopting practices to enhance animal welfare (Dessart et al., 2019).

Behavioural interventions in the Irish LULUCF and Agriculture Sector

While there are many behavioural interventions to change farmer behaviour suggested in the international behavioural science literature as presented above, we did not identify behaviourally informed policies in this sector in Ireland.

However, there are noteworthy initiatives across Ireland that encourage behavioural change which could rely on nudges and other behavioural interventions in the future. These initiatives include the Teagasc's Signpost programme, the Teagasc Sustainability Digital Platform, the Glanbia/Tírlán and Baileys/Sustainable Farming Academy, Kerry Group's Evolve dairy sustainability programme, Bord Bia's Origin Green, Rewild Wicklow, the Burren Life Programme, Green Restoration Ireland Cooperative Society Ltd, Farmcarbon, and Ag Climatise, among others.

Summary, Recommendations, and Further Reading

As shown above, there is considerable scope for the use of behavioural interventions such as nudges to support and change farming practice. It is also true, however, that the majority of the current experimental agricultural and LULUCF literature consists of laboratory experiments, and artificial or framed field experiments. Moving forward, there is potential for taking more behavioural experiments into the field, including embedding such experiments in agri-environmental programs (Palm-Forster et al., 2019).

Further work applying behavioural economic principles to agricultural adoption of sustainable practice could benefit from better understanding of people's responses to risk, deviations from expected utility, and modelling of learning, social, and time preferences (Streletskaya et al., 2020).

Selected further reading:

- An academic paper on "Behavioural factors affecting the adoption of sustainable farming practices: a policy-oriented review" (Dessart et al., 2019) that examines voluntary adoption of conservation practices and develops a framework summarising various behavioural determinants.
- An academic paper on "The influence of behavioural factors and external conditions on Dutch farmers' decision making in the transition towards circular agriculture" (de Lauwere et al., 2022)
- Palm-Forster et al. (2019) examine studies of land use using the MINDSPACE framework (Dolan et al., 2012) to organise how behavioural intervention can be applied in the agri-environmental domain and areas in need of additional research.
- An academic review paper on "Behavioural land use policy studies: Past, present, and future" (Bao & Robinson, 2022).

Marine

Key Behaviours in the Marine Sector

Ireland aims to expand marine protected areas to 30% by 2030. The associated expansion of marine renewable energy will have impacts on the marine environment (Reilly et al., 2015). To expand marine renewable energy, Ireland announced the establishment of the Maritime Area Regulatory Authority (MARA), which is regarded as an essential turning point. This authority will act as the regulatory body of developments in Ireland's maritime area. Establishing this authority is a major stepping stone due to their focus on applications, licences, consent of offshore development, investigations, and regulations of maritime areas.

Behavioural insights are particularly relevant to the Clean Oceans Initiative. This initiative is the umbrella name for a range of BIM (Ireland's Seafood Development Agency) and seafood industry supported programmes to minimise the impact their sector has on our oceans, for example by reducing litter related to fishing, retirement of fishing gear, and waste management services. A recent stakeholder engagement exercise identified several reasons for slow progress in the marine protection sector (Augustenborg, Lentz, and Pender, 2023). These included insufficient planning regimes, inadequate delegation of marine protected areas, a lack of political will and momentum, and lack of sufficient resources to progress marine related commitments, along with low public acceptance due to the potential impacts on fishing communities. Viewing these issues through a behavioural lens could be valuable.

Here, we focus on some behaviours that may be amenable to behavioural change interventions. Many of these are related to the Clean Oceans Initiative: Maintain the high participation rate of 96% in the clean oceans initiative; reduce fishery plastic waste (e.g. ghost nets and illegally dumped materials in the marine environment); reduce marine and seabed litter; retrieve marine litter; facilitate the responsible retirement of aquaculture and fishing gear; reduce inputs and fuel use in the production of seafood; and increase compliance with fishery controls with stipulations for recreational fishers to declare catches.

Behavioural interventions internationally

Most of the evidence on behavioural change in the maritime sector relates to compliance with fishing regulations. Nudges may represent an inexpensive and potentially effective tool to increase compliance with rules and regulations related to recreational fishing (Mackay et al., 2018). Nudges such as framing, changing the physical environment, presenting default options, and social norms, should complement existing deterrence regimes rather than being used as stand-alone measures. However, Mackay et al. (2018) also highlight that only a few studies have investigated nudges in this sector.

Social Norms: Social norms can be used to increase compliance with regulations in the context of recreational fishing (Mackay et al., 2018). For example, a case study of compliance with fishery regulations in Australia showed that acts of non-compliance are widely circulated by the Australian Fisheries departments on social media and disapproving comments are often added. Mackay et al. (2018) suggest that such an experience might deter people from not complying. Overfishing might be framed as "greedy" behaviour that goes against the social norm (Cinner & Aswani, 2007).

Framing: Another nudge described by Mackay et al. (2018) aims to encourage fishers to only catch fish that are significantly larger than the regulated minimum size. The Inland Fisheries Service distributes rulers to the fishers which show the legal minimum size limit, but also additional sizes of fish that are described as "Impressive!" and "Worth bragging about!". These additional size descriptions take attention away from the legal minimum size limit which might act as an anchor for some fishers and thus lead to small fish being caught more frequently.

Reminders: To remind fishers that they must not keep fish below the minimum size limit, spray-painted reminders to measure catch that is the same size as the minimum legal size of the commonly caught flathead are used in Australia (Mackay et al., 2018). In Tasmania, the government has spray-painted a stylised picture of a Sand Flathead on the ground, along with the message "Measure your catch" to remind fishers. Another form of a reminder is

the use of short messages to increase reporting compliance as implemented in Greenland's salmon fisheries, where fishers are 6% more likely to report their salmon catch after receiving the message reminder (Snyder et al., 2021).

Behavioural interventions in the Irish Marine Sector

We are not aware of any nudge-type interventions in the Irish Marine sector. However, the nature of the Clean Oceans Initiative suggests that behavioural interventions may be valuable. The initiative is voluntary, suggesting that harder interventions such as mandates have not been implemented.

Summary, Recommendations, and Further Reading

Given that the Government relies on voluntary measures and no incentives (Augustenborg et al., 2023), behavioural interventions such as nudges seem worthy of consideration for this sector.

Selected further reading:

- An Academic paper "When push comes to shove in recreational fishing compliance, think 'nudge'" by (Mackay et al., 2018) which discusses the potential of behavioural interventions to improve voluntary compliance in the marine sector.
- A review of water and marine related commitments within Ireland's Programme for Government: Progress, challenges for implementation, and gaps in existing commitments. Commissioned by An Forum Uisce (Augustenborg, et al., 2023)

Part 3: Synthesis and discussion

Summary and Reflection

Potential of Green Nudging in Ireland

This report identified that behavioural interventions can be effective in the **buildings and energy sectors** to encourage energy efficiency investments and change the way energy is used in our daily lives. In Ireland, behavioural interventions are frequently used in these sectors to encourage environmentally friendly decisions, and Ireland is amongst the leading countries worldwide in these sectors. International policy documents refer particularly to the work by the SEAI Behavioural Economics Unit (e.g. Users TCP and IEA, 2020).

The potential for behavioural change in the **transport sector** using behavioural interventions such as nudges is low. The international literature suggests that it is very difficult to change travel behaviour using soft interventions, potentially because travel is very habitual and determined by the available travel infrastructure. Accordingly, there are not many nudges applied in the Irish transport sector. However, there is potential in the transport sector to use behavioural insights to make existing policies (e.g. road space reallocation; electric vehicle uptake; public transport use) more effective and acceptable to the public.

The international literature suggests that there are various effective behavioural interventions that can change farmer and land manager decisions in the **agriculture and land use and land-use change and forestry sectors**. However, no use of nudges could be identified in Ireland in these sectors, and there is a clear deficit of behavioural research studies testing nudges in this area.

International literature on nudges in the **marine sector** is limited/lacking. More research is needed in this area to identify whether behavioural interventions can be effective in the marine sector before implementing such interventions in Ireland.

There is scope in **all sectors** in Ireland to improve the design and implementation of environmental policies. When acknowledging behavioural insights, in areas such as limited

attention, present bias, and social norms, policies can be made more effective than policies that ignore such behavioural insights.

The green nudges shown to be most effective and most promising are changes regarding default settings, simplification, and social norm messages. However, whether these nudges are applicable depends on a variety of factors. Therefore, it is crucial to first conduct a behavioural analysis of the determinants of the behaviour that a policy maker attempts to change before changing it.

Green nudges are a policy instrument that can help achieve environmental targets. Policymakers can utilise this instrument to complement more traditional policies. Ignoring behavioural insights and green nudges leaves the potential for environmental behavioural change untapped. Given the extent of the environmental challenges Ireland is facing, it would be a mistake not to consider all cost-effective policy levers, including those arising from behavioural insights.

Limitations

While green nudges have the potential to change behaviour in a cost-effective way, they will not be sufficient to achieve environmental targets. Nudges tend to be small and relatively cheap changes of the choice architecture, and anticipating massive effects from small changes is not realistic. Green nudges that have big effects (for example, defaulting people into green electricity contracts with a pre-ticked box) should be viewed as the exception rather than the rule. To achieve big changes, big interventions are needed. Behavioural interventions should be seen as complementary to more traditional interventions rather than as substitutions for them.

Another potential limitation is that nudges are sometimes seen as unethical behavioural influence by policymakers. It is true that nudges can be unethical, for example, when they are manipulative or do not respect people's preferences. Nudges might also change people's values, opinions, and preferences which is seen as unethical by some (although this is rarely discussed in the literature). However, unintentional unethical misuse of behavioural insights can be prevented by utilising ethics frameworks such as the good practice principles for the

ethical use of behavioural science by the OECD (2022) and the nudge FORGOOD ethics framework (Lades & Delaney, 2022).

Recommendations for Environmental Policy Making

Based on the work reviewed above, as well as recent developments in behavioural public policy, we suggest several specific and interlinked recommendations below.

View Environmental Challenges Through a Behavioural Lens

It should be standard practice to view existing and new processes and policies through a behavioural lens. To do so, it is important to be aware of various potential green nudges that could be applied as reviewed in Part 2 of this report. However, it is also important to identify the right place and time to use such nudges and other interventions. Having a particular nudge in mind (e.g. "I will use a green default") and looking for settings where it can be applied is likely to fail. Instead, it is key to develop a detailed understanding of the most relevant decisions people make; the behavioural factors that influence these decisions; and potential touchpoints where the decisions could be influenced. Only then should specific nudges be selected and tested. Using an applied behavioural change framework such as BASIC (OECD, 2019; see section 2.8) helps to guide policymakers in this regard. Based on this and related frameworks, guidance should be developed and adopted for the systematic and consistent incorporation of social and behavioural science into environmental policy development and implementation for climate action in Ireland. In addition, such a framework may also be suitable for other environmental policy areas.

In other words, we recommend viewing existing processes that require people to make decisions through a behavioural lens before designing and implementing behavioural interventions and looking for opportunities to include behavioural interventions when designing environmental policy more generally (see also Hallsworth, 2023). This behavioural lens should be formalised in guidance documents that provide systematic support in the policy process.

Conduct Behavioural Audits

To obtain a detailed understanding of the most relevant decisions people make, as well as potential touchpoints through which behavioural interventions could change behaviour, behavioural audits are an appropriate tool. In a typical behavioural audit, the policymaker systematically examines and evaluates relevant processes and behaviours (Soman & Yeung, 2021). Behavioural audits can be organised around flowcharts that map several relevant decisions in a process to specific behavioural bottlenecks (e.g. complication, lack of awareness, lack of role models, missing consumer trust, etc.). These flowcharts help to first identify relevant decisions and the contexts in which these decisions are made. Second, they help to identify specific behavioural bottlenecks that may affect these decisions. Behavioural audits often rely on existing materials and literature, as well as new data collected in focus groups, interviews, surveys, observations, etc. The behavioural audit can be interpreted as using a "behaviour lens" to interpret existing processes and behaviours.

A specific type of behavioural audit is the so called **"sludge audit"** (Shahab & Lades, 2022; Sunstein, 2022). In sludge audits, institutions and businesses carry out reviews of their processes intending to reduce excessive or unnecessary behavioural frictions that make it harder for people to do what they want (i.e. sludge) and in turn improve the experience of the people who interact with the organisation and potentially saving money for the organisation in the process (Sunstein, 2021c). Sludge audits are increasingly used by in the academic literature (Mills et al., 2023) and by policy organisations (NSW Behavioural Insights Unit, 2022).

Conduct Diagnostic Studies

Diagnostic behavioural studies are an alternative way to better understand when and how to use behavioural interventions. To effectively change behaviour, it is important to diagnose why this behaviour occurs. Diagnostic studies can, for example, show gaps in comprehension and misperceptions of environmental behaviours (Andersson et al., 2022; Timmons & Lunn, 2022). When such misperceptions result in environmentally harmful behaviour, interventions will be different than when anti-environmental sentiments are the reason. Hence, we recommend conducting diagnostic tests that explain why particular green

behaviours are not enacted. The ESRI's Behavioural Research Unit (BRU) has pioneered the application of diagnostic behavioural research to policy problems to identify candidate solutions (Lunn, 2019). Depending on the diagnosis, nudges might be the appropriate policy response. However, other policy options, both softer and harder, might be more effective.

Consider the Full Spectrum of Behavioural and Traditional Policies

Behavioural audits and diagnostic studies will suggest that green nudges are the most promising policy instrument in some contexts. In other contexts, other behavioural public policies, such as boosts and nudge plus (see section 2.4), may be preferable. It is also possible that non-behavioural policy interventions, such as mandates, bans, taxes, and subsidies, are the best policy option, for example when behavioural audits and diagnostic studies suggest that behavioural barriers are not the main limiting factors. It is likely that the implementation and design of these more traditional approaches can be improved through behavioural insights. Combining multiple policy approaches will be needed to solve the challenges arising due to climate change, biodiversity loss, and pollution.

Test Interventions (Where Feasible)

To establish whether a behavioural intervention causally influences behaviour, behavioural scientists tend to rely on **experiments and randomised controlled trials**. Before going into the field and implementing interventions in the real world, lab experiments should be used to pre-test the policy design. Pre-tests help to maximise the efficiency of research programmes on behaviour change and more interventions can be tested in lab experiment than could be in the field. The most promising interventions should be tested in randomised controlled trials in the field in the appropriate contexts.

When testing behavioural interventions in the field, it is important to measure the **effects of the interventions over time**. Long-term effects are crucial when addressing climate change through changing behaviours that are frequently repeated. **Heterogenous treatment effects** should also be considered in these evaluations. The same nudge might be effective for some but ineffective for others. If possible, personalised nudged should be considered to increase effectiveness. Moreover, it should be considered whether and to what extent findings from

a behavioural intervention in one area **generalise** and can be applied in another area as well. For example, international cooperations can test whether the same policy works in different countries.

However, testing for causal effects in experiments is not always feasible or desirable. By the nature of experiments and randomised controlled trials, they focus attention on *local* effects that can be illustrated using simple (and convincing) bar graphs. These methods are not able to analyse "potentially important but slow-acting mechanisms that operate with long and variable lags" as argued by Deaton (2024). While it is often recommended that all behavioural interventions must be tested in randomised controlled trials, these tests are rarely conducted for traditional policies, such as regulations or incentives. Policymakers can reflect on whether they require higher standards regarding the evidence needed for relatively soft behavioural interventions than for harder traditional interventions and whether that is appropriate.

Consider Ethics

Governments must apply behavioural insights responsibly. Unethical applications of behavioural insights should be avoided and can lead to reduced trust by citizens on governmental functions. Tools such as the FORGOOD ethics framework (Lades & Delaney, 2022) summarised in section 2.6 and the Policy Paper by the (OECD, 2022) on "Good Practice Principles For Ethical Behavioural Science In Public Policy" can help policymakers navigate the potentially complex ethical questions.

Invest in Behavioural Expertise in the Government

Ireland has made some investments to identify the best ways behavioural insights can be used to support environmental policymaking. For example, behavioural groups at the ESRI, SEAI, and EPA provide valuable information to improve environmental policymaking and funding for behavioural environmental research is made available. However, some areas of great relevance for climate change have not received a lot of attention in Ireland. These areas include the agricultural and marine sectors as reviewed above and biodiversity, adaptation, and business. Investing in people who can translate the most robust findings

from behavioural science to the policy contexts and inform policymaking would be a cost-effective way to support the green transition. Many low-hanging fruits can still be captured by identifying policies and processes that are not optimal, which becomes obvious once they are viewed through a behavioural lens.

Recommendations for Future Research

Internationally and in Ireland, most research funding related to climate change is directed to the natural and technical sciences (Overland & Sovacool, 2020). Given that the importance of behavioural insights has long been undervalued, this is not surprising. However, recent decades have demonstrated that behavioural insights can be used to change behaviour in cost-effective ways and that many low-hanging fruits are still to be captured. Therefore, it is helpful to allocate more resources on behavioural policies that can change environmentally significant decisions. Behavioural scientists in Ireland working on environmental topics (e.g. at the ESRI, the SEAI, and the EPA) are very busy, suggesting there is scope and need to fund additional behavioural scientists working on environmental issues.

This chapter suggests some particularly important and promising areas for future research that will be helpful to inform environmental policymaking with behavioural insights. These suggestions are organised around three themes:

- Extending the scope of research on behavioural insights for environmental policymaking (10.1. to 10.4.),
- Methodological recommendations (10.6. to 10.7.), and
- The links between individual-level and system-level interventions (10.8. and 10.9.)

Develop Sector-Specific and Policy-Specific Behavioural Guidelines

Creating more detailed sector-specific and policy-specific guidelines for Irish environmental policymaking would be helpful to complement this more general report. These guidelines should consider the Ireland-specific policies and processes and recommend ways to improve these based on behavioural insights. Sector-specific guidelines could identify issues and

opportunities that policymakers should consider when developing policies and interventions, including sector relevant examples of what is meant by each intervention. It would be particularly beneficial to estimate the gap between the current behaviour and the behaviour that could be achieved with behavioural interventions. This would also identify instances where behavioural interventions alone are not sufficient to achieve targets and where harder policies such as regulation and taxation is required.

Such blue-sky follow-up documents may inspire policy makers to use behavioural insights in novel ways. Besides the sectors reviewed in this document (electricity, buildings, transport, agriculture and LULUCF, and marine), also the enterprise, public, and other sectors could be included. The first step in these reports should be the identification of specific behaviours that should be changed. For example, most of the actions described in the 2023 Climate Action Plan's Industry chapter do not contain behavioural elements. However, it is important to identify the key behaviours and decisions made in business contexts that are amenable to behavioural interventions and relevant to the environment.

Policy-specific guidelines could focus more on specific climate actions. The recent work by the SEAI Behavioural Economics Unit on heat pumps serves as a good example for specific work with clear and actionable recommendations that are concretely applied to a specific policy area rather than a whole sector. Other specific areas include behaviours, such as household and business energy conservation measures, building retrofit decisions, car purchase decisions, water conservation measures, flying, recycling and waste management, and climate friendly food choices. Especially for such specific work, collaborations between researchers and stakeholders to jointly develop Irish applications of behavioural interventions are key. Researchers and policymakers should coordinate to make sure that the focus of the research is on policy relevant topics.

Conduct Behavioural Research on Adaptation

More behavioural research has focused on mitigation activities than on adaptation measures, and studies that have investigated adaptation from a behavioural perspective have focused on studying risk perception, flooding and hurricanes, and preparedness behaviours. Few of these studies use experiments and establish causal relationships (van

Valkengoed & Steg, 2019). More behavioural work could be conducted on immediate emergency responses, such as evacuation and preparation measures, such as insurance purchases and adaptation retrofitting. Moreover, there are not many behavioural studies investigating adaptation to heatwaves and droughts though Ireland is at risk of more such events in the future (Murphy et al., 2017), as well as information seeking and evacuation behaviours and no studies on vector-borne diseases (van Valkengoed & Steg, 2019).

Conduct Behavioural Research on Biodiversity Conservation

Another area that could benefit from more behavioural insights is biodiversity conservation (Balmford et al., 2021; Nielsen, Marteau, et al., 2021). There is limited evidence on how nudges and other behaviourally informed interventions can influence how consumers, land managers, and policymakers make decisions regarding threatened species, wildlife harvesting and overharvesting, habitat loss and degradation, protected area designations, or land management. Instead, most attempts to change conservation behaviour rely on traditional policy approaches, such as education, regulation and incentives (Balmford et al., 2021).

Better Understand the Behaviour of Specific Individuals

Most behavioural science research focuses on better understanding and changing the behaviour of individual consumers. However, the largest effects on the environment are often the result of behaviour of specific individuals. For example, the carbon footprints of affluent people are higher than those of poorer parts of the population. Hence, behavioural research should focus on the rich. Another group to focus on are elderly retirees who might not benefit from the return on investment of home retrofits but could nonetheless renovate their homes and install solar panels. Behavioural research can also focus on powerful individuals who can make decisions of environmental significance such as policymakers, corporate leaders, wealthy investors, community leaders, “influencers”, etc. would help.

Increase Expertise for Behavioural Scientists Using more Varied Methodologies

Behavioural scientists favour lab and field experiments to identify the causal effects of behavioural policy interventions on pre-defined outcomes. The use of randomised controlled trials that identify such effects is an important strength of the field. However, a sole focus on experiments and causal inference can limit the scope of insights that can be gained (Deaton, 2024). A future generation of behavioural scientists should be trained to use alternative methodologies to generate behavioural insights. For example, it is possible to identify behavioural barriers, such as present bias, loss aversion, and limited attention, to pro-environmental behaviour through qualitative research in interviews and focus groups. Moreover, observational research using ecologically valid methodologies, such as experience sampling (Shiffman et al., 2008) or the day reconstruction method (Kahneman et al., 2004) can provide policy relevant behavioural insights (SEAI Behavioural Economics Unit, 2023). Computational modelling approaches, such as agent-based modelling, will also be used more frequently in the future to better understand how behavioural interventions are influenced by and influence the wider system (Del Valle et al., 2024). Moreover, large scale observational surveys such as Climate Change in the Irish Mind are valuable and will complement experimental and qualitative insights.

Explore the Use of Participatory Approaches to Design Behavioural Policies

Researchers and policy makers can collaborate and develop participatory approaches to design behavioural interventions in cross-sectoral collaborations. By facilitating bottom-up, participatory approaches, stakeholders recognise that behaviourally informed change is a social process which can be informed and influenced by many stakeholders. However, not much is known about how such participatory approaches are most effective. Future research should test different types of participatory approaches to design and implement behavioural interventions and provide guidelines. For example, farmers' input should be incorporated in the design of agri-environmental schemes where possible. Such participatory approaches have the potential to increase trust between those who are tasked with the design of the processes and policies and those who are subject to them.

Explore the Effects of Repeated and Combined Green Nudges

Effective behavioural interventions are likely to require repetition as it is unlikely that a single behavioural message changes behaviour in the long term. For example, how often a behaviourally informed message is repeated is likely more important than optimising the specific word choice in that message. However, the latter is easier to test in experiments and randomised controlled trials. Future research should identify ways to test whether the combination of multiple nudges and the repeated exposure to nudges influences environmentally relevant behaviour.

Analyse the Interdependencies between Behavioural Change and System Change

Combining behavioural science and systems analysis is an important research frontier (Del Valle et al., 2024). While most assessments of behavioural interventions measure the causal effect of one intervention on a pre-specified outcome, the real world is much more complex and multi-causal. It can be described as being composed of multiple systems with multiple levels of actors who interact with each other. People's choices are influenced by their own capabilities and preferences, friends, family, neighbours, and others, available physical and financial opportunities, and political and organizational structures and institutions such as laws, media, and organisational codes of practice (Nielsen et al., 2024). Individual behaviour is influenced by contexts in these systems and can also change these contexts. This can lead to unpredicted effects. More research is also needed to understand the influence of individual-level behavioural change on system -level change (Nielsen et al., 2024). Busara, a non-profit organization that applies behavioural insights in the Global South, has recently begun to work on better understanding and changing "broken behavioural systems", thus integrating behavioural science and systems analysis. This type of research is very important to better understand the various ways how behaviour can influence environmental factors in the next decade.

Research how Behavioural Insights can Improve and Interact with Traditional Environmental Policies

Behavioural scientists have started to call for more systematic research on how behavioural interventions interact with traditional policy instruments (Gravert & Shreedhar, 2022). However, there are still large gaps of knowledge in this area (Nielsen et al., 2024). Some future behavioural science research should include the following:

Public acceptability: For environmental behavioural policy interventions to be politically feasible, they need to be accepted by the public (Bergquist et al., 2022). Policymakers rarely push policies that they know are not liked by a critical mass of people. Several factors have been identified to predict whether people accept (behavioural) policies (Banerjee et al., 2021; Grelle & Hofmann, 2024). However, open questions remain. For example, how and when do individual-level and contextual factors matter? How do preferences for hard and soft policies evolve over time? Are there policy preference spillovers between different domains (Banerjee et al., 2021)? Especially in sectors where behavioural interventions have been shown to be of limited effectiveness (e.g. transport), behavioural research can be used to better understand whether people accept non-behavioural policies such as road-space reallocation, congestion charges, or changes parking fee structures.

Policy design: Market-based instruments such as taxes and subsidies can be informed by behavioural insights. For example, providing subsides for retrofits immediately rather than after a delay has a stronger effect if people are present biased. Charging a fee for single-use plastic cups can be more effective than giving a discount for using porcelain mugs due to loss aversion. Making prices more salient so that they grab more of the limited attention people process can make taxes more effective. Simplifying and automating payment mechanism can help individuals with limited cognitive bandwidth to make required payments and thus reduce inequalities.

References

Abrahamse, W., & Schuitema, G. (2020). Chapter 1.1 - Psychology and energy conservation: Contributions from theory and practice. In M. Lopes, C. H. Antunes, & K. B. Janda (Eds.), *Energy and Behaviour* (pp. 19–44). Academic Press. https://doi.org/10.1016/B978-0-12-818567-4.00001-6

Ainslie, G. (1975). Specious reward: A behavioral theory of impulsiveness and impulse control. *Psychological Bulletin*, *82*(4), 463–496. https://doi.org/doi.org/10.1037/h0076860

Akbulut-Yuksel, M., & Boulatoff, C. (2021). The effects of a green nudge on municipal solid waste: Evidence from a clear bag policy. *Journal of Environmental Economics and Management*, *106*, 102404. https://doi.org/10.1016/j.jeem.2020.102404

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics*, *95*(9), 1082–1095. https://doi.org/10.1016/j.jpubeco.2011.03.003

Allcott, H. (2015). Site selection bias in program evaluation. *The Quarterly Journal of Economics*, *130*(3), 1117–1165.

Allcott, H., & Kessler, J. B. (2019). The welfare effects of nudges: A case study of energy use social comparisons. *American Economic Journal: Applied Economics*, *11*(1), 236–276.

Allcott, H., & Knittel, C. (2019). Are Consumers Poorly Informed about Fuel Economy? Evidence from Two Experiments. *American Economic Journal: Economic Policy*, *11*(1), 1–37. https://doi.org/10.1257/pol.20170019

Allcott, H., & Mullainathan, S. (2010). Behavior and energy policy. *Science*, *327*(5970), 1204–1205.

Allcott, H., & Sunstein, C. R. (2015). Regulating Internalities. *Journal of Policy Analysis and Management*, *34*(3), 698–705. https://doi.org/10.1002/pam.21843

Allcott, H., & Taubinsky, D. (2015). Evaluating behaviorally motivated policy: Experimental evidence from the lightbulb market. *American Economic Review*, *105*(8), 2501–2538.

Alta Planning + Design & Behavioural Insights Team. (2017). *Applying Behavioural Insights to Transportation Demand Management* (Alta Industry Resources). https://altago.com/resources/behavioral-insights-transportation-demand-management/

Andersson, Y., McGowan, F., Timmons, S., & Lunn, P. (2023). *Status Quo Bias Impedes Active Travel Policy by Changing the Process of Opinion Formation* [EESRI Working Paper]. ESRI. https://esri.ie/publications/status-quo-bias-impedes-active-travel-policy-by-changing-the-process-of-opinion

Andersson, Y., Timmons, S., & Lunn, P. (2022). *Youth knowledge and perceptions of climate mitigation*. Economic and Social Research Institute.

Andor, M. A., & Fels, K. M. (2018). Behavioral Economics and Energy Conservation – A Systematic Review of Non-price Interventions and Their Causal Effects. *Ecological Economics*, *148*, 178–210. https://doi.org/10.1016/j.ecolecon.2018.01.018

Andor, M. A., Gerster, A., Peters, J., & Schmidt, C. M. (2020). Social Norms and Energy Conservation Beyond the US. *Journal of Environmental Economics and Management*, *103*, 102351. https://doi.org/10.1016/j.jeem.2020.102351

Andrews, A. C., Clawson, R. A., Gramig, B. M., & Raymond, L. (2013). Why do farmers adopt conservation tillage? An experimental investigation of framing effects. *Journal of Soil and Water Conservation*, *68*(6), 501–511. https://doi.org/10.2489/jswc.68.6.501

Arnott, B., Rehackova, L., Errington, L., Sniehotta, F. F., Roberts, J., & Araujo-Soares, V. (2014). Efficacy of behavioural interventions for transport behaviour change: Systematic review, meta-analysis and intervention coding. *International Journal of Behavioral Nutrition and Physical Activity*, *11*(1), 133. https://doi.org/10.1186/s12966-014-0133-9

Augustenborg, C. A., Lentz, P. & Pender, A. (2023). A review of water and marine related commitments within Ireland's Programme for Government: Progress, challenges for implementation, and gaps in existing commitments. Commissioned by An Forum Uisce. December 2023. https://thewaterforum.ie/app/uploads/2024/06/Water-Committments-Progress-Report-for-An-Fo%CC%81ram-Uisce-Augustenborg-et-al.pdf

Balmford, A., Bradbury, R. B., Bauer, J. M., Broad, S., Burgess, G., Burgman, M., Byerly, H., Clayton, S., Espelosin, D., Ferraro, P. J., Fisher, B., Garnett, E. E., Jones, J. P. G., Marteau, T. M., Otieno, M., Polasky, S., Ricketts, T. H., Sandbrook, C., Sullivan-Wiley, K., … Nielsen, K. S. (2021). Making more effective use of human behavioural science in conservation interventions. *Biological Conservation*, *261*, 109256. https://doi.org/10.1016/j.biocon.2021.109256

Banerjee, S., Galizzi, M. M., John, P., & Mourato, S. (2023). Sustainable dietary choices improved by reflection before a nudge in an online experiment. *Nature Sustainability*, 1–11. https://doi.org/10.1038/s41893-023-01235-0

Banerjee, S., & John, P. (2021). Nudge plus: Incorporating reflection into behavioral public policy. *Behavioural Public Policy*, 1–16. https://doi.org/10.1017/bpp.2021.6

Banerjee, S., Savani, M., & Shreedhar, G. (2021). Public support for 'soft' versus 'hard' public policies: Review of the evidence. *Journal of Behavioral Public Administration*, *4*(2). https://doi.org/10.30636/jbpa.42.220

Bao, H. X. H., & Robinson, G. M. (2022). Behavioural land use policy studies: Past, present, and future. *Land Use Policy*, *115*, 106013. https://doi.org/10.1016/j.landusepol.2022.106013

Bar-Gill, O. (2023). Smart disclosure: Promise and perils. In *Research Handbook on Nudges and Society* (pp. 174–187). Edward Elgar Publishing. https://www.elgaronline.com/edcollchap/book/9781035303038/book-part-9781035303038-18.xml

Behavioural Insights Team. (2019). *Impacts of alternatives to In-Home Displays on customers' energy consumption*.

Behavioural Insights Team, UK. (2023). *Promoting retrofitting among homeowners in Ireland through a behavioural lens: Evidence review and policy recommendations* (Behavioural Insights for Policy). https://www.seai.ie/data-and-insights/behavioural-insights/publications/promoting-retrofitting-am-2/

Belton, C. A., & Lunn, P. D. (2020). Smart choices? An experimental study of smart meters and time-of-use tariffs in Ireland. *Energy Policy*, *140*, 111243.

Benartzi, S., Beshears, J., Milkman, K. L., Sunstein, C. R., Thaler, R. H., Shankar, M., Tucker-Ray, W., Congdon, W. J., & Galing, S. (2017). Should Governments Invest More in Nudging? *Psychological Science*, *28*(8), 1041–1055. https://doi.org/10.1177/0956797617702501

Bergquist, M., Nilsson, A., Harring, N., & Jagers, S. C. (2022). Meta-analyses of fifteen determinants of public opinion about climate change taxes and laws. *Nature Climate Change*, *12*(3), 235–240. https://doi.org/10.1038/s41558-022-01297-6

Bertoldi, P., Boza-Kiss, B., Della Valle, N., & Economidou, M. (2021). The role of one-stop shops in energy renovation-A comparative analysis of OSSs cases in Europe. *Energy and Buildings*, *250*, 111273.

Bertoldi, P., & Della Valle, N. (2021). *Mobilising citizens to invest in energy efficiency: An overview of concepts and approaches for encouraging decisions to invest in energy efficiency*. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/137315

Beshears, J., Choi, J. J., Laibson, D., & Madrian, B. C. (2009). The importance of default options for retirement saving outcomes: Evidence from the United States. In *Social security policy in a changing environment* (pp. 167–195). University of Chicago Press. http://www.nber.org/chapters/c4539.pdf

Bollinger, B., & Gillingham, K. (2012). Peer Effects in the Diffusion of Solar Photovoltaic Panels. *Marketing Science*, *31*(6), 900–912. https://doi.org/10.1287/mksc.1120.0727

Brandsma, J. S., & Blasch, J. E. (2019). One for all?–The impact of different types of energy feedback and goal setting on individuals' motivation to conserve electricity. *Energy Policy*, *135*, 110992.

Brick, C., Sherman, D. K., & Kim, H. S. (2017). "Green to be seen" and "brown to keep down": Visibility moderates the effect of identity on pro-environmental behavior. *Journal of Environmental Psychology*, *51*, 226–238. https://doi.org/10.1016/j.jenvp.2017.04.004

Broch, S. W., & Vedel, S. E. (2012). Using Choice Experiments to Investigate the Policy Relevance of Heterogeneity in Farmer Agri-Environmental Contract Preferences. *Environmental and Resource Economics*, *51*(4), 561–581. https://doi.org/10.1007/s10640-011-9512-8

Brown, D. (2018). Business models for residential retrofit in the UK: A critical assessment of five key archetypes. *Energy Efficiency*, *11*(6), 1497–1517.

Burns, K., & Mountain, B. (2021). Do households respond to Time-Of-Use tariffs? Evidence from Australia. *Energy Economics*, *95*, 105070. https://doi.org/10.1016/j.eneco.2020.105070

Byrne, D. P., Nauze, A. L., & Martin, L. A. (2018). Tell Me Something I Don't Already Know: Informedness and the Impact of Information Programs. *The Review of Economics and Statistics*, *100*(3), 510–527. https://doi.org/10.1162/rest_a_00695

Caballero, N., & Ploner, M. (2022). Boosting or nudging energy consumption? The importance of cognitive aspects when adopting non-monetary interventions. *Energy Research & Social Science*, *91*, 102734.

Cappa, F., Rosso, F., Giustiniano, L., & Porfiri, M. (2020). Nudging and citizen science: The effectiveness of feedback in energy-demand management. *Journal of Environmental Management*, *269*, 110759.

Carlsson, F., Gravert, C., Johansson-Stenman, O., & Kurz, V. (2021). The use of green nudges as an environmental policy instrument. *Review of Environmental Economics and Policy*, *15*(2), 216–237. https://doi.org/10.1086/715524

Chabé-Ferret, S., Le Coent, P., Reynaud, A., Subervie, J., & Lepercq, D. (2019). Can we nudge farmers into saving water? Evidence from a randomised experiment. *European Review of Agricultural Economics*, *46*(3), 393–416. https://doi.org/10.1093/erae/jbz022

Charlton, S. G., Starkey, N. J., & Malhotra, N. (2018). Using road markings as a continuous cue for speed choice. *Accident Analysis & Prevention*, *117*, 288–297. https://doi.org/10.1016/j.aap.2018.04.029

Chater, N., & Loewenstein, G. (2023). The i-frame and the s-frame: How focusing on individual-level solutions has led behavioral public policy astray. *Behavioral and Brain Sciences*, *46*, e147. https://doi.org/10.1017/S0140525X22002023

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, *58*(6), 1015.

Cinner, J. E., & Aswani, S. (2007). Integrating customary management into marine conservation. *Biological Conservation*, *140*(3), 201–216. https://doi.org/10.1016/j.biocon.2007.08.008

Çoker, E. N., Pechey, R., Frie, K., Jebb, S. A., Stewart, C., Higgs, S., & Cook, B. (2022). A dynamic social norm messaging intervention to reduce meat consumption: A randomized cross-over trial in retail store restaurants. *Appetite*, *169*, 105824. https://doi.org/10.1016/j.appet.2021.105824

Collins, M., & Curtis, J. (2017). An examination of the abandonment of applications for energy efficiency retrofit grants in Ireland. *Energy Policy*, *100*, 260–270.

Comerford, D. A., Lange, I., & Moro, M. (2018). Proof of concept that requiring energy labels for dwellings can induce retrofitting. *Energy Economics*, *69*, 204–212.

Composto, J. W., & Weber, E. U. (2022). Effectiveness of behavioural interventions to reduce household energy demand: A scoping review. *Environmental Research Letters*, *17*(6), 063005. https://doi.org/10.1088/1748-9326/ac71b8

Conly, S. (2012). *Against Autonomy: Justifying Coercive Paternalism*. Cambridge University Press.

Cornago, E. (2021). *The Potential of Behavioural Interventions for Optimising Energy Use at Home – Analysis*. https://www.iea.org/articles/the-potential-of-behavioural-interventions-for-optimising-energy-use-at-home

Cosmo, V. D., & O'Hora, D. (2017). Nudging electricity consumption using TOU pricing and feedback: Evidence from Irish households. *Journal of Economic Psychology*, *61*, 1–14. https://doi.org/10.1016/j.joep.2017.03.005

Damgaard, M. T., & Gravert, C. (2018). The hidden costs of nudging: Experimental evidence from reminders in fundraising. *Journal of Public Economics*, *157*, 15–26.

de Lauwere, C., Slegers, M., & Meeusen, M. (2022). The influence of behavioural factors and external conditions on Dutch farmers' decision making in the transition towards circular agriculture. *Land Use Policy*, *120*, 106253. https://doi.org/10.1016/j.landusepol.2022.106253

de Ridder, D., Kroese, F., & van Gestel, L. (2022). Nudgeability: Mapping conditions of susceptibility to nudge influence. *Perspectives on Psychological Science*, *17*(2), 346–359. https://doi.org/10.1177/1745691621995183

Deaton, A. (2024). Rethinking Economics or Rethinking My Economics. *IMF F&D*. https://www.imf.org/en/Publications/fandd/issues/2024/03/Symposium-Rethinking-Economics-Angus-Deaton

Del Valle, E. D., Jang, C., & Wendel, S. (2024). *Behavioral Systems: Combining behavioral science and systems analysis* (Busara Groundwork). https://www.busara.global/our-works/behavioral-systems/

DellaValle, N., & Zubaryeva, A. (2019). Can we hope for a collective shift in electric vehicle adoption? Testing salience and norm-based interventions in South Tyrol, Italy. *Energy Research & Social Science*, *55*, 46–61. https://doi.org/10.1016/j.erss.2019.05.005

DellaVigna, S., & Linos, E. (2022). RCTs to scale: Comprehensive evidence from two nudge units. *Econometrica*, *90*(1), 81–116.

Dessart, F. J., Barreiro-Hurlé, J., & Van Bavel, R. (2019). Behavioural factors affecting the adoption of sustainable farming practices: A policy-oriented review. *European Review of Agricultural Economics*, *46*(3), 417–471.

Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R., & Vlaev, I. (2012). Influencing behaviour: The mindspace way. *Journal of Economic Psychology*, *33*(1), 264–277. https://doi.org/10.1016/j.joep.2011.10.009

Duquette, E., Higgins, N., & Horowitz, J. (2012). Farmer Discount Rates: Experimental Evidence. *American Journal of Agricultural Economics*, *94*(2), 451–456. https://doi.org/10.1093/ajae/aar067

Ebeling, F., & Lotz, S. (2015). Domestic uptake of green energy promoted by opt-out tariffs. *Nature Climate Change*, *5*(9), 868–871. https://doi.org/10.1038/nclimate2681

Egebark, J., & Ekström, M. (2016). Can indifference make the world greener? *Journal of Environmental Economics and Management*, *76*, 1–13.

Ettema, D., Friman, M., Gärling, T., Olsson, L. E., & Fujii, S. (2012). How in-vehicle activities affect work commuters' satisfaction with public transport. *Journal of Transport Geography*, *24*, 215–222. https://doi.org/10.1016/j.jtrangeo.2012.02.007

Ferraro, P. J., Messer, K. D., Shukla, P., & Weigel, C. (2022). Behavioral Biases among Producers: Experimental Evidence of Anchoring in Procurement Auctions. *The Review of Economics and Statistics*, 1–40. https://doi.org/10.1162/rest_a_01215

FitzGerald, C. (2019). *The Framing of Climate Action in Ireland: Strategic Considerations* (17; NESC Secretariat Papers). https://www.nesc.ie/work-programme-archive/climate-change/the-framing-of-climate-action-in-ireland-strategic-considerations/

Frank, R. H. (1985). *Choosing the right pond: Human behavior and the quest for status.* Oxford University Press.

Gabaix, X. (2019). Behavioral inattention. In *Handbook of behavioral economics: Applications and foundations 1* (Vol. 2, pp. 261–343). Elsevier. https://www.sciencedirect.com/science/article/pii/S2352239918300216?casa_token=cJmXqI0JBp4AAAAA:nL1cjsImRRASvG1rOO1LgI-nXZyKfruK3pvnqR2XWgRRxB0gbbfqWmfMXnAcSGKYCFg7XQoy5g

Gardner, G. T., & Stern, P. C. (2008). The Short List: The Most Effective Actions U.S. Households Can Take to Curb Climate Change. *Environment: Science and Policy for Sustainable Development*, *50*(5), 12–25. https://doi.org/10.3200/ENVT.50.5.12-25

Gehlert, T., Schulze, C., & Schlag, B. (2012). Evaluation of different types of dynamic speed display signs. *Transportation Research Part F: Traffic Psychology and Behaviour*, *15*(6), 667–675. https://doi.org/10.1016/j.trf.2012.07.004

Gilbert, B., & Zivin, J. G. (2014). Dynamic salience with intermittent billing: Evidence from smart electricity meters. *Journal of Economic Behavior & Organization*, *107*, 176–190.

Gillingham, K. T., & Bollinger, B. (2021). Social Learning and Solar Photovoltaic Adoption. *Management Science*, *67*(11), 7091–7112. https://doi.org/10.1287/mnsc.2020.3840

Giubergia, D., Piras, F., Tuveri, G., Sottile, E., & Meloni, I. (2023). Assessing the impact of normative messages in encouraging the use of sustainable mobility. An experimental study. *Sustainable Cities and Society*, *99*, 104868. https://doi.org/10.1016/j.scs.2023.104868

Gosnell, G. K., List, J. A., & Metcalfe, R. D. (2020). The Impact of Management Practices on Employee Productivity: A Field Experiment with Airline Captains. *Journal of Political Economy*, *128*(4), 1195–1233. https://doi.org/10.1086/705375

Gravert, C., & Collentine, L. O. (2021). When nudges aren't enough: Norms, incentives and habit formation in public transport usage. *Journal of Economic Behavior & Organization*, *190*, 1–14.

Gravert, C., & Shreedhar, G. (2022). Effective carbon taxes need green nudges. *Nature Climate Change*, *12*(12), Article 12. https://doi.org/10.1038/s41558-022-01515-1

Grelle, S., & Hofmann, W. (2024). When and Why Do People Accept Public-Policy Interventions? An Integrative Public-Policy-Acceptance Framework. *Perspectives on Psychological Science*, *19*(1), 258–279. https://doi.org/10.1177/17456916231180580

Grüne-Yanoff, T., & Hertwig, R. (2016). Nudge versus boost: How coherent are policy and theory? *Minds and Machines*, *26*(1), 149–183. https://doi.org/10.1007/s11023-015-9367-9

Guo, Y., Kelly, J. A., & Clinch, J. P. (2022). Variability in total cost of vehicle ownership across vehicle and user profiles. *Communications in Transportation Research*, *2*, 100071. https://doi.org/10.1016/j.commtr.2022.100071

Hafenbrädl, S., Waeger, D., Marewski, J. N., & Gigerenzer, G. (2016). Applied decision making with fast-and-frugal heuristics. *Journal of Applied Research in Memory and Cognition*, *5*(2), 215–231.

Hafner, B. R., Elmes, D., Read, D., & White, M. P. (2019). Exploring the role of normative, financial and environmental information in promoting uptake of energy efficient technologies. *Journal of Environmental Psychology*, *63*, 26–35. https://doi.org/10.1016/j.jenvp.2019.03.004

Hagmann, D., Ho, E. H., & Loewenstein, G. (2019). Nudging out support for a carbon tax. *Nature Climate Change*, *9*(6), 484–489. https://doi.org/10.1038/s41558-019-0474-0

Hallsworth, M. (2023). A manifesto for applying behavioural science. *Nature Human Behaviour*, *7*(3), Article 3. https://doi.org/10.1038/s41562-023-01555-3

Halpern, D. (2015). *Inside the nudge unit: How small changes can make a big difference*. Random House.

Hermann, D., Sauthoff, S., & Mußhoff, O. (2017). Ex-ante evaluation of policy measures to enhance carbon sequestration in agricultural soils. *Ecological Economics*, *140*, 241–250. https://doi.org/10.1016/j.ecolecon.2017.05.018

Holst, G. S., Musshoff, O., & Doerschner, T. (2014). Policy impact analysis of penalty and reward scenarios to promote flowering cover crops using a business simulation game.

Biomass and Bioenergy, *70*, 196–206. https://doi.org/10.1016/j.biombioe.2014.08.009

Howley, P., & Ocean, N. (2021). Doing More with Less: Leveraging Social Norms and Status Concerns in Encouraging Conservation Farm Practices. *Land Economics*, *97*(2), 372–387. https://doi.org/10.3368/le.97.2.372

Institute for Prospective Technological Studies (Joint Research Centre), Colen, L., Gomez y Paloma, S., Latacz-Lohmann, U., Lefebvre, M., Préget, R., & Thoyer, S. (2015). *(How) can economic experiments inform EU agricultural policy?* Publications Office of the European Union. https://data.europa.eu/doi/10.2791/17634

IPCC Climate Change. (2023). Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I. *II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*.

Jachimowicz, J. M., Duncan, S., Weber, E. U., & Johnson, E. J. (2019). When and why defaults influence decisions: A meta-analysis of default effects. *Behavioural Public Policy*, *3*(2), 159–186. https://doi.org/10.1017/bpp.2018.43

Johansson, M., Rahm, J., & Gyllin, M. (2013). Landowners' Participation in Biodiversity Conservation Examined through the Value-Belief-Norm Theory. *Landscape Research*, *38*(3), 295–311. https://doi.org/10.1080/01426397.2012.673576

Jorgensen, B. S., Fumei, S., & Byrne, G. (2021). Reducing Peak Energy Demand among Residents Who Are Not Billed for Their Electricity Consumption: Experimental Evaluation of Behaviour Change Interventions in a University Setting. *International*

Journal of Environmental Research and Public Health, *18*(16), 8406. https://doi.org/10.3390/ijerph18168406

Kacha, O., Filippo Muzi-Falconi, JingKai Ong, Jesper Akesson, & Robert Metcalfe. (2024). *Applying behavioural insights to unlock residential demand flexibility: Guidebook for practitioners* (The Behaviouralist).

Kahneman, D. (2011). *Thinking, Fast and Slow*. Farrar Straus & Giroux.

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1991). Anomalies: The endowment effect, loss aversion, and status quo bias. *The Journal of Economic Perspectives*, 193–206.

Kahneman, D., Krueger, A. B., Schkade, D. A., Schwarz, N., & Stone, A. A. (2004). A survey method for characterizing daily life experience: The day reconstruction method. *Science*, *306*(5702), 1776–1780. https://doi.org/10.1126/science.1103572

Kahneman, D., & Tversky, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive Psychology*, *3*(3), 430–454.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the Econometric Society*, *47*(2), 263–292.

Kaiser, M., Bernauer, M., Sunstein, C. R., & Reisch, L. A. (2020). The power of green defaults: The impact of regional variation of opt-out tariffs on green energy demand in Germany. *Ecological Economics*, *174*, 106685.

Kirkman, E. (2019). Free riding or discounted riding? How the framing of a bike share offer impacts offer-redemption. *Journal of Behavioral Public Administration*, *2*(2), Article 2. https://doi.org/10.30636/jbpa.22.83

Kondylis, F., Mueller, V., Sheriff, G., & Zhu, S. (2016). Do Female Instructors Reduce Gender Bias in Diffusion of Sustainable Land Management Techniques? Experimental Evidence From Mozambique. *World Development*, *78*, 436–449. https://doi.org/10.1016/j.worlddev.2015.10.036

Kormos, C., Gifford, R., & Brown, E. (2015). The Influence of Descriptive Social Norm Information on Sustainable Transportation Behavior: A Field Experiment. *Environment and Behavior*, *47*(5), 479–501. https://doi.org/10.1177/0013916513520416

Kormos, C., Sussman, R., & Rosenberg, B. (2021). How Cities Can Apply Behavioral Science to Promote Public Transportation use. *Behavioral Science & Policy*, *7*(1), 95–115. https://doi.org/10.1177/237946152100700108

Kristal, A. S., & Whillans, A. V. (2020). What we can learn from five naturalistic field experiments that failed to shift commuter behaviour. *Nature Human Behaviour*, *4*(2), 169–176.

Kuhfuss, L., Préget, R., Thoyer, S., & Hanley, N. (2016). Nudging farmers to enrol land into agri-environmental schemes: The role of a collective bonus. *European Review of Agricultural Economics*, *43*(4), 609–636. https://doi.org/10.1093/erae/jbv031

Kuhfuss, L., Préget, R., Thoyer, S., Hanley, N., Le Coent, P., & Désolé, M. (2016). Nudges, Social Norms, and Permanence in Agri-environmental Schemes. *Land Economics*, *92*(4), 641–655.

Kurz, V. (2018). Nudging to reduce meat consumption: Immediate and persistent effects of an intervention at a university restaurant. *Journal of Environmental Economics and Management*, *90*, 317–341. https://doi.org/10.1016/j.jeem.2018.06.005

Lades, L. K., Clinch, J. P., & Kelly, J. A. (2021). Maybe tomorrow: How burdens and biases impede energy-efficiency investments. *Energy Research & Social Science*, *78*, 102154.

Lades, L. K., & Delaney, L. (2022). Nudge FORGOOD. *Behavioural Public Policy*, *6*(1), 75–94. https://doi.org/10.1017/bpp.2019.53

Laibson, D. (1997). Golden eggs and hyperbolic discounting. *Quarterly Journal of Economics*, *112*(2), 443–477. https://doi.org/10.1162/003355397555253

Le Coent, P., Préget, R., & Thoyer, S. (2017). Compensating Environmental Losses Versus Creating Environmental Gains: Implications for Biodiversity Offsets. *Ecological Economics*, *142*, 120–129. https://doi.org/10.1016/j.ecolecon.2017.06.008

Le Coent, P., Préget, R., & Thoyer, S. (2021). Farmers Follow the Herd: A Theoretical Model on Social Norms and Payments for Environmental Services. *Environmental and Resource Economics*, *78*(2), 287–306. https://doi.org/10.1007/s10640-020-00532-y

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and Decision Making. *Annual Review of Psychology*, *66*(1), 799–823. https://doi.org/10.1146/annurev-psych-010213-115043

Liebe, U., Gewinner, J., & Diekmann, A. (2021). Large and persistent effects of green energy defaults in the household and business sectors. *Nature Human Behaviour*, *5*(5), Article 5. https://doi.org/10.1038/s41562-021-01070-3

Linden, S. V. D., Pearson, A. R., & Boven, L. V. (2021). Behavioural climate policy. *Behavioural Public Policy*, *5*(4), 430–438. https://doi.org/10.1017/bpp.2020.44

Loewenstein, G. (2000). Emotions in economic theory and economic behavior. *American Economic Review*, *90*(2), 426–432.

Loewenstein, G., O'Donoghue, T., & Rabin, M. (2003). Projection bias in predicting future utility. *The Quarterly Journal of Economics*, *118*(4), 1209–1248.

Lohmann, P. M., Gsottbauer, E., Doherty, A., & Kontoleon, A. (2022). Do carbon footprint labels promote climatarian diets? Evidence from a large-scale field experiment. *Journal of Environmental Economics and Management*, *114*, 102693. https://doi.org/10.1016/j.jeem.2022.102693

Long, Z., Kormos, C., Sussman, R., & Axsen, J. (2021). MPG, fuel costs, or savings? Exploring the role of information framing in consumer valuation of fuel economy using a choice experiment. *Transportation Research Part A: Policy and Practice*, *146*, 109–127. https://doi.org/10.1016/j.tra.2021.02.004

Loschelder, D. D., Siepelmeyer, H., Fischer, D., & Rubel, J. A. (2019). Dynamic norms drive sustainable consumption: Norm-based nudging helps café customers to avoid disposable to-go-cups. *Journal of Economic Psychology*, *75*, 102146.

Lunn, P. (2019). Nudger beware: Diagnosis precedes remedy. *Journal of Behavioral Economics for Policy*, *3*(S), 23–26.

Mackay, M., Jennings, S., van Putten, E. I., Sibly, H., & Yamazaki, S. (2018). When push comes to shove in recreational fishing compliance, think 'nudge'. *Marine Policy*, *95*, 256–266. https://doi.org/10.1016/j.marpol.2018.05.026

Madrian, B. C., & Shea, D. F. (2001). The power of suggestion: Inertia in 401 (k) participation and savings behavior. *The Quarterly Journal of Economics*, *116*(4), 1149–1187.

Massfeller, A., Meraner, M., Hüttel, S., & Uehleke, R. (2022). Farmers' acceptance of results-based agri-environmental schemes: A German perspective. *Land Use Policy*, *120*, 106281. https://doi.org/10.1016/j.landusepol.2022.106281

Meier, J., Andor, M. A., Doebbe, F. C., Haddaway, N. R., & Reisch, L. A. (2022). Review: Do green defaults reduce meat consumption? *Food Policy*, *110*, 102298. https://doi.org/10.1016/j.foodpol.2022.102298

Mertens, S., Herberz, M., Hahnel, U. J. J., & Brosch, T. (2022). The effectiveness of nudging: A meta-analysis of choice architecture interventions across behavioral domains. *Proceedings of the National Academy of Sciences*, *119*(1), e2107346118. https://doi.org/10.1073/pnas.2107346118

Mills, S., Whittle, R., Ahmed, R., Walsh, T., & Wessel, M. (2023). Dark patterns and sludge audits: An integrated approach. *Behavioural Public Policy*, 1–27. https://doi.org/10.1017/bpp.2023.24

Moore, J. (2012). *The Social and Behavioural Aspects of Climate Change* (3; NESC Secretariat Papers).

Moser, S., & Mußhoff, O. (2016). Ex-ante Evaluation of Policy Measures: Effects of Reward and Punishment for Fertiliser Reduction in Palm Oil Production. *Journal of Agricultural Economics*, *67*(1), 84–104. https://doi.org/10.1111/1477-9552.12114

Mullainathan, S., & Shafir, E. (2013). *Scarcity: Why having too little means so much*. Macmillan.

Mullainathan, S., & Thaler, R. H. (2001). Behavioral Economics. *International Encyclopedia of Social Sciences*, *Pergamon Press*, 1094–1100.

Mundaca, L., Román-Collado, R., & Cansino, J. M. (2022). Assessing the impacts of social norms on low-carbon mobility options. *Energy Policy*, *162*, 112814. https://doi.org/10.1016/j.enpol.2022.112814

Murphy, C., Noone, S., Duffy, C., Broderick, C., Matthews, T., & Wilby, R. L. (2017). Irish droughts in newspaper archives: Rediscovering forgotten hazards? *Weather*, *72*(6), 151–155. https://doi.org/10.1002/wea.2904

Mzoughi, N. (2011). Farmers adoption of integrated crop protection and organic farming: Do moral and social concerns matter? *Ecological Economics*, *70*(8), 1536–1545. https://doi.org/10.1016/j.ecolecon.2011.03.016

Ní Choisdealbha, Á., Timmons, S., & Lunn, P. D. (2020). Experimental evidence for the effects of emissions charges and efficiency information on consumer car choices. *Journal of Cleaner Production*, *254*, 120140. https://doi.org/10.1016/j.jclepro.2020.120140

Nielsen, K. S., Cologna, V., Bauer, J. M., Berger, S., Brick, C., Dietz, T., Hahnel, U. J. J., Henn, L., Lange, F., Stern, P. C., & Wolske, K. S. (2024). Realizing the full potential of behavioural science for climate change mitigation. *Nature Climate Change*, 1–9. https://doi.org/10.1038/s41558-024-01951-1

Nielsen, K. S., Cologna, V., Lange, F., Brick, C., & Stern, P. C. (2021). The case for impact-focused environmental psychology. *Journal of Environmental Psychology*, *74*. https://lirias.kuleuven.be/retrieve/631092

Nielsen, K. S., Marteau, T. M., Bauer, J. M., Bradbury, R. B., Broad, S., Burgess, G., Burgman, M., Byerly, H., Clayton, S., Espelosin, D., Ferraro, P. J., Fisher, B., Garnett, E. E., Jones, J. P. G., Otieno, M., Polasky, S., Ricketts, T. H., Trevelyan, R., van der Linden, S., … Balmford, A. (2021). Biodiversity conservation as a promising frontier for behavioural science. *Nature Human Behaviour*, *5*(5), 550–556. https://doi.org/10.1038/s41562-021-01109-5

Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative Social Influence is Underdetected. *Personality and Social Psychology Bulletin*, *34*(7), 913–923. https://doi.org/10.1177/0146167208316691

Nova, F., & Lades, L. K. (2022). *Nudges and Other Behavioural Public Policy Instruments to Encourage Environmentally Friendly Behaviour* (PublicPolicy.Ie).

NSW Behavioural Insights Unit. (2022, October 20). *Sludge Toolkit* [Landing Page]. NSW Government; NSW Government. https://www.nsw.gov.au/behavioural-insights-unit/sludge-toolkit

Nuffield Council on Bioethics. (2007). *Public health: Ethical issues*. https://www.nuffieldbioethics.org/publications/public-health/guide-to-the-report/policy-process-and-practice

Ocean, N., & Howley, P. (2021). Using Choice Framing to Improve the Design of Agricultural Subsidy Schemes. *Land Economics*, *97*(4), 933–950. https://doi.org/10.3368/le.97.4.041620-0055R1

O'Donoghue, T., & Rabin, M. (1999). Doing It Now or Later. *American Economic Review*, *89*(1), 103–124. https://doi.org/10.1257/aer.89.1.103

OECD. (2017a). *Behavioural Insights and Public Policy—Lessons from Around the World—En—OECD*. http://www.oecd.org/gov/regulatory-policy/behavioural-insights-and-public-policy-9789264270480-en.htm

OECD. (2017b). *Tackling Environmental Problems with the Help of Behavioural Insights*. https://www.oecd-ilibrary.org/content/publication/9789264273887-en

OECD. (2019). *Tools and Ethics for Applied Behavioural Insights: The BASIC Toolkit*. https://www.oecd-ilibrary.org/governance/tools-and-ethics-for-applied-behavioural-insights-the-basic-toolkit_9ea76a8f-en

OECD. (2022). *Good practice principles for the ethical use of behavioural science in public policy*. https://oecd-opsi.org/publications/bi-gpps/

OECD. (2024). *LOGIC: Good Practice Principles for Mainstreaming Behavioural Public Policy* (OECD Publishing). https://oecd-opsi.org/publications/logic-mainstreaming-behavioural-science/

OIRA. (2023). *Tackling the Time Tax: How the Federal Government Is Reducing Burdens to Accessing Critical Benefits and Services*. https://www.digitalbenefitshub.org/resources/tackling-the-time-tax-how-the-federal-government-is-reducing-burdens-to-accessing-critical-benefits-and-services

Oliver, A. (2013). From nudging to budging: Using behavioural economics to inform public sector policy. *Journal of Social Policy*, *42*(4), 685–700. https://doi.org/10.1017/S0047279413000299

Overland, I., & Sovacool, B. K. (2020). The misallocation of climate research funding. *Energy Research & Social Science*, *62*, 101349. https://doi.org/10.1016/j.erss.2019.101349

Palm-Forster, L. H., Ferraro, P. J., Janusch, N., Vossler, C. A., & Messer, K. D. (2019). Behavioral and Experimental Agri-Environmental Research: Methodological Challenges, Literature Gaps, and Recommendations. *Environmental and Resource Economics*, *73*(3), 719–742. https://doi.org/10.1007/s10640-019-00342-x

Palm-Forster, L. H., & Messer, K. D. (2021). Experimental and behavioral economics to inform agri-environmental programs and policies. In C. B. Barrett & D. R. Just (Eds.), *Handbook of Agricultural Economics* (Vol. 5, pp. 4331–4406). Elsevier. https://doi.org/10.1016/bs.hesagr.2021.10.006

Pannell, D. J., Marshall, G. R., Barr, N., Curtis, A., Vanclay, F., & Wilkinson, R. (2006). Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture*, *46*(11), 1407–1424. https://doi.org/10.1071/EA05037

Parrish, B., Heptonstall, P., Gross, R., & Sovacool, B. K. (2020). A systematic review of motivations, enablers and barriers for consumer engagement with residential demand response. *Energy Policy*, *138*, 111221.

Paunov, Y., & Grüne-Yanoff, T. (2023). Boosting vs. nudging sustainable energy consumption: A long-term comparative field test in a residential context. *Behavioural Public Policy*, 1–26. https://doi.org/10.1017/bpp.2023.30

Pillai, A., Reaños, M. T., & Curtis, J. (2021). An examination of energy efficiency retrofit scheme applications by low-income households in Ireland. *Heliyon*, *7*(10), e08205.

Read, D., & Van Leeuwen, B. (1998). Predicting Hunger: The Effects of Appetite and Delay on Choice. *Organizational Behavior and Human Decision Processes*, *76*(2), 189–205.

Reaños, M. A. T., Curtis, J., Meier, D., & Pillai, A. (2024). Looking beyond energy efficiency and the role of financial literacy in experiencing fuel poverty: Evidence from Irish homeowners. *Energy Research & Social Science*, *112*, 103515. https://doi.org/10.1016/j.erss.2024.103515

Reijula, S., & Hertwig, R. (2022). Self-nudging and the citizen choice architect. *Behavioural Public Policy*, *6*(1), 119–149. https://doi.org/10.1017/bpp.2020.5

Reilly, K., O'Hagan, A. M., & Dalton, G. (2015). Attitudes and perceptions of fishermen on the island of Ireland towards the development of marine renewable energy projects. *Marine Policy*, *58*, 88–97. https://doi.org/10.1016/j.marpol.2015.04.001

Reiner, C., Beard, G., Park, T., & Kinnear, N. (2020). *Driving and accelerating the adoption of electric vehicles in the UK* (TRL The Future of Transport).

https://assets.publishing.service.gov.uk/media/5f4f8fe0d3bf7f0a28d9ca9c/driving-and-accelerating-the-adoption-of-electric-vehicles-in-the-uk.pdf

Reisch, L. A., & Sunstein, C. R. (2021). Plant-based by default. *One Earth*, *4*(9), 1205–1208. https://doi.org/10.1016/j.oneear.2021.08.007

Sajan, S. (2023, January 23). Engaging people on energy saving – the right communication leading to lasting actions | Blog | SEAI. *Sustainable Energy Authority Of Ireland | SEAI*. https://www.seai.ie/blog/energy-conservation-comms/

Samuelson, W., & Zeckhauser, R. (1988). Status quo bias in decision making. *Journal of Risk and Uncertainty*, *1*(1), 7–59.

Schneider, I., & Sunstein, C. R. (2017). Behavioral considerations for effective time-varying electricity prices. *Behavioural Public Policy*, *1*(2), 219–251.

Schubert, C. (2017). Green nudges: Do they work? Are they ethical? *Ecological Economics*, *132*, 329–342.

Schuitema, G., Aravena, C., & Denny, E. (2020). The psychology of energy efficiency labels: Trust, involvement, and attitudes towards energy performance certificates in Ireland. *Energy Research & Social Science*, *59*, 101301. https://doi.org/10.1016/j.erss.2019.101301

Schuitema, G., Steg, L., & Forward, S. (2010). Explaining differences in acceptability before and acceptance after the implementation of a congestion charge in Stockholm. *Transportation Research Part A: Policy and Practice*, *44*(2), 99–109. https://doi.org/10.1016/j.tra.2009.11.005

Schultz, P. W., Estrada, M., Schmitt, J., Sokoloski, R., & Silva-Send, N. (2015). Using in-home displays to provide smart meter feedback about household electricity consumption: A randomized control trial comparing kilowatts, cost, and social norms. *Energy*, *90*, 351–358.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, *18*(5), 429–434. https://doi.org/10.1111/j.1467-9280.2007.01917.x

SEAI. (2017). *Behavioural insights on energy efficiency in the residential sector* (Behavioural Insights for Policy). https://www.seai.ie/data-and-insights/behavioural-insights/publications/behavioural-insights-on-e/

SEAI. (2019). *Changing energy behaviour – what works?* https://www.seai.ie/data-and-insights/behavioural-insights/publications/changing-energy-behaviour/

SEAI. (2020a). *Driving Purchases of Electric Vehicles in Ireland: A Behavioural Economics Perspective*. https://www.seai.ie/data-and-insights/behavioural-insights/publications/driving-purchases-of-elec/

SEAI. (2020b). *Encouraging heat pump installations in Ireland: A Behavioural Economics Perspective*. https://www.seai.ie/data-and-insights/behavioural-insights/publications/encouraging-heat-pump-ins/

SEAI. (2020c). *Home Energy Events: Leveraging peer effects to increase the installation of energy efficiency measures in Ireland*. https://www.seai.ie/data-and-insights/behavioural-insights/publications/home-energy-events-levera/

SEAI. (2022a). *Communication strategies to encourage energy conservation: Recommendations based on a rapid review of behavioural science literature.* (Behavioural Insights for Policy). https://www.seai.ie/data-and-insights/behavioural-insights/publications/communication-strategies/

SEAI. (2022b). *Consumers ability to operate heat pumps and their controls. Insights from a survey and online experiment*. https://www.seai.ie/data-and-insights/behavioural-insights/publications/consumers-ability-to-oper/

SEAI. (2023). *Promoting retrofitting among homeonwers in Ireland through a behavioural lens: Evidence review and policy recommendations*. https://www.seai.ie/data-and-insights/behavioural-insights/publications/promoting-retrofitting-am-2/

SEAI. (2024a). *Encouraging heat pump adoption in heat pump ready oil-heated homes. Insights from a homeowner survey and willingness to pay experiment* (Behavioural Insights for Policy). https://www.seai.ie/data-and-insights/behavioural-insights/publications/heatpump-adoption-survey/

SEAI. (2024b). *Encouraging heat pump adoption in heat pump ready oil-heated homes. Insights from structured interviews with heat pump installers* (Behavioural Insights for Policy). https://www.seai.ie/data-and-insights/behavioural-insights/publications/heatpump-adoption-intervi/

SEAI Behavioural Economics Unit. (2023). *Behavioural Energy and Travel Tracker. Results report 1 – heating season 2022/2023*. https://www.seai.ie/data-and-insights/behavioural-insights/publications/behavioural-energy-and-tr/

Sexton, S. E. (2011). *Conspicuous Conservation: The Prius Effect and Willingness to Pay for Environmental Bona Fides*.

Sexton, S. E., & Sexton, A. L. (2014). Conspicuous conservation: The Prius halo and willingness to pay for environmental bona fides. *Journal of Environmental Economics and Management*, *67*(3), 303–317.

Shahab, S., & Lades, L. K. (2022). Sludge and transaction costs. *Behavioural Public Policy*, 1–22. https://doi.org/10.1017/bpp.2021.12

Sheeder, R. J., & Lynne, G. D. (2011). Empathy-Conditioned Conservation: "Walking in the Shoes of Others" as a Conservation Farmer. *Land Economics*, *87*(3), 433–452. https://doi.org/10.3368/le.87.3.433

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology*, *4*, 1–32.

Snyder, H. T., Cox, M. E., Bork Hansen, S., Connors, C., & Eckstein, S. (2021). Deterrents and nudges improve compliance in Greenland's Atlantic salmon (Salmo salar) fishery. *ICES Journal of Marine Science*, *78*(8), 2809–2817. https://doi.org/10.1093/icesjms/fsab159

Soman, D. (2020). Sludge: A Very Short Introduction. *BEAR.[Online][Date Accessed: 18/09/2020]: Https://Www. Rotman. Utoronto. ca/-/Media/Files/Programs-and-Areas/BEAR/White-Papers/BEARxBIOrg-Sludge-Introduction. Pdf*.

Soman & Yeung (Eds.). (2021). *The Behaviorally Informed Organization*. University of Toronto Press. https://utorontopress.com/9781487507893/the-behaviorally-informed-organization

Sparkman, G., & Walton, G. M. (2017). Dynamic norms promote sustainable behavior, even if it is counternormative. *Psychological Science*, *28*(11), 1663–1674. https://doi.org/10.1177/0956797617719950

Stadelmann, M., & Schubert, R. (2018). How do different designs of energy labels influence purchases of household appliances? A field study in Switzerland. *Ecological Economics*, *144*, 112–123.

Streletskaya, N. A., Bell, S. D., Kecinski, M., Li, T., Banerjee, S., Palm-Forster, L. H., & Pannell, D. (2020). Agricultural Adoption and Behavioral Economics: Bridging the Gap. *Applied Economic Perspectives and Policy*, *42*(1), 54–66. https://doi.org/10.1002/aepp.13006

Sunstein, C. R. (2013). *Simpler: The future of government*. Simon and Schuster.

Sunstein, C. R. (2019). *On Freedom*. Princeton University Press.

Sunstein, C. R. (2021a). Are food labels good? *Food Policy*, *99*, 101984.

Sunstein, C. R. (2021b). Behaviorally Informed Mandates? Internalities, Externalities, and Fuel Economy. *New York University Environmental Law Journal*, *29*(3), 493–504.

Sunstein, C. R. (2021c). *Sludge: What Stops Us from Getting Things Done and what to Do about it*. MIT Press.

Sunstein, C. R. (2022). Sludge audits. *Behavioural Public Policy*, *6*(4), 654–673.

Sussman, R., Tan, L. Q., & Kormos, C. E. (2020). Chapter 14 - Behavioral interventions for sustainable transportation: An overview of programs and guide for practitioners. In J. Zhang (Ed.), *Transport and Energy Research* (pp. 315–371). Elsevier. https://doi.org/10.1016/B978-0-12-815965-1.00014-4

Szaszi, B., Higney, A., Charlton, A., Gelman, A., Ziano, I., Aczel, B., Goldstein, D. G., Yeager, D. S., & Tipton, E. (2022). No reason to expect large and consistent effects of nudge interventions. *Proceedings of the National Academy of Sciences*, *119*(31), e2200732119.

Thaler, R. H. (2015). *Misbehaving: The Making of Behavioral Economics*. WW Norton & Company.

Thaler, R. H. (2018). Nudge, not sludge. *Science*, *361*(6401), 431–431.

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness.* Yale University Press.

Thaler, R. H., & Sunstein, C. R. (2021). *Nudge*. Yale University Press.

The Behavioural Insights Team. (2014). *EAST: Four simple ways to apply behavioural insights*. https://www.behaviouralinsights.co.uk/publications/east-four-simple-ways-to-apply-behavioural-insights/

Thomas, F., Midler, E., Lefebvre, M., & Engel, S. (2019). Greening the common agricultural policy: A behavioural perspective and lab-in-the-field experiment in Germany. *European Review of Agricultural Economics*, *46*(3), 367–392. https://doi.org/10.1093/erae/jbz014

Tiefenbeck, V., Goette, L., Degen, K., Tasic, V., Fleisch, E., Lalive, R., & Staake, T. (2018). Overcoming Salience Bias: How Real-Time Feedback Fosters Resource Conservation. *Management Science*, *64*(3), 1458–1476. https://doi.org/10.1287/mnsc.2016.2646

Timmons, S., Andersson, Y., McGowan, F., & Lunn, P. (2023). *Using Behavioural Science to Design and Implement Active Travel Infrastructure: A Narrative Review of Evidence* [Working Paper]. ESRI. https://esri.ie/publications/using-behavioural-science-to-design-and-implement-active-travel-infrastructure-a

Timmons, S., & Lunn, P. (2022). *Public understanding of climate change and support for mitigation*. Research Series.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*(4157), 1124–1131.

Ungemach, C., Camilleri, A. R., Johnson, E. J., Larrick, R. P., & Weber, E. U. (2018). Translated Attributes as Choice Architecture: Aligning Objectives and Choices Through Decision Signposts. *Management Science*, *64*(5), 2445–2459. https://doi.org/10.1287/mnsc.2016.2703

Users TCP and IEA. (2020). *Behavioural insights for demand-side energy policy and programmes: An environment scan* (User-Centred Energy Systems Technology Collaboration Programme). https://doi.org/10.47568/6OR105

van Valkengoed, A. M., & Steg, L. (2019). Meta-analyses of factors motivating climate change adaptation behaviour. *Nature Climate Change*, *9*(2), 158–163. https://doi.org/10.1038/s41558-018-0371-y

Verplanken, B., & Orbell, S. (2022). Attitudes, Habits, and Behavior Change. *Annual Review of Psychology*, *73*(1), 327–352. https://doi.org/10.1146/annurev-psych-020821-011744

Verplanken, B., Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, *28*(2), 121–127. https://doi.org/10.1016/j.jenvp.2007.10.005

Vlakveld, W., Goldenbeld, C., & De Groot, J. (2022). Road signs depicting childrens's book illustrations temporarily reduce speed on urban roads. *Transportation Research Part F: Traffic Psychology and Behaviour*, *87*, 236–248. https://doi.org/10.1016/j.trf.2022.04.005

Vlasceanu, M., Doell, K. C., Bak-Coleman, J. B., Todorova, B., Berkebile-Weinberg, M. M., Grayson, S. J., Patel, Y., Goldwert, D., Pei, Y., Chakroff, A., Pronizius, E., van den Broek, K. L., Vlasceanu, D., Constantino, S., Morais, M. J., Schumann, P., Rathje, S., Fang, K., Aglioti, S. M., … Van Bavel, J. J. (2024). Addressing climate change with behavioral science: A global intervention tournament in 63 countries. *Science Advances*, *10*(6), eadj5778. https://doi.org/10.1126/sciadv.adj5778

Wallander, S., Ferraro, P., & Higgins, N. (2017). Addressing Participant Inattention in Federal Programs: A Field Experiment with the Conservation Reserve Program. *American*

Journal of Agricultural Economics, *99*(4), 914–931. https://doi.org/10.1093/ajae/aax023

Watkins, K. E., Ferris, B., Borning, A., Rutherford, G. S., & Layton, D. (2011). Where Is My Bus? Impact of mobile real-time information on the perceived and actual wait time of transit riders. *Transportation Research Part A: Policy and Practice*, *45*(8), 839–848. https://doi.org/10.1016/j.tra.2011.06.010

Wilson, C., Crane, L., & Chryssochoidis, G. (2015). Why do homeowners renovate energy efficiently? Contrasting perspectives and implications for policy. *Energy Research & Social Science*, *7*, 12–22.

Wu, S., Palm-Forster, L. H., & Messer, K. D. (2021). Impact of peer comparisons and firm heterogeneity on nonpoint source water pollution: An experimental study. *Resource and Energy Economics*, *63*, 101142. https://doi.org/10.1016/j.reseneeco.2019.101142

Wu, T., Shang, Z., Tian, X., & Wang, S. (2016). How hyperbolic discounting preference affects Chinese consumers' consumption choice between conventional and electric vehicles. *Energy Policy*, *97*, 400–413. https://doi.org/10.1016/j.enpol.2016.07.004

Zeelenberg, M. (1999). Anticipated regret, expected feedback and behavioral decision making. *Journal of Behavioral Decision Making*, *12*(2), 93–106.

Appendix

Methodological Notes

This report is based on five rapid scoping reviews of the literature on how behavioural science can inform and support climate action policy in the following sectors: electricity; buildings; Transport; Agriculture; Land Use, Land Use Change and Forestry; and Marine. These sectors were selected as the Irish 2023 Climate Action Plan mentions specific behavioural that we considered potentially amenable to behavioural interventions.

What are scoping reviews? Scoping reviews synthesise existing knowledge using a systematic approach. They are useful for answering broad questions such as *"What is the nature of the evidence?"* or *"What is known about this concept?"*. The question raised here: *"What are areas of achievement and areas of deficit for behavioural research and its incorporation into climate policy formation and implementation in Ireland?"*is of a similar breadth and hence scoping reviews are the adequate tool to use.

The aims of the scoping reviews were to:

1. Identify from the international academic literature behavioural interventions that have successfully been used to tackle climate change in the five sectors.
2. Identify whether and how behavioural interventions have been applied in Ireland in the five sectors.
3. Identify gaps and potential for future integration of behavioural insights into climate change policy.

To identify behavioural interventions that have successfully been used to tackle climate change in the five sectors (Aim 1), we relied on three approaches: First, we used rapid scoping reviews and semi-systematic search strategies to identify the most relevant behavioural insights in each sector using Google Scholar, as well as forward and backward searches. For each sector, we specified two relevant groups of search terms. The first group contained sector-specific search terms that allow us to find behavioural studies in the

various sub-areas of the sector (e.g. “EVs”, “active travel”, and “public transport” in the transport sector). The second group included search terms that helped us find literature on behavioural insights (e.g. “nudge”, “behavioural insights”, and “behavioural science”). Second, we complemented the systematic search processes with the newest developments in artificial intelligence and used *Elicit The AI Research Assistant*, which uses machine learning to help find relevant academic papers.
Finally, the report also relied on existing expertise and knowledge of behavioural science research conducted in Ireland.

To identify whether and how behavioural interventions have been applied in Ireland in the five sectors (Aim 2), we relied on the grey literature, policy documents, and our existing knowledge of the work done by Irish behavioural scientists. We also reached out to Irish behavioural scientist colleagues and asked for examples of applied behavioural insights in the environmental domain.

To identify gaps and potential for future integration of behavioural insights into climate change policy (Aim 3), we compared the findings from Aim 1 and 2.