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# GOAL-SUSTAIN

## The role of goal-support in sustainable decision making: Implications for policymakers and digital businesses

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# Zusammenfassung

Der vorliegende Bericht enthält den Abschlussbericht des GOAL-SUSTAIN-Projekts, das die Rolle der Verhaltenswissenschaft bei der Überbrückung der Kluft zwischen umweltfreundlichen Einstellungen und tatsächlichem Verhalten hervorhob. GOAL-SUSTAIN konzentrierte sich auf das Verständnis und die Beeinflussung umweltfreundlichen Verhaltens durch Interventionen, die auf dem Konzept der Selbstkontrolle und verwandten psychologischen Interventionen basieren. Ziel des Projekts war es, zu untersuchen, wie externe Ressourcen wie Feedback und Entscheidungshilfen genutzt werden können, um Einzelpersonen zu einem nachhaltigeren Lebensstil zu bewegen. Das Forschungsprojekt stützte sich auf die Kognitions-, Neuro- und Verhaltenswissenschaften, um die kognitiven Grundlagen umweltbezogener Entscheidungen zu untersuchen.

GOAL-SUSTAIN unterstreicht die Bedeutung einer kollaborativen Forschungsagenda und schlägt mehrere Empfehlungen und politische Schlussfolgerungen vor, um die Rolle der Verhaltenswissenschaft bei der Eindämmung des Klimawandels zu stärken. Einzelpersonen und Haushalte beeinflussen den Klimawandel durch verschiedene soziale Rollen, und die Projektergebnisse unterstreichen die Notwendigkeit eines umfassenderen Beitrags der Verhaltenswissenschaften zur Eindämmung des Klimawandels. GOAL-SUSTAIN umfasste Laborexperimente und Feldforschung, um die Wirksamkeit von sozial- und umweltpsychologisch fundierten Massnahmen zu untersuchen. Insgesamt zielte das Projekt darauf ab, Erkenntnisse darüber zu gewinnen, warum verhaltensorientierte Massnahmen erfolgreich sind oder scheitern, und zielführende Technologien zur Erreichung von Energie- und Emissionsreduktionszielen zu entwickeln.

# Résumé

Ce rapport présente le rapport final du projet GOAL-SUSTAIN, qui a mis l'accent sur le rôle de la science comportementale pour combler le fossé entre les attitudes pro-environnementales et le comportement réel. GOAL-SUSTAIN s'est concentré sur la compréhension et l'influence des comportements pro-environnementaux par le biais d'interventions basées sur le concept de maîtrise de soi et d'interventions psychologiques connexes. Le projet visait à explorer la manière dont les ressources externes, telles que le retour d'information et l'aide à la décision, peuvent être utilisées pour encourager les individus à adopter des modes de vie plus durables. Le projet de recherche s'est appuyé sur les sciences cognitives, les neurosciences et les sciences du comportement pour étudier les fondements cognitifs de la prise de décision en matière d'environnement.

GOAL-SUSTAIN souligne l'importance d'un programme de recherche collaboratif et propose plusieurs recommandations et conclusions politiques visant à renforcer le rôle des sciences comportementales dans l'atténuation du changement climatique. Les individus et les ménages influencent le changement

climatique à travers divers rôles sociaux et les résultats du projet soulignent la nécessité d'une contribution plus large des sciences du comportement à l'atténuation du changement climatique. Le projet GOAL-SUSTAIN comprenait des expériences en laboratoire et des recherches sur le terrain pour comprendre l'efficacité des interventions fondées sur la psychologie sociale et environnementale. Dans l'ensemble, le projet visait à comprendre pourquoi les politiques comportementales réussissent ou échouent et à développer des technologies permettant d'atteindre les objectifs en matière d'énergie et de réduction des émissions.

# Summary

The present report presents the final report of the GOAL-SUSTAIN project, which emphasized the role of behavioral science in bridging the gap between pro-environmental attitudes and actual behavior. GOAL-SUSTAIN focused on understanding and influencing pro-environmental behavior through interventions based on the concept of self-control and related psychological interventions. The project aimed to explore how external resources, such as feedback and decision support, can be used to encourage individuals to adopt more sustainable lifestyles. The research project drew on cognitive science, neuroscience, and behavioral science to study the cognitive foundations of environmental decision-making.

GOAL-SUSTAIN highlights the importance of a collaborative research agenda and proposed several recommendations and policy conclusions addressed to strengthen the role of behavioral science in climate change mitigation. Individuals and households influence climate change through various social roles and the project results stress the need for a broader contribution of behavioral science to climate change mitigation. GOAL-SUSTAIN included laboratory experiments and field research to understand the effectiveness of interventions grounded in social and environmental psychology. Overall, the project aimed to provide insights into why behavioral policies succeed or fail and develop goal-supporting technologies for achieving energy and emissions reduction goals.

# Main findings

1) Environmental behavior can be studied in newly established experimental protocols such as the Carbon Emission Task (Berger & Wyss, 2021).

2) Self-control helps to understand the environmental attitude-behavior gap. People high in self-control have a smaller attitude-behavior gap than people low in self-control (Wyss, Berger, and Knoch, 2022).

3) Research in environmental psychology needs to take into account actual behavior to a stronger degree than it currently does (Lange et al., 2023).

4) Voluntary pro-environmental behavior is much lower in the field than routinely found in laboratory research (Berger et al., 2022).

5) Opt-out policies (default nudges) are highly effective in energy contract choice (Bregulla et al., 2023), but high costs crowd out their effectiveness (Berger, Kilchenmann, et al., 2022).

6) Recommendations to improve behavioral science encompass various elements in terms of research procedure, impact, and empirical approaches (Nielsen et al., 2023)

7) Self-control is can be conceptualized as a multi-level perspective (Hofmann, 2023, Wyss et al., 2023), followed by debates about the limits of individualized approaches to climate change mitigation (Chater & Loewenstein, 2023)

8) Behavioral science can aid policy responses in concrete situations, such as the gas crisis (Berger, Ockenfels, & Zachmann, 2023).

9) Behavioral science should take a key supporting role in implementing policies that require human behavior (Nielsen et al., 2023)

10) Behavioral science is best seen as a complement to other, more traditional policy, not as a replacement.

# Contents

# 1 Introduction

## 1.1 Background information and current situation

Preventing catastrophic consequences of climate change requires swift and decisive action at the global level and within national strategies (Creutzig & al, 2022; Hough-Guldberg et al., 2018; IPCC, 2022). At the level of individual consumers, this transition to a $CO_2$-free economy and society requires profound changes in people's lifestyles, including behavior change (Ivanova & al, 2020; Nielsen, Nicholas, et al., 2021; Nielsen & others, 2020). This affects multifaceted areas such as household energy (Composto & Weber, 2022), nutrition (Verfuerth et al., 2021; Wynes et al., 2018), or travel behavior (Böcker et al., 2016; Javaid et al., 2020). Despite widespread pro-environmental attitudes and a multitude of mitigation options, people's actual behavior does often not match their environmental attitudes (Kollmuss & Agyeman, 2002a; Langenbach et al., 2020a; Nielsen & others, 2022). For this reason, theoretical and empirical research has begun to examine the auxiliary role that behavioral science (see ***Policy Box 1***) plays in closing the attitude behavior gap (Steg, 2023; Steg & others, 2022; Steg & Vlek, 2009). As part of this endeavor, the role of cognitive resources in pro-environmental behavior have been started to be scrutinized (Bamberg, 2013; Baumgartner et al., 2019; Langenbach et al., 2020; Wyss et al., 2022). Building on this theorizing, the GOAL-SUSTAIN project focused on how to deliver behavioral scientific interventions that support goal-consistent behavior of individuals. The project was grounded in a recent shift in thinking in the behavioral sciences, whereas an individualized approach to solving global cooperation problems have been criticized and behavioral science has devoted much work into how to improve its impact (Chater & Loewenstein, 2023; Haushofer & Metcalf, 2020; Lange et al., 2023; Milkman et al., 2021; Nielsen, Cologna, et al., 2021; Nielsen & others, 2020).

Drawing on laboratory and field experiments, the research project sought ways to use goal support (e.g., feedback, decision support, etc.) to encourage people to engage in pro-environmental behaviors (Nielsen & Bauer, 2019). In creating an analytical framework based on self-regulation from which to understand the effectiveness of policy tools and digital solutions for promoting pro-environmental behavior, the project relied on a core process of social psychological research (Allcott & Mullainathan, 2010; Duckworth, 2011; Kollmuss & Agyeman, 2002; Nielsen, 2017; Tiefenbeck et al., 2018, 2019).

Based on the recent "cognitive" shift in theorizing in the field of environmental psychology (Bamberg, 2013b; Nielsen, 2017) and promising results from our own research on the cognitive foundations of environmental behavior (Langenbach et al., 2020) and on solutions for energy companies (Ebeling & Lotz, 2015), the present project aimed to investigate the role of external resources in solving the self-control problem. The capacity for self-control and interventions based on self-control have not yet been studied in projects on environmental psychology that focus on actual environmental behavior or field experiments in sustainable behavior.

**Policy Box 1: Behavioral science in the energy and climate change realm**

Behavioral science involves studying the behavior of individuals and households, spanning various disciplines such as anthropology, economics, political science, psychology, and sociology, as well as engaging in transdisciplinary research. Individuals and households play crucial roles in influencing the course of climate change through diverse social roles, including citizenship, consumption, participation in organizations, community involvement, and investment decisions. Notably, in their consumer roles, they significantly contribute to global greenhouse gas (GHG) emissions through the consumption of goods and services.

Efforts in behavioral science to address climate change have traditionally centered on individuals' consumer behaviors. This research often focuses on commonly observed actions like recycling, dietary choices, or modes of travel. It also explores the influence of individual characteristics such as knowledge and attitudes on predicting these behaviors. While these aspects are valuable and have generated useful insights, there is untapped potential for behavioral science to make broader contributions to understanding and promoting climate change mitigation.

Within the project, we sought to enhance the impact of behavioral science in this context. It is essential to expand the scope of research and foster better integration across disciplines, both within and beyond the behavioral sciences. This includes incorporating insights and questions from mitigation practices. As a result from the international collaborations within the project, we advocate for a more collaborative research agenda aimed at optimizing the quality and impact of studies on individual behavior in climate change mitigation. To guide this agenda, we propose ***six recommendations*** for both fundamental and applied research on individual climate behavior, broadly defined as behaviors directly or indirectly influencing GHG emissions. The recommendations are presented in the Results section and are based on scientific work published in Nielsen et al. (2023).

Thus, we aimed to elicit more knowledge about the effects in energy-related decision-making. We aimed to use the construct of "self-control" to generate new policy insights and provide policymakers with an expanded "toolbox" of behavioral science interventions to guide behavior toward the underlying goal of transitioning to cleaner energy. This critically complements the current approach of a still loose collection of "working interventions" without an underlying unified theoretical concept (e.g., "nudges," etc.).

In doing so, the project borrowed from the call made by scholars for more research on the cognitive basis of environmental decision-making (Bamberg, 2013b; Nielsen, 2017; Weber, 2017). This is in line with the general call for more process knowledge to better understand human behavior (Crusius et al., 2012). From a cognitive perspective on the gap between environmental attitudes and behaviors, the capacity for self-control has been theorized as a particularly important variable underlying people's

(in)ability to put their pro-environmental attitudes into action. In general, people need self-control when faced with a conflict between two mutually exclusive motives: a stronger motive that promises immediate reward and a weaker motive that promises greater long-term (Duckworth et al., 2016). In such situations, the capacity for self-control can help people align their behavior with their long-term goals (Hofmann et al., 2012; Milyavskaya & Inzlicht, 2017) for example, by laboriously inhibiting temptations that would provide a short-term reward (Fujita, 2011) Although this ability can be influenced by situational influences (Hofmann et al., 2012), people also differ substantially and chronically in their general disposition to exercise self-control. This trait in an individual is thought to be relatively stable over time and across situations (Gottfredson & Hirschi, 1990). Also, the disposition of self-control is generally associated with significant benefits in many areas of life (e.g., Tangney et al., 2004).

Cognitive and neuroscience research provided initial evidence to suggest that self-control may similarly benefit pro-environmental decision-making. For example, previous research has found that working memory capacity (Langenbach et al., 2019) or baseline activation in the right lateral prefrontal cortex (Baumgartner et al., 2019) is associated with people's self-reported daily pro-environmental behaviors. This suggests that people's cognitive resources, such as the capacity for self-control, may act as a resource for foregoing carbon-intensive personal benefits to protect the long-term goal of contributing to climate change mitigation (Baumgartner et al., 2019; Langenbach et al., 2019). However, it was still unclear whether trait self-monitoring can help people behave in accordance with their pro-environmental attitudes. There was also still the question of whether previous findings on cognitive resources can be applied to actual, objectively measured, rather than merely self-reported pro-environmental choices.

## 1.2 Purpose of the project

Previous research has pointed to situational components, such as lack of access to public transportation or environmentally friendly products, as well as cultural factors that make it harder for people to behave according to their environmentally friendly attitudes (Creutzig et al., 2016; Creutzig & al, 2022; Steg & Vlek, 2009). However, even when contextual factors fundamentally enable sustainable behavior, people often do not act accordingly, which we refer to as the "attitude-behavior gap" (Kollmuss & Agyeman, 2002). Another long-standing explanation is that people with high environmental attitudes predominantly engage in pro-environmental behavior when the perceived economic or "psychological" costs (e.g., time or effort) are sufficiently low (Henn et al., 2020; Kaiser, 2021; Kaiser & Lange, 2021a; Lange, 2022; Lange et al., 2023). This helps explain why attitudes generally predict various "low-cost" environmentally friendly behaviors such as recycling, but are often unable to explain "high-cost" behaviors such as driving less or flying less (Diekmann & Jann, 2000; Diekmann & Preisendörfer, 1998; Enzler & Diekmann, 2019). On the other hand, it has been theorized that people are more tempted to engage in unsustainable behaviors when the environmental benefits associated with incurring such costs are estimated to be low. Despite these advances, however, it is still not entirely clear why positive

environmental attitudes often do not predict environmental behavior, even when people are generally willing to bear the personal costs of a sustainable choice and are aware of the associated environmental benefits.

As a result, scholars have called for more research on the cognitive underpinnings of environmental decision making, consistent with the general call for more process knowledge to better understand human behavior (Nielsen, 2017). From a cognitive perspective on the gap between environmental attitudes and behavior, the ability to exercise self-control has been theorized as a particularly important variable underlying people's (in)ability to put their pro-environmental attitudes into action. In general, people need self-control when faced with a conflict between two mutually exclusive motives: a stronger motive that is expected to yield immediate rewards and a less strong motive that promises greater long-term rewards (Duckworth et al., 2016; Wyss et al., 2022). In such situations, the ability to self-regulate can help people align their behavior with their long-term goals, for example, by "inhibiting" temptations that provide short-term rewards.

Past research on self-regulation research has placed a strong emphasis on people's internal regulatory processes and has shown that goal-compliant habits, proactive avoidance of temptations, reappraisal of tempting situations, and inhibition of pre-potent impulses are key strategies. These strategies enable people to achieve long-term goals even though shorter-term pleasures conflict with them. However, recent research has also shown that people with high self-control tend to externally regulate their social environment, thereby creating better decision-making conditions that are more likely to lead to success. One such regulation of the social environment is goal support (Nielsen & Bauer, 2019). Throughout the work program in this grant, we sought to investigate “external regulation” strategies. In essence, our conceptual approach is to find ways to adjust the external world, in order to render internal self-regulation strategies (e.g., inhibition) needless, consistent with a multilevel approach to understanding and using self-control (Hofmann, 2023).

One way to address self-regulation from the outside is to focus on smart digital solutions and energy policy tools which can be an important lever to help people support their goals. Although not explicitly based on theories of self-regulation, technological and policy solutions have already been proposed in prior research. For example, changing energy tariff choices from opt-in to green energy contracts to opt-out of such contracts increased enrollment in to green energy dramatically (Ebeling & Lotz, 2015) and lastingly (Liebe et al., 2021). Relatedly, delivering real-time feedback while people are showering (i.e., an energy-intensive process) results in substantial reduction of energy consumption (e.g., Tiefenbeck et al., 2018).

GOAL-SUSTAIN was thus conceptually grounded on existing theoretical developments in social and environmental psychology and was based on existing field experiments from our own research group and work beyond of our group. It built on an extensive body of previous work, largely funded by competitive research grants (e.g., postdoctoral mobility grants, EU-Horizon projects, DFG research

units, etc.). The project closely collaborated with the Virtual Institute of Smart Energy consortium project (funded by the European Regional Development Fund and the state of NRW/Germany, Prof. Dr. Andreas Löschel, co-led by Dr. Christoph Feldhaus), which focuses on digital solutions based on sound behavioral research.

## 1.3 Objectives

Overall, the project had ***two objectives***, namely contributing to laboratory/online research (work package 1) and to complement laboratory findings with field research in people's natural decision environment (work package 2). The goal of work package 1 was to investigate the role of different interventions grounded in social and environmental psychology that may increase pro-environmental decision-making in laboratory experiments and to test them for scalability. Due to the chronic over-reliance of self-report measures in environmental psychology, part of work package 1 was the development and validation of novel research tools that emphasize the use of actual behavior, rather than verbal reports of past behaviors or intentions. The goal of work package 2 was to conduct field research in Switzerland and beyond. Specific objectives of single studies are detailed below. In summary, the goal of work packages 1 and 2 is to gain a better theoretical understanding of why behavioral policies work or do not work. This will then enable effective intervention to deliver goal-supporting technologies to people and achieve energy and emissions reduction goals (see **Policy Box 2**).

**Policy Box 2: A self-control view on the environmental attitude behavior gap**

A well-established research finding indicates that individuals' environmental attitudes often do not strongly translate into actions that significantly reduce their environmental impact. This phenomenon, commonly referred to as the attitude-behavior gap (Carrington et al., 2014; Hassan et al., 2016; Kollmuss & Agyeman, 2002; Peattie, 2010) or value-action gap (Babutsidze & Chai, 2018; Barr, 2007), is particularly pertinent in the realm of climate change mitigation. Despite mounting evidence that requires swift and urgent behavioral changes, unsustainable behaviors persist, and policymakers may be hesitant to propose the most effective measures due to potential public backlash (Lorenzoni et al., 2007; Wynes & Nicholas, 2017). Often times, the dissemination of accurate information and environmental education is widely recognized as crucial for promoting sustainability (Liefländer & Bogner, 2014; Nisbet, 2009; Wals et al., 2014). This prompts the question of when attitudes can genuinely serve as a catalyst for advancing environmental objectives and, alternatively, when other factors such as incentives or behavioral interventions are more effective.

It remains puzzling why positive environmental attitudes frequently do not accurately predict environmental behavior, even when individuals express a willingness to bear personal costs for pro-environmental choices and are cognizant of the associated environmental benefits. Consequently,

there is a growing call within the scientific community for more research into the cognitive underpinnings of environmental decision-making (Bamberg, 2013; Nielsen, 2017; Weber, 2017). This aligns with the broader need for enhanced process-knowledge to gain a deeper understanding of human behavior (Crusius et al., 2012; Nielsen, van der Linden, et al., 2020).

Taking a cognitive e perspective on the environmental attitude-behavior gap, researchers have emphasized the significance of self-control capacity as a key variable influencing individuals' ability to act on their pro-environmental attitudes. Generally, self-control becomes crucial when individuals face a conflict between two mutually exclusive motives: one more potent motive that promises an immediate reward and another less potent motive that offers a greater long-term (Duckworth et al., 2016). In such scenarios, self-control capacity can assist individuals in aligning their behavior with long-term goals, such as inhibiting temptations that provide short-term gratification (Fujita, 2011). While situational factors can influence this capacity, individuals also exhibit considerable and chronic variations in their general disposition to exert self-control, assumed to be relatively stable over time and situations (Gottfredson & Hirschi, 1990), with associated benefits in various aspects of life (e.g., Tangney et al., 2004).

But because people are generally busy with their lives and environmental protection is often not a primary day-to-day concern, researchers have begun to rethink the concept of self-control. Rather than attempting an increase in self-control and other self-regulation – a dominant approach in the clinical psychological practice – they have begun to attempt to behaviorally design decision environmental that render self-control less relevant. This includes making green energy tariffs the default choice (e.g., Ebeling & Lotz, 2015) or increasing the salience of environmental externalities through real-time feedback (e.g., Tiefenbeck et al., 2018).

Evidence from cognitive science and neuroscience lends initial support to the notion that trait self-control may similarly contribute to pro-environmental decision-making. Studies have found links between working memory capacity (Langenbach et al., 2020) or baseline activation in a related brain area (specifically, the right lateral prefrontal cortex; Baumgartner et al., 2019) and individuals' self-reported daily pro-environmental behavior. This suggests that cognitive resources, including self-control capacity, may serve as a resource for resisting carbon-intensive personal benefits, aligning with the long-term goal of contributing to climate change mitigation (Baumgartner et al., 2019; Langenbach et al., 2020). However, uncertainties persist regarding whether trait self-control genuinely facilitates alignment with pro-environmental attitudes and whether previous findings on cognitive resources extend to actual, non-self-reported pro-environmental decision-making.

# 2 Procedures and methodology

The overarching methodological approach of GOAL-SUSTAIN drew on the new science of "behavioral economic engineering" founded, among others, by (Bolton & Ockenfels, 2012). According to Bolton and Ockenfels (2012), behavioral economic engineering is the "science of designing real-world institutions and mechanisms that align individual incentives and behavior with underlying goals." Actively designed economic mechanisms abound in real markets, most notably in frequency and security auctions, energy markets, emissions trading rules, worker compensation plans, or matching and online markets. Behavioral economics research recognizes that people often do not behave or behave contrary to the assumptions of traditional economic theory, and therefore seeks to design markets and decision environments based on sound behavioral and cognitive science research.

Traditional economic theory typically abstracts from some "details of human behavior" and argues that these details are relatively insignificant and therefore unlikely to result in a loss of accuracy. However, a wealth of empirical evidence challenges this conclusion, showing that even small details of mechanisms, small changes in available information, or small deviations from rationality or self-interest or common knowledge about it can dramatically alter predictions – even before we consider other real-world complexities associated with a particular context. Over the past decade, behavioral economic engineering has received much research attention. However, a major shortcoming of today's behavioral economic engineering is the low focus on cognitive processes, which the present project aims to counteract.

A key element of behavioral economic engineering is the use of the decision laboratory as a wind-channel to pre-test field interventions. Therefore, GOAL-SUSTAIN used the laboratory as a "wind channel" to test psychological theories, before testing the most promising measures in practice, which in turn is crucial for both digital solution providers and policy makers. In doing so, we can rely on particularly novel methods introduced by our research group. A major problem in environmental psychology has been that laboratory research has generally been unable to attribute real-world environmental consequences to behavior and has therefore relied exclusively on self-reported or more artificial behaviors (see **Policy Box 3**). We therefore sought to develop paradigms to measure environmentally consequential behavior (Lange, 2022; Lange et al., 2023; Lange & Dewitte, 2019; Nielsen, Cologna, et al., 2021). This enables laboratory work with real environmental consequences, which has rarely been done before in environmental psychological research. It was expected that laboratory experiments based on this task would provide significantly better insights for the field experiments in work package 2.

**Policy Box 3: Measuring pro-environmental behavior**

Researchers and practitioners alike are routinely interested in measuring behavior. Pro-environmental behavior is commonly characterized by its impact on the natural environment. For an

action to qualify as pro-environmental, it must either yield measurable environmental benefits (as per the impact-oriented definition) or be undertaken with the specific intention of promoting environmental well-being (according to the intent-oriented definition; Stern, 2000). However, the positive outcomes for the environment are not the sole consequences associated with pro-environmental behavior. Typically, these environmental gains come at a behavioral cost, such as monetary expenses, time commitment, or expended effort, which may dissuade individuals from participating in such behaviors, as noted by Gifford (2011), Kaiser (2021) or Lange (2023). Comprehending how individuals negotiate the trade-off between environmental benefits and behavioral costs is crucial for advancing the science of pro-environmental behavior and developing behaviorally informed strategies to address environmental challenges.

Despite their definitional significance, the consequences of pro-environmental behavior often received insufficient attention in prior research. This insufficiency in existing research was one of the starting points of GOAL-SUSTAIN. In past research, rather than examining real-world environmentally relevant situations and behaviors with tangible costs, a considerable portion of pro-environmental behavior studies concentrates on analyzing inconsequential verbal responses to self-report items and hypothetical scenarios (Gifford, 2014; Lange et al., 2018; Steg & Vlek, 2009b). While these verbal responses may be of scientific interest in their own right, serving as indicators of individuals' dedication to environmental protection (as seen in Kaiser et al., 2018; Kaiser & Lange, 2021; Kaiser & Wilson, 2004), they cannot be expected to generate findings applicable to real-life environmental situations (Klein & Hilbig, 2019; Lewandowski Jr & Strohmetz, 2009). The external validity of experiments relying on verbal responses is questionable since making statements about engagement in pro-environmental behaviors involves few of the consequences associated with actual behavioral participation.

An alternative approach to investigating inconsequential verbal responses is the utilization of **behavioral paradigms** or **experimental models** of pro-environmental behavior. Behavioral paradigms are systematically structured model situations that replicate the relationships between behaviors and their consequences present in the situations meant to be modeled (Lange, 2022). As a critical innovation, these paradigms all feature actual behavior that is environmentally consequential. As part of GOAL-SUSTAIN, we developed the Carbon Emission Task (Berger & Wyss, 2021), one of currently a handful of experimental approaches to measure environmental behavior (see Lange, 2023, for a review). The paradigm is detailed in the **Results** section, as the methodology was one deliverable in the project.

# 3 Results and discussion

Results in this report are structured around the objectives of the single work packages. The objective of work package 1 was the provision of wind-channel tests of various interventions to test alignment of pro-environmental attitude and behavior and/or the promotion of pro-environmental behavior. Work package 1 relied initially on the development of novel tasks to measure consequential pro-environmental behavior. We limit the results to the most relevant publications here, all publications are referenced in the “Publications” part of this report. Work package 2 comprises field work.

## 3.1 Obtained qualitative and quantitative results (laboratory work)

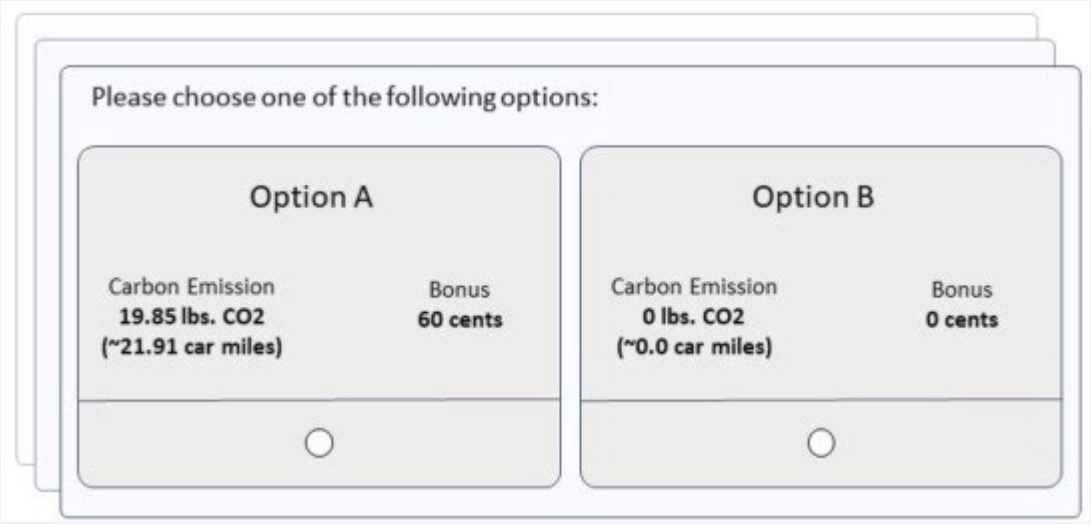
Within the project, we introduced the *Carbon Emission Task* (CET, see **Policy Box 4**) as a new behavioral paradigm grounded in experimental economics. The CET assesses consequential pro-environmental behavior in laboratory, online, or classroom studies. Participants face repeated tradeoffs between financial bonus opportunities paired with real carbon emissions and foregoing such opportunities while staying carbon neutral. In two studies, we found that people react systematically to the incentives set out in the task and that average pro-environmental behavior correlates with related constructs. Higher bonus prospects decrease pro-environmental behavior, whereas higher environmental consequences increase pro- environmental behavior. Average pro-environmental behavior in the CET correlates with environmental attitudes, belief in climate change, and demographic factors such as gender, education, or political orientation. Finally, average pro-environmental behavior in the CET predicts participants’ reported carbon footprints and their extraction behavior from a common-resource pool. Taken together, our findings suggest that the CET relates to constructs often used in psychological research, but due to its relationship with experimental economics may help to integrate the two disciplines and synthesize the research efforts. In addition, it opens the door for novel research questions testing behavioral reactions under varying sets of incentives. In sum, the CET offers the research community a fast and efficient tool to assess actual and consequential pro-environmental behavior in a way that appeals to various social scientific disciplines. The validation paper was published in the *Journal of Environmental Psychology* (Berger & Wyss, 2021).

Furthermore, we collaborated with other researchers who also want to *emphasize the role of actual behavior* in research on pro-environmental behavior. Therefore, we published a correspondence in which we call for research that goes beyond self-reports (Lange et al., 2023). When environmental psychologists collect information about behavior, they can pursue different objectives. They may seek to measure characteristics of particular behaviors that naturally occur in the lives of people, such as the frequency of meat consumption or the time spent in natural environments. Alternatively, researchers may want to record responses to experimentally arranged situations to study how behavior varies as a function of contextual changes or psychological manipulations. Yet another objective may entail using

behavioral information to infer psychological characteristics of persons, such as their environmental attitude or connectedness to nature. In all three cases, self-reports seem to be the most common source of data in environmental psychology (Lange et al., 2018; Steg & Vlek, 2009). While the correspondence does not argue for a general abandonment of self-reports, it showcases that that overreliance on this data collection method limits the conclusiveness, generalizability, and practical impact of research in environmental psychology. The correspondence was published in the *Journal of Environmental Psychology* (Lange et al., 2023).

**Policy Box 4: The Carbon Emission Task (CET, Berger & Wyss, 2021)**

As defined in the project goals, environmental psychology was in need of a broader set of experimental tasks that allow strict control over the experimental situation while preserving measurements of consequential behavior. To this end, we introduced a novel paradigm coined the "Carbon Emission Task" (CET, see figure in box) as an experimental game. Experimental games allow efficient studying of human behavior with real-world stakes attached to behavioral consequences and have been widely used and accepted as dependent variables in experimental or correlational studies. In addition, such games have been shown to measure stable latent personality constructs.




The CET taps into the well-established observation that individual and environmental consequences are often in conflict. People routinely face choices in which their short-term behavior leads to negative long-term environmental consequences. The CET therefore measures people's willingness to trade-off short-term financial benefits with actual environmental costs realized by a carbon emission. Generally, the CET manipulates two structural drivers of pro-environmental behavior: the individual benefits attached to environmentally unfriendly choices and the environmental harm associated with that consequence. Although within environmental psychology, the development of tasks suitable to study such trade-offs with consequential measures is still in its infancy, the CET can build on existing efforts in the creation of such tasks, noteworthy the Pro-Environmental Behavior Task (PEBT) introduced by Lange et al. (2018) 2. In the PEBT, participants make a series of laboratory decisions about taking a figurative "car" versus "bike". Participants experience two types of consequences: the waiting time and

the environmental consequence. Taking the bike typically increases participants' waiting times and, therefore, the overall time they spent in the task, but it spares a lightbulb from being ignited that results in a carbon emission. Participants face repeated trade-offs sacrificing their time at the benefit of saving the emission. Thus, regarding the underlying rationale, the PEBT and the CET are very closely related, yet differ in important aspects. Both the PEBT and the CET assume that individuals have a goal conflict between a potent short-term goal (CET: receiving a financial payment; PEBT: saving time) and the long-term goal of engaging in pro-environmental behavior. Yet, the two tasks differ, reflecting different types of tradeoffs people face in the real-world. Sometimes, being environmentally friendly is costly in terms of time, sometimes it is costly in terms of money. Although both variables are of interest, the fact that the CET uses money makes it likely more suitable to bridge the gap to experimental economic research, as this field typically uses money as a source of utility prototypical experiments.

The CET consists of a series of 25 choices between an Option A and an Option B with varying personal and environmental incentives. Option A leads to a financial compensation for the decision maker, however also causing a carbon externality. Choosing Option B foregoes this financial compensation, while staying carbon neutral. Following previous research about the difficulty of estimating the environmental consequence based on carbon weight itself, decision makers in the CET are supported with familiar reference units to better make sense of environmental information. Thus, in addition to the emission information displayed as total weight (i.e., “lbs CO2 emitted”), the amount of carbon emitted is also provided in “equivalent car miles driven”.

As a crucial next step of the project, we tested the degree to which *self-control* moderates the attitude-behavior gap in the domain of environmental behavior. This would empirically legitimize our theoretical approach. Despite a strong consensus about humanity's responsibility for climate change, many people fail to behave in line with their pro-environmental attitudes, and the question of how to overcome this environmental attitude-behavior gap remains a puzzle. To address this lacuna, the project research provided further insights into motivational, dispositional, and structural factors underlying pro-environmental behavior. Based on the Carbon Emission Task (n = 1,536), we showed that pro-environmental attitudes are more predictive of pro-environmental behavior when personal costs are low or environmental benefits are high. Importantly, self-control helps people to act in line with their attitudes, suggesting that self-control is a crucial trait for protecting people's long-term pro-environmental goals. We propose that mitigation strategies should take into account the motivational, dispositional, and structural complexity associated with pro-environmental decisions, in line with the “goal-support” approach we laid out in the theoretical background. The research was published in the *Journal of Environmental Psychology* (Wyss, Knoch, & Berger, 2022).

Next, we tested the assumption that the typical sensitivity we observe in the CET (cost- and benefit sensitivity) should be particularly pronounced for people who accept anthropogenic climate change. Despite the strong scientific consensus about the existence of anthropogenic climate change, widespread skepticism in the general population continues to exist. Past research has largely relied on self-reported behaviors or behavioral intentions when investigating downstream 'behavioral'

consequences of climate change denial. As a consequence, there remains a large gap in the literature about how belief in climate change interacts with the pursuit of self-interested, environmentally harmful behaviors. To fill that gap, the present research used a novel, experimental economic paradigm (the Carbon Emission Task) that allows to attach true environmental consequences to laboratory decisions. Based on ~56 000 pollution decisions from 2273 participants in more than 30 countries, we found that belief in climate change meaningfully affects decision-making. Our results showed that climate change skepticism predicts self-interested choices and highlights that sceptics have an insensitive acceptance of emissions, reaping benefits no matter how large the climate cost are or how small the personal benefits become. Therefore, our results critically augmented meta-analytic evidence arguing that downstream behavioral consequences are small to medium in their effect size. We discussed the use of experimental economic paradigms as a crucial innovation tool for psychological research addressing people's willingness to engage in climate action. The research was published in *Environmental Research Letters* (Berger & Wyss, 2021).

To motivate goal-support intervention, we tested the degree to which behavior is coherent in the Carbon Emission Task. Therefore, we performed an experiment testing the degree to which decision makers' pro-environmental behavior is "*coherently arbitrary*". Coherent arbitrariness refers to the phenomenon that behavior in experimental models may only appear rational, as if supported by fixed preferences, despite being affected by arbitrary factors unrelated to preferences. Using the Carbon Emission Task, the present research extended this behavioral economic finding to pro-environmental behavior research. We found that (a) objectively identical trade-offs are evaluated substantially differently depending on the relative rather than absolute price level of comparative choices, and (b) people's environmental values correlate robustly with behavior across conditions. This result may also help to explain findings documenting a motivation-impact gap in pro-environmental behavior, as people may find it difficult to objectively and globally assess the costs and benefits associated with their choices. They legitimize the use of goal- support to steer behavior. The research was published in *Current Research in Ecological and Social Psychology* (Berger & Bregulla, 2023).

As a *first intervention wind-channeled in the laboratory*, we conducted a controlled online experiment and showed how a transparent decision support environment promotes people's pro-environmental behavior. Participants completed a validated experimental protocol (i.e., the Carbon Emission Task), where they were asked to trade off financial gains and environmental externalities. In a treatment where participants received decision support via colored feedback, they engaged in more pro-environmental behavior than in a neutral control treatment. Furthermore, pro-environmental values positively correlated with corresponding behavior in both treatments. The data does not support the hypothesis that decision support moderates the relationship between pro-environmental values and pro-environmental behavior, or that the correlation between environmental motivation and behavior is moderated to a lesser extent by self-control under the decision support treatment. The research was published in *Die Unternehmung* (*Swiss Journal of Business Research and Practice*, Bregulla, 2022).

As a *second intervention*, we started with the observation that empirical research had previously shown that loss framing appears to be a promising tool to promote pro-environmental behavior. However, only a limited amount of experimental research has examined the effect of loss framing on actual behavior. Drawing on a consequential behavioral task (N = 897) to study true voluntary pro-environmental

behavior, we found slightly higher pro-environmental behavior in a LOSS frame. However, this effect was small and only marginally statistically significant. Interestingly, the effect of loss framing was stronger and statistically significant for people with low intrinsic motivation to protect the environment. Together, this suggests tailoring the framing of gain and loss specifically to peoples' environmental values. The research is in the editorial process (under review) at the final submission of this report (Hauser & Bregulla, 2023). The working paper is available online (see below for details).

Finally, we tested *11 expert-crowdsourced behavioral-change interventions* on four climate mitigation outcomes: beliefs, policy support, information sharing, and a consequential behavioral task. Across 54,658 participants from 60 countries, the interventions' relative effectiveness differed across outcomes. Beliefs were strengthened most by decreasing psychological distance (by 2.1%). Policy support was increased most by writing a letter to a future generation member (1.8%). Information sharing willingness was stimulated most by inducing negative emotions (10.8%). No intervention increased the more effortful behavior–several interventions even reduced it. However, the effects of each intervention differed depending on people's initial climate beliefs. These findings suggest that effective interventions must be tailored to audience characteristics and target behaviors. The research is in the editorial process (revisions under review) at the final submission of this report (Vlasceanu et al. 2023). The paper is accepted at the peer-reviewed journal *Science Advances* and a pre-print is available online (https://osf.io/preprints/psyarxiv/cr5at).

## 3.2 Obtained qualitative and quantitative results (field work)

As part of the project, we tested the degree to which *behavioral regularities* can be found in a field-setting. To do so, we collaborated with a Swiss airline. Many scientific studies have tried to assess people's willingness-to-pay to offset their own flight-related carbon emissions. Before our study, these studies were overwhelmingly grounded in hypothetical stated-preference approaches, with very limited knowledge about external validity. Therefore, we conducted an observational field study involving a final sample of 63,520 bookings made with a European airline, which allowed us to gauge actual willingness-to-pay for carbon dioxide compensation in a revealed-preference approach. Our pre-registered study showed that the median willingness-to-pay to voluntarily offset a ton of carbon dioxide from flight-related emissions is zero, with the mean willingness-to-pay being around 1 EUR. Aggregated voluntary willingness-to-pay thus dramatically falls short of current prices to offset carbon dioxide, for example through the EU-ETS. Our results thereby question the suitability of self-reported, hypothetical assessments of offsetting and raise caution about the effectiveness of offsetting schemes, which currently do not very successfully internalize flight-related cost of emissions. The research was published in *Global Environmental Change* (Berger et al., 2022).

Next, we sought to translate the research on *cost-sensitivity* to the domain of one of most effective behavioral architecture elements (i.e., altering defaults). Behavioral public policy has received broad research attention, particularly in the domain of motivating pro-environmental behaviors. We investigated how far the efficacy of arguably one the most popular behavioral policy tools (green 'default change' nudges) depends on the associated cost. On the basis of a field study involving carbon offsets for over 30,000 flights booked by more than 11,000 airline customers, we showed that green defaults

have a large effect on voluntary climate action, even when several hundreds of Euros are at stake. The effect fully vanishes only as costs approach approximately €800. The research was published in *Nature Human Behaviour* (Berger et al., 2022).

Finally, we re-assessed the effectiveness of *green energy defaults* in energy tariff choices. Green energy defaults in tariff choices have received substantial research and practical attention. In this longitudinal field study, we examined their effectiveness in a potential moment of change that can disrupt routine decision-making. Exploiting a merger in the Swiss energy landscape, we tested how a novel branding and a price change affected people's adherence to a green energy default. Our central result–based on 143,313 meters (data 2019-2022)–is that defaults are very stable. Of those 120,150 with strict default adherence 2019-2021, 99.4% also stick with the green energy default after the merger. The minority who change largely move to cheaper, more conventional energy tariffs. The findings provide a novel perspective on energy tariff defaults and offer more evidence for their effectiveness. Our results indicate that while percentage-wise large, objectively moderate price changes do not meaningfully impact the effectiveness of defaults. The research is currently in the editorial process (submission stage). The working paper is available online (see below for details).

## 3.3 Experiences gathered

One key insight from the work on GOAL-SUSTAIN (particularly the workshop results) was that behavioral science research and application can contribute much more to understanding and advancing climate change mitigation than it currently does (summary: Policy Box 5). One essential requirement is that behavioral scientists broaden the focus of their work and through better integration across disciplines and fields. A proposition that emerged (Nielsen et al., 2023) was that of a more collaborative research agenda with the goal of optimizing the quality and impact of research on individual behavior in climate change mitigation. This encompassed six recommendations for fundamental and applied research, which are presented as a scientific paper in Nielsen (2023) and summarized here. Recommendations 1-3 are about what research to prioritize, Recommendation 4 proposes how to improve research methods, and Recommendations 5-6 focus on the interpretation, accumulation, and communication of behavioral knowledge and integration of behavioral science research with other sciences and practice. Together, the recommendations emphasize how research groups and larger communities can collaborate in studying individual climate behavior. Some recommendations can be implemented easily, but others are complicated, effortful, and more dependent on resources. In Nielsen et al. (2023), we therefore emphasize the critical enabling roles of universities, funders, governments, and other organizations. In outlining the recommendations, we synthesize knowledge from heterogeneous and often siloed research areas.

**Policy Box 5: Six recommendations for behavioral science in climate change mitigation, based on Nielsen et al. (2023).**

Here, we summarize the recommendation made in Nielsen et al. (2023). More details are presented in the main text.

1. Study a wider range of individual climate behaviors.
2. Address the variety, complexity, and interconnectedness of behavioral determinants
3. Study and evaluate the mitigation potential of behavior change initiatives.
4. Diversify and augment the methodological toolbox.
5. Increase attention to issues of heterogeneity, generalizability, context specificity, and robustness in interpreting research findings.
6. Integrate and theorize.

A first recommendation is to *study a wider range of individual climate behaviors*. Scientists and practitioners frequently equate individual climate behavior with consumption behavior. Behavioral science research has mostly accepted this implicit definition and has focused even more narrowly on everyday activities like recycling. Less research exists on the acquisition and maintenance of high-impact consumer durables like homes, appliances, motor vehicles, and activities like air travel.

Second, *the variety, complexity, and interconnectedness of behavioral determinants needs to be more carefully assessed*. Behavior is the result of a complex interplay between individual characteristics and larger social, physical, and systemic factors. For example, an individual's choice of transport mode to work may be co-determined by personal factors such as tastes or preferences, needs of other household members or acquaintances, all available transport modes, and patterns of urban development. The most impactful influences on individual choices have often been shaped by previous, historical, decisions that have influenced the pattern of social, physical, and socioeconomic opportunities and constraints. Different disciplines and theoretical perspectives speak more confidently about some determinants than others. In either case, behavioral science can only be effective by taking these realities into account.

Third, it is important to study and evaluate the *mitigation potential of behavior change initiatives*. Addressing climate change requires major behavioral changes, particularly for those living in the Global North. A considerable body of research has developed principles for designing initiatives to make them more effective at promoting behavior change both by individuals and larger social entities and for engaging the public in environmental decision-making. Initiatives to change behavior should generally be analyzed in terms of their technical potential, behavioral plasticity, and feasibility (Nielsen, Stern, et al., 2020). These factors together determine the impact of initiatives on GHG emissions, as initiatives

can only approach their technical potential to the extent they reduce behavioral, social, and political barriers to adoption and successful implementation (Nielsen et al., 2023).

Fourth, *behavioral science needs to diversify and augment its methodological toolbox*. Realizing Recommendations 1-3 and maximizing the quality of research on individual climate behavior requires methodological diversity and measures with high behavior validity (Nielsen et al., 2023). Indeed, multiple methods and triangulation across methods – including qualitative and quantitative, observational and experimental – are essential for developing robust and nuanced evidence specific to particular individuals, behaviors, and contexts. As much of behavioral science relies on self-reports of past behavior or behavioral proxies (e.g., intentions, personal norms, or willingness to change), GOAL-SUSTAIN played a crucial role in augmenting said methodological toolbox (Berger & Wyss, 2021). Studies using self-reported behavior or behavioral proxies can provide important starting points for identifying and understanding determinants of behavior. However, they have important limitations and can be biased, inaccurate, and disconnected from actual behavior and climate impact (Lange, 2022; Lange et al., 2023; Lange & Dewitte, 2019).

Fifth, *behavioral science should increase attention to issues of heterogeneity, generalizability, context specificity, and robustness in interpreting research findings*. Behavioral science has overwhelmingly studied populations in North America and Europe (Ghai, 2021; Henrich et al., 2010), and university curricula reflect this lack of global breadth, as we noted in Nielsen et al. (2023). Even within these countries, sample designs and sample sizes are seldom large and diverse enough to explore the intersections of factors like gender identity, race/ethnicity, political contexts, and social class that influence socioeconomic status and create structural constraints on individual climate behavior. Within GOAL-SUSTAIN, several mitigation measures were proposed and executed, such as large-scale observational field studies in Switzerland and beyond, or international Many Labs collaborations.

Finally, and sixth, most contemporary behavioral scientists employ a deductive approach to testing and applying theories to study individual climate behavior. Research following this approach has made important contributions to the understanding of behavior and how to change it, but sometimes the strong focus on theory testing has interfered with the ambition to study the most impactful climate-relevant behaviors and their most impactful determinants (Nielsen, Cologna, et al., 2021, but see van Valkengoed et al., 2022). When theory testing is the main study objective, researchers are incentivized to choose measures, behaviors, and research settings that are conducive to finding effects(Lange et al., 2021). Researchers rarely put theories to the strongest test possible to identify boundary conditions. As a result, infrequent and difficult-to-observe high-impact behaviors (e.g., those performed by individuals in non-consumer roles) are overlooked. We therefore recommend that researchers also include *more descriptive and inductive research approaches*.

## 3.4 Critical examination of the findings

In terms of the laboratory work package, the newly established behavioral task (“Carbon Emission Task”, CET; Berger & Wyss, 2021) has high internal reliability as higher amounts of pollution or financial incentives monotonically affect behavior of respondents. Like any other task tapping into valuation of goods, the CET, however, does not necessarily provide an accurate understanding about the absolute, objective, and stable level of an individual's willingness-to-pay for the avoidance of an environmental externality. Criticisms may stem from two areas in particular. First, a lot of research has addressed the reference-dependence of human judgment and decision-making, suggesting that humans evaluate prospects both relatively and absolutely (Kahneman & Tversky, 1979; Koszegi & Rabin, 2006). Although behavior is sometimes internally consistent, it can be shifted in absolute terms by seemingly irrelevant factors, such as anchoring effects (Ariely et al., 2003). Thus, although higher amounts of pollution may decrease the probability of behaviors directed at short-term financial benefits within a series of CET trials, our research published in Berger and Bregulla (2023) suggests that behavior can be scope insensitive.

Second, the Carbon Emission Task pitches environmental benefits against personal, financial benefits. Although there is a strong consensus that mitigating climate change is costly, not all of these costs are necessarily financial. For example, the PEBT (Lange et al., 2018) uses saved time as a non-monetary short-term motive potentially at odds with people's motive to behave environmentally friendly, for example going out of one's way to recycle (Andersson & von Borgstede, 2010). Yet, other pro-environmental behaviors may save some money (e.g., taking a shorter shower, Tiefenbeck et al., 2019; taking a bike instead of a car on a rainy day, Nankervis, 1999), but they generally require some degree of foregoing an immediate hedonic benefit. Whereas the CET captures a simple money-environment tradeoff, it is not designed to investigate behaviors with such co-benefits in detail.

Relatedly, CET behavior will not necessarily capture pro-environmental behaviors that take the form of long-term investments that serve both the environment and a decision-maker's finance. Such situations emerge especially when government subsidies are set into place to create financial incentives to act more pro-environmentally friendly. For example, investments into clean energy, adoption of electric vehicles and other forms of investment behaviors may qualify as pro-environmental while still leading to better financial outcomes in the long term. This form of pro-environmental behavior is likely better captured by economic games focusing on patience and time-preference (Andreoni et al., 2015).

Finally, our results reported in Berger et al. (2023) display lack of such cost-sensitive behavior in the context of actual behavior in a real market. While we do find cost-sensitive behavior in laboratory experiments, we do not observe strong positive willingness-to-pay in the domain of airline offsets. This underscores the necessity to combine laboratory and field work, in order to derive policy-recommendation.

In terms of the field work more generally, we find that results are sometimes very context specific. While we do find positive willingness to engage in pro-environmental behavior in a choice architecture that is conducive to it (Berger, Kilchenmann, Lenz, Ockenfels, et al., 2022), we find almost no pro-environmental behavior in a choice architecture that is not optimal to promote pro-environmental behavior (Berger, Kilchenmann, Lenz, & Schlöder, 2022). Previously determined choice architecture findings (e.g., defaulting energy customers into opt-out green tariffs) proved highly robust (Bregulla et al., 2023). This necessitates a more context-sensitive approach to understanding behavior. Behavioral science may produce results that are highly context-sensitive, a point which we elaborate on in the policy recommendations below.

# 4 Conclusions and policy recommendations

Based on the concrete project results highlighted above, we infer the following conclusions and policy recommendations. These conclusions are grounded in several of the original research results produced throughout the grant (Berger, Ebeling, et al., 2022; Berger, Kilchenmann, Lenz, Ockenfels, et al., 2022; Berger, Kilchenmann, Lenz, & Schlöder, 2022; Berger et al., 2023; Berger & Wyss, 2021; Lange et al., 2023; Mathieu et al., 2023; Wyss et al., 2022) as well as work currently still in the editorial process, and the broader literature.

The integration of psychological theories, particularly self-control, into environmental problem-solving is most effective when approached at multiple levels (Hofmann, 2023; Wyss et al., 2022). Traditionally viewed as an individual struggle, self-control is now understood within a broader context, involving interactions between individuals and their environments. This shift calls for a comprehensive multilevel approach, considering micro-, meso-, and macro-level analyses (Hofmann, 2023). Routinely, the microenvironments individuals inhabit are shaped by various actors at different levels, impacting the availability, affordability, and normativeness of choices (Creutzig, Niamir, et al., 2022; Hofmann, 2023; IPCC, 2022b). A multilevel perspective on self-control can identify structural barriers to behavior change, offering insights for public policymaking. This approach also highlights unexplored issues related to agency, power dynamics, and the role of public policy support in altering systems that capitalize on self-control 'failures.'

In the realm of behavioral science, transdisciplinarity in fieldwork is crucial for tailoring solutions to local contexts and gaining high acceptance. Acknowledging that much behavioral science work relies on proxies and short-term analyses (Bergquist et al., 2023; Composto & Weber, 2022; Jachimowicz et al., 2019; Mertens et al., 2022; Nisa et al., 2019), prioritizing field studies is recommended for better policy prescriptions (Berger, Kilchenmann, Lenz, & Schlöder, 2022; Bergquist et al., 2023; Haushofer & Metcalf, 2020). Recognizing the diversity of behavioral challenges across different contexts, a collaborative process involving policymakers and behavioral scientists ensures tailored interventions

that address specific nuances (Berger et al., 2023). Emphasizing the importance of local knowledge enriches policy formulation and fosters community ownership and acceptance of interventions (Creutzig, Roy, et al., 2022; Jenny & Betsch, 2022; Steg, 2023).

Furthermore, adopting established behavioral science frameworks is encouraged for prospective behavioral interventions (Creutzig, Niamir, et al., 2022; Nielsen, Stern, et al., 2020b; van Valkengoed et al., 2022). Standardized feasibility analyses, drawing from existing frameworks in behavioral science and climate change mitigation research, help prioritize impactful interventions. For instance, a tripartite framework involving technical potential, initiative feasibility, and behavioral plasticity can guide the order of testing interventions based on overall demand reduction potential (Nielsen, Stern, et al., 2020b). This approach ensures that the most impactful interventions are implemented first, optimizing the effectiveness of behavioral solutions.

We summarize three central policy recommendations in **Policy Box 6**.

**Policy Box 6: Policy recommendations derived from GOAL-SUSTAIN**

**1) The contribution of self-control and other psychological theories to environmental problems is best harnessed in a multi-level context, embedding individual and structural level variables through an analysis at the micro-, meso-, and macrolevel.**

While research on self-control has traditionally understood it as an individual struggle, the current understanding of self-control surpasses this individual level and embeds self-control in a more holistic context (Hofmann, 2023). Historically, self-control has often been characterized as an intrapersonal mechanism, personality trait, temperament, or cognitive ability. However, this individual-centric perspective is increasingly being challenged by better descriptions of reality that acknowledge person–environment transactions (Chater & Loewenstein, 2023; Hofmann, 2023; Wyss et al., 2022). Various actors – including the self – but also companies, the state and other organizations actively participate in strategically selecting and shaping environments that increase or decrease self-control success. This, in turn, necessitates a more comprehensive multilevel approach. Microenvironments are influenced by various agents at the micro, meso, and macro (system) levels of analysis (Hofmann, 2023). These agents impact the availability, salience, proximity, affordability, and normativeness of various choice options. A multilevel perspective on self-control can reveal structural barriers to behavior change and, consequently, provide entry points for public policy-making. A policy goal could be to reduce self-control need, and thereby help align people's preference and behavior. Moreover, adopting a multilevel approach brings to light unexplored issues related to agency, power dynamics, and the awareness of behavior being shaped. It also highlights the potentially significant role of public policy support and collective action in altering systems that take advantage of self-control 'failures' (Hofmann, 2023). This shift in perspective encourages a more nuanced understanding of self-control, recognizing its embeddedness in broader environmental contexts.

**2) Transdisciplinarity in field work is essential to adopt behavioral science solutions to local contexts and to gain high acceptance in the population.**

While the potential of behavioral science is widely acknowledged (Andor & Fels, 2018; Berger et al., 2023; Clayton et al., 2015; Composto & Weber, 2022; Creutzig et al., 2018; Creutzig, Roy, et al., 2022; Fesenfeld et al., 2022; Geiger et al., 2017; Jachimowicz et al., 2019; Mertens et al., 2022; Nisa et al., 2019; van Valkengoed et al., 2022). much work in the domain of behavioral science stems from work that does not address actual behavior, but often relies on behavioral proxies, short-term analysis, and limited external validity (Lange et al., 2023; Lange & Dewitte, 2019; Nisa et al., 2019). We therefore recommend recognizing and prioritizing the significance of (behavioral) fieldwork in behavioral science research that ultimately leads to better policy prescriptions. Field studies provide real-world insights, bridging the gap between theoretical frameworks and the practical complexities of human behavior.

Furthermore, the diversity of behavioral challenges across different contexts routinely requires that policy makers steer away from one-size-fits-all solutions in favor of tailored interventions. We therefore advocate for a collaborative process involving policymakers and behavioral scientists to conduct thorough contextual analyses. This ensures that policy solutions are finely tuned to address specific behavioral nuances, increasing the probability of successful implementation and impact.

This approach emphasizes the vital role of local knowledge in shaping effective policies. Local insights provide an in-depth understanding of community dynamics, cultural influences, and existing behavioral patterns not evident through traditional research methods. It remains often unclear in how far published behavioral science results translate to various social and cultural contexts. Fostering partnerships between policymakers, behavioral scientists, and community leaders enriches policy formulation but also fosters community ownership and acceptance of interventions (Brandt et al., 2013; Lawrence et al., 2022).

**3) It is important to rely on established behavioral science framework wherever possible.**

We suggest that standardized feasibility analyses should precede prospective behavioral interventions. This approach can follow existing frameworks adopted from behavioral science and climate change mitigation research. For example, Nielsen et al. (2020) suggest a tripartite framework that involves technical potential, initiative feasibility, and behavioral plasticity. Technical potential refers to the maximum energy demand reduction if the opportunity is fully realized. Initiative feasibility

refers to the likelihood that a change agent will adopt and implement the initiative. Behavioral plasticity measures the extent to which the target of a mitigation initiative, as implemented, responds to it as intended. By using this or other frameworks (Creutzig et al., 2018, 2018; van Valkengoed et al., 2022), the most impactful prospective behavioral interventions are fielded first, and the order of testing follows the overall demand reduction potential.

# 5 Outlook and next steps

Within the scope of the GOAL-SUSTAIN project, we sought to deliver research results that help strengthen the contribution of behavioral science to mitigating the existential threat of climate change (Nielsen et al., 2023). The window for avoiding catastrophic climate change and realizing the necessary societal changes is rapidly closing (IPCC, 2022), requiring that science continuously keeps an “eye on the prize”. This means making behavioral science research directly useful for and accessible to citizens, policy makers, organizational decision makers, other scientific disciplines, and other change agents (Nielsen et al., 2023). Doing this requires a profound understanding of how decisions are made and what factors and stakeholders influence them. Thereby, a key part of GOAL-SUSTAIN was an improved assessment of behavior compared to self-reported measures (Berger & Wyss, 2021; Lange et al., 2023) The proposed recommendations based on Nielsen et al. (2023, see above) need not undermine efforts to advance theory development and can improve understanding of human behavior. In fact, embracing heterogeneity and context-specificity will strengthen theorizing and research on mechanisms of change, which in turn can improve intervention development. Thereby, a key next step is to strengthen fundamental research in pro-environmental behavior, in order to provide a more robust understanding of the phenomena associated with climate-friendly behavior.

The six recommendations made in Nielsen et al., (2023) reflect a vision for the future of research on individual climate behavior. This vision should materialize in a robust, integrative, and policy-relevant research program on the behavioral dimensions of climate change mitigation. Critical to our vision are more coordinated and effective research priorities, resource allocation, and evidence curation, as well as closer collaboration with other scientific communities and practitioners. This will aid the application of behavioral insights toward complementing and increasing the impact of technological and policy initiatives, such as by advancing their adoption and diffusion (Nielsen, van der Linden, et al., 2020b; Stern et al., 2010; Vandenbergh & Gilligan, 2017). One way to facilitate this collaboration is to establish better formal structures (e.g., committees, scientific bodies) that collate and synthesize evidence from behavioral science and directly feed into larger scientific collaborations around climate change mitigation (e.g., the IPCC). Research funders can also prioritize work that integrates consideration of technical potential with analyses of initiative feasibility and behavioral plasticity (Nielsen et al., 2023).

Achieving this vision requires overcoming various challenges within and outside the academic system. For example, solutions-focused and interdisciplinary research is not always valued and rewarded in disciplinary behavioral science departments (Unknown, 2021). Developing effective interdisciplinary teams can also be challenging, even with helpful reflections on and insights from past experiences (De Bruin & Granger, 2019; Kelly & al, 2019). Journals and funding bodies can better support exploratory, inductive, context-specific, and multi-method research to complement the prevailing preference for deductive theory and experimental methods (Nielsen, Cologna, et al., 2021). This together poses risks and barriers to some researchers. However, especially well-established researchers can become agents of change and work towards addressing such barriers (e.g., as employers, editors, members of hiring committees, or reviewers of funding applications, Nielsen et al., 2023).

Some policy recommendations made here also imply more ambitious research projects whose feasibility will depend on time, data, and funding availability. For example, public institutions and private companies are often gatekeepers to accessing rich behavioral data and should therefore invite and more closely collaborate with behavioral scientists to transparently study individual climate behavior, as has been done throughout the GOAL-SUSTAIN project (Berger, Ebeling, et al., 2022; Berger, Kilchenmann, Lenz, Ockenfels, et al., 2022). The behavioral and social sciences currently receive only a fraction of the funding allocated to researching climate change mitigation (Overland & Sovacool, 2020), which constrains the possibilities. A substantial increase in funding should be justified for the associated opportunity costs. Importantly, an improved research program on individual climate behavior can also have synergistic effects on broader climate change mitigation objectives, many of which are deeply dependent on human behavior (Mathieu et al., 2023). This includes the diffusion of low-carbon technologies, the implementation of climate policies, the reformation of organizational strategies and cultures, and transitioning to alternative economic and work paradigms. Behavioral insights can similarly aid the improvement of other important research programs around climate change mitigation, such as better capturing the use phase in life cycle assessment (Pohl et al., 2022; Polizzi di Sorrentino et al., 2016; Saner et al., 2013; Sohn et al., 2021) or more accurately representing human responses in integrated assessment models (Beckage & al, 2018; McCollum & al, 2017; Moore & al, 2022; Nielsen, Stern, et al., 2020b).

# 6 National and international cooperation

GOAL-SUSTAIN was embedded into several pre-existing (inter-)national research collaborations and novel research collaborations were formed in an effort to deliver critical subparts of the project. Here we only list those collaborations that have resulted in a trajectory of scientific publications, and that are closely tied to the project.

***National collaborations:***

A key national collaboration of GOAL-SUSTAIN was done with the Department of Social Neuroscience and Social Psychology of the University of Bern (Chair: ***Prof. Dr. Daria Knoch***). The collaboration has resulted in multiple project-relevant publications (see below for scientific output). The collaboration centered around work on behavioral tasks and the role of self-control in decision-making.

Another critical collaboration was entertained with BKW Energie AG. It was crucial to deliver important project outcomes, most importantly studies on external validity of environmental tasks as well as related field studies. Together with their consumer experience and survey team (main contact: ***Patrick Röösli***), we realized our field study and our lab-in-the-field study.

More broadly, the project was embedded into the activities of the ***Swiss Social Science & Humanities Energy Group*** (SSH Energy), which is also partly supported by the Swiss Federal Office of Energy. The workshops of the SSH Energy Group were used to disseminate the project results scientifically and to enable networking within Switzerland. As part of the group, doctoral students were allowed to show their work and receive critical feedback. As several doctoral students were funded through SFOE programs, the workshop also facilitated networking between these students and their projects. The group has helped to embed our specific research results within the greater context of social science and humanities and their role in the energy transition.

In addition to collaborations within the SSH Energy Group, the project benefited from several other national research collaborations, evidenced by ***invited lectures*** delivered by Sebastian Berger at several Swiss universities. These include ***ETH Zürich*** (host: joint Master Program in Climate Science with the University of Bern), the ***University of Geneva*** (host: Prof. Dr. Tobias Brosch), and the ***University of Basel*** (host: Prof. Dr. Ulf Hahnel).

***International collaborations:***

International collaborations have been a cornerstone of the project and several international collaborations were key in delivering relevant project milestones.

First and foremost, the project involved joined research between the Bern team of GOAL-SUSTAIN and the chair of ***Prof. Dr. Andreas Löschel*** (formerly University of Münster, now Ruhr-Universität Bochum), particularly ***Dr. Christoph Feldhaus***. The research projects of the Bochum research group have several synergies, which we leveraged for GOAL-SUSTAIN. These include the START project (funded by the BMBF and the Australian government, project number: 03EK3046C), the Virtual Institute Smart Energy (VISE, funded by the European Regional Development Fund EU ERDF, project number: ERDF-0600038 34.02.10.09-005), PENNY (EU-Horizon, together with ETH-Z, Co-PI: Massimo Filippini), and NOSTA-

CLIMATE (funded by the BMBF, jointly with the Centre for European Economic Research ZEW, project number: 01LA1813E).

Noteworthy, the project involved an international workshop "Current Trends in Environmental Behavioral Science" hosted at the University of Bern in September 2022 by Sebastian Berger. The topic of the workshop was the role of behavioral science and environmental psychology in terms of climate change mitigation and the energy transition. The workshop consisted of several work meetings and was appended by outreach events to transmit workshop- and project-related knowledge into the Bernese research community.

Participants of the workshop were internationally renowned behavioral scientists and environmental psychologists, who have been globally recruited and invited to the University of Bern. The goal of the project was to come up with recommendations for the effective use of behavioral science in the energy transition and to help address climate change. These recommendations were detailed in the ***Results*** section of this report, and form the basis of a joint paper (Nielsen et al., 2023).

Participants included: ***Prof. Dr. Jan Bauer*** (Copenhagen Business School, DK), ***Prof. Dr. Cameron Brick*** (University of Amsterdam, NL), ***Dr. Viktoria Cologna*** (Harvard University, USA), ***Dr. Kim Doell*** (New York University, USA, since then moved to University of Vienna, AU), ***Dr. Charlotte Kukowski*** (Cambridge University, UK), ***Prof. Dr. Kristian Nielsen*** (Cambridge University, UK, since then moved to Copenhagen Business School, DK), ***Prof. Dr. Ulf Hahnel*** (University of Basel, CH), ***Prof. Dr. Laura Henn*** (University of Kassel, DE, since then moved to University of Hildesheim, DE), ***Dr. Florian Lange*** (KU Leuven, BE), ***Prof. Dr. Kim Wolske*** (University of Chicago, USA).

Another international collaboration was the ***Many Labs Climate***, led by ***Prof. Dr. Madalina Vlasceanu*** and ***Prof. Dr. Jay van Bavel*** (both New York University, USA) and ***Dr. Kim Doell*** (University of Vienna, AU), together with a team of ***200+ scientists*** around the globe. In this global megastudy, we crowdsourced interventions previously found to stimulate pro-environmental behavior from behavioral science experts. We then tested these interventions in a global sample spanning 60 countries and about 57’000 experimental participants (as outlined above and referenced below).

Another key international collaboration was the ***Many Labs Trust in Science and Science-Related Populism (TISP)***, led by ***Dr. Viktoria Cologna*** (Harvard University, USA) and ***Dr. Niels Mede*** (University of Zürich, CH). ***TISP*** involved a global data collection on several variables also related to environmental psychology (see below for references). Additional core research team members are: ***Prof. Dr. John Besley*** (Michigan State University), ***Prof. Dr. Cameron Brick*** (University of Amsterdam, NL), ***Dr. Marina Joubert*** (Stellenbosch University, SA), ***Prof. Dr. Naomi Oreskes*** (Harvard University, USA), ***Prof. Dr. Ed Maibach*** (George Mason University, USA), ***Prof. Dr. Sabina Mihelj*** (Loughborough University, UK), ***Prof. Dr. Mike Schäfer*** (Universität Zürich, CH), and ***Prof. Dr. Sander van der Linden*** (Cambridge University, UK).

Next, during the project duration, we additionally hosted several ***international visiting scholars*** to help work on joint projects. ***Dr. Maria Zwicker*** (former PhD student, University of Amsterdam, NL) spent the fall semester of 2022 at the University of Bern to collaborate within GOAL-SUSTAIN. In addition, **Prof. *Dr. Kim Wolkse*** (University of Chicago, USA) spent the fall semester 2023 within the project group, to advise and consult in the domain of our joint research activities. Due to the fruitful exchanges and overall success of the exchange scholar program, future research visits will include other doctoral students from the University of Amsterdam (NL) and other visiting professors will be invited.

Finally, we have formed several ad-hoc collaborations to jointly work on research projects relevant to the grant. Scholars have been recruited to optimally reach synergies in methods and topical experiences. Collaborators include ***Prof. Dr. Axel Ockenfels*** (University of Cologne, DE), ***Prof. Dr. Sander van der Linden*** (Cambridge University, UK), or ***Dr. Georg Zachman*** (Bruegel Brüssel, BE), among others.

# 7 Communication

GOAL-SUSTAIN was accompanied by communication on various levels. Within the framework of science communication, close cooperation was maintained with the communications department of the University of Bern. Publications resulting from the project were all distributed by the media department to press distributors in Switzerland and abroad and attracted media attention. Supporting activities took place via social media platforms (Twitter, LinkedIn, Facebook, Instagram).

The project GOAL-SUSTAIN was presented to the interested public as part of the Sustainability Day of the Bernese universities. The Sustainability Day took place on November 5, 2021. There, the University of Bern, the Bern University of Applied Science and the PH Bern showed in an impressive breadth what they contribute concretely to the UN Sustainable Development Goals - but also where further action is needed. Government Councilor Christine Häsler summarized the task of the universities in the transformation to a sustainable world as follows: "It is crucial that implementation is knowledge-based and purposeful," thus picking up centrally on the rhetoric of the GOAL-SUSTAIN project. The panel was essentially about how to address behavioral patterns of unsustainable lifestyles.

At the beginning of 2022, a panel consisting of Dr. Ann-Kathrin Faust, Deepak Bansal and Dr. Christoph Feldhaus presented the topic "Ways into the energy future: Mastering climate change with science, economy and society" to an interested audience and discussed the implementation of the energy transition. The event was organized as a “IOP trifft Praxis” episode, in which die Institute of Organization and Human Resources Management (IOP) provides crucial outreach to stakeholders from industry, state, and society.

In summer 2022, the workshop "Current Trends in Environmental Behavioral Science" took place at the University of Bern, where an international selection of researchers addressed current issues in environmental behavioral science (see above). Dr. Kristian Nielsen (Cambridge University), Prof. Dr. Cameron Brick (University of Amsterdam), Dr. Kim Doell (then New York University, USA), and Prof. Dr. Kim Wolske (University of Chicago) were panelists of a public discussion on how to use behavioral science in the climate crisis.

In terms of international conferences, the project results were disseminated at the 2023 International Conference on Environmental Psychology (ICEP) in Aarhus, Denmark. Sebastian Berger contributed a scientific talk in the Symposium “Taking Behavioral Costs Seriously” (hosts: Dr. Florian Lange, KU Leuven, BE, and Maximilian Adler, Otto-von-Guericke University Magdeburg, DE). In addition, Sebastian Berger co-hosted a symposium with Dr. Viktoria Cologna (Harvard University, USA) on “Novel approaches in environmental psychology”. The project results were additionally disseminated at the 2023 conference of Division 34 of the American Psychological Association. Finally, projects results were also disseminated at the 2023 conference of the International Society for Justice Research in Munich, Germany.

In order to make the research results available to as broad a professional audience as possible as well as to the interested public, we have made all publications resulting from the project freely available within the framework of Open Access, either through OA publications or through pre-prints on BORIS, the publication platform of the University of Bern.

Finally, the project results were featured in several Swiss media, among them SRF, many newspapers, and in guest pieces in magazines such as Swiss Grid.

# 8 Publications

Publications are most routinely published as open access publications or are freely available via the University of Bern Open Publishing System (boris.unibe.ch). Working papers are available upon request from Sebastian Berger.

**2021**

*Berger, S., & Wyss, A. M. (2021). Measuring pro-environmental behavior using the carbon emission task. Journal of Environmental Psychology, 75, 101613.*

Abstract
The present research introduces the Carbon Emission Task (CET) as a new behavioral paradigm grounded in experimental economics. It assesses consequential pro-environmental behavior in

laboratory, online, or classroom studies. Participants face repeated tradeoffs between financial bonus opportunities paired with real carbon emissions and foregoing such opportunities while staying carbon neutral. In two studies, we find that people react systematically to the incentives set out in the task and that average pro-environmental behavior correlates with related constructs. Higher bonus prospects decrease pro-environmental behavior, whereas higher environmental consequences increase pro-environmental behavior. Average pro-environmental behavior in the CET correlates with environmental attitudes, belief in climate change, and demographic factors such as gender, education, or political orientation. Finally, average pro-environmental behavior in the CET predicts participants' reported carbon footprints and their extraction behavior from a common-resource pool. Taken together, our findings suggest that the CET relates to constructs often used in psychological research, but due to its relationship with experimental economics may help to integrate the two disciplines and synthesize the research efforts. In addition, it opens the door for novel research questions testing behavioral reactions under varying sets of incentives. In sum, the CET offers the research community a fast and efficient tool to assess actual and consequential pro-environmental behavior in a way that appeals to various social scientific disciplines.

Link: https://www.sciencedirect.com/science/article/pii/S0272494421000669

*Berger, S., & Wyss, A. M. (2021). Climate change denial is associated with diminished sensitivity in internalizing environmental externalities. Environmental Research Letters, 16 074018*

Abstract

Despite a strong scientific consensus about the existence of anthropogenic climate change, widespread skepticism in the general population continues to exist. Past research has largely relied on self-reported behaviors or behavioral intentions when investigating downstream 'behavioral' consequences of climate change denial. As a consequence, there remains a large gap in the literature about how belief in climate change interacts with the pursuit of self-interested, environmentally harmful behaviors. To fill that gap, the present research uses a novel, experimental economic paradigm that allows to attach true environmental consequences to laboratory decisions. Based on ~ 56 000 pollution decisions from 2273 participants in more than 30 countries, we find that belief in climate change meaningfully affects decision-making. Our results show that climate change skepticism predicts self-interested choices and showcases that sceptics have an insensitive acceptance of emissions, reaping benefits no matter how large the climate cost are or how small the personal benefits become. Our results thereby contrast existing work relying on self-reports, which underscores the importance of behavioral tasks. We discuss the use of experimental economic paradigms as a crucial innovation tool for psychological research addressing people's willingness to engage in climate action.

Link: https://iopscience.iop.org/article/10.1088/1748-9326/ac08c0

*Wyss, A. M., Berger, S., Baumgartner, T., & Knoch, D. (2021). Reactions to warnings in the climate commons. Journal of Environmental Psychology, 78, 101689.*

Abstract

People receive daily environmental warnings about the risk of reaching critical climate tipping points leading to irreversible consequences. However, little is known about whether such warnings promote behavioral change, or how emotions underlie such responses. Here, we present two preregistered online experiments, in which group members can harvest financial resources from a common pool while risking collective over-exploitation causing an actual environmental externality. We find that warnings are effective and that the self-conscious emotion guilt consistently correlates with (Study 1) and mediates (Study 2) the effect of warnings on sustainable behavioral change. This suggest that warnings, as a lever of experienced guilt, may qualify as an effective strategy to promote cooperation in the climate commons.

Link: https://www.sciencedirect.com/science/article/pii/S0272494421001420

**2022**

*Berger, S., Ebeling, F., Feldhaus, C., Löschel, A., & Wyss, A. M. (2022). What motivates smart meter adoption? Evidence from an experimental advertising campaign in Germany. Energy Research & Social Science, 85, 102357. https://doi.org/10.1016/j.erss.2021.102357*

Abstract

Motivating individuals to engage in transformative behaviors aimed to mitigate the adverse effects of climate change seizes to be a large challenge of environmental social science. In particular, in remains unclear how to best promote the uptake of novel, digital technologies when it comes to efficient energy management. To contribute to this challenge, the present Perspective investigates factors associated with energy customers' interest in smart meters, based on an exploratory pilot field experiment in Germany (n = 4,147 clients of a German energy firm). Specifically, we set up an online field experiment and vary the arguments emphasized towards its actual customers (medium to large customers) that speak in favor of using a smart meter in an advertising campaign initiated by the firm. We find that customers are particularly interested in the technology when they learn that it may enable them to realize savings (as compared to environmental, technological or legal reasons). This result crucially adds to contrary results emphasizing moral (i.e., environmental) motives, suggesting that it may be detrimental to shift focus away from financial motives when promoting digital technologies in the energy market, particular among medium to large consumers of energy.

Link: https://www.sciencedirect.com/science/article/pii/S2214629621004485

*Berger, S., Kilchenmann, A., Lenz, O., Ockenfels, A., Schlöder, F., & Wyss, A. M. (2022). Large but diminishing effects of climate action nudges under rising costs. Nature Human Behaviour, 1–5. https://doi.org/10.1038/s41562-022-01379-7*

Abstract

Behavioural public policy has received broad research attention, particularly in the domain of motivating pro-environmental behaviours. We investigate how far the efficacy of arguably one the most popular behavioural policy tools (green 'default change' nudges) depends on the associated cost. On the basis of a field study involving carbon offsets for over 30,000 flights booked by more than 11,000 airline customers, we show that green defaults have a large effect on voluntary climate action, even when several hundreds of Euros are at stake. The effect fully vanishes only as costs approach approximately €800.

Link: https://www.nature.com/articles/s41562-022-01379-7

*Berger, S., Kilchenmann, A., Lenz, O., & Schlöder, F. (2022). Willingness-to-pay for carbon dioxide offsets: Field evidence on revealed preferences in the aviation industry. Global Environmental Change, 73, 102470. https://doi.org/10.1016/j.gloenvcha.2022.102470*

Abstract

Voluntary offsetting of flight-related emissions is an important cornerstone of passengers' individual efforts to contribute to climate change mitigation. Hence, many scientific studies have tried to assess people's willingness-to-pay to offset their own flight-related carbon emissions. Up-to-date, these studies are overwhelmingly grounded in hypothetical stated-preference approaches, with very limited knowledge about external validity. Here, we report on an observational field study involving a final sample of 63,520 bookings made with a European airline, allowing us to gauge actual willingness-to-pay for carbon dioxide compensation in a revealed-preference approach. Our pre-registered study shows that the median willingness-to-pay to voluntarily offset a ton of carbon dioxide from flight-related emissions is zero, with the mean willingness-to-pay being around 1 EUR. Aggregated voluntary willingness-to-pay thus dramatically falls short of current prices to offset carbon dioxide, for example through the EU-ETS. Our results thereby question the suitability of self-reported, hypothetical assessments of offsetting and raise caution about the effectiveness of offsetting schemes, which currently do not very successfully internalize flight-related cost of emissions.

Link: https://www.sciencedirect.com/science/article/pii/S0959378022000085

*Berger, S., & von Bieberstein, F. (2022). Experiments in sustainability research: Avenues for behavior change in firms and markets. Die Unternehmung, 76(3), 293-297.*

Link: https://www.nomos-elibrary.de/10.5771/0042-059X-2022-3/die-unternehmung-jahrgang-76-2022-heft-3?page=1

*Bregulla, D. (2022). Real-time decision support promotes pro-environmental behavior. Die Unternehmung, 76(3), 298–314.*

Abstract
In this controlled online experiment, I show how a transparent decision support environment promotes people's pro-environmental behavior. Participants complete a validated experimental protocol (i.e., the Carbon Emission Task), where they are asked to trade off financial gains and environmental externalities. In a treatment where participants receive decision support via colored feedback, they engage in more pro-environmental behavior than in a neutral control treatment. Furthermore, pro-environmental values positively correlate with corresponding behavior in both treatments. The data does not support the hypothesis that decision support moderates the relationship between pro-environmental values and pro-environmental behavior, or that the correlation between environmental motivation and behavior is moderated to a lesser extent by self-control under the decision support treatment.

Link: https://www.nomos-elibrary.de/10.5771/0042-059X-2022-3/die-unternehmung-jahrgang-76-2022-heft-3?page=1

*Feldhaus, C., Lingens, J., Löschel, A., & Zunker, G. (2022). Encouraging consumer activity through automatic switching of the electricity contract—A field experiment. Energy Policy, 164, 112855. https://doi.org/10.1016/j.enpol.2022.112855*

Abstract
Consumer behavior in terms of regular searching for and switching between suppliers is key to induce competition in markets and to increase efficiency. In the electricity market, though, we observe very little switching activity. One way to engage consumers may be to automate the choice of the contract. However, little is known about the determinants of consumers' use of automation services. To address this question, we present a stylized model of how households take their decision to enroll into an automation service and, based on that, run a field experiment with about 2600 customers of a German service provider that offers its customers to automatically switch between electricity contracts on their behalf. We provide evidence that arguments derived from our stylized model that aim to increase the take up of the automation service can be ineffective or even have detrimental effects. Thereby, we provide evidence that it might be difficult to realize potential efficiency-gains of a digitized world.

Link: https://www.sciencedirect.com/science/article/pii/S0301421522000805

*Wyss, A. M., Knoch, D., & Berger, S. (2022). When and how pro-environmental attitudes turn into behavior: The role of costs, benefits, and self-control. Journal of Environmental Psychology, 79, 101748. https://doi.org/10.1016/j.jenvp.2021.101748*

Abstract

Despite a strong consensus about humanity's responsibility for climate change, many people fail to behave in line with their pro-environmental attitudes, and the question of how to overcome this environmental attitude-behavior gap remains a puzzle. To address this lacuna, the present research provides further insights into motivational, dispositional, and structural factors underlying pro-environmental behavior. Based on a decision-task with actual environmental consequences (n = 1,536), we show that pro-environmental attitudes are more predictive of pro-environmental behavior when personal costs are low or environmental benefits are high. Importantly, self-control helps people to act in line with their attitudes, suggesting that self-control is a crucial trait for protecting people's long-term pro-environmental goals. We propose that mitigation strategies should take into account the motivational, dispositional, and structural complexity associated with pro-environmental decisions.

Link: https://www.sciencedirect.com/science/article/pii/S0272494421002012

**2023**

*Berger, S., Bregulla, D. (2023). Coherently Arbitrary Pro-Environmental Behavior. Current Research in Ecological and Social Psychology, 4, 100094. https://doi.org/10.1016/j.cresp.2023.100094.*

Abstract

An accurate understanding of pro-environmental behavior is a key research topic within environmental psychology and a prerequisite for an adequate psychological response to environmental issues. In this study, we present an experiment testing the degree to which decision makers' pro-environmental behavior is "coherently arbitrary". Coherent arbitrariness refers to the phenomenon that behavior in experimental models may only appear rational, as if supported by fixed preferences, despite being affected by arbitrary factors unrelated to preferences. Using the Carbon Emission Task, the present research extends this behavioral economic finding to pro-environmental behavior research. We find that (a) objectively identical trade-offs are evaluated substantially differently depending on the relative rather than absolute price level of comparative choices, and (b) biospheric values correlate robustly with behavior across conditions. This result may also help to explain findings documenting a motivation-impact gap in pro-environmental behavior, as people may find it difficult to objectively and globally assess the costs and benefits associated with their choices.

Link: https://www.sciencedirect.com/science/article/pii/S2666622723000072

*Berger, S., Ockenfels, A., & Zachmann, G. (2023). Behavioral science can aid household participation in gas savings. Joule, 7(1), 1-4.*

Abstract/Summary
In this comment, we suggest that the behavioral sciences, when including transdisciplinary and experimental methods, can substantially aid this savings effort. Behavioral scientific energy research—a vibrant area of research between academia, the private sector, and governments since the 1970s—already plays an important role in the policy response to promote demand reduction, as evidenced by various efforts orchestrated by governments and implemented at lower levels (e.g., local energy providers). Indeed, behavioral science as a tool to reduce gas demand is particularly relevant for the mitigation of the current supply crisis.

Link: https://www.sciencedirect.com/science/article/pii/S2542435122006080

*Bregulla, D., Zwicker, M. V., & Berger, S. (2023). Stability of green default adherence in a costly moment of change. Manuscript submitted for publication. https://doi.org/10.31219/osf.io/cbndh*

Abstract
Green energy defaults in tariff choices have received substantial research and practical attention. In this longitudinal field study, we examine their effectiveness in a potential moment of change that can disrupt routine decision-making. Exploiting a merger in the Swiss energy landscape, we test how a novel branding and a price change affect people's adherence to a green energy default. Our central result–based on 143,313 meters (data 2019-2022)–is that defaults are very stable. Of those 120,150 with strict default adherence 2019-2021, 99.4% also stick with the green energy default after the merger. The minority who change largely move to cheaper, more conventional energy tariffs. The findings provide a novel perspective on energy tariff defaults and offer more evidence for their effectiveness. Our results indicate that while percentage-wise large, objectively moderate price changes do not meaningfully impact the effectiveness of defaults.

Link: https://osf.io/cbndh/download

*Brückmann, G., Berger, S., Caviola, H., Hahnel, U. J., Piana, V., Sahakian, M., ... & with the Swiss Social Science and Humanities Energy Research Group. (2023). Towards more impactful energy research: The salient role of social sciences and humanities. PLoS climate, 2(2), e0000132.*

Abstract/Summary
Despite long-standing pleas for interdisciplinarity and a more significant role of social sciences and humanities, energy research (ER) largely remains the remit of hard sciences, such as climatology, physics, and engineering. Contributions of social sciences and humanities (SSH) are routinely separated and rarely considered in discussions about energy strategies. This is particularly problematic because citizens have a role to play in the decarbonization of energy systems through the pursuit of more localized and collective forms of renewable energy production, reduced and more efficient energy usage, and voting for necessary regulatory changes. More generally, social, political, and socio-

technical changes will be needed at every scale to ensure a successful energy transition.

Link: https://journals.plos.org/climate/article?id=10.1371/journal.pclm.0000132

*Lange, F., Berger, S., Byrka, K., Brügger, A., Henn, L., Sparks, A. C., ... & Urban, J. (2023). Beyond self-reports: A call for more behavior in environmental psychology. Journal of Environmental Psychology, 86, 101965.*

Abstract/Summary

When environmental psychologists measure behavior, they can pursue different objectives. They may seek to quantify characteristics of particular behaviors that naturally occur in the life of people, such as the frequency of meat consumption or the time spent in natural environments. Alternatively, researchers may want to measure responses to experimentally arranged situations to study how behavior varies as a function of contextual changes or psychological manipulations. Yet another objective may entail using behavioral information to infer psychological characteristics of persons, such as their environmental attitude or connectedness to nature. In all three cases, behavioral information is commonly obtained from participants' verbal responses to questionnaire items (Lange et al., 2018; Steg & Vlek, 2009). We believe that overreliance on this practice limits the conclusiveness, generalizability, and practical impact of research in environmental psychology. In this letter, we highlight some ways to overcome these limitations.

Link: https://www.sciencedirect.com/science/article/pii/S0272494423000130

*Mathieu, J., Berger, S., Sterl, S., Rai, V., & Rosenow, J. (2023). Pursuing energy security via technologies and human behavior. One Earth, 6(9), 1074-1076.*

Abstract/Summary

Securing an accessible, reliable, and affordable clean-energy future for every home and business remains a crucial sustainability challenge. In a recent Cell Press Forum on Sustainability, a diverse panel of experts assembled to shed light on the connections between renewable energy technologies, human behavior, and energy security. Following the event, the panelists were asked: what and where are the opportunities to leverage technology and human behavior to pursue energy security toward a just renewable energy future?

Link: https://www.sciencedirect.com/science/article/pii/S259033222300355X

*Wyss, A. M., Berger, S., & Knoch, D. (2023). Pro-environmental behavior in a common-resource dilemma: The role of beliefs. Journal of Environmental Psychology, 92, 102160.*

*Abstract:*

Despite the overwhelming scientific evidence about the anthropogenic nature of climate change, a vocal minority continues to spread skepticism. This inhibits pro-environmental action and fosters a false

perception of social reality, leading people to underestimate the pro-environmental intentions and actions of others required to facilitate rapid and deep decarbonization. Previous efforts to address these beliefs through environmental interventions have yielded inconsistent outcomes. In two studies, we jointly examine the role of first-order climate change beliefs and beliefs about others' behavior (Study 1) as well as second-order climate change beliefs (Study 2) in pro-environmental decision-making in controlled laboratory settings. The studies involve a common-resource dilemma – in which a negative environmental externality is triggered depending on the group's collective decision-making. Our findings show that while first-order climate change beliefs weakly predict pro-environmental behavior, second-order climate change beliefs do not correlate with participants' choices when accounting for first-order climate change beliefs. However, beliefs about others' behavior strongly predict people's choices. We discuss the results in terms of the role different types of beliefs play in environmental decision-making.

Link: https://www.sciencedirect.com/science/article/pii/S0272494423002086

**2024**

*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 behavioral science for climate change mitigation. Nature Climate Change, 14(4), 322-330.*

*Abstract:*
Behavioral science has yielded insights about the actions of individuals, particularly as consumers, that affect climate change. Behaviors in other spheres of life remain understudied. In this Perspective, we propose a collaborative research agenda that integrates behavioral science insights across multiple disciplines. To this end, we offer six recommendations for optimizing the quality and impact of research on individual climate behavior. The recommendations are united by a shift towards more solutions-focused research that is directly useful to citizens, policymakers and other change agents. Achieving this vision will require overcoming challenges such as the limited funding for behavioral and social sciences and structural barriers within and beyond the academic system that impede collaborations across disciplines.

*Link: https://www.nature.com/articles/s41558-024-01951-1*

*Berger, S., Hauser, D., Lange, A., & van der Linden, S. (2024). Measuring belief in climate change with a single item. Global Environmental Psychology.*

*Abstract:*

Brief, but psychometrically valid assessments of psychological constructs are increasingly needed to be included in larger psychological and other social scientific studies, such as Many Labs projects or

representative surveys. Here, we provide a novel one-item measure of individual differences in belief in climate change. Based on two studies (N = 913, N = 288) recruited from various global regions, we establish convergent, predictive, and discriminant validity. More specifically, we find that the single-item measure correlates with other constructs measuring belief in climate change and with relevant downstream constructs, among them intentions to engage in pro-environmental behavior, actual consequential behavior, and self-reported everyday behaviors. We therefore conclude that the single item is a suitable instrument to measure belief in climate change when multiple-item assessments are either too costly or otherwise unfeasible.

*Vlasceanu, M., Doell, K. C., Bak-Coleman, J., Grayson, S., Pei, Y., Pronizius, E., Vlasceanu, D., Constantino, S., Goldwert, D., Patel, Y., Chakroff, A., Aglioti, S. M., Alfano, M., Alvarado-Yepez, A. J., Andersen, A., Anseel, F., Apps, M., Asadli, C., et al., & Van Bavel, J. J. (2024). Addressing Climate Change with Behavioral Science: A Global Intervention Tournament in 63 Countries. Science Advances.*

*Abstract:*
Effectively reducing climate change requires dramatic global behavioral-change. Here, we tested 11 expert-crowdsourced behavioral-change interventions on four climate mitigation outcomes: beliefs, policy support, information sharing, and an effortful tree-planting behavioral task. Across 54,658 participants from 60 countries, the interventions' relative effectiveness differed across outcomes: Beliefs were strengthened most by decreasing psychological distance (by 2.1%), policy support was increased most by writing a letter to a future generation member (1.8%), information sharing willingness was stimulated most by inducing negative emotions (10.8%), and no intervention increased the more effortful behavior–several interventions even reduced tree planting contributions. However, the effects of each intervention differed depending on people's initial climate beliefs. These findings suggest that effective interventions must be tailored to audience characteristics and target behaviors.

*Link: https://www.science.org/doi/10.1126/sciadv.adj5778*

*Berger, S., & Wyss, A. (2024). Measuring Environmental Behavior with the Carbon Emission Task: Lessons from our file drawer. Umweltpsychologie.*

*Link to pre-print: https://osf.io/a6pgu/download*

*Hauser, D., & Bregulla, D. (2024). Saving the World Voluntarily: Experimental Evidence of Gain-Loss Framing on Voluntary Pro-Environmental Behavior. Ecological Economics, 226, December 2024, 108344*

Abstract
Empirical research shows that loss framing appears to be a promising tool to promote pro-environmental behavior. However, only a limited amount of experimental research has examined the effect of loss framing on actual behavior. Here, we use a variation of the Work for Environmental Protection Task

(Lange & Dewitte, 2022) to study true voluntary pro-environmental behavior. In an online experiment (N= 897), we find a trend of higher working efforts in the LOSS frame. However, this effect is small and marginally statistically significant. Interestingly, the effect of loss framing is stronger and statistically significant for people with low intrinsic motivation to protect the environment. Together, this suggests tailoring the framing of gain and loss specifically to peoples' environmental values.

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