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# Norms, prices, and commitment: A comprehensive overview of field experiments in the energy domain and treatment effect moderators

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This paper provides a comprehensive overview of field experiments utilizing social norms, commitment and price-based interventions to promote energy conservation, load shifting, and energy efficiency behaviors. Treatment effects reported in the extant literature, as well as the factors that may strengthen or dampen these effects are reviewed. We find that social norm and incentive-based interventions mostly achieve small reductions in energy consumption, and that the effects of commitment-based interventions are essentially zero for the most part. Incentive effects on energy efficiency investments are mostly non-existent, save for a few exceptions. One gap that we identify is the almost complete absence of field experiments leveraging social norms or commitment to promote energy efficiency investments. We discuss a broad range of (mostly under-researched) plausible moderators of the interventions' effects. Crucially, a more careful attention to moderators in future research can highlight instances in which interventions can be effective, notwithstanding their modest or non-existent average treatment effects. Our review offers a starting point in this regard.

## KEYWORDS

energy conservation, energy efficiency, social norms, incentives, commitment, goal setting, interventions, moderators

## Introduction

It has long been theorized that social norms, prices and commitment are important determinants of people's decisions, including in the energy domain. More recently, policy makers and other practitioners are becoming increasingly interested in the possibility of harnessing these factors to promote desirable behaviors on a large scale. These behaviors include energy conservation, load shifting, and the uptake of low-emission technologies such as electric cars and residential solar panels. A widespread adoption of these behaviors represents one of the cornerstones of climate protection policies

(Dietz et al., 2009; Stern et al., 2016; Ivanova et al., 2020). However, while existing laboratory and survey research can serve as a tentative guide for policy makers aiming to implement normative, pecuniary and commitment strategies in policy design, there are clear limitations of these methodologies in terms of internal and/or external validity: most notable is the difficulty of transplanting findings beyond laboratory settings and the commonly used convenience samples (Levitt and List, 2007; Mitchell, 2012; Galizzi and Navarro-Martinez, 2019), the difficulty of drawing causal conclusions from correlational research (Ferraro and Miranda, 2014, 2017; Wichman and Ferraro, 2017), as well as biased responses when behavior is self-reported rather than objectively measured (Kormos and Gifford, 2014; but see Vesely and Klöckner, 2020). All these issues are compounded by more general methodological limitations of much previous research in the social sciences, especially the reliance on small samples, leading to unreliable findings (Stanley et al., 2018). For these and other reasons, researchers in the energy domain are turning to field experiments, a method particularly well-suited for accurate program evaluation and for drawing policy recommendations (Frederiks et al., 2016).

A number of previous meta-analyses focus on the role of social norms (Delmas et al., 2013; Andor et al., 2020a; Buckley, 2020; Nemati and Penn, 2020), prices (Faruqui and Sergici, 2010; Delmas et al., 2013; Labandeira et al., 2017, 2020; Zhu et al., 2018; Buckley, 2020; Nemati and Penn, 2020) and commitment (Andor et al., 2020a) in the energy domain. Here we in part build on these efforts, reflecting their conclusions in our overall evaluation of the field. The present review is nevertheless built on a considerably broader evidence base than any of the previous meta-analyses. We also review the latest research in the area produced since the publication of previous meta-studies. By synthesizing findings from previous meta-analyses, as well as from recent studies, we are able to provide the most comprehensive overview of research on norms, incentives and commitment in the energy domain up to date.

Unlike any of the previous research syntheses, we in addition provide a detailed outline of factors possibly moderating the interventions' effects (i.e., interventions being more or less effective in some contexts or for some target groups). Current research in the energy domain increasingly focuses on the contexts and target group characteristics that may contribute to the interventions' success or failure, as this is of great theoretical but also applied interest (e.g., Andor et al., 2020b). Despite this growing interest, and as our review reveals, research on factors moderating intervention effects specifically in the energy field is still quite limited. To supplement this limited evidence, we discuss moderators that were identified in studies other than field experiments (e.g., in lab experiments) and in studies focusing on pro-environmental and sustainable behaviors more generally and not solely in the energy domain.

Thus, our goal is to evaluate the likely effects of applying three types of interventions (norms, incentives, and

commitment) in the energy behavior domain, as well as discussing possible moderators of the interventions' effects (the latter discussion being based also on the broader literature on sustainable behavior). We deliberately abstain from discussing the manifold and diverse theoretical underpinnings of norm compliance (here the interested reader is referred for example to Cialdini et al., 1990; Bicchieri, 2006; Jacobson et al., 2011), commitment and goal setting (see e.g., Frederick et al., 2002; Locke and Latham, 2002), and incentive effects (see e.g., Camerer and Hogarth, 1999; Bonner and Sprinkle, 2002), as these are not directly relevant to this work's objectives.

*Social norm* interventions are based on providing participants of field experiments with information about the behavior of other people and about the socially acceptable standards of behavior. They have been employed in hundreds of previous field experiments on energy conservation (for seminal contributions see especially Schultz et al., 2007 and Allcott, 2011b). An advantage of norm-based interventions is that they are easily scalable (Allcott, 2011b; Bator et al., 2014) and often fairly cost-effective (Allcott and Rogers, 2014; Gillingham and Tsvetanov, 2018; but see Andor et al., 2020b). Behavioral effects, however, are typically only modest in magnitude, as detailed in Section Overall effectiveness of social norm interventions. We suspect this may be partly due to the treatment interacting with baseline behavior levels (Schultz et al., 2007, 2016) and other factors such as electricity prices (Sudarshan, 2017), decision observability (Vesely and Klöckner, 2018), participants' issue involvement (Göckeritz et al., 2010), group identification (De Dominicis et al., 2019) or political orientation (Costa and Kahn, 2013). We therefore discuss possible boundary conditions and moderators of social norm intervention effects in Section Boundary conditions and moderators of intervention effects.

We further discuss interventions based on providing participants in field experiments with monetary *incentives* (e.g., rebates) or with information on financial implications of their actions (e.g., financial savings that can be achieved by purchasing an energy efficient appliance). It is a standard assumption in economics that incentives shape and constrain people's decisions. Thus, it is not surprising that people can be motivated by financial considerations also in the context of energy-related behaviors, including hybrid and battery electric vehicle adoption (Hardman et al., 2017; Münzel et al., 2019), installation of residential solar panels (Dharshing, 2017; Bollinger et al., 2020), preferences for green electricity (Ek and Söderholm, 2008; Neumann and Mehlkop, 2020), and electricity consumption (Faruqui and Sergici, 2010; Labandeira et al., 2017). We take a closer look at the magnitude of incentive effects reported in previous field experimental studies in Section Effectiveness of incentive-based interventions overall.

In *commitment/goal-setting* interventions, participants are asked to commit to future behaviors or specific behavioral goals that are related to reducing energy consumption. They

have been used, with varying degrees of success, to encourage various sustainable behaviors, including unplugging electrical appliances when not in use (van der Werff et al., 2019), electricity conservation (Pallak and Cummings, 1976; Loock et al., 2013), water conservation (Jaeger and Schultz, 2017), travel mode choice (Matthies et al., 2006), and towel reuse during hotel stays (Baca-Motes et al., 2013; Terrier and Marfaing, 2015). Meta-analyses of experimental studies by Abrahamse and Steg (2013), Lokhorst et al. (2013) and Nisa et al. (2019) indicate that commitment tends to have a positive effect on pro-environmental behavior, but as we show in Section Effectiveness of commitment-based interventions overall, the usefulness of commitment-based strategies in the energy behavior domain appears to be limited.

The focus of our paper is on social norms, incentives and commitment. In selecting these three intervention types, we cover the prime price and non-price intervention approaches in the energy behavior field, while keeping the scope of the review manageable. Specifically, we chose to exclude feedback interventions from our review (the interested reader is referred e.g., to Karlin et al., 2015) and information-based interventions. Additionally, we also chose not to cover interventions that have only been deployed occasionally so far and including them in a review may be premature before additional evidence accumulates (e.g., competition or pro-social incentives, see Alberts et al., 2016; Azarova et al., 2020).

Unlike most previous research syntheses, we pay particularly close attention to potential moderators of the interventions' effects. Moderators are factors that can render the effect of an intervention more or less pronounced (MacKinnon, 2011; Hayes, 2013). For instance, when an intervention motivates behavioral change in one segment of the population (e.g., people above a certain age) but leaves another segment of the population unaffected (e.g., people below a certain age), then the characteristic that defines this population segment (i.e., age) is expected to moderate the intervention's effect.

We deem moderators to be highly relevant from an applied perspective: Suppose a field trial shows an intervention having a small overall effect on energy conservation (a very common outcome, as we shall see in the Results Section). This can mean different things depending on the presence of influential moderators. Assuming that there are no variables moderating the intervention's effect, the intervention has a small effect on all its targets across the board, and as a result, the policy maker may decide to discard it from future programs due to its lack of effectiveness. In a second scenario, let us assume that there is a variable strongly moderating the intervention's effect – e.g., young people do not respond to it at all and older people respond to it strongly. In this second scenario, it makes sense for the policy maker to target subgroups responsive to the treatment in subsequent deployments of the intervention program.

## Methods

### Inclusion criteria

The following criteria were applied to select studies for inclusion in the part of the literature review focusing on the interventions' main effects (i.e., Sections Overall effectiveness of social norm interventions, Effectiveness of incentive-based interventions overall, and Effectiveness of commitment-based interventions overall below):

- (1) The study was a published or unpublished empirical study (e.g., journal article, book chapter, working paper) or a meta-analysis of empirical studies. The full text of the study was accessible through our database subscriptions.
- (2) The method used in the study was either a field experiment or a quantitative meta-analysis of field experimental studies.
- (3a) Among the treatments investigated in the study was at least one of the following: social norms, incentives, commitment.
- (4a) Among the dependent variables was at least one behavior in the energy domain (e.g., energy consumption, adoption of energy efficient appliances).
- (5) If a study was included in one of the meta-analyses covered in the present review, that study itself was not included in the present review in order to minimize bias due to double-counting of effect sizes.

For inclusion of studies in the part of the literature review focusing on moderators of the interventions' effects, we retained the above criterion (1), omitted criteria (2) and (5), and relaxed criteria (3a) and (4a) as follows:<sup>1</sup>

- (3b) Among the (measured or manipulated) independent variables investigated in the study was at least one of the following: social norms, incentives, commitment.
- (4b) Among the dependent variables was at least one pro-environmental behavior (e.g., energy consumption, adoption of energy efficient appliances, recycling).<sup>2</sup>

Finally, to be included in the part of the review focusing on moderators, the study had to:

- (6) Present results for one or more moderators of the effect of one or more of the independent variables norms, incentives, and commitment.

<sup>1</sup> The reason for modifying the inclusion criteria for the sections focusing on moderators was the limited number of studies reporting relevant moderator effects that met the stricter criteria.

<sup>2</sup> Note that naturally we also cite studies unrelated to pro-environmental behavior as part of discussing the main findings.

## Literature search and selection of studies

We located sources potentially relevant for inclusion in our review using three search strategies:

- (1) The first strategy consisted of searching the Web of Science database using a combination of terms such as “norm,” “social comparison” and “field experiment.” The search string is reproduced in [Appendix](#). This way, we located 31,052 potentially relevant sources.
- (2) The second strategy consisted of ancestry and descendancy searches. This yielded 83 additional potentially relevant sources.
- (3) Finally, we included 23 additional potentially relevant papers previously known to the authors.

The search was completed in March 2021. In the next step, we screened the abstracts of all sources located *via* the above search strategies, retaining those that could not be excluded based on the inclusion criteria presented in Section Inclusion criteria. This resulted in a selection of 429 potentially relevant sources. The full texts of these sources were then inspected to determine whether they met our inclusion criteria. Fifty studies met criteria for inclusion in the sections on main effects, 101 studies met criteria for inclusion in the sections on moderator effects, and 26 sources met both sets of criteria.

## Coding of studies

For each source included in the review, we coded the methodology used, the target behavior, the type of intervention, an approximate size of the effect of the intervention (see the next paragraph for details), and whether there were relevant moderator effects.

For the purposes of this report, a change of <5 percent compared to control was considered a “small” effect, a change of 5–10 percent was considered a “medium-sized” effect, and a change of more than 10 percent was considered a “large” effect. Similarly, a change of 40 percent or less of standard deviation compared to control was considered a small effect, a change of 40–80 percent of standard deviation was considered a medium-sized effect, and a change of over 80 percent of standard deviation was considered a large effect. A correlation below |0.2| was considered a small effect, a correlation between |0.2| and |0.4| was considered medium-sized, and a correlation above |0.4| was considered large.

These cut-offs are selected based on established recommendations (e.g., [Cohen, 1988](#)) and taking into account opinions of scholars and practitioners in the energy field. In case an effect reported in a primary study or meta-analysis was statistically indistinguishable from zero, we state that there was “no effect” (rather than that the effect was “small”). Only the direction of the effect is coded when its size cannot be determined from what is reported in the primary study. It

should be noted that it is not always easy to compare the effect size metrics used in the different papers (e.g., percentage change vs. change expressed in standard deviation units). The above interpretation of the quantitative values is therefore only meant to give an approximate sense of the quantitative data, without attempting to precisely compare the effect sizes across studies.

We summarize the methodological framework used in our paper in [Figure 1](#).

## Results

For each intervention, we first present an overview of the results regarding their overall effect, then review possible moderators and boundary conditions of those effects, and conclude by discussing limitations of existing research and directions for future research.

### Social norms interventions

#### Overall effectiveness of social norm interventions

As documented in [Table 1](#), previous social norm field experiments mostly achieved small and often statistically insignificant reductions in energy consumption (e.g., [Delmas et al., 2013](#); [Jachimowicz et al., 2018](#); [Buckley, 2020](#)). However, larger effects were occasionally observed (e.g., [Leoniak and Cwalina, 2019](#); [Brülisauer et al., 2020](#)). Furthermore, observational and survey research suggests the possibility of substantial norm effects on eco-friendly technology adoption ([Graziano and Gillingham, 2015](#); [Barth et al., 2016](#); [Wolske et al., 2017](#); [Bollinger et al., 2022](#)). However, there are almost no field experiments that leverage social norms to promote eco-friendly technology adoption—with the exception of [Beltramo et al. \(2015\)](#), finding no effect of norms on adoption of fuel efficient cook stoves in Uganda, [Bollinger et al. \(2022\)](#), finding no effect of norms on adoption of fuel efficient cook stoves in Mali, [Bollinger et al. \(2020\)](#), finding a large effect on the adoption of residential solar panels), and partly [Holladay et al. \(2019\)](#), finding no effect on energy efficiency investments *via* normative messages promoting home energy audits).

#### Boundary conditions and moderators of intervention effects

To answer the question whether social norm interventions are more effective under select conditions and when specific subgroups are targeted, we provide an overview of possible boundary conditions and moderators of social norm intervention effects proposed and tested in the literature.

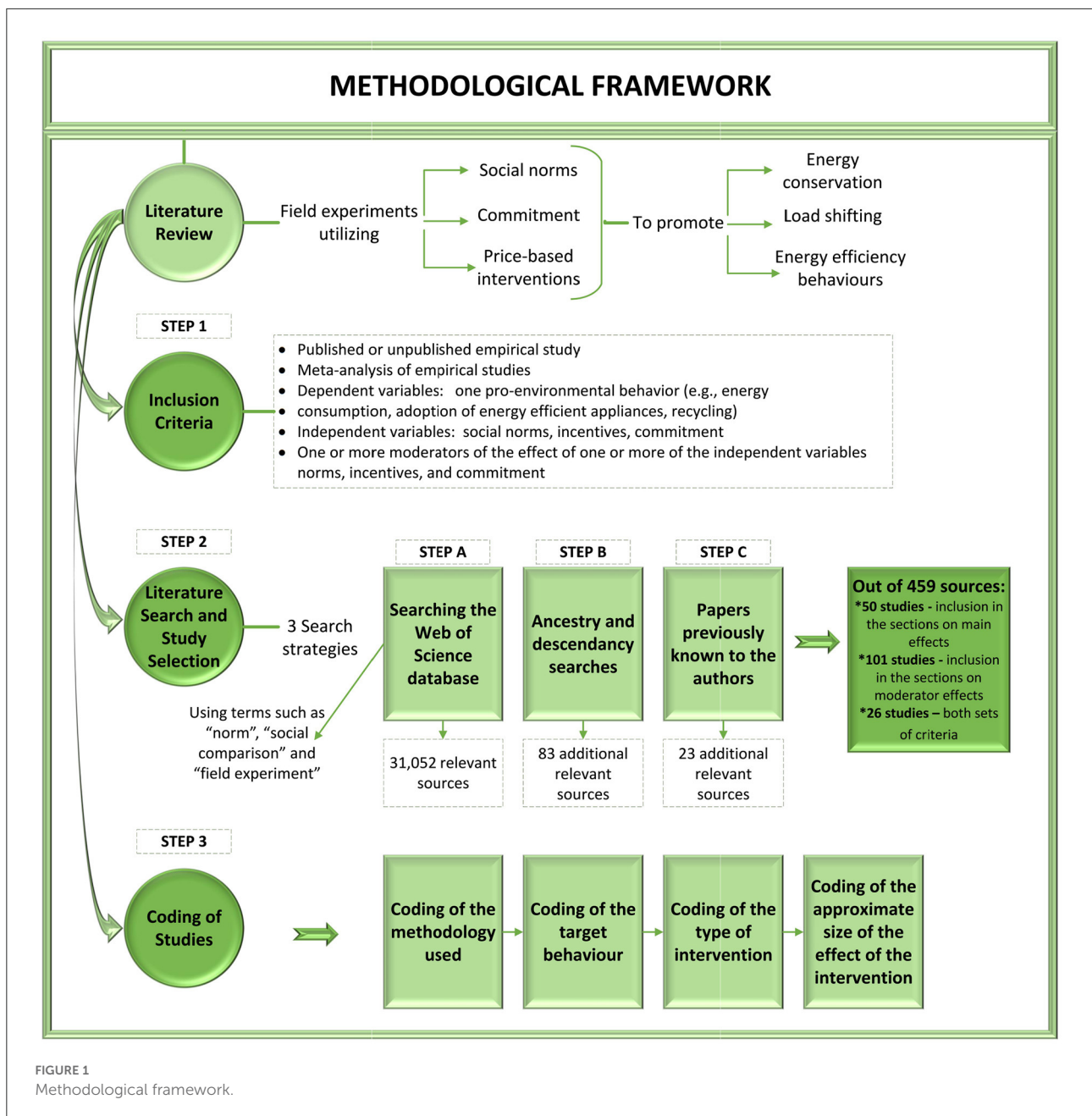


FIGURE 1 Methodological framework.

Here, we emphasize that the evidence base concerning factors modulating the effectiveness of social norms is still limited. Thus, the findings presented below, should be regarded as tentative prior to additional replication efforts (see Maniadis et al., 2014; Allcott, 2015).

We find that there are 14 possible moderators of social norm effects, which we discuss in turn in the following:

(a) Baseline behavior levels. Participants with higher energy consumption at baseline tend to be more responsive to social norm information (e.g., Allcott, 2011b; Ayres et al.,

2013; Ferraro and Price, 2013; Byrne et al., 2018; Andor et al., 2020b; Brülisauer et al., 2020; but see Schultz et al., 2015; Henry et al., 2019). This is especially true when high pre-treatment users also endorse pro-environmental values (Bonan et al., 2019).

(b) Group identification. People who identify with a reference group are more likely to adhere to that group’s norms. For evidence from an energy conservation field experiment, see De Dominicis et al. (2019). Dixon et al. (2015), on the other hand, found no evidence for a moderating effect of group identification in their survey on energy conservation

TABLE 1 Overview of former research—social norms.

Source	Main methodology used	Main target behavior(s)	Effect of social norm confirmed?
Andor et al. (2020a)	Meta-analysis of field experimental studies	Energy conservation	Small decrease in energy consumption
Buckley (2020)	Meta-analysis of field experimental studies	Energy conservation	No effect (meta-regression results, full model specification)
Delmas et al. (2013)	Meta-analysis of field experimental studies	Energy conservation	No effect (meta-regression results, full model specification)
Jachimowicz et al. (2018)	Meta-analysis of field experimental studies	Energy conservation	Small decrease in energy consumption (results for Opower trials)
Andor et al. (2020b)	Field experiment	Energy conservation	Small, marginally significant decrease in energy consumption (the estimate reaches conventional levels of statistical significance in models with outliers removed)
Bator et al. (2019)	Field experiment	Energy conservation	Small short-term and moderate long-term decrease in energy consumption (results for the “feedback” treatment in Study 2)
Beltramo et al. (2015)	Field experiment	Adoption of fuel-efficient cook stoves	No effect
Bogard et al. (2020)	Field experiment	Energy conservation	Moderate decrease to small increase (sic!) in energy consumption (depending on treatment)
Bollinger et al. (2020)	Field experiment	Adoption of residential solar panels	Large increase in installations relative to control (result for the “pro-social” treatment; longer-term post-campaign effects not considered here)
Bonan et al. (2019)	Field experiment	Energy conservation	No effect
Bonan et al. (2021)	Field experiment	Adoption of fuel-efficient cook stoves	No effect
Bonan et al. (2020)	Field experiment	Energy conservation	No effect to small decrease in energy consumption (depending on program duration)
Brandon et al. (2017)	Field experiment	Energy conservation	Small decrease in energy consumption
Brandon et al. (2019)	Field experiment	Energy conservation during peak-load events	Small to moderate decrease in energy consumption (depending on treatment)
Brülsauer et al. (2020)	Field experiment	Energy conservation	Large decrease in energy consumption
Byrne et al. (2018)	Field experiment	Energy conservation	No effect
Caballero and DellaValle (2021)	Field experiment	Energy conservation	Mixed results depending on model specification (no effect in the model without controls; moderate decrease in consumption in the model with psycho-social controls; large increase in consumption in the model with household and demographic controls)
Charlier et al. (2021)	Field experiment	Energy conservation	No effect
Crago et al. (2020)	Field experiment	Energy conservation	No effect
Henry et al. (2019)	Field experiment	Energy conservation	Small decrease in energy consumption
Holladay et al. (2019)	Field experiment	Takeup of home energy audits	No effect (result for social comparisons in terms of CO <sub>2</sub> emissions) Large increase in audit uptake (results for social comparisons in terms of energy consumption and in terms of energy consumption expenditures)
		Investment in home energy efficiency improvements	No effect
Kácha and Ruggeri (2019)	Field experiment	Energy conservation	No effect
Kandul et al. (2020)	Field experiment	Energy conservation	Small decrease in temperature setting
Komatsu and Nishio (2015)	Field experiment	Motivation to conserve energy	No effect to small increase in motivation compared to control (depending on the type of normative message used)

(Continued)

TABLE 1 (Continued)

Source	Main methodology used	Main target behavior(s)	Effect of social norm confirmed?
Leoniak and Cwalina (2019)	Field experiment	Switching off unused lights	Large increase in light switching (main effect of the injunctive norm sign compared to request only in Studies 1 and 2) No effect (main effect of the descriptive norm sign compared to request only in Studies 1 and 2)
List et al. (2017)	Field experiment	Energy conservation	Small decrease in energy consumption
Liu et al. (2016)	Field experiment	Signing a petition to adjust a public building's thermostat to save energy	Moderate increase in likelihood of signing the petition
Mi et al. (2020a)	Field experiment	Energy conservation	No effect (result for the "normative information" condition)
Mi et al. (2020b)	Field experiment	Energy conservation	Large decrease in energy consumption (result for groups with comparative feedback)
Murakami et al. (2022)	Field experiment	Energy conservation during peak-demand hours	No effect
Myers and Souza (2020)	Field experiment	Energy conservation	No effect
Ojima et al. (2019)	Field experiment	Energy conservation	No effect (compared to a feedback only condition)
Pellerano et al. (2017)	Field experiment	Energy conservation	Small decrease in energy consumption
Wong-Parodi et al. (2019)	Field experiment	Energy conservation	Large decrease in energy consumption

in the workplace. Thus, while the notion of an interaction between group norms and group identification is relatively uncontroversial in other sustainability domains (Terry et al., 1999; Fielding et al., 2008; White et al., 2009; Masson and Fritsche, 2014; Bertoldo and Castro, 2016; for related evidence on the role of "self-construal" see White and Simpson, 2013), only tenuous support for this hypothesis currently exists in the context of performing energy-related behaviors.

- (c) Proximity of the norm source. Existing research indicates that proximity of the norm source (the reference group) matters for norm-compliance in the context of energy and resource conservation (Goldstein et al., 2008; Loock et al., 2012; Shen et al., 2016) and eco-friendly technology adoption (Graziano and Gillingham, 2015; Barth et al., 2016; Bonan et al., 2021; Bollinger et al., 2022). At least up to a point, greater proximity of the reference group seems to be associated with its greater normative influence (but see Mertens and Schultz, 2021). Among the reasons for a greater influence of (relatively) proximal reference groups could be that people are more aware of them (Bollinger et al., 2022), that the conduct of these groups provides cues that seem more pertinent to the decision maker's own situation (Goldstein et al., 2008; Passafaro et al., 2019) or that the decision maker identifies with these groups (Agerström et al., 2016).
- (d) Subjective social norms. Participants with strong subjective social norms for energy conservation at baseline are more responsive to normative interventions (Anderson et al., 2017).
- (e) Personal norms. Participants holding strong personal pro-environmental norms are less susceptible to social norms conveyed *via* interventions (Schultz et al., 2016; but see Wan et al., 2017).
- (f) Issue involvement. Somewhat similar to the previous case, participants exhibiting greater personal involvement in conservation issues are less responsive to social norms (Göckeritz et al., 2010; see also Lapinski et al., 2017).
- (g) Environmental concern. Environmental concern does not seem to reliably predict how people respond to normative peer influence (Moons and De Pelsmacker, 2012, 2015; Delmas and Lessem, 2014). Results reported in Ek and Söderholm (2008), however, suggest that people scoring high on environmental concern may be more receptive to social norms in the context of purchasing electricity from renewable sources.
- (h) Innovativeness. Innovative individuals do not seem to differ from others in their willingness to align their behavior with perceived normative expectations of their peers (Moons and De Pelsmacker, 2015; Lundheim et al., 2021).
- (i) Altruism. Delmas and Lessem (2014) report that conformity with energy saving norms is generally not affected by one's altruism.
- (j) Decision observability. People can become more norm compliant when their decisions are publicly observable—see Vesely and Klöckner (2018) for an experiment on donations to environmental organizations, and Babutsidze and Chai (2018) for a correlational study focusing on a range of pro-environmental behaviors. However, this effect was not confirmed in the context of investments

in renewable energy (Vesely et al., 2022). More broadly, Nemati and Penn (2020) report that when behavior was publicly observable, information-based interventions (including, but not limited to, norm-based interventions) had more pronounced effects on electricity conservation.

- (k) Behavior difficulty and other costs. Sudarshan (2017) report that an intervention utilizing normative feedback led to reduced consumption of cheap grid electricity, but not of more expensive electricity generated from a backup diesel source. Thus, when prices were high, norms seemed powerless to motivate energy conservation.

Andersson and von Borgstede (2010), on the other hand, found that while perceived social norms influenced both low-cost and high-cost waste recycling behaviors in households, normative influences were more pronounced in the latter. In another study on household recycling, however, Hage et al. (2009) found no evidence for an interaction between perceived social norms and a proxy for behavior difficulty, namely the access to nearby waste collection points.

Taken together, these findings suggest that normative influences can be relatively ineffective both when behavior costs are high and when they are low, but do not offer clear answers as to when to expect which. More research in this area is needed, especially in the context of energy-related decisions.

- (l) Cultural context. Analyses reported by Bergquist et al. (2019) suggest that people in more individualistic countries (e.g., many European countries) may be more responsive to pro-environmental social norms than people in collectivistic countries (e.g., many Asian countries, see Hofstede et al., 2010). However, this finding should be interpreted with caution, as it is based on a meta-analysis across studies with design differences, which were not taken into account in the analysis. A counter-example can be found in a questionnaire study by Eom et al. (2016), where social norms predicted intention to purchase eco-friendly products in participants from a highly collectivist country (Japan), but not in participants from a highly individualistic country (the US).

Cultural differences (broadly speaking) exist within nations as well—some suggestive evidence on how these can impact the effectiveness of norm-based interventions is provided by Gillingham and Tsvetanov (2018). They detected a substantially greater effect of their intervention, designed to promote the uptake of home energy audits, in rural compared to urban areas (but see Loock et al., 2012 reporting comparable norm effects in urban and rural areas).

- (m) Perceived social norms appear to shape moral obligation to engage in energy conservation and efficiency behaviors only in liberals, but not in conservatives, in the United States (Arpan et al., 2013). Costa and Kahn (2013) report

heterogeneous treatment effects that can be traced back to political ideology, with liberals responding more strongly than conservatives to energy conservation norms. No differences in treatment effects related to the political ideology of the intervention's targets were, however, found in Gillingham and Tsvetanov (2018). Using municipality-level data from Germany, Inhoffen et al. (2019) detected weaker peer effects on solar panel installations in municipalities with larger Green party vote shares (however, this result should be interpreted as suggestive, due to the spatial data aggregation).

## Limitations of existing research and future directions

We see four main areas in which subsequent research can advance our understanding of social norm effects, as well as policy applications of norm-based interventions.

First, it would be beneficial to broaden the scope of targeted behaviors. Previous social norm field experiments focused primarily on low-cost curtailment behaviors, notably on encouraging people to curtail their energy consumption at home and in public spaces (Allcott, 2011b; Bator et al., 2014; Leoniak and Cwalina, 2019) and on other simple low-cost, low-involvement actions like towel reuse (Goldstein et al., 2008; Schultz et al., 2008), tire pressure checks (Yeomans and Herberich, 2014) and closing windows when the heating is on (Ornaghi et al., 2018). Even though a portion of energy use reductions achieved in energy conservation campaigns à la Allcott (2011b) seems to stem from energy efficiency investments, rather than solely from a change in habits (Brandon et al., 2017), promoting household energy efficiency and eco-friendly investments also more directly would be useful.

With the exception of Beltramo et al. (2015), Holladay et al. (2019), Bollinger et al. (2020) and Bonan et al. (2021), we are aware of no previous field experiments using norm-based interventions to motivate high-cost investment decisions in the energy domain, such as purchasing electric cars or solar panels. This contrasts with an abundance of correlational studies on eco-friendly technology adoption (e.g., Korcaj et al., 2015; Barth et al., 2016; Wolske et al., 2017; Noppers et al., 2019). Future field experimental research should devote increased attention to a wider variety of energy-related choices, comprising both curtailment and investment. Motivating such a broader range of high-cost, high-involvement behaviors is essential for achieving ambitious climate change mitigation goals (Dietz et al., 2009; Stern et al., 2016; Bjelle et al., 2018; Ivanova et al., 2020).

Results reported by McCoy and Lyons (2017) even suggest that interventions (in their case, providing feedback via smart meters) successfully targeting energy curtailment may unintentionally inhibit households' investments in energy efficiency, supporting the argument for targeting both investment and curtailment behaviors.



Secondly, replicating promising findings on factors modulating interventions' effects is needed. Previous research suggests that social norm interventions can be particularly effective, for example, when targeting intensive energy users, or those with strong ties to their (norm) reference group, as discussed in Section Boundary conditions and moderators of intervention effects. However, initially promising findings need to be replicated and tested in field conditions.

Third, subsequent research should carefully evaluate possible unintended side effects of normative interventions. One limitation of earlier studies is that the interventions' impact on their targets' emotional wellbeing has been largely neglected. Interventions are typically solely evaluated in terms of their effects on the target behavior, and sometimes in terms of their cost-effectiveness. Evidence on how social norm interventions designed to foster sustainable energy-related behavior affect their targets' emotional wellbeing is sparse and inconclusive. A number of studies suggest that social norm interventions can induce negative emotional states, for example anger (Aronson and O'Leary, 1982-83; Allcott, 2011b; Sussman and Gifford, 2012; Ayres et al., 2013; Costa and Kahn, 2013; Bergquist and Nilsson, 2016), other studies suggest a positive effect on emotions (Delmas and Lessem, 2014; Vesely et al., 2022), and some studies detect no discernible effects or report mixed findings (Toner et al., 2014; Allcott and Kessler, 2019; Leoniak and Cwalina, 2019). Ensuring that customers' and constituents' emotional discomfort does not result from an intervention is vital for companies and policy makers. Such considerations are similarly vital in terms of promoting subsequent sustainable behaviors; in particular, Carrus et al. (2021) specifically support the role of emotions and their strong link with energy-related behaviors and intentions in their meta-analysis of previous research on this topic.

Finally, to understand if social norm interventions work, it is necessary to isolate their unique effects (i.e., effects that can be uniquely attributed to norms and not to other intervention elements). Many "social norm" interventions employed in field experiments on energy conservation combine information on social norms with additional treatment elements. For example, in Allcott (2011b), Ayres et al. (2013), Costa and Kahn (2013) and many other studies, social norm information is augmented with feedback on own consumption and with energy saving advice. Bator et al. (2019) and Mack et al. (2019) combine social norm information with other intervention modules, including energy saving recommendations, individual feedback, and commitment (see also Andor and Fels, 2018, who present a graphical overview of different intervention combinations in a larger set of studies). Bundling social norm information with other instruments in this way creates an identification problem, making it difficult to isolate the unique effect of norms. Thus, there is a need for more field experiments capable of estimating the unique effect of social norms (see Delmas et al., 2013; Harries et al., 2013; Anderson et al., 2017; Bhanot, 2021).

In Figure A1 in the Appendix, we summarize the results of the analysis of social norm interventions.

## Incentive-based interventions

### Effectiveness of incentive-based interventions overall

Incentive-based interventions typically achieve small or statistically insignificant reductions in energy use, as documented in Supplementary Table 1 (e.g., Delmas et al., 2013; Buckley, 2020). However, cases of larger effects are not unknown (Faruqui and Sergici, 2010; Ito et al., 2018; Burkhardt et al., 2019; Bollinger and Hartmann, 2020). In the next section, we discuss a number of factors potentially contributing to the interventions' success or failure.

Concerning eco-friendly technology adoption, most field experiments found no effect of pecuniary strategies (e.g., Allcott and Sweeney, 2017; Gillingham and Bollinger, 2021). However, interestingly, large effects have been found in a number of cases (e.g., Allcott and Taubinsky, 2015; Gillan, 2018; Bollinger et al., 2020; Fowlie et al., 2021), and some non-experimental studies also suggest a substantial potential of monetary instruments (see Gallagher and Muehlegger, 2011; Münzel et al., 2019). For a detailed overview see Supplementary Table 1.

Incentives seem to represent a potentially powerful policy instrument, despite the real possibility that an incentive-based strategy will be unsuccessful. Thus, there is a need for continued examination of the types of incentive-based strategies that fare better than others, and of the specific contexts and recipient characteristics affecting their performance. For example, cash incentives may be more effective than providing information on prospective savings in some cases (Allcott and Taubinsky, 2015; Rodemeier and Löschel, 2020).

Moreover, even when incentives have the desired effect initially, research in a number of domains, including energy conservation and eco-friendly technology adoption, suggests that the effects may quickly dissipate once incentives are withdrawn (Dharshing, 2017; Ito et al., 2018; Azarova et al., 2020). Many authors also argue that incentives partially crowd out intrinsic motivation and pro-social motives (Deci, 1971; Deci et al., 1999; but see Steinhorst and Klöckner, 2018; Kaiser et al., 2020). Thus, if the mere provision of incentives crowds out intrinsic motivation and pro-sociality to some extent, incentives need to be powerful enough to create a positive net effect on the desired outcome.

Another question concerns the relative suitability of positive motivation (e.g., subsidies and discounts) vs. negative motivation (e.g., taxes and fines). As far as behavioral outcomes go, negative motivation may be somewhat more effective (for evidence from a labor context see Hossain and List, 2012; Hong et al., 2015). Research on public acceptance of sustainability policies, however, indicates that the more heavy-handed "push"

measures (e.g., taxes and fines) are typically less acceptable than softer “pull” measures like subsidies and rebates (Tobler et al., 2012; Rhodes et al., 2017; Mahmoodi et al., 2018; Keizer et al., 2019).

## Boundary conditions and moderators of intervention effects

Are incentive-based interventions more effective under certain conditions and when targeting specific subgroups of the population? Apart from studies exploring the role of socio-demographic moderators, existing research in the energy-behavior domain is largely silent on this issue. Given the paucity of available data, we should therefore once again underscore that the findings presented here should be regarded as tentative prior to several rounds of successful replication.

Our literature review suggests eight possible moderators of incentive-based effects, which are discussed below.

- (a) Socio-demographic characteristics. Numerous studies<sup>3</sup> provide evidence that socio-demographic characteristics, including age, gender, education, income, home ownership, and parental status, help determine people’s responsiveness to incentives and prices. Findings are, however, typically mixed and inconclusive. For example, lower-income consumers sometimes appear to be more responsive to incentives and energy and technology prices (Reiss and White, 2005; Alberini et al., 2011; Allcott, 2011a; Ito, 2015; Ida et al., 2016; DeShazo et al., 2017; Houde, 2018; Charlier and Kahouli, 2019; Lundgren and Schultzberg, 2019; Schmitz and Madlener, 2020), but other studies disconfirm or qualify this link (Nesbakken, 1999; Herter, 2007; Faruqui et al., 2013; Moshiri, 2015; Zhang, 2015; Schulte and Heindl, 2017; Hansen, 2018; Alberini et al., 2019; Harding et al., 2020; Prest, 2020). Inconsistent findings could be partly due to methodological differences across studies or context-dependency of the effects.
- (b) Political preferences and environmental concern. Schwartz et al. (2015) and Xu et al. (2015) report that the relative effectiveness of monetary vs. environmental appeals

depends on the target audience’s political preferences (and environmental concern, in Xu et al., 2015).

- (c) Personal norms. Steinhilber and Matthies (2016) found that people with strong (but not people with weak) pro-environmental personal norms may be more responsive to information about the negative environmental impacts of energy consumption compared to information about monetary savings associated with energy conservation. Hunecke et al. (2001), on the other hand, found no interaction between incentives and personal norms in the context of travel mode choice. For related evidence concerning the role of personal norms and values in the context of paper conservation appeals, see van den Broek et al. (2017).
- (d) Environmental identity and attitudes. DellaValle and Zubaryeva (2019) indicate that individuals scoring high on pro-environmental identity may be more responsive to incentive-based interventions promoting the uptake of eco-friendly technology. See also Fenrick et al. (2014) for suggestive evidence of environmental attitudes affecting consumer responses to electricity pricing.
- (e) Time preferences. Response to potential future cost-savings from eco-friendly technology adoption appears to be steeper for individuals more willing to delay consumption (DellaValle and Zubaryeva, 2019).
- (f) Baseline behavior levels. Findings concerning responsiveness to energy prices of households with different consumption levels are mixed (Herter, 2007; Kaza, 2010; Gilbert and Graff Zivin, 2014; List et al., 2017; Royal and Rustamov, 2018; Harding et al., 2020; Prest, 2020; Schmitz and Madlener, 2020; Todd-Blick et al., 2020; Murakami et al., 2022). This could be partly due to context- or behavior-specificity of the effects (see Kaza, 2010). In addition, it may be difficult to detect subtle non-linear effects with conventional methods (see Prest, 2020).
- (g) Context effects. The influence of incentives on energy-related behaviors may depend on the context determined by other policies and intervention tools, for example information provision (see Hayes and Cone, 1977; Sexton et al., 1989; Allcott, 2011a; Ashraf et al., 2013; Kahn and Wolak, 2013; Krause et al., 2013; Harding and Lamarche, 2016; Jenn et al., 2018; Palmer et al., 2018; Figueroa et al., 2019; Bollinger and Hartmann, 2020; Frondel and Kussel, 2020; Harding et al., 2020; Rodemeier and Löschel, 2020; McKenna et al., 2021), feedback on own consumption (see Hayes and Cone, 1977; Woo et al., 2013; Jessoe and Rapson, 2014; Harding and Lamarche, 2016; Martin and Rivers, 2018; Bollinger and Hartmann, 2020; Harding et al., 2020; Prest, 2020; McKenna et al., 2021), social norms feedback (see Dolan and Metcalfe, 2015; List et al., 2017; Sudarshan, 2017; Rezvani et al., 2018; Brent and Wichman, 2020), or the use of enabling and automation technologies like smart programmable thermostats (see Faruqui and Sergici, 2011;

<sup>3</sup> See e.g., Nesbakken (1999), Reiss and White (2005), Herter (2007), Rehdanz (2007), Meier and Rehdanz (2010), Alberini et al. (2011, 2019), Allcott (2011a), Mills and Schleich (2012), Ito (2015), Moshiri (2015), Yang and Zhao (2015), Zhang (2015), Bjerkan et al. (2016), Ida et al. (2016), Wichman et al. (2016), Zhang et al. (2016), DeShazo et al. (2017), Schulte and Heindl (2017), Hansen (2018), Houde (2018), Ščasný et al. (2018), Silva et al. (2018), Sovacool et al. (2018, 2019), Charlier and Kahouli (2019), Kormos et al. (2019), Lundgren and Schultzberg (2019), Bollinger et al. (2020), Deryugina et al. (2020), Harding et al. (2020), Jenn et al. (2020), Rodemeier and Löschel (2020), Schmitz and Madlener (2020), Stojanovski et al. (2020), and Wolske (2020).

Davis et al., 2013; Faruqui et al., 2013; Suter and Shammin, 2013; Woo et al., 2013; Harding and Lamarche, 2016; Gillan, 2018; Bollinger and Hartmann, 2020; Harding et al., 2020).

## Limitations of existing research and future directions

Three main avenues for subsequent research are apparent. As in the case of social norm interventions, replicating promising findings on factors modulating interventions' effects is necessary before drawing firm theoretical and policy conclusions. Economic theory provides substantial support for the general idea that the effects of monetary incentives vary according to individuals, and that contextual factors modulate incentive effects. This issue should be more thoroughly investigated in the domain of energy-related behavior, building on research by Reiss and White (2005), Schwartz et al. (2015), Xu et al. (2015), and others.

Secondly, the presence of incentives may alter the effect of interventions invoking social norms, pro-environmental attitudes and other intrinsic motives (Drews et al., 2020; but see Brent and Wichman, 2020; West et al., 2021). Results reported by Sudarshan (2017) showcase the potential importance of this issue for energy conservation campaigns. The author found that, in the absence of monetary incentives to conserve energy, adding incentives to a norm- and feedback-based intervention completely eliminated the positive effect of the intervention. Pellerano et al. (2017) report a similar finding. The usefulness of complementing financial incentives with non-pecuniary instruments (and vice versa) thus needs to be assessed in subsequent research.

And finally, one may wonder about the long-term effects of incentives on behavior and motivation. It can be useful to examine whether, and if so, to what extent, their effect remains after incentives are discontinued (see e.g., Ito et al., 2018; Azarova et al., 2020), and to what extent provision of incentives affects intrinsic motivation (see Steinhilber and Klöckner, 2018).

The results of our analysis of incentive-based interventions are illustrated in Figure A2 in the Appendix.

## Commitment and goal setting

### Effectiveness of commitment-based interventions overall

As documented in Table 2, the effectiveness of commitment and goal setting strategies employed in previous field experimental studies on energy conservation has been very limited (e.g., Lokhorst et al., 2015; van der Werff et al., 2019; Andor et al., 2020a; but see Aydin et al., 2018 who found suggestive evidence for a strong effect of combining feedback and goal setting in their field quasi-experiment). The results are slightly more encouraging for pro-environmental behavior

more generally (Lokhorst et al., 2013; Nisa et al., 2019). A possible approach therefore is to increase the salience of the environmental impact of intense energy consumption when asking participants to commit to energy conservation goals.

### Boundary conditions and moderators of intervention effects

Evidence concerning possible boundary conditions and moderators of the effect of commitment on energy-related behaviors is extremely limited. What evidence there is suggests that the following six factors may moderate the success of commitment interventions:

- (a) Personal pro-environmental norms. Matthies et al. (2006) demonstrate that the efficacy of commitment-based strategies is enhanced when the committing individuals hold strong personal norms in favor of the target behavior.
- (b) Values. People holding strong "egoistic" values appear to be more responsive to commitment opportunities, and people with strong "biospheric" values are sometimes less responsive (Brandtsma and Blasch, 2019).
- (c) Public commitment. Commitments made in public appear to be more effective than private commitments (Pallak and Cummings, 1976; see also Epton et al., 2017). People may also be more willing to commit when doing so publicly rather than privately (see Exley and Naecker, 2017 for evidence from an academic context).
- (d) Behavior difficulty. van der Werff et al. (2019) report that commitment can be used as a lever to motivate difficult energy-saving behaviors, but not easy behaviors.
- (e) Goal difficulty. When combined with feedback on own consumption, difficult energy saving goals appear to be more effective in curbing consumption than easier ones (Becker, 1978; for related evidence from other domains see Epton et al., 2017).
- (f) Feedback provision. When difficult energy saving goals are set, feedback provision boosts energy conservation. Feedback does not appear to facilitate conservation when easy to achieve energy saving goals are set (Becker, 1978; for related evidence from other domains see Neubert, 1998; Epton et al., 2017).

### Limitations of existing research and future directions

Additional research is needed to examine the emotional experiences that accompany commitment. These would presumably depend on whether or not a commitment was made, and, if so, on whether or not the actor successfully completed the behavior or goal to which they committed. The possibility of negative emotions that may be associated especially with public commitment is discussed in Lokhorst

TABLE 2 Overview of former research—commitment and goal setting.

Source	Main methodology used	Main target behavior(s)	Effect of commitment confirmed?
Andor et al. (2020a)	Meta-analysis of field experimental studies	Energy conservation	No effect (results for self-set goals) Small decrease in energy consumption (results for externally set goals)
Barata et al. (2017)	Field experiment	Energy conservation	No effect
Bell et al. (2016)	Field experiment	Energy conservation	Moderate increase in self-reported energy conservation behaviors
Ghesla et al. (2020)	Field experiment	Energy conservation	No effect (result for the “goal” treatment)
Legault et al. (2020)	Field experiment	Energy conservation	No effect (result for the motivational and goal-setting intervention)
Lokhorst et al. (2015)	Field experiment	Energy conservation	No effect on most behaviors, but a large increase in room temperature setting (i.e., an increase in energy consumption)
Loock et al. (2013)	Field experiment	Energy conservation	No effect to small decrease in energy consumption (depending on treatment)
Löschel et al. (2020)	Field experiment	Energy conservation	No effect
Shen et al. (2019)	Field experiment	Energy conservation	No effect
van der Werff et al. (2019)	Field experiment	Completely switching off unused appliances (instead of using standby)	No effect

et al. (2015), and results in Löschel et al. (2020) illustrate that people may prefer to avoid receiving goal-setting nudges. On the other hand, Baca-Motes et al. (2013) and Joo et al. (2018) found no negative effects of commitment interventions on customer satisfaction in the context of resource conservation campaigns in hotels.

As we found only very limited evidence regarding influential moderators of commitment strategies, subsequent research is called for investigating the attitudinal, personality and contextual moderators affecting their success. Null results reported e.g., in Lokhorst et al. (2015) stress the need for a careful implementation of commitment-based strategies, including the consideration of influential moderators of the interventions' effects.

Similarly to the case of social norm research, also in case of studies on commitment it would be useful to isolate the unique effect of commitment and goal setting interventions. One problem with existing research is that commitment-based interventions are oftentimes coupled with other intervention elements, such as energy consumption feedback and energy saving tips (Abrahamse et al., 2007; Harding and Hsiaw, 2014; Mack et al., 2019; Mi et al., 2019; Legault et al., 2020), which precludes a clean attribution of the interventions' effects specifically to commitment.

Finally, to the best of our knowledge, although relatively easy to implement, there are no field experimental studies on the influence of prior commitment on subsequent eco-friendly technology adoption and energy-efficiency investments. This is a promising area for future investigations.

Figure A3 in the Appendix provides a graphical presentation of the key results presented in this subsection about commitment and goal setting interventions.

## Concluding discussion

This literature review gives us an idea of what could be the most effective approaches in behavioral intervention design. In Figure 2, we present a graphical summary of the key outcomes and results of our analysis, which we discuss below.

First, we show that there is no “silver bullet” approach. None of the intervention types have reliably large effects (i.e., irrespective of the context and target population). However, some interventions seem to have greater potential than others. In a number of cases, economically meaningful effects have been achieved with incentive-based strategies (e.g., Faruqi and Sergici, 2010; Allcott and Taubinsky, 2015; Ito et al., 2018; Bollinger et al., 2020) and norms (e.g., Leoniak and Cwalina, 2019; Brülisauer et al., 2020). The evidence to support the usefulness of commitment and goal setting strategies is much weaker.

Second, we discussed the potential, as well as the problems associated with combining different intervention elements (e.g., norms and incentives) in a single intervention package. The drawbacks are clear: confounding issues preclude a clear identification of the most effective intervention elements when they are bundled without appropriate control conditions (cf.

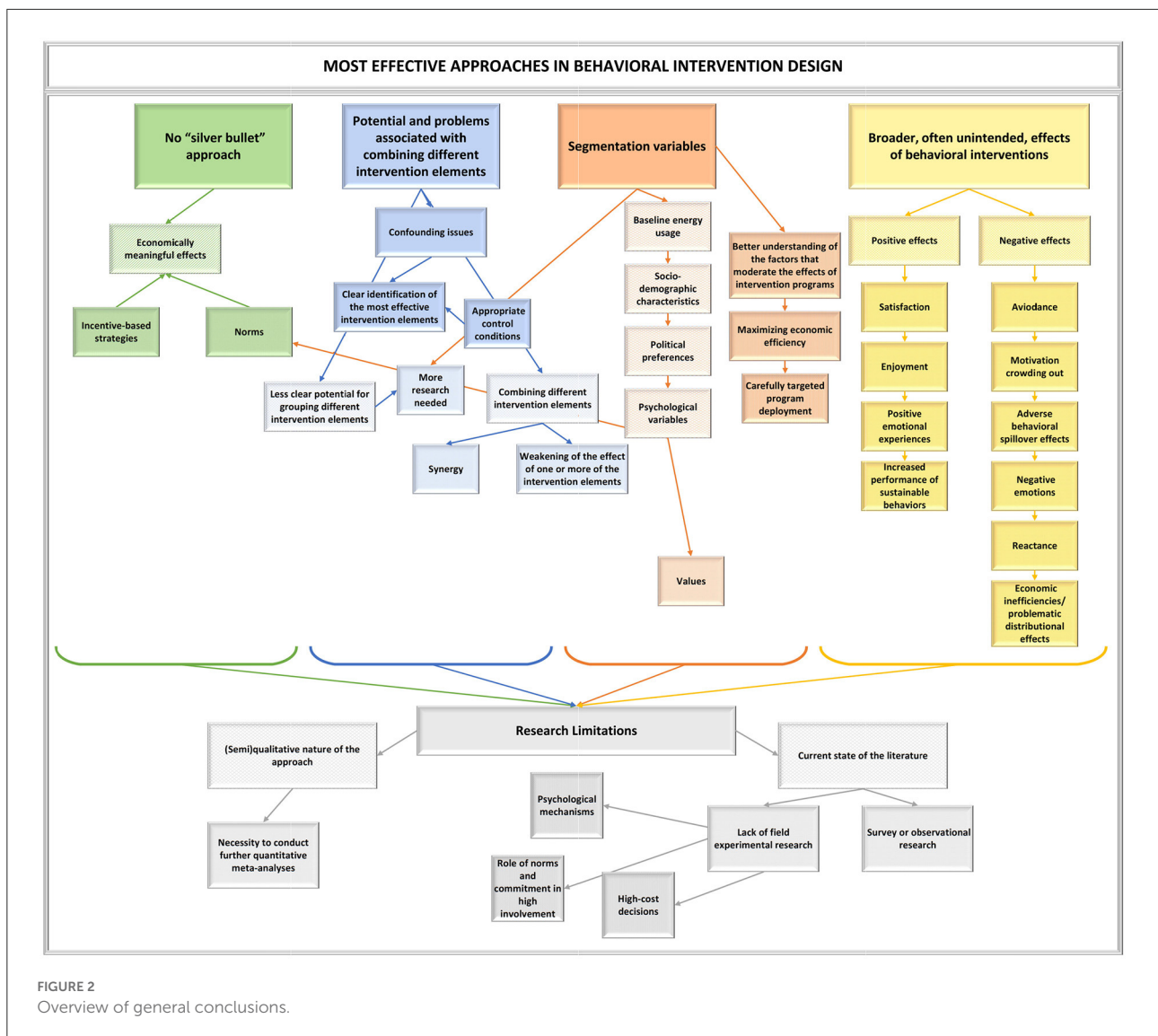


FIGURE 2  
Overview of general conclusions.

Delmas et al., 2013; Harries et al., 2013; Frederiks et al., 2016; Bhanot, 2021). The potential for grouping different intervention elements is less clear, and this important issue requires more research. As discussed in a recent paper by Drews et al. (2020), combining different intervention elements can lead to synergy (the intervention package as a whole having a stronger effect than each individual component), but it can also lead to a weakening of the effect of one or more of the intervention elements. While intuition suggests that interventions with more elements are more effective (cf. Abrahamse et al., 2007; Dietz et al., 2009; Osbaldiston and Schott, 2012; Mack et al., 2019), research often rather suggests an absence of synergistic effects when using multiple intervention elements (Harries et al., 2013; Schwartz et al., 2015; Alberts et al., 2016; Anderson et al., 2017; Pellerano et al., 2017; Sudarshan, 2017; Martin and Rivers, 2018).

Third, regardless of whether the intervention has a generally relatively strong effect, the effect can be substantially increased by targeting the intervention to the most receptive groups. The segmentation variables that we reviewed include, for example, baseline energy usage (Schultz et al., 2007, 2016; Allcott, 2011b), socio-demographic characteristics (Bollinger et al., 2020; Rodemeier and Löschel, 2020; Stojanovski et al., 2020), political preferences (Costa and Kahn, 2013; Schwartz et al., 2015; Xu et al., 2015), and psychological variables, such as personal norms (Schultz et al., 2016; Steinhorst and Matthies, 2016) and values (Bonan et al., 2019; Brandsma and Blasch, 2019). More research is needed to consolidate our understanding of the role of the various segmentation variables. A better understanding of the factors that moderate the effects of intervention programs is a prerequisite for maximizing economic efficiency *via* carefully

targeted program deployment. Similarly, a shift toward more advanced, tailored and sequentially adaptive intervention programs (such as those showing promise in the medical field, see e.g., Nahum-Shani et al., 2018; Miller, 2019) depends on insights into the type of interventions most suited to particular individuals.

Fourth, researchers and practitioners' attention should focus on the broader, often unintended, effects of behavioral interventions. These can be positive, such as satisfaction, enjoyment and other positive emotional experiences (Herter, 2007; Delmas and Lessem, 2014; Vesely et al., 2022), and increased performance of sustainable behaviors not targeted by the interventions (Steinhorst et al., 2015; Carlsson et al., 2021; Jessoe et al., 2021; see Maki et al., 2019; Geiger et al., 2021 for meta-analyses). However, negative effects include avoidance (Löschel et al., 2020), motivation crowding out (Lavergne et al., 2010; Schwartz et al., 2015), adverse behavioral spillover effects (Tiefenbeck et al., 2013; McCoy and Lyons, 2017; Bjelle et al., 2018), negative emotions (Sussman and Gifford, 2012) and reactance (Bergquist and Nilsson, 2016), as well as economic inefficiencies (Allcott and Greenstone, 2012) and problematic distributional effects (Azarova et al., 2019; White and Sintov, 2020). To find the best approach, interventions thus need to be thoroughly pre-tested prior to their large-scale roll out, and evaluated not only in terms of their intended behavioral impact, but also in terms of their (unintended) downstream effects.

Like all literature reviews, we were limited by the semi-qualitative nature of our approach. As new evidence accumulates, it will be appropriate to conduct further quantitative meta-analyses covering these topics. Still, our approach made it possible to combine evidence from previous meta-analyses and more recent studies in a much more comprehensive manner than previous works in the area. To lay the groundwork for the future, experimenters should adhere to reporting standards conducive to subsequent research synthesis efforts.

Another limitation of the present study stemmed from the current state of the literature itself. In particular, our conclusions were not always based solely on field experimental research (where no or very little field experimental evidence was available). Instead, we occasionally resorted to evidence from laboratory, survey or observational research to illustrate various points. To some extent, this is perhaps inevitable, as field experimental research can only go so far when examining for example the underlying psychological mechanisms. On the other hand, in some cases, field experimental research was conspicuous by its absence, especially regarding the role of norms and commitment in high-involvement, high-cost decisions such as the uptake of eco-friendly technologies. This research gap and others outlined in

this review point to many opportunities for meaningful research contributions.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary files, further inquiries can be directed to the corresponding author/s.

## Author contributions

Conceptualization and writing—review and editing: SV, CK, GC, LT, FC, MB, AK, and AS. Methodology: SV, CK, GC, LT, and FC. Data collection and analysis and writing—original draft: SV. All authors contributed to the article and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.967318/full#supplementary-material>

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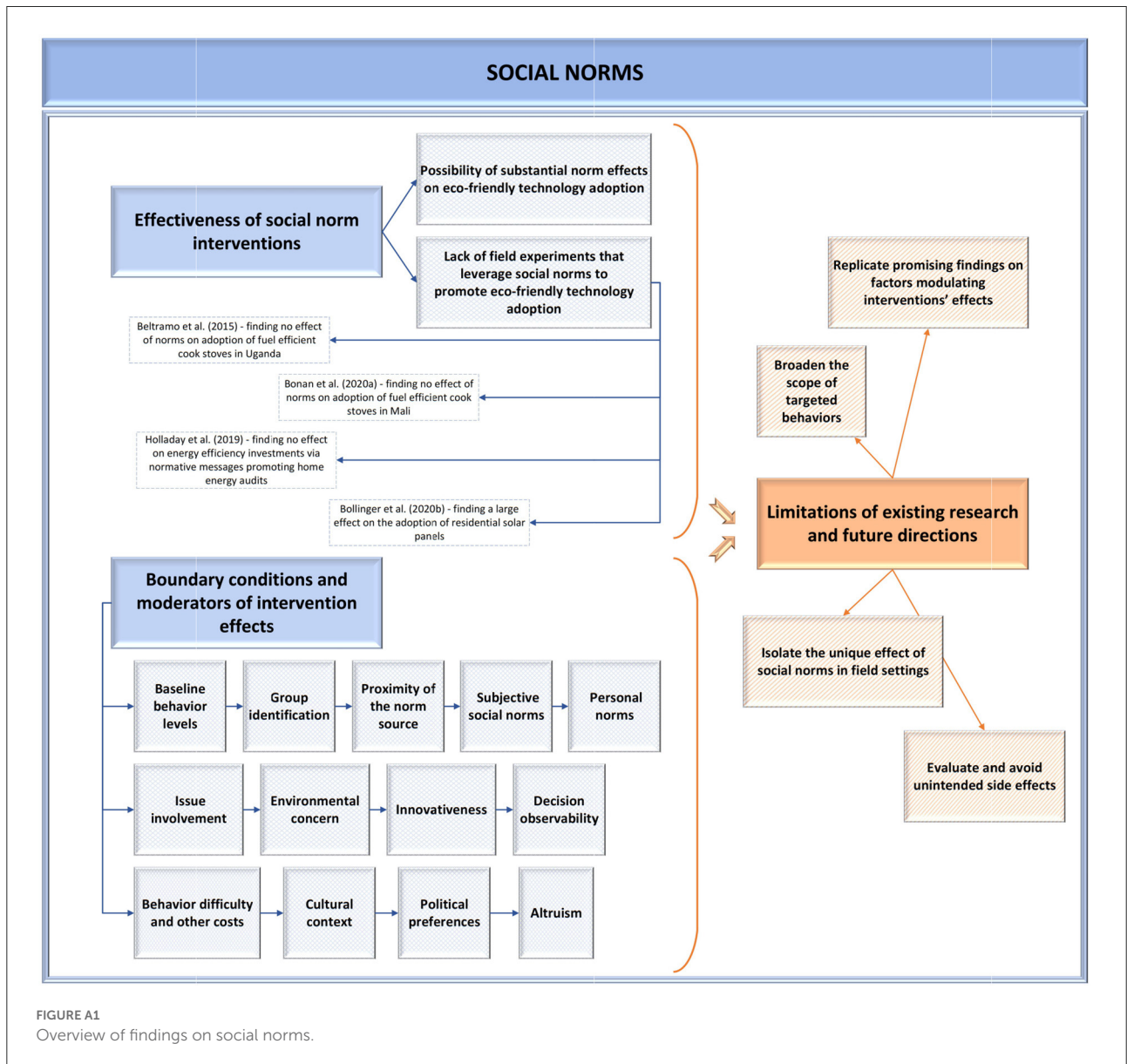
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Appendix: Figures



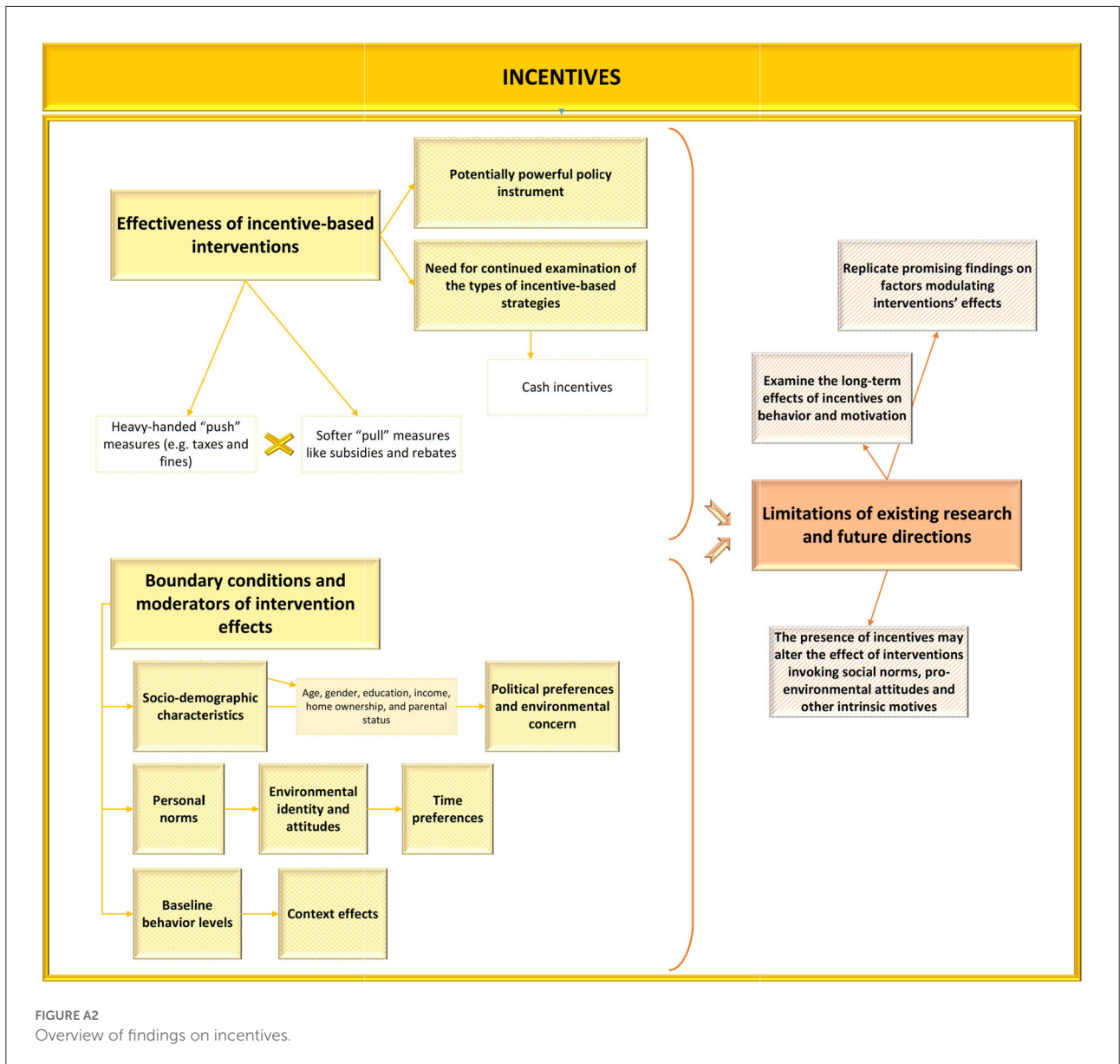


FIGURE A2  
Overview of findings on incentives.

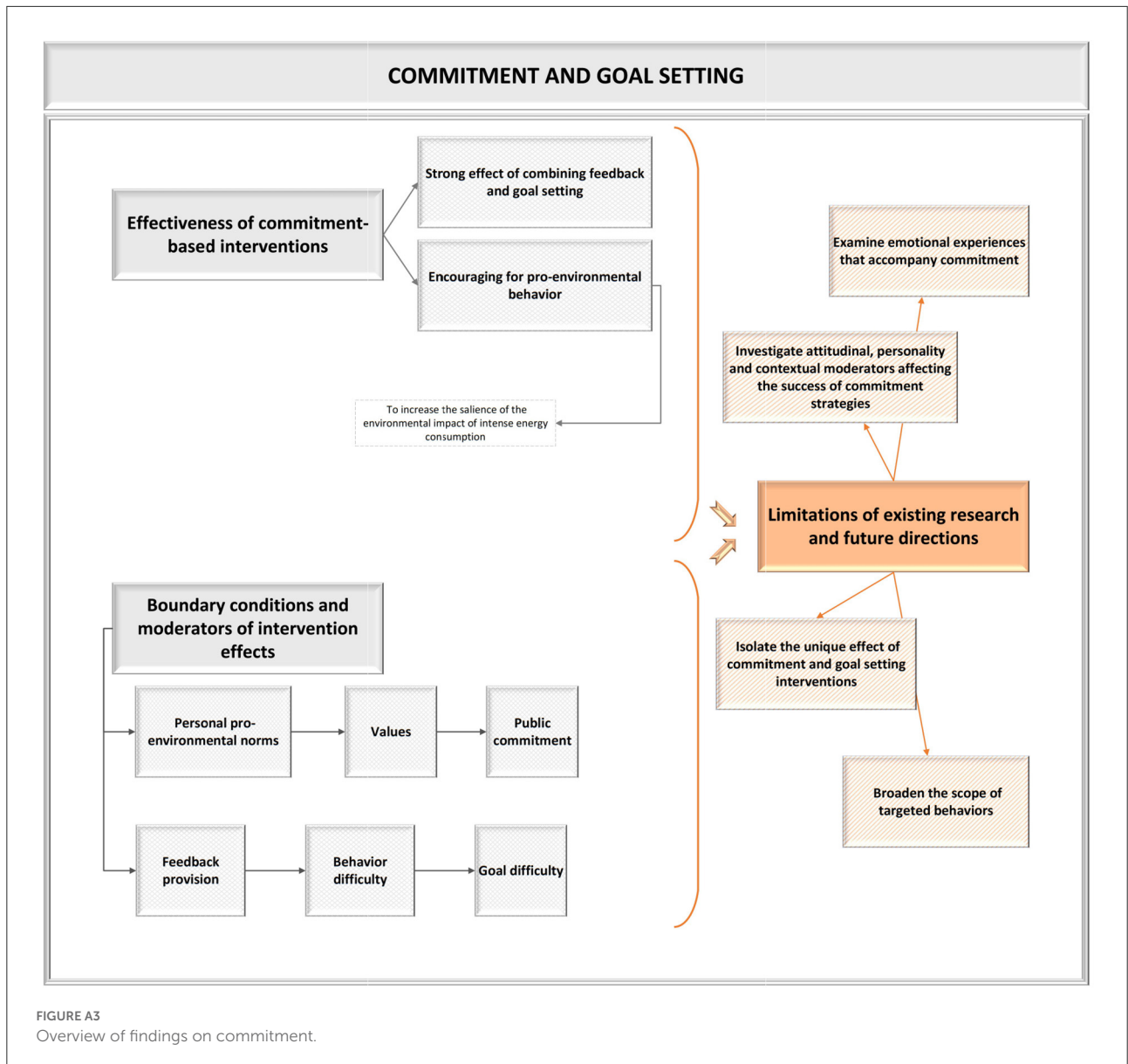


FIGURE A3  
Overview of findings on commitment.



## Appendix: Search string used to search the Web of Science database

TOPIC: ((norm\* OR peer\* OR “social comparison\*” OR “social influence\*” OR “social feedback” OR “social nudge\*” OR “social information” OR “social pressure” OR “social signal\*” OR “social group\*” OR “group comparison\*” OR “group feedback” OR “group pressure” OR conform\* OR “home energy report\*” OR “model\*ing” OR “neighbo\*” OR “block leader\*” OR commit\* OR goal\* OR pledge\* OR “self\*control” OR “self\*regulation” OR incentiv\* OR pric\* OR money OR pay\* OR cash OR cost\* OR sale\* OR discount\* OR expenditure\* OR financ\* OR monetary OR pecuniary OR economic OR subsid\* OR rebate\* OR tariff\* OR tax\* OR credit\* OR reward\* OR penal\* OR sanction\* OR gain\* OR loss\* OR “time\*of\*use” OR “critical\*peak” OR “peak\*demand” OR “peak\*time” OR “real\*time pric\*” OR “electricity bill\*” OR “energy bill\*” OR waive\*) AND (“field experiment\*” OR “field stud\*” OR “field trial\*” OR “randomized controlled trial\*” OR RCT OR pilot\* OR “program\* evaluation\*”) AND (energy OR electric\* OR renewable\* OR wind OR solar OR consum\* OR conserv\* OR curtail\* OR reduc\* OR “energy saving\*” OR “electricity saving\*” OR “energy us\*” OR “electricity us\*” OR “energy demand” OR “electricity demand” OR “demand management” OR “demand response” OR invest\* OR adopt\* OR purchas\* OR

buy\* OR subscri\* OR uptake OR install\* OR weatheariz\* OR heat\* OR cooling OR “air conditioning” OR energy audit\* OR “electric car\*” OR “electric vehicle\*” OR e-car\* OR hybrid\* OR “electric bicycle\*” OR e-bike\* OR “energy\*efficien\*” OR “smart meter\*” OR technolog\* OR appliance\* OR photovoltaic\*))

Refined by: WEB OF SCIENCE CATEGORIES: (ENVIRONMENTAL SCIENCES OR GREEN SUSTAINABLE SCIENCE TECHNOLOGY OR PSYCHOLOGY OR ENERGY FUELS OR ENGINEERING ELECTRICAL ELECTRONIC OR TRANSPORTATION SCIENCE TECHNOLOGY OR MANAGEMENT OR EDUCATION SCIENTIFIC DISCIPLINES OR ENGINEERING ENVIRONMENTAL OR BUSINESS OR ENVIRONMENTAL STUDIES OR ECONOMICS OR OPERATIONS RESEARCH MANAGEMENT SCIENCE OR MULTIDISCIPLINARY SCIENCES OR TELECOMMUNICATIONS OR INFORMATION SCIENCE LIBRARY SCIENCE OR BEHAVIORAL SCIENCES OR ENGINEERING MULTIDISCIPLINARY OR PSYCHOLOGY APPLIED OR SOCIAL SCIENCES INTERDISCIPLINARY OR PSYCHOLOGY MULTIDISCIPLINARY OR EDUCATION EDUCATIONAL RESEARCH)

Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI.