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# Bridging the Attitude-Behaviour Gap in Household Energy Consumption

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***Abstract*—The attitude-behaviour gap in energy consumption refers to the imparity between people's environmental values (and attitudes) and their actual behavior in consumption. This paper calls for the facilitation of the *behaviour change process* that is implementable in the context of one's everyday life to address the attitude-behaviour gap in household energy consumption. Two interrelated intervention design constructs are proposed based on the results of literature review, namely (1) providing consumers accurate information about actionable suggestions in the specific context of their everyday life, and (2) fostering consumers' motivation to engage in the behavior change process towards energy conservation. Smart Grid technologies are instrumental in both intervention types.**

## I. Introduction

People consume energy through many relatively inconspicuous actions in daily household practices and routines. How and to what extent these daily actions affect energy use and in turn the environment are not always readily apparent to average consumers [1]. This knowledge deficit poses significant constraints for consumers to perform and engage in energy conservation (and energy efficiency) behaviours, and acquiring such information is often time consuming [2]. Information-based intervention strategies in the context of Smart Grids that aim at correcting such knowledge deficits have become more and more common [1]. In literature, two main types of information-based interventions are distinguished: providing consumers with (I) feedback about the amount of their energy use and energy savings, and (II) information about energy conservation and efficiency measures (and tips). Smart Grid technology is instrumental in both intervention types.

Experiments and field test related to such interventions show a high degree of variability across and sometimes also within studies: some interventions have marginal significance or no observable differences, some are effective to different degrees, and some may even have negative effects [3], [1]. For example, simply providing energy conservation measures often do not sufficiently motivate consumers to conserve energy [1]. Tailored home audits are effective in a number of studies due to personalized and context-specific information. More frequent energy feedback are often reported to be more effective. Rewards can have a positive but rather short-lived effect. Monetary strategies do not necessarily affect energy consumption behaviour, and may even lead to relative increase in usage rather than induce conservation [1], [4].

In general, literature suggests that relevant information tends to result in higher knowledge levels but not necessarily in behaviour changes or energy savings [3]. Despite growing environmental awareness and articulated preference for 'green' lifestyles, people's environmental values and attitudes often fail to materialize in actual environmental actions and behaviour changes, from energy conservation, to recycling, to the purchase of green/sustainable products [5]. This imparity is commonly referred to as the attitude-behavior gap or the value-action gap [5].

There are information-based intervention strategies shown to be effective in some contexts, for some behaviors, and for some individuals; no single strategy stands out as being uniformly the most effective [6] since many determinants can frame and shape energy consumption behaviors (and voluntary changes), e.g, a consumer's prior knowledge, the type of information provided, how it is provided, and the context in which the information is communicated, to name just a few [1]. What is important is to match the strategies to the individuals, the behavior and the context [6], [7].

In this paper, the facilitation of the *behavior change process* that is implementable in the context of one's everyday life is proposed to bridge the attitude-behavior gap in household energy consumption. The paper extensively discusses literature and draws on our own previous experience [8], [9] in the design of smart grid based household energy interventions.

## II. Bridging the Attitude-Behavior Gap

An increasing 'green' attitude by consumers is not sufficient to produce changes towards energy conservation behavior — there is an imparity in actual environmental actions. What frames and shapes environmental behavior is a complex issue. Although there is no single framework or theory that provides definitive explanations for the attitude-behavior gap [6], literature provides suggestions that shed some light on this issue.

People perform (or do not perform) certain environmental actions for many reasons. The reasons for acting are often referred to as motives or motivation. A distinction can be made between *primary motives* and *selective motives* [11]. The former motives influence decisions to engage (or not to engage) in a whole class of actions or behaviors. They can be understood as general attitudes towards certain actions. Selective motives influence decisions on specific actions. They have direct positive or negative impact on the actions. In this

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sense, primary motives, such as altruistic and social values that build up attitudes, do not have direct influence on specific actions. They are often covered up by more immediate selective motives, which evolve around personal and everyday needs and context such as comfort, practicality and complexities in daily life [12].

The countervailing influences of context-specific reasons for or against specific actions, i.e., the selective motives, are strong antecedents of one's decisions on actions [5]. In particular, a decision is often influenced more by reasons against the action [13]. This means, one may fail to or decide not to perform environmental actions due to context-specific reasons against the actions despite the fact that one holds environmental values and attitudes. In general, one's willingness and ability to take energy conservation actions are constrained by the context-specific reasons in everyday life.

In many cases, people act habitually or routinely rather than making reasoned choices [13]. Habits are learned sequences of actions that have become automatic responses to specific cues and are functional in obtaining certain goals or end-states. Those who have tried to change a habit, even in a minor way, would discover how difficult it is even if the new behavior has distinct advantages over the old one [14]. When an individual wants to establish a new behavior, the person has to practice it — one might be perfectly willing to change certain behavior but still not do so because the person does not persist enough in practicing the new behavior until it becomes a habit [14]. A sustained behavior change requires learning a new habit.

### A. Facilitating the Behavior Change Process

To bridge the attitude-behavior gap, this paper poses behavior change does not occur as a single event, but rather as a gradual process that people go through to make durable change [10]. The context of everyday life is important in the sense that it is a key determinant of household energy consumption where the attitude-behavior gap appears. Thus household energy consumption behavior interventions need to be design in this context. The goal of this process is to motivate consumers to learn and practice new energy consumption behaviors until those behaviors become new habits that are embedded in the specific context of their everyday life. In particular, this means that (1) consumers need to be provided with accurate information about actionable suggestions on how to achieve potential energy conservation, and (2) the intervention design also needs to provide personalized means to motivate consumers to voluntarily practice and repeat the energy conservation actions in the specific context of their everyday life.

The negative and immediate consequence of the constraints such as the busyness and competing priorities of everyday life on energy conservation is often underestimated [15]. Many energy conservation actions are rather difficult and costly, making people unmotivated to take actions [16]. Information-based intervention strategies in themselves are especially effective when the pro-environmental behaviour is relatively convenient and not very costly (in terms of money, time, effort and/or social disapproval), and when individuals do not face severe external constraints on the behaviour [17]. Although energy conservation know-how does not necessarily lead to behavior change, nor is it a motive for pro-environmental behavior, the lack of knowledge can be a barrier to behavior change [18]. Available evidence indicates that despite many householders showing 'green' attitudes, they lack the necessary actionable knowledge to conserve energy in the specific context of their everyday life [19]. Providing such information in an accurate way, and fostering motivation to engage in the action process of behavior change towards energy conservation are the two interrelated design constructs this paper proposes. They are discussed in the next two sections.

## III. Providing Accurate and Actionable Information in the Behavior Change Process

This section discusses the first design construct to bridge the attitude-behavior gap. Schultz [18] distinguishes three types of knowledge in environmental actions. *Procedural knowledge* is about the where, when, and how of some task. *Impact knowledge* is an individual's belief about the consequence of some task. *Normative knowledge* is one's beliefs about the behaviors of others. An information-based intervention design can aim to increase all three types of knowledge. The discussion in this section addresses the procedural and impact information of energy conservation actions (normative information is addressed in the next section). The first design construct proposes four design elements which are discussed in the subsequent paragraphs.

An information-based intervention for household energy conservation should provide consumers with actionable recommendations and tips about how to conserve energy. These recommendations and tips are referred to in this paper as *Action suggestions*. The suggestions should be easily incorporated into one's everyday household practices for the reasons discussed above. This can be achieved e.g., by ways that (1) make action suggestions inexpensive micro-actions or decompose a complex action into smaller steps, (2) tailor the suggestions to the context of one's everyday life, and (3) provide the suggestions (to consumers) in an easily accessible way.

One-time actions (or one-shot behaviors) refer to efficiency (increasing) behaviors, many of which entail the purchase of energy-efficient equipments [19] e.g. purchasing a fridge with an A+++ energy label, or installation of attic insulation. In contrast, routine actions refer to curtailment behaviors that involve repetitive efforts to use equipments less frequently or intensively [19], e.g., thawing food in the refrigerator, or air-drying clothes. On the one hand, one-time actions often require purchasing whereas most routine actions have no financial cost. On the other hand, one-time actions are often more cost-effective in the long-term [20] and their energy saving potential is generally considered to be greater than that of routine actions [19]. There are also actions in-between one-time and routine, such as occasionally vacuuming behind the fridge and regularly defrosting the freezer. While many interventions

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| Design Construct 1: | Provide accurate information about actionable suggestions in the behavior change process towards energy conservation. |
| Element 1.1 | Develop and enhance consumers' energy conservation know-how through action suggestions that are accessible and implementable in the context of everyday life. |
| Element 1.2 | Provide suggestions ranging from one-time actions to routine actions. |
| Element 1.3 | Explicitly express action suggestions with concrete and reliable content. |
| Element 1.4 | Indicate the effort entailed by a suggested action and its potential impact in an understandable way. |

aim to change routine practices [20], this paper proposes to provide suggestions that range from one-time actions to routine actions.

The complexity of the information presented, the framing of the message, and the credibility of the source are among the key issues in delivering effective information [18]. Explicitly mentioning the intervention strategy and specifying its exact content and which behaviors are targeted has two benefits [3]: the specifications (1) can provide clear information and suggestions to consumers, and (2) can be used as a decisive factor in evaluating an intervention's (in)effectiveness. It is important to provide consumers reliable information and suggestions on energy conservation strategies and actions, and not to confuse consumers with conflicting or inconsistent advises. The perceived reliable sources are e.g., national and international energy authorities, consumer and environmental organisations as well as reliable private contacts such as neighbours and friends in contrast to commercial organizations [12].

The potential benefits (or outcomes) of an action, and the practicality and convenience (or inconvenience) of performing the action are important for people's decisions on adopting and sustaining the action [18]. This paper proposes to express the effort and impact of each action in an easily understandable way, e.g., on a scale of one to five. This also makes the effort and impact of the suggested actions easily comparable.

## IV. Fostering Motivation to Engage in the Behavior Change Process

This section discusses the second design construct to bridge the attitude-behavior gap. The construct proposes five design elements that are discussed in the paragraphs thereafter. The provision of normative information is addressed by this construct.

People not only have different amounts but also different kinds of motivation [21]. The most basic distinction is between *intrinsic motivation*, which is defined as the doing of an activity for its inherent satisfactions (rather than for its presumed instrumental value), and *extrinsic motivation*, which is defined as the doing of an activity to attain some separable outcome or consequence [21]. In the context of energy conservation, intrinsic motivators of actions are e.g., the exploratory and curiosity-driven aspect of the actions; extrinsic motivators are e.g. tangible rewards, competitions, and removal of social pressure.

A large body of research favors intrinsic motivation over extrinsic motivation for two main reasons. First, intrinsic motivation is more likely to result in long-term behaviour change compared to extrinsic motivation [22]. Extrinsic motivators can motivate energy conservation behaviors, particularly one-time actions; however, behaviors that must be repeated, i.e., routine behavior, will likely stop once extrinsic motivators are removed; extrinsic motivators may even inadvertently increase self-centered behaviors over environmental behaviors [23]. Second, intrinsic motivation more likely leads to positive spillover of environmental behaviors, while extrinsic motivation more likely leads to negative spillover; positive or negative spillover refers to the effect that one environmental behavior increases or decreases the likelihood of additional environmental behaviors [24].

In order to maintain and enhance a high level of intrinsic motivation, people must experience the satisfaction of both the needs for a *feelings of competence*, and a *sense of autonomy*; this means that people not only experience the perceived competence (or self-efficacy), but also their behavior to be self-determined, i.e., free choice rather than being controlled [21]. In such cases, an individual has a strong internal *locus of control*, which is a decisive factor of action [14]. A person's locus of control is conceptualized in literature as being internal or external [25]. An individual with a strong internal locus of control has the perception that one has the ability to bring about change through one's own actions, whereas an individual with a strong external locus of control believes that one's own actions are insignificant and change can only be brought about externally, e.g., by other people and institutions [25].

In situations where intrinsic motivation is low or absent, this paper proposes to follow Ryan and Deci [21] to promote more active and volitional forms of extrinsic motivation. Extrinsic motivation can have different forms with different degrees of internalization and integration of the values and behavioral regulations that motivate the behavior [21]. *Internalization* is the process of an individual's taking in a value or behavioral regulation, e.g., conscious personal valuing of an action, and self-endorsement of a goal [21]. *Integration* is the process where one further and more fully transforms the behavioral regulation into one's own so that it is congruent with one's other values and needs, i.e., it occurs when the identified regulations have been fully assimilated to the self [21].

A person might originally be exposed to an activity because of an extrinsic motivator, e.g. a reward, and if the motivator is not perceived as too controlling, such exposure or action process may allow the person to experience the activity's

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| Design Construct 2: | Foster consumers' motivation to engage in the behavior change process towards energy conservation. |
| Element 2.1 | Enhance and maintain intrinsic motivation. |
| Element 2.2 | Promote active and volitional forms of extrinsic motivation. |
| Element 2.3 | Use social norms and public commitment to address low motivation. |
| Element 2.4 | Facilitate consumers to reflect on lifestyle choices. |
| Element 2.5 | Engage all household members. |

intrinsically interesting properties, resulting in an orientation shift [21]. During the exposure, the person can be presented with perspectives that may inform and shape their beliefs and behavior [26]. Consequently, the person may increasingly internalize and integrate the values and behavioral regulations during the process [21]. Ryan and Deci [21] also suggest that the *sense of relatedness*, i.e., belongingness and connectedness to the person, group or culture disseminating a value or behavioral regulation, and the *feelings of competence* facilitate internalization, and additionally the *sense of autonomy* facilitates integration of values and behavioral regulations.

Following the aforementioned theory, supporting (1) relatedness, (2) competence, and (3) autonomy can promote more active and volitional forms of extrinsic motivation, and can facilitate (intrinsic and extrinsic) motivation in the intervention design in general. The sense of relatedness can be promoted e.g. by actively engaging and deeply involving consumers throughout the intervention process.

Normative knowledge (i.e. perceived social norms), which can be descriptive or injunctive, refers to one's understanding of the behavior of others [18]. Descriptive norms are beliefs about what other people are doing, often referred to as *norms of is*, whereas injunctive norms are beliefs about what people think they should be doing, often referred to as *norms of ought* [18]. Research indicates that normative beliefs can predict a variety of behaviors, and normative interventions are effective in promoting environmental behavior change by giving cues as to what is appropriate and desirable [18], [1].

There are quite a few instances, however, where normative beliefs would not predict behavior, i.e., when one perceives that a behavior is desired but does not perceive that the others are doing it, when one thinks that the impact or benefits of one's own actions is very low, i.e., a strong external locus of control, or when one's behavior is not directly observable by other people. Many of these situations can be characterized as *commons dilemmas*, a.k.a. the tragedy of the commons [27]. That is, whether to reduce one's own rate of consumption, sacrificing one's own desires, freedom to consume, and perhaps personal well-being, for the future of the group, or to continue using the resources at the same rate for one's own gain and with no regard for others, risking the common pool of resources. Free riders are examples of the commons problem. The free rider effect appears in collective behaviors when an individual puts less effort on a common task or consumes more of the common good than one's fair share. In energy consumption, this might happen e.g., when the energy cost is included in the rent [28].

Besides using private ownership and policy interventions to regulate the commons problem (which is not the focus of this paper), communications that make actions or commitment to actions more publicly observable may lead individuals to act in the interest of the group [18]. It is often reported that individuals are considerably more likely to reduce their use of the common when they believe that the others who share access to the common will also limit their use. When one's own behavior and that of others are publicly observable, the behavior is more likely to be affected by changes in normative beliefs [29].

Brynjarsdottir et. al. [26] critically reviewed ICT technologies designed for environmental behavior interventions (and persuasions). The authors point out that existing designs have a narrowed vision of sustainability in that they overly focus on modernistic (technological) system change and monitoring of individual consumption, entrusting designers with the responsibility to decide what is or is not appropriate environmental behavior. They suggest to lessen the prescription of environmental or sustainable actions chosen by designers, who may not connect with users' actual everyday life experiences, and instead to make designs that help elicit issues of sustainability, and encourage users for open-ended reflection on what it actually means to be sustainable with lifestyle choices that make sense in the context of their everyday life. With this goal in mind, to design interventions that can facilitate consumers to reflect on their lifestyle choices in relation to energy conservation. In particular, this can be achieved e.g. by ways that (1) deeply involve consumers in the co-design process, and improve the intervention design through iteration and feedback from consumers, (2) give consumers freedom to choose and schedule energy conservation actions according to their own everyday life context, and (3) facilitate commenting and discussions among consumers through the intervention.

Energy conservation does not have to be a lone activity, and interventions can be designed beyond individuals [26], [7]. The artifacts, technologies and resource systems to date are typically designed for 'household resource managers', often men, although they are far from the only energy users in households [15]. Families with children generally consume more energy than those without, and this consumption tends to increase as children grow older [30]. Studies show that children enjoy the involvement and responsibility in helping save energy, and parents' commitment also increases when they think about energy conservation in the context of their

children's education [2], [30]. Discussing and establishing common family responsibilities around energy consumption is reported to be effective [31]. Therefore, this paper proposes to engage all household members in energy conservation and the behavior change process.

## V. Conclusion

This paper calls for an approach to facilitate the behavior change process that can be implemented in the context of one's everyday life to address the attitude-behavior gap in household energy conservation. It is motivated by the fact that durable behavior change for energy conservation does not occur as a single event but rather as a gradual process, during which the specific context of people's everyday life have strong and immediate influences on specific energy consumption actions, and the negative consequences of the constraints are often underestimated. Smart Grid technology forms a necessary, but not sufficient, conditions for the effective design of these kind of interventions.

To design an intervention that facilitates users' behavior change process towards household energy conservation, the design should follow the theory-driven basis previously discussed with an iterative and user-centered co-design process. The design constructs and elements proposed often recur to be relevant and useful during design; they however need further contextualization and personalization with the engagement of local users and stakeholders.

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