BEYOND CARROT-AND-STICK: HOW VALUES AND ENDOGENOUS MOTIVATIONS AFFECT RESIDENTIAL GREEN IS ADOPTION

Completed Research Paper

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Abstract

Research on the adoption of information systems (IS) has been dominated by mechanistic motivational theories (extrinsic vs. intrinsic motivation). In contrast, the Self-Determination Theory (SDT) goes beyond the traditional dichotomy of extrinsic and intrinsic motivation by distinguishing between different types of motivation based on one's perceived self-determination when performing a behavior (Ryan and Deci 2000). Our study contributes to IS research by examining the role of endogenous motivation on the adoption of Green IS. Our research model additionally investigates the role of personal values as they ultimately motivate actions (Schwartz 2009) and are suggested to be important antecedents of eco-innovations' adoption. To test our model we collected data from an online survey from 1.319 consumers, both actual users and non-users. Results show that especially autonomous motivations are influential drivers of Green IS adoption. Further, a comparison of both groups reveals that extrinsic rewards tend to be more relevant for non-users.

Keywords: Green IS, endogenous motivation, personal values, technology adoption

Introduction

Based upon general motivational theories information systems (IS) research has a long history of examining individual motivation for IS adoption and acceptance in organizational and private settings (see Venkatesh et al. 2012; Venkatesh et al. 2003). These studies mostly understood motivation from a mechanistic perspective differentiating solely between extrinsic or intrinsic motivations. From this viewpoint extrinsically motivated users perceive a system as "instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions" (Davis et al. 1992, p. 1112). Intrinsically motivated users in contrast, use a system "for no apparent reinforcement other than the process of performing the activity per se" (Davis et al, 1992, p. 1112). For a long time the literature on organizational IS adoption treated IS predominantly as tools which are "implemented within an organization for the purpose of improving the effectiveness and efficiency" (Hevner et al. 2004). This utility-performance contingency also dominated research on individual IS adoption, that is understanding IS solely through its *instrumental value*, meaning what something is *for* (Yoo 2010). This perspective however neglects that people perform activities which do not necessarily have value for other things like experimenting with a system's features. These activities embody an *inherent value*, i.e. what something *is* (Yoo 2010). Prior studies consequently argue that a system's aim (i.e., utilitarian or hedonic) needs to be considered when studying the influence of different motivations (e.g., Hirschman and Holbrook 1982; Lin and Bhattacherjee 2010; van der Heijden 2004). However, what happens if a system's purpose is not purely utilitarian or hedonic? Those IS that provide both utilitarian and hedonic value are referred to as mixed systems (Sun and Zhang 2006).

A rapidly emerging class of mixed systems is Green IS. The main purpose of Green IS is to increase environmental sustainability (Melville 2010; Watson et al. 2010). Hence, different from conventional adoption in which resources are private, individual Green IS adoption entails a social welfare element since the environment is a common good. Therefore, Green IS is a special case of mixed systems as their aim is threefold: utilitarian, hedonic, and socio-environmental. Thus, employing conventional approaches to study the influence of motivations on Green IS adoption is not adequate as the traditional "carrot-and-stick" conception of motivation—that is incentives motivate behavior—neglects the impact of users' internalized principles and values that affect behaviors which are important antecedents of eco-friendly behavior (e.g., Milfont et al. 2010). In contrast to mechanistic motivational theories, the Self-Determination Theory (SDT) contends that in predicting behaviors the *type* of motivation—that is, autonomous versus controlled motivation—is more important than the mere *amount* of motivation (see Deci and Ryan 2002; Ryan and Deci 2000). People who perceive their actions as autonomously driven experience a sense of choice; whereas people whose behaviors are linked to feelings of external pressure and coercion perceive their actions as being controlled (Malhotra et al. 2008; Venkatesh 1999; Wunderlich et al. 2013). According to the SDT, motivation is endogenous, since individuals volitionally initiate all behaviors (Ryan and Deci 2000; Skinner 1953). This explanation contrasts with mechanistic motivation theories, which contend that behaviors are either being triggered extrinsically by rewards or intrinsically when the activity itself is the reward (exogenous motivation). SDT considers behavior as being motivated not directly by external stimuli, but rather by the subjective psychological meaning of these stimuli. This perspective treats behavior not as a result of expected rewards, but rather as an act of individual volition that may even be undermined by extrinsic rewards (Curry et al. 1991; Deci 1971; Dholakia 2006; Frey and Oberholzer-Gee 1997; Pritchard et al. 1977). Research on the adoption of eco-innovation additionally suggests that personal values related to universalism, benevolence, or hedonism are important determinants of adoption and usage (Jansson 2009; Kranz and Picot 2011). To advance our understanding of individual Green IS adoption and usage further, we also scrutinize the role of personal values on endogenous motivations as proposed by Vallerand's (1995; 1997; 2000) hierarchical model of motivation. In this model personal values influence contextual motivations which lead to beliefs and behaviors. In light of these observations, our study addresses the following research question:

> *RQ: Do values and endogenous motivations influence users' perceptions, intentions, and the use of residential Green IS in a hierarchical fashion?*

The goal of the present study is to extend research into the effects of motivation on information systems' individual adoption by delving more deeply into users' endogenous motivations. In particular, the present study assesses the impact on consumers' experienced volition by going beyond the dichotomy of extrinsic versus intrinsic motivation which overlooks the "independent, mutually reinforcing, or countervailing

effects of various motivations" (Malhotra et al. 2008, p. 270). The results will also contribute to the question of how to build sustainable IS (Watson et al. 2011) which is essential for the success of Green IS. To address our research question, we develop a comprehensive model drawing on research in social and environmental psychology and IS. To test our model, we conducted a large-scale customer survey. Specifically, we draw on representative samples of both non-users and users. The remainder of the paper is organized as follows: We first present the theoretical foundation and propose our research model. We then outline the research methodology and our results. The paper concludes with a discussion of the key results, implications of our findings, and directions for future research.

Theoretical Background

Motivation in IS research

IS research on motivation is still dominated by Davis et al.'s (1992) motivational model. Their model studied computer use at work emphasizing the dichotomy of extrinsic and intrinsic motivation. Since their seminal paper many studies in IS research adopted this conceptualization treating extrinsic motivation in instrumental terms—that is, with respect to its perceived usefulness—and intrinsic motivation as enjoyment or playfulness (Roberts et al. 2006; Venkatesh et al. 2003). For a long time the unchallenged assumption was that whether a system's adoption is influenced by extrinsic or intrinsic motivational drivers depends on the system's purpose (Gerow et al. 2012). While hedonic systems aim to generate pleasure, utilitarian systems' goal is to enhance performance. Recent research challenges this dichotomous categorization of IS suggesting that a system's purpose lies on a continuum between utilitarian and hedonic features (Sun and Zhang 2006). In this respect King (2005) and Gerow et al. (2012) found that the usage of utilitarian systems can also be influenced by hedonism. In their meta-analysis Gerow et al. (2012) provide evidence that for the adoption of utilitarian systems intrinsic motivation is equally important as extrinsic motivation in predicting the intention toward using utilitarian and hedonic systems. However, their meta-analysis drew upon the common conceptualization of extrinsic and intrinsic motivation of prior studies. These studies have considered motivation to differ only in terms of amount (e.g., Bandura 1996), in the sense that more motivated individuals "will aspire to greater achievement and be more successful in their efforts than people with less motivation" (Cadwallader et al. 2010, p. 221). Therefore, there is an urgent need for research into individual IS adoption that can provide a more systematic and comprehensive understanding of the influence of endogenous motivations particularly in relation to mixed systems (Gerow et al. 2012). Our study seeks to address this gap by going beyond the dichotomy of extrinsic versus intrinsic motivation that has dominated IS research for two decades as this view limits our understanding of the extent to which different types of endogenous motivations affect individual behavior. As Malhotra et al. (2008) claim, a "more generalizable conceptualization is necessary to account for users' endogenous psychological states to advance user motivation research". This is particularly important for IS adoption research since the same external stimuli can have different effects, which explains why some users more readily accept IT or services than other users do (Malhotra and Galletta 2003; Malhotra and Galletta 2004).

Green IS

Among scholars and business practitioners alike Green IS has recently attracted considerable attention since IS is projected to play a substantial role in the transition towards more efficient and environmentally sustainable business practices (Watson et al. 2010). Recent IS literature hence stresses the importance of Green IS as a major future strategic field in IS research and the IT industry (Baker et al. 2011; Dao et al. 2011; Melville 2010). Literature on Green IS addresses questions related to IS-usage of individuals, groups, organizations, and society that help eco-sustainable practices to emerge and diffuse (Chen et al. 2010; Dedrick 2010; Hilpert et al. 2013; Ijab et al. 2012). The impacts of Green IS on eco-sustainability can be classified into

(1) first order (direct effects due to the physical existence and usage of IS/IT, "Green in IS" or "Green IT"),
(2) second order (indirect effects due to more sustainable business processes, "Green by IS"),
(3) or third order effects (causing medium- or long-term changes of behavior towards more eco-sustainability) (vom Brocke and Seidel 2012, pp. 296).

Our study examines the determinants of individual adoption and usage of the smart metering technology (SMT) which has the potential to produce first, second and third order effects and thus to transform the energy sector. The SMT comprises a digital electronic meter and a communication gateway which allows bidirectional communication between households, energy suppliers, and all other actors in the electricity value chain. By improving communication and coordination, the whole electric system is supposed to work more efficiently and sustainably as renewable energy sources can be integrated more effectively. Beyond metering energy usage, the SMT enables the provision of a variety of home-energy management services to residential consumers. These services are defined as an assortment of services that are facilitated by the SMT and can be accessed via different channels using, for example, displays in the living area, the electricity meter, applications running on mobile devices, or the internet. Our definition of SMT does not differentiate between the services it facilitates and the access devices (e.g., home display, mobile device). They are treated as a holistic entity. For instance, the home-energy management services enable consumers to check their home energy consumption anytime and anywhere, to modulate demand according to load- and time-based tariffs (indirect load control), to automatically curtail or increase demand in peak or low-load times (direct load control), to use marketplaces for in-home consumer technologies or related support services. Thus, the services facilitated by the SMT provide convenience, security, and efficiency to users by entailing both utilitarian functions like controlling and reducing costs or providing detailed information about electricity usage and hedonic functions by providing value-added services such as home automation or assisted living. Beyond these direct benefits for users, the SMT also involves socio-environmental benefits. As the SMT helps reducing higher polluting peak demand and enable a more effective integration of often volatile renewable energy sources, they help providing energy in a more sustainable manner which preserves health, society, and the environment (Ostrom et al. 2010). Thus, unlike other mixed systems a blend of utilitarian, hedonic, and socio-environmental reasons is expected to drive Green IS adoption and usage.

Hypotheses Development

In the following, we develop our research model (see Figure 1). Traditional research into the adoption of innovations and information technology emphasizes that characteristics of the innovation or technology affect consumers' adoption or intention to adopt (Davis et al. 1989). However, other researchers have argued that consumer-related factors might be more important than innovation characteristics in explaining adoption behavior (e.g., Im et al. 2007; Kleijnen et al. 2005). Prior adoption research has demonstrated that motivations mediate the effects of innovation characteristics, such as relative advantage, complexity, or compatibility, on adoption and are thus powerful predictors of adoption (Meuter et al. 2005). The major foundations of our theoretical framework is Vallerand's (1995; 1997; 2000) model of hierarchical motivation and the Organismic Integration Theory (OIT), which is a sub-theory of SDT (Deci and Ryan 1985). Figure 1 shows our conceptual framework. Depending on the respondents' experience with the SMT, the dependent variable is either intention to adopt (non-users) or continuance intention (users). We refer to consumers' intention as the subjective probability that a person will adopt (non-users) or continue using (users) the SMT (Kim et al. 2009a).

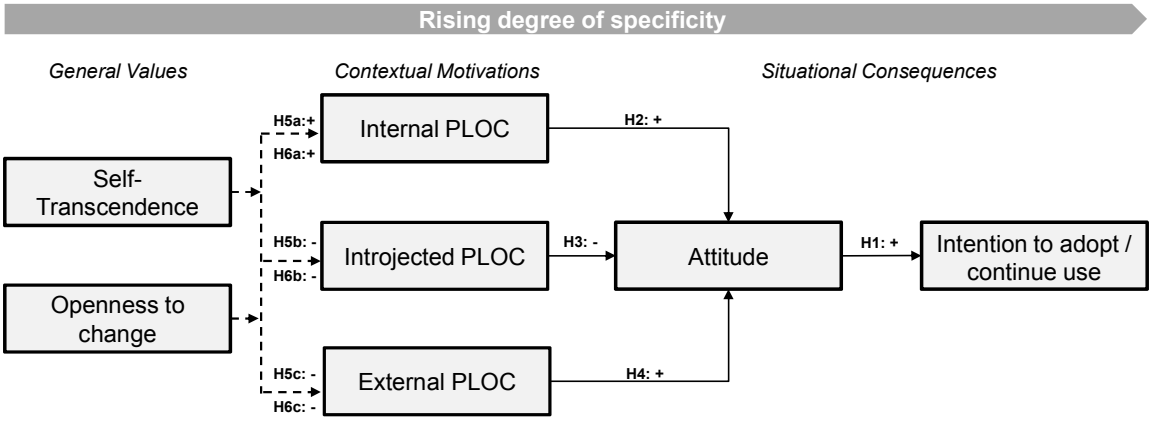

Figure 1. The research model

Although in the area of IS research attitude has mostly been treated as an ambiguous and inconclusive construct (Legris et al. 2003), in psychology its relevance for individual behavior has always been emphasized (Kim et al. 2009b; Yang and Yoo 2004). Psychology suggests that attitude guides individual behavior by filtering information and shaping an individual's perception of the world (Fazio 1986). It reflects a person's evaluation of performing a certain behavior, i.e. adopting a technology/service, is good or bad. In relation to technology adoption, attitude can be said to delineate the extent to which a person likes or dislikes using a technology (Venkatesh 1999). Attitude is at the high level of human cognition and can be regarded as the evaluation of a stimulus that helps to regulate the behavior with respect to the stimulus (Ajzen and Fishbein 2005). Individuals' beliefs that adopting or continuing to use SMT will lead to particular consequences (i.e., costs and benefits) will eventually determine their attitude toward adopting or using the technology. In the context of our study, attitude is conceptualized as a consumer's judgment of whether using the SMT is favorable or unfavorable. Prior research has found ample support for the impact of attitudes on the intention to adopt information technologies (Kranz and Picot 2011; Lee and Kozar 2008). We thus assume that the attitude towards using the SMT is positively related to intention.

Hypothesis 1: *Attitude towards the SMT positively influences the intention to use Green IS.*

Organismic Integration Theory: Internal, External, and Introjected PLOC

Using Green IS like SMT does not only result in benefits for users, such as lower expenditures or increased energy consumption control, but also in indirect benefits for society, such as lower greenhouse gas emissions. Consequently, the traditional "carrot-and-stick" notion that incentives motivate behavior neglects the impact of consumers' internalized principles and values on behaviors (see Dholakia 2006). Investigating this impact should be especially important for behaviors that are beneficial to individual consumers and society. In the past IS research has conceptualized motivation as primarily exogenous, meaning that behavior is a result of external stimuli. In contrast, our study of SDT considers behavior as being motivated not directly by external stimuli, but rather by the subjective psychological meaning of these stimuli. Our research design explores the contention that—in predicting behavior surrounding the use of SDT—the *type* of motivation—that is, autonomous versus controlled motivation—is more important than the mere *amount* of motivation (see Deci and Ryan 2002; Ryan and Deci 2000). Individuals who perceive their actions as autonomously driven experience a sense of volition and choice, whereas people whose behaviors are linked to feelings of pressure and coercion originating from external sources perceive themselves as being controlled. Prior research shows that perceived autonomous motivation has a greater effect on behavior than controlled forms of motivation (e.g., Cadwallader et al. 2010; Dholakia 2006; Malhotra et al. 2008; Venkatesh 1999).

In understanding the influence of the perceived degree of self-determination on behavior, OIT has proved to be valuable in a number of scientific areas (Cadwallader et al. 2010; Deci and Ryan 2002). OIT conceptualizes individually experienced levels of autonomy as existing along a continuum of motivation (see figure 2) referred to as the perceived locus of causality (PLOC), which is the degree to which an individual experiences a behavior as initiated and endorsed by the self (Ryan and Connell 1989). The degree to which individuals appropriate and internalize external influences determines the perceived locus of causality they experience when performing a behavior ranging from external to internal regulation. Regulation refers to an internalized principle or value (e.g., an individual sense of autonomy) that controls behavior (Cadwallader et al. 2010, Wunderlich et al. 2013). The more a value is appropriated and internalized, the more the regulation is perceived as autonomous. Hence, external regulation describes controlled forms of behavior that are performed because of external influences or pressures. In contrast, internal regulation implies that people perceive themselves as the origin of their behavior. That is, they experience the behavior as self-determined reflecting higher degrees of internalization. Thus, the continuum ranges from two relatively autonomous forms of motivation (i.e., intrinsic and identified regulation) to two relatively controlled forms of motivation (i.e., external regulation and introjected regulation) (Ryan & Connell, 1989). We suggest that the different types of PLOC exert cumulative effects on behavioral intentions that can be assigned to different types of endogenous motivations (Deci and Ryan 1985). Internal PLOC comprises feelings of volition, through which actors perceive themselves as the origin of behaviors occurring for reasons like enjoyment or because they are in line with personal values

and goals (Ryan and Connell 1989). By internalizing external regulations, individuals embrace the regulations as personally meaningful which is particularly pertinent to the adoption of Green IS.

PLOC refers to context-related motivations. Thus, PLOC is hypothesized to influence behavior not only through "the here and now of motivation" (Vallerand 1997, p. 293), but also beyond the various behaviors in a particular context through more generalized motivations. These motivations are associated with broad life contexts such as interpersonal relationships or the environment (Cadwallader et al. 2010). The hierarchical model of motivation proposes that motivation at the contextual level affects cognitions and motivation at the situation level in a top-down fashion (Vallerand 1997). Thus, OIT motivational constructs at the contextual level (i.e., internal, introjected, and external PLOC) are expected to be antecedents of attitude (Vallerand 1997).

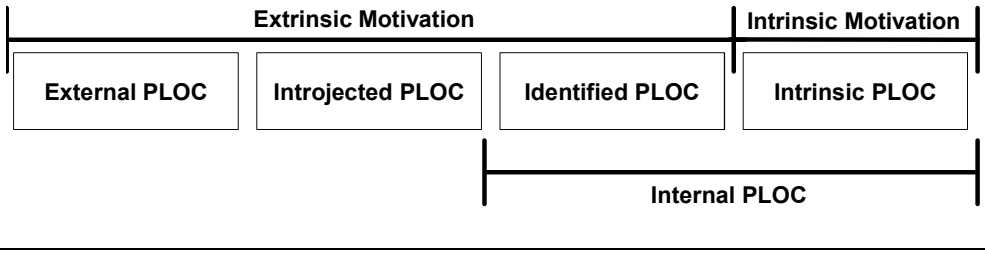

Figure 2. Endogenous motivations (based on Malhotra et al. 2008)

Internal PLOC

Internal PLOC comprises intrinsic and identified PLOC. Both states are characterized by feelings of volition in which actors perceive themselves as origins of the behavior. While intrinsic PLOC is associated with spontaneous and instinctive behaviors occurring for reasons like enjoyment, identified PLOC refers to actions in line with personal values and goals which are performed with a feeling of autonomy (Ryan and Connell 1989). In contrast to intrinsic PLOC the behavior is motivated extrinsically. However, the action is not triggered by external rewards or influences. Instead, external regulation is internalized so that individuals regard the regulation as personally meaningful. Identified PLOC is thus an important state with regard to the adoption of Green IS as their usage is linked with individual and societal improvements such as preserving the environment.

Individuals who are autonomously motivated to engage in a particular activity usually perceive their behavior in that context as important to themselves and valued and as congruent with their psychological needs (Sheldon 2002). Contextual motivation is expected to lead to greater awareness, interest, and value regarding the respective behavioral outcomes. As a result, individuals are more likely to recognize related information that delineates the benefits of the behaviors and they thus form a positive attitude (Hagger et al. 2006). Thus, if consumers internalize external regulations regarding the SMT's positive impact on environmental sustainability in a way that the behavior is perceived as a self-endorsed choice, they will be more likely to adopt and use the SMT. Additionally some people may be intrinsically motivated to adopt the SMT either because of curiosity (e.g., detailed information on energy usage) or to find out whether they are able to reduce their home energy consumption. Therefore, we propose

Hypothesis 2: *Internal PLOC positively influences the attitude to use Green IS.*

Introjected PLOC

Introjected PLOC refers to a state in which a behavior is performed because of "contingencies administered by the self, such as the pursuit of contingent self-worth or the avoidance of affective states such as guilt or shame" (Hagger et al. 2006). When adopting or using an IS under the influence of introjected PLOC the behavior is not one's volitional choice, but the behavior of others is imposed on oneself (Walsh et al. 2010). IS are then used to increase individual self-esteem and to appeal to others who are deemed important. When performing a behavior that is motivated by such extrinsic motivations

individuals often have feelings linked to pressure, ambivalence, anxiety, or frustration (Ryan and Deci 2000b). This is the result of a negative correlation between self-valuation of associated tasks as well as perceived autonomy and behavioral intentions (Deci et al. 1994). Behavior driven by introjected PLOC is therefore expected to result in negative evaluative feelings as individuals perceive the behavior as mandated. This phenomenon is particularly prevalent in the domain of eco-friendly behaviors as performing these behaviors is often a result of social influence. Thus, if an individual feels guilty or ashamed if not adopting/using an IS, the more unfavorable the attitude towards using the IS (Csikszentmihalyi 1998). Therefore, we propose

Hypothesis 3: *Introjected PLOC negatively influences the attitude towards using Green IS.*

External PLOC

External PLOC, corresponding to an external regulation represents extrinsic motivation in its most basic way. Individuals then perceive their behavior as a result of external authorities or compliance (Ryan and Connell 1989). External PLOC represents the least autonomous form of extrinsic motivation. An individual may then adopt an IS because of coercive pressure from influential others. However, an individual may adopt or use the same system because external regulations are personally important. Thus, if external motivations like financial rewards or social appreciation for acting as an environmentally responsible person are personally important to users they should still have a positive influence on attitude (Melancon et al. 2011). Therefore, we propose

Hypothesis 4: *External PLOC positively influences the attitude towards using Green IS.*

The Role of Personal Values

Social psychology defines a personal value as "an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" (Rokeach 1973, p. 5). Reflecting the central role of values as guiding principles of thought and action (Feather 2002; Rohan 2000) literature in a number of fields, including IS (Myyry et al. 2009), consumer behavior (Durvasula et al. 2011) and environmental psychology (Milfont et al. 2010; Stern et al. 1993) has intensively studied the impact of values on attitude and behavior. In this respect consumers' behaviors can be viewed as a means to reach desired values or end-states (Michon and Chebat 2004). However, as values are rather broad dispositions the influence on behavior is mediated through a number of less abstract factors such as worldviews, belief, and attitudes (Milfont et al. 2010). Both Vallerand (2000) and Schwartz (2009) contend that values can be used to explain the motivational bases of attitudes and behavior of individuals and societies. Accordingly we assume that cognitions are structured hierarchically ranging from abstract cognitions (e.g., values) to mid-range cognitions (e.g., motivations) to specific attitudes affecting a particular behavior. The most commonly used method to measure value clusters (self-transcendence, self-enhancement, openness to change, and conservatism, see figure 3) is Schwartz's Value Survey (SVS) (Schwartz 1992; Schwartz and Boehnke 2004). The SVS distinguishes ten distinct values which can be characterized along two bipolar dimensions. The first dimension relates to the conflict between *openness to change* (following personal interests and being flexible and open-minded) versus *conservation* (preserving the status quo and conforming to norms and traditions). The second dimension relates to the conflict between collective-oriented biospheric and altruistic values (*self-transcendence*) and individual-oriented values associated with power, hedonism, and achievement (*self-enhancement*). Research in environmental psychology has shown that these clusters relate to both environmental attitudes and ecological behavior (Milfont et al. 2010).

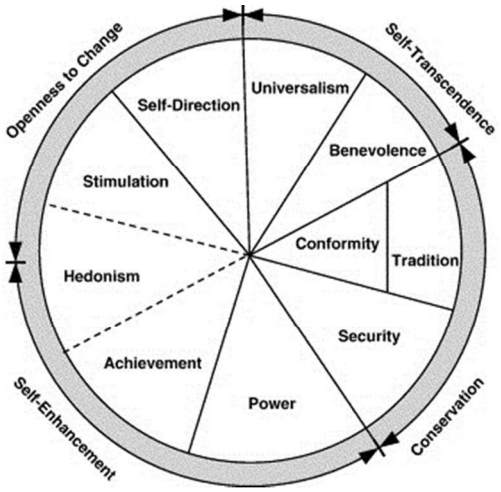

Figure 3. Schwartz's model of the relations between values (based on Schwartz 1992)

Self-transcendence

The self-transcendence cluster comprises biospheric (environmental) and altruistic (non-environmental) values. In predicting eco-friendly behaviors self-transcendence has been found to influence environmental attitude and behaviors (Milfont et al. 2010; Schultz et al. 2005). Using the SMT has positive effects on the natural environment as electric power can be used more efficiently. Thus, the adoption/usage of SMT can be regarded as an eco-friendly behavior associated with consumers' altruistic and biospheric orientation as reflected by the self-transcendence cluster. Values like benevolence and universalism are regarded as origins of any green consumer behavior (McCarty and Shrum 2001; Stern et al. 1993). Empirical studies support this notion. For instance, Poortinga et al. (2004) found that the acceptability of home energy-saving measures increases with people's environmental concerns and decreases with the importance of the self-enhancement value dimension. Variables reflecting individuals' social and biospheric orientation also proved to be positively related to the adoption of various eco-innovations like alternative fuel vehicles (Jansson 2009), domestic photovoltaic systems (Keirstead 2007), and the participation in green electricity programs (Clark et al. 2003; Rowlands et al. 2003).

Following Vallerand (2000) and Schwartz (2009) we hypothesize that one's self-transcendent orientation has an indirect influence on attitude through PLOC since PLOC refers to broader contextual motivations and attitude is at the high level of human's cognitions. Internal PLOC refers to a state in which an individual is either intrinsically motivated or has internalized external stimuli which are congruent with one's values. Thus, we contend that the higher a user's altruistic (a world at peace, social justice and equality) and biospheric (protecting the environment, respecting nature, unity with nature) values, the higher their internal PLOC. In contrast, the relationship between self-transcendence and introjected and external PLOC in contrast is expected to be negative. Pursuing a behavior for external contingencies such as obedience or self-esteem (introjected PLOC) or financial rewards (external PLOC) is driven by values opposed to self-transcendence, i.e. self-enhancement. If an individual is oriented towards self-enhancement then SMT-adoption/usage is more likely to be affected by external regulation such as avoiding shame and increasing social prestige among peers, family, or neighbors (introjected PLOC). Similarly for external PLOC, values linked to one's self-interest (e.g., energy savings, convenience) are expected to have a greater influence than altruistic or biospheric values. Therefore, we propose

Hypothesis 5a: *Self-transcendence is positively related to internal PLOC.*

Hypothesis 5b: *Self-transcendence is negatively related to introjected PLOC.*

Hypothesis 5c: *Self-transcendence is negatively related to external PLOC.*

Openness to change

The higher-order cluster of openness to change is comprised of values regarding stimulation and self-direction and is opposed to the conservation cluster that pools values related to security, conformity, and tradition. This bipolar dimension indicates the extent to which people are motivated to follow their own intellectual and emotional interests in unpredictable and uncertain situations (openness) versus conserving the status quo and the certainty it provides (conservation) (Schwartz and Boehnke 2004). With regard to the influence of openness to change on internal PLOC we assume that the more innovative, independent, and excitement-seeking an individual is, the higher their perceived internal PLOC with regard to adopting/using a new technology. On the contrary we hypothesize that users aiming at preserving the status quo and its certainty are inclined to adopt/use a new IS like the SMT especially if they conform with and appeal to other people. Thus, we expect that openness to change will be negatively related to introjected PLOC. Moreover, we assume that openness to change will influence external PLOC negatively. Following Schwartz and Boehnke (2004) we posit that more conservative users tend to obey more to the recommendations of authorities such as governments, NGOs and are more attracted by health- and safety-preserving technologies and services. While openness to change may be positively associated with the convenience of services enabled by the SMT through its relation to hedonism, we hypothesize that the influence of self-direction referring to enjoying one's independence and being outside of the control of others prevails, since using the SMT and its services means ceding some control over consumption to third parties. Therefore, we propose

Hypothesis 6a: *Openness to change is positively related to internal PLOC.*

Hypothesis 6b: *Openness to change is negatively related to introjected PLOC.*

Hypothesis 6c: *Openness to change is negatively related to external PLOC.*

Research Design and Method

Sample and Data-Collection Procedure

In order to empirically test our conceptual framework and hypotheses, we conducted a large-scale survey. Our study draws on a sample of both actual users and non-users of the SMT. To collect a representative sample of users, we collaborated with a major energy provider in Germany. The company provided access to their customer database. We drew a random sample of 6,500 users who were invited via email to participate in an online-survey. To collect a sample of non-users, we collaborated with a market research company that hosts a representative panel of German citizens. Members of this panel were invited to participate in the survey if they were (co-)responsible for energy decisions in their household. In total 2,117 consumers were invited via email to participate in the survey. We removed uncompleted questionnaires and questionnaires with an implausibly short handling time. With respect to the non-users, 675 completed questionnaires were used for further analyses resulting in a high response rate of 41.6 %. The participants ages ranged from 16 to 77 (mean: 49) and 49.9 % were female. With respect to the users, 644 completed questionnaires were used for further analyses (response rate 16.1%). The participants ages ranged from 18 to 79 (mean: 54) and 10.9 % were female. The high percentage of male respondents in the user sample can be explained by the fact that multi-person households dominate the regional market served by the energy provider and when asked for the person (co-)responsible for energy-related decisions mostly men replied.

Measurement of Constructs

We followed standard psychometric scale development procedures. All scales used in the study together with descriptive statistics and psychometric properties are shown in Table 1 and in the Appendix. If not indicated otherwise items were assessed on a seven-point Likert-type rating scale ranging from strongly disagree (1) to strongly agree (7). We aimed to use existing items as much as possible but had to adapt them to the context of this study. First, the items were evaluated by peers and experts in the area of technology adoption and psychology. Based on the reviews several items were reworded or rephrased. This helped to achieve face and content validity of the scales (Hardesty and Bearden 2004; Moore and Benbasat 1991). Further, we conducted a series of pilot studies to evaluate and refine our measures. We conducted a qualitative (with eight practitioners and eight researchers) and two quantitative pilot studies

(with n = 20 and n = 110) (Moore and Benbasat 1991). While the sample for the pilot study was small, the computed reliabilities of the scales indicated that they were appropriate for use in a larger study (Brown and Venkatesh 2005). In the final model, we measured our dependent variable, the customer's intention to adopt the SMT, with a reflective three-item scale based on Davis et al. (1989). Similar to Kim et al. (2009a), we measured adoption intention for actual non-users and continuance intention for users (Bhattacherjee 2001). We used reflective measures for the customer's attitude towards the technology (three items) based on Davis et al. (1989).

For the three scales capturing the internal, introjected and external perceived locus of causality (PLOC), we employed measures proposed by Ryan and Connell (1989) and added additional items to create a better fit to the study's context resulting in a reflective four-item scale for the internal, a reflective three-item scale for the introjected PLOC and a reflective three-item scale for the external PLOC.

Self-transcendence and openness to change were measured with the 10-item 'Short Schwartz's Value Survey' (Lindeman and Verkasalo 2005). Respondents rated each value on a nine-point rating scale 'as a guiding principle in my life' ranging from -1 (opposed to my values), 0 (not important) to 7 (of supreme importance). To calculate the dimensions of self-transcendence and openness to change based on this scale, we used the formula proposed by Lindeman and Verkasalo (2005).

Analysis

SmartPLS Version 2.0 M3 (Ringle et al. 2005) was used to analyze the data. PLS models are typically analyzed in two stages: The first stage involves the assessment of the reliability and the validity of the measurement model and the second stage involves the assessment of the structural model (Hulland 1999).

To assess the validity of our instruments we performed tests recommended in prior research using PLS (e.g., Bhattacherjee and Premkumar 2004; Brown and Venkatesh 2005; Chin 1998, 2001; Gefen and Straub 2005; Hulland 1999). Convergent item validity can be established by satisfying three criteria: First, each item should load significantly on their respective constructs (Gefen and Straub 2005). While many researchers suggest that items should have a loading of .70 or above, others suggest that it is "often common to find that at least several measurement items in an estimated model" have loadings below "the .70 threshold, particularly when new items or newly developed scales are employed" (Hulland 1999). Good research practice also suggests that items with loadings less than .50 should be dropped (Hulland 1999). Second, the composite reliabilities should be greater than .70 (Hulland 1999), and third the average variance extracted (AVE) for each construct should be greater than .50 (Bhattacherjee and Premkumar 2004). Each of the items loaded significantly on their respective construct; all items (except for one) had loadings of .70 or higher, and none of the items loaded on their construct below the cutoff value of .50. Further, as Tables 1a and 1b highlight, the composite reliabilities of all constructs are over .70 and the AVEs of all constructs are beyond the threshold value of .50. This established the convergent validity of our items.

Gefen and Straub (2005) suggest that discriminant validity can be established by examining the correlation between the latent variable scores with the measurement items, and ensuring that the measurement items load higher on their "assigned factor" than on any other factor which is the case in our study. Another way to establish discriminant validity is to ensure that the square root of the AVE of a construct exceeds all correlations between that factor and any other construct within the study (Bhattacherjee and Premkumar 2004; Fornell and Larcker 1981; Gefen and Straub 2005). Tables 1a and 1b highlight that the square root of the AVEs for all the constructs are indeed larger than the correlation between that construct and other constructs (the square root of the AVEs is reported on the main diagonal, with the off-diagonal cells reflecting the correlation between that construct and other constructs). This confirmed the relative discriminant validity of our instrument.

Table 1a. Correlations and Measurement Information (Non-User Sample)

	Mean (STD)	CR	AVE	1	2	3	4	5	6	7
Attitude	5.08 (1.65)	.97	.91	**.95**						
External PLOC	4.79 (1.96)	.86	.67	.66	**.79**					
Internal PLOC	4.32 (1.85)	.92	.74	.69	.67	**.84**				
Introjected PLOC	2.31 (1.44)	.93	.81	.14	.21	.29	**.90**			
Intention	4.11 (1.69)	.96	.88	.70	.62	.73	.25	**.91**		
Openness to change	3.97 (0.42)	-	-	.01	-.04	.01	-.02	.01	**1.00**	
Self-Transcendence	4.55 (0.58)	-	-	.04	.04	.07	.04	.00	-.57	**1.00**

Note: STD: standard deviation; CR: composite reliability; AVE: average variance extracted. CR and AVE cannot be computed for formative measures.

Table 1b. Correlations and Measurement Information (User Sample)

	Mean (STD)	CR	AVE	1	2	3	4	5	6	7
Attitude	5.64 (1.53)	.96	.90	**.95**						
External PLOC	4.36 (1.96)	.79	.57	.28	**.79**					
Internal PLOC	4.90 (1.69)	.88	.64	.54	.46	**.84**				
Introjected PLOC	1.88 (1.37)	.92	.80	-.11	.19	.09	**.90**			
Intention	4.54 (1.72)	.91	.77	.55	.34	.56	.01	**.91**		
Openness to change	3.93 (0.38)	-	-	-.00	-.01	.02	-.02	.03	**1.00**	
Self-Transcendence	4.54 (0.56)	-	-	-.01	.01	.01	-.03	-.08	-.52	**1.00**

Note: STD: standard deviation; CR: composite reliability; AVE: average variance extracted. CR and AVE cannot be computed for formative measures.

Results

Hypothesis Testing

To test the hypothesized effects of our model we examined the significance of the parameter estimates using bootstrapping with n = 1,000 samples. Results of model estimations are shown in Table 2. Results confirm the hypothesized positive effect of consumers' attitude towards the SMT on the consumer's intentions ($\beta_{non\text{-}users} = .70$, $p < .01$; $\beta_{users} = .55$, $p < .01$), confirming H1 for both samples.

With respect to the role of the consumer's perceived locus of causality, internal PLOC positively affects the attitude towards the SMT in both samples ($\beta_{non\text{-}users} = .47$, $p < .01$; $\beta_{users} = .52$, $p < .01$). The introjected PLOC shows a negative effect on consumer's attitude towards the SMT ($\beta_{non\text{-}users} = -.08$, $p < .01$; $\beta_{users} = -.17$, $p < .01$), whereas external PLOC – as hypothesized – has a positive effect in both samples ($\beta_{non\text{-}users} = .36$, $p < .01$; $\beta_{users} = .08$, $p < .05$). Thus, we find support for H2-H4.

Concerning the values, self-transcendence has a significant positive effect on the internal PLOC in the non-user sample, whereas its effect is not significant in the user sample ($\beta_{non\text{-}users} = .11$, $p < .05$; $\beta_{users} = .03$, $p > .05$).Thus, H5a is supported for the non-user sample, while it has to be rejected in the user sample.

The effects of self-transcendence on the introjected ($\beta_{non\text{-}users}$ = .05, p > .05; β_{users} = -.05, p > .05) and external PLOC ($\beta_{non\text{-}users}$ = .03, p > .05; β_{users} = .01, p > .05) are not significant in either of our samples. Thus, H5b and c are rejected. Regarding openness to change, the data did not support H6a proposing that openness to change has a positive effect on the internal PLOC ($\beta_{non\text{-}users}$ = .07, p > .05; β_{users} = .03, p > .05). H6b stating that openness to change negatively influences introjected PLOC was also rejected by the data ($\beta_{non\text{-}users}$ = .01, p > .05; β_{users} = -.05, p > .05). H6c also had to be rejected. Openness to change did not show a significant effect on the external PLOC ($\beta_{non\text{-}users}$ = -.03, p > .05; β_{users} = -.00, p > .05). Overall, the model could explain a substantial proportion ($R^2_{non\text{-}users}$ = .55; R^2_{users} = .32) of the variance in consumer's intentions for both samples.

Comparison of Users and Non-Users

To test for systematic differences among non-users and users of the SMT we additionally conducted an exploratory analysis as reported in Table 2. We estimated our structural model for both sub-samples separately. We then tested whether the parameter estimates obtained for the sub-samples significantly differed using the t-test suggested by Chin (2000). The idea is to test whether the differences in the parameter estimates between the two samples are different from zero.

Table 2. Results of Model Estimation and Model Comparison

	Non-User Sample	**User Sample**	**Sample Comparison**	
Path	Path Coefficient	Path Coefficient	t-value	p
Attitude → Intention (H1)	.702**	.552**	3.879	.000**
Internal PLOC → Attitude (H2)	.470**	.516**	.834	.405
Introjected PLOC → Attitude (H3)	-.075**	-.167**	1.795	.073
External PLOC → Attitude (H4)	.361**	.079*	5.259	.000**
Self-Transcendence → Internal PLOC (H5a)	.107*	.026	1.142	.254
Self-Transcendence → Introjected PLOC (H5b)	.046	-.050	1.424	.155
Self-Transcendence → External PLOC (H5c)	.030	.011	.261	.795
Openness to change → Internal PLOC (H6a)	.070	.030	.580	.562
Openness to change → Introjected PLOC (H6b)	.010	-.048	.894	.372
Openness to change → External PLOC (H6c)	-.026	-.001	.338	.735
Note: **p < .01, *p < .05.				

Most of the results do not differ significantly between users and non-users. Only two significant differences can be observed. First, the external PLOC is a stronger determinant of the attitude towards the SMT for non-users than for users ($\beta_{non\text{-}users}$ = .36, β_{users} = .08; t = 5.26, p < .01). Although only significant at the 10% level, the same effect is observable with regard to the relationship between introjected PLOC and attitude towards the SMT ($\beta_{non\text{-}users}$ = -.08, β_{users} = -.17; t = 1.80, p < .10). Second, attitude towards the SMT has a greater influence on consumer's intentions for non-users than for users ($\beta_{non\text{-}users}$ = .70, β_{users} = .55; t = 3.88, p < .01).

Discussion

The goal of this study was to develop and test a comprehensive model of residential consumers' intention to adopt or continue using a particular Green IS. Understanding the influence of consumers' values and

endogenous motivations regarding the SMT and the services it enables is both a business asset and a social imperative to ensure sustainable energy production and consumption. Moreover, such innovations are increasingly viewed as an enabler of a "society-driven innovation" with policies at national and regional level that are "using service innovation to address societal challenges and as a catalyst of societal and economic change" (European Commission 2009, p. 70). We developed and tested our model with a sample of 1.319 actual users and non-users of the SMT. Our study shows that consumers' endogenous motivational states are important direct antecedents of attitude and indirect antecedents of non-users' adoption intention and users' continuance intention. Overall, the model reliably explained a high amount of variance of attitude (R^2_{users} = .32, $R^2_{non\text{-}users}$= .55). Our study contributes to IS research in the following ways:

Our results refine our understanding of user motivations by disentangling the role of collections of motivations affecting consumers. Different endogenous motivations are shown to have different effects on users' attitudes. For both samples internal PLOC was found to be a stronger predictor than external and introjected PLOC. This finding is in line with prior work on the effects of external rewards on the adoption of e-learning systems (Malhotra et al. 2008) and on relational marketing outcomes (Dholakia 2006; Melancon et al. 2011). With greater experience external stimuli seem to be more fleeting implying that current SMT-users are predominantly driven by volition and feelings of autonomy. External PLOC was also shown to have a substantial effect on attitude for both samples. However, the impact was significantly stronger for non-users implying that their attitude formation relies more on external rewards and regulations compared to the early adopting group of SMT-users. The study's results further confirm the hypothesized negative influence of introjected PLOC on attitude. When a behavior is performed to avoid shame and to obey others, an individuals' attitude towards that behavior is negatively affected. This effect is significantly stronger for users than for non-users. For the user-group the attitude towards a behavior that is perceived as imposed by others is especially unfavorable. The early adopting user group seems to be more independent and nonconformist. In general, the findings implicate that mixed systems like the Green IS examined in our study is driven by a blend of factors pertaining to performance-related, hedonic, and socio-environmental outcomes whose importance differ among users and non-users. Thus, the study provides evidence that the drivers of individual adoption and use are more dependent on an individual's assessment and characteristics than the system's purpose. Therefore, IS research should abandon the long-standing notion that the aim of an IS serves as a boundary condition (Gerow et al. 2012) for the determinants of adoption: this is essential in order to avoid neglecting crucial factors that affect the adoption of contemporary mixed IS.

Theoretical Implications

The study conbributes to IS sustainability research by investigating the effect of values. A key characteristic of residential Green IS is to deliver services in a sustainable manner, i.e., preserving health, society and the environment. However, our results provide marginal evidence for values regarding altruism and universalism (self-transcendence) and stimulation, self-direction and some hedonism (openness to change) significantly affecting attitude towards adopting or continuing to use Green IS. Although research in environmental psychology and consumer behavior stresses the role of values, only self-transcendence was found to influence internal PLOC significantly in the non-users sample. Several other studies report similarly weak findings. Although values represent what is important to individuals in life, predicting their influence on specific behaviors or contextual motivations is difficult. Research in psychology suggests the impact of values is rarely conscious (Schwartz 2009). Hence, though values refer to desirable objectives that motivate action, values often do not enter individuals' awareness when evaluating a particular behavior. Another reason for the weak influence of values on motivations may lie in employing the short version of Schwartz's Value Survey due to space restrictions: some recent research indicates that the short form may suffer from low reliability (Verkasalo et al. 2009). Thus future research may better apply the full SVS. Some studies such as (Cai and Shannon 2012) claim that values have a direct effect on attitude. We tested these relationships but could not find evidence for self-transcendence or openness to change directly affecting attitude.

To sum up, the study found strong empirical evidence that endogenous motivational factors are important determinants of attitude formation and weak evidence for values affecting contextual motivations. Therefore, we encourage further research to delve more deeply in the role of endogenous motivations and the value-motivation nexus. In both samples internal PLOC had a substantial positive effect on attitude. As

the construct internal PLOC comprises intrinsic motivations such as natural inclinations toward mastery, interest, and exploration Green IS research can use our findings to study behavioral triggers of individual Green IS adoption in more depth and to build IS that combine utilitarian, hedonic, and socio-environmental features in a way that positively "nudges" individual behavior. With respect to the weak relation between values and motivations, Vallerand (2000) suggests that in some situations the influence of values might be mediated by other factors such as competence, relatedness, or autonomy which might offer a fruitful direction for future research. It is also possible that Green IS adoption is affected only by some of the SVS value dimensions such as universalism or tradition. Hence, future studies may focus on particular value dimensions which are presumed to influence endogenous motivations. The study also yields important inferences for research in the domain of Green IS adoption and acceptance. The results suggest that external regulation in the form of incentives and recommendations that are consistent with consumers' values positively influence individual endogenous motivations which eventually increase the probability of individuals performing the behavior in question. The challenge for Green IS research is thus to delve deeper into the question which consumer segments (e.g., innovators, early adopters, early majority, late majority, and laggards) are affected by which external regulations to increase their extrinsic motivation.

Managerial Implications

Social, legal, and economic pressures are forcing companies from diverse sectors to implement environmentally sustainable business practices for delivering goods and services (Melville 2010; Watson et al. 2011). An increasing number of corporations are embracing a triple bottom line perspective towards sustainability. This includes a firm's environmental, societal, and economic performance (Elkington 1997). The present study focuses on the energy sector, which is especially affected by the movement towards environmental sustainability. The diffusion of SMT is the key enabler of energy suppliers' move from a goods-oriented business model (producing and selling energy) towards a service- or solution-based approach and to manage the fundamental shift towards a more green energy supply. By providing a bidirectional communication channel SMT enables a variety of home-energy management services. The key question is how to leverage and market the technology and encourage consumers to use SMT and the services it enables. Our study presents important insights into the underlying needs and motivations of consumers required to build eco-effective IS (Chen et al. 2008; Watson et al. 2011). Our findings underline the substantial positive effect of internal PLOC. Users who feel non-coerced about adopting Green IS are more likely to do so. Thus, providers of Green IS have to establish an understanding about which extrinsic and intrinsic motivations are important to their target groups. However, as our study shows firms have to take into consideration that 'visionary' early users are driven by other factors than the more 'pragmatic' group of actual non-users. As the results show, external PLOC has a stronger effect on the attitudes towards the SMT of inexperienced users. Hence, reaching the mainstream customer requires providing meaningful extrinsic motivations which complement users' internal PLOC-driven by their feelings of autonomy.

Limitations and Further Research

Besides it contributions, this study also has some limitations which should be addressed by future research. First, this study was geographically confined to Western Europe, more precisely the South-West of Germany. Future research should address cultural and regional differences to validate the results. Second, the cross-sectional design of the data limits our findings in at least two ways. First, with regard to transformative services, user perceptions may change significantly over time: for example, because of changing societal values or contemporary incidents. Second, the posited causal relationships can only be inferred. Thus, we encourage future research to employ longitudinal research designs. Third, we focused on a particular Green IS. This may limit the generalizability of the findings. Further research might investigate other Green IS building upon our research model. Finally, our model could be extended to investigate moderators of the effects of external and internal PLOC to answer questions about when and how the effects of these psychological states differ.

Conclusion

A key goal of adoption research is to identify and understand how managerially controllable antecedents influence consumers' adoption intentions. This study provides important insights into the role of

endogenous motivations guiding consumers' attitudes towards adopting Green IS. By disentangling extrinsic and intrinsic motivations our research provides new evidence on how sustainable services adoption is influenced by different endogenous psychological states. Our study serves as a starting point for further research into the role of users' endogenous motivations and values on Green IS and provides essential implications for building Green IS. From a practitioners' point of view the model can help to identify effective strategies to address and encourage customers to use Green IS by increasing endogenous motivations. Such strategies are expected to lead to a more persistent and superior behavioral performance (Deci and Ryan 2002).

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Appendix

Construct (Source)	**Items**
Attitude towards the SMT (Davis et al. 1989)	I assume that it is a good idea to use the SMT. I think that it is reasonable to use the SMT. All in all, I think it is a bad idea to use the SMT.* I like the idea, to use the SMT.
Intention to adopt the SMT (Davis et al. 1989)	I can imagine using the SMT regularly in my household. I plan to use the SMT in the future. I intend to use the SMT in everyday life.
Internal PLOC (Ryan and Connell 1989)	I use the system ... ... because I want to help protecting the environment. ... because I personally like using the SMT. ... because I think it is personally important to myself. * ... because I want to learn how to use the SMT. ... because I enjoy using the SMT.

External PLOC (Ryan and Connell 1989)	I use the system ... ... because it is recommended by my energy supplier. ... because it is recommended by governmental institutions.* ... because using the SMT offers me financial incentives. ... because the European Union recommends using the SMT.* ... because I can avoid price peaks in peak load times.	
Introjected PLOC (Ryan and Connell 1989)	I use the system... ... because I would feel bad about myself if I don't use the SMT.* ... because my peers think that I should use it. ... because it is "in" to do something to help protecting the environment.* ... because my friends think that I should use it. ... because I want my colleagues to like me.	
The 10-item, 9-point Short Schwartz's Value Survey (0=opposed to my values, 1=not important, 4=important, 8=of supreme importance) (Lindeman & Verkasalo, 2005)	Power	Social power, authority, wealth, successful, capable, ambitious, influential
	Achievement	Pleasure, enjoying life, self-indulgent
	Hedonism	Daring, a varied life, an exciting life
	Stimulation	Creativity, curious, freedom, independent, choosing own goals
	Self-direction	Protecting the environment, a world of beauty, unity with nature
	Universalism	Equality, a world at peace, social justice, broadminded, wisdom
	Benevolence	Helpful, honest, forgiving, loyal, responsible
	Tradition	Humble, devout, accepting my portion in life, respect for tradition, moderate
	Conformity	Politeness, obedient, honoring parents and elders, self-discipline
	Security	National security, social order, clean, family security, reciprocation of favors
Note: * Items were dropped as they had low factor loadings on respective constructs.		