

# The Impact of Endogenous Motivations on Adoption of IT-Enabled Services: The Case of Transformative Services in the Energy Sector

Journal of Service Research  
16(3) 356-371  
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sagepub.com/journalsPermissions.nav  
DOI: 10.1177/1094670512474841  
jsr.sagepub.com  


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## Abstract

Transformative services represent a crucial topic in future service research. Particularly in the energy sector, consumer adoption of transformative—often IT-enabled—services is essential to increased environmental sustainability. As adopting these services increases both individual and collective well-being, research has to delve more deeply into the origins of consumers' motivations. For this reason, this study aims at augmenting the understanding of how different types of motivation determine consumers' intention to adopt transformative services. The proposed model integrates the theory of planned behavior and the self-determination theory and is tested with survey data gathered from 462 users and 537 nonusers of home energy management services. Results indicate that consumers' motivations are major direct determinants of intentions to adopt. While this finding notably holds when consumers perceive the adoption as self-determined and internalize associated values such as environmentalism, motivations based on external rewards and feelings of compulsion matter to a lesser extent. A comparison of users and nonusers reveals important differences in motivation, in particular that extrinsic motivations tend to be more relevant for nonusers than for users.

## Keywords

IT-enabled services, consumer motivation, information technology, transformative services, service adoption

Recent service research has underlined the major strategic importance of sustainability and technology infusion for service innovations (Kunz and Hogreve 2011; Ostrom et al. 2010), making the development of transformative services one of the current top research priorities. In investigating transformative service, which is a “service that centers on creating uplifting changes and improvements in the well-being of both individuals and communities” (Ostrom et al. 2010, p. 12), researchers highlighted that these services should be particularly effective for improving the sustainability of production and consumption.

Research on information systems (IS) has also emphasized that information technology (IT) is a “change actant in sustainability innovation” (Bengtsson and Ågerfalk 2011, p. 96), and that “Green-IS” in particular presents a major future challenge for the IT sector. Research analyzing how IS can help reduce energy consumption to support environmental sustainability is of particular interest (Watson, Boudreau, and Chen 2010). In this respect, “emerging information and communication technology services can have a major impact on future energy and resource consumption through a range of services, including remote working, energy and waste management systems, improved logistics, and so on” (Ostrom et al. 2010, p. 12).

Thus, technology and service infusion as well as transformative services are particularly important in the energy sector.

Ongoing liberalization of energy markets, scarcity of and dependence on fossil resources, and environmental concerns have been triggering substantial changes throughout the industry. More specifically, the share of renewable, often decentralized energy sources like wind or photovoltaic often produced by consumers has been expanding on a large scale (Achrol and Kotler 2012).

As a response to these challenges, energy suppliers are being forced to move from a goods-oriented business model (producing and selling energy) to a service- or solution-based approach, such as managing energy production and consumption, marketing energy produced by consumers, or offering home automation services. To achieve this fundamental change, smart metering

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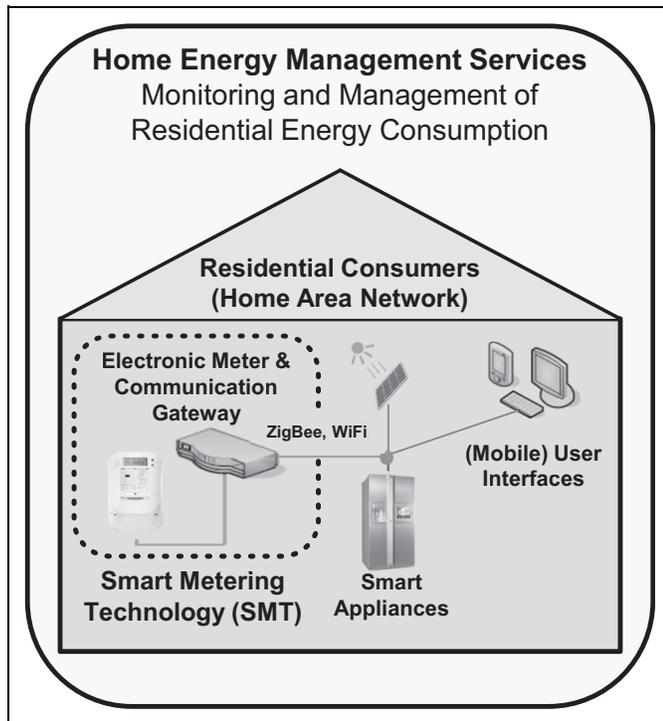
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**Figure 1.** The nature of home energy management services.

technology (SMT) is crucial for energy suppliers (Accenture 2011). SMT is an IT artifact that comprises a digital electronic meter with an intelligent communication gateway (Figure 1), which allows bidirectional communication both within households (e.g., the gateway manages smart home appliances' energy consumption) and between households, energy suppliers, and other actors along the value chain (e.g., by sending price signals to households).

SMT allows the electric system to work more efficiently and sustainably. Beyond metering energy use, SMT enables transformative services, which we refer to as home energy management services (HEMS), which serve as a mechanism to “incentivize consumers to fulfill their needs from services that are less resource intensive than their corresponding products” (Ostrom et al. 2010, p. 11). However, the first SMT rollouts have provoked consumer backlash, as most introductions have made SMT mandatory. This resistance may be a result of consumers feeling forced to perform a particular behavior.

Research in diverse areas has shown the substantial impact of an individual's perceived autonomy in initiating behavior on the likelihood of performing this behavior (Cadwallader et al. 2010; Hagger, Chatzisarantis, and Harris 2006; Malhotra, Galletta, and Kirsch 2008). In the case of transformative services, adoption will often be strongly advised or even mandatory, as these services enhance both individual and collective well-being, leading consumers to perceive adoption as a behavior they perform mainly because of external pressures. Understanding what motivates consumers to adopt transformative services with a sense of volition and choice is a key challenge for marketing scholars and practitioners alike.

Another important aspect of transformative services' adoption is the influence of personal values and norms. In contrast to adoption of conventional services, where benefits mainly arise for the individual, transformative services also entail societal benefits. With respect to how internalized values influence volitional behaviors, it is important to consider the different origins of motivation (Malhotra, Galletta, and Kirsch 2008; Melancon, Noble, and Noble 2011).

Against this background, the goal of this study is to analyze the determinants of consumers' adoption of transformative services. In particular, we focus on different types of motivations as determinants of consumers' intention to adopt transformative services. Our study goes beyond the dichotomy of extrinsic versus intrinsic motivation which has dominated the service and IS research (Venkatesh et al. 2003), but which has neglected the “independent, mutually reinforcing, or countervailing effects of various motivations” (see also Cadwallader et al. 2010; Malhotra, Galletta, and Kirsch 2008, p. 270). Individuals perceive engagement in a behavior as occurring along a continuum, ranging from self-determined to controlled forms of behavior (Deci and Ryan 1985). With regard to transformative services, understanding the *type* of motivation is essential since personal values are presumed to be important adoption drivers in this context (Kranz and Picot 2011).

To advance the understanding of how endogenous psychological feelings of autonomy, freedom, conflict, and external pressure affect consumer decisions to adopt transformative services, we develop a comprehensive model. In particular, we build on the theory of planned behavior (TPB; Ajzen 1991) and the self-determination theory (SDT; Deci and Ryan 2002; Ryan and Deci 2000b). The two theories provide complementary explanations: While the TPB's constructs explain the performance of specific target behaviors, SDT's constructs relate to more generalized types of motivations. Therefore, the SDT's constructs can be regarded as antecedents of the TPB's constructs (Hagger, Chatzisarantis, and Harris 2006). Although the TPB and SDT are each well studied, this study is the first to integrate them in the context of transformative service research.

To empirically test our model, we conducted a large-scale survey that draws on representative samples of both users and nonusers of HEMS. The nature of the samples is important, as prior research has relied on substantially smaller, mostly convenience samples (Kranz and Picot 2011).

### *Transformative Services and HEMS*

So far, research on transformative services has predominantly been conceptual in nature. The core of transformative services is the notion of a “transformation” toward a higher individual and collective well-being. The idea of transformation builds on the concept of sustainable development, which the *Brundtland Commission* defined as a “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations 1987). Therefore, the normative idea of transformation is that marketing

scholarship and practice need to embrace the concept of sustainability as a major aspect of the marketing paradigm (Huang and Rust 2011). From a managerial point of view this includes, for example, minimizing wasteful consumption, increasing environmental awareness, and demarketing certain harmful products or technologies (Achrol and Kotler 2012).

Over the past few years, research on transformative consumer research has gained increasing attention (Mick et al. 2012). Most research so far deals with health and nutritional issues, for example how to fight obesity (Chandon and Wansink 2007; Wansink 2006). However, research on consumer actions in benefit of the environment is still sparse (for an exception, see Goldstein, Cialdini, and Griskevicius 2008). The same holds for transformative services, which generally address a “triple bottom line” of economic, ecological, and social outcomes (Elkington 1997). Services are considered to be crucial for transformation and able to be more effectively transformed than physical goods because they are by definition customer-centric and cocreated (Ostrom et al. 2010).

Transformation can result from the modification of existing services or from the development of new services. Prior work has shown that message framing or persuasion effects (e.g., Cornelissen et al. 2008; Goldstein, Cialdini, and Griskevicius 2008; Kronrod, Grinstein, and Wathieu 2012) as well as psychological “nudges” (Thaler and Sunstein 2009) are effective mechanisms for modifying existing services and influencing consumer behavior in a way that (1) individual and collective well-being can be increased (Huang and Rust 2011) and (2) consumers do not feel limited in their way of living.

When new transformative services are developed, IT is able to fulfill these two conditions by enabling the creation of “smart services” (Kunz and Hogreve 2011; Schumann, Wunderlich, and von Wangenheim 2012). Smart services are “delivered to or through intelligent products that feature awareness and connectivity” (Wunderlich, von Wangenheim, and Bitner 2012, p. 1). In this respect, we define HEMS as an assortment of services that are facilitated by SMT. HEMS enable energy consumers to check their home energy consumption via different channels (e.g., home display, Internet portal) and eventually their production in real time 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), or to use marketplaces for in-home consumer technologies or related support services. Our definition of HEMS does not differentiate between services and the IT devices but treats these as a whole.

Beyond these direct benefits for users, HEMS are transformative in nature, in that they are eco-efficient services that aim at contributing to sustainable development (Halme et al. 2006; Ostrom et al. 2010). HEMS are sustainable because they help by reducing energy consumption and higher polluting peak demand, and enable more effective integration of often volatile renewable energy sources leading to direct benefits for the consumer and indirect benefits for society.

## Theoretical Framework and Hypotheses

Traditional research on the adoption of innovations and IT emphasizes that the characteristics of the innovation or technology affect consumers’ actual or intended adoption (Arts, Frambach, and Bijmolt 2011; Davis, Bagozzi, and Warshaw 1989). However, consumer-related factors might be more important than innovation characteristics in explaining adoption (e.g., Im, Mason, and Houston 2007; Kleijnen, de Ruyter, and Andreassen 2005). For example, the consumer’s technology readiness in terms of intrinsic and extrinsic motivations is a major determinant of adoption (Meuter et al. 2005; Parasuraman 2000). Moreover, prior service adoption research has demonstrated that these motivations mediate the effects of innovation characteristics, such as relative advantage, complexity, or compatibility, on adoption (Meuter et al. 2005). The major foundations of our theoretical framework are the TPB (Ajzen 1991) and organismic integration theory (OIT), which is a subtheory of SDT (Deci and Ryan 1985). Figure 2 shows our conceptual framework.

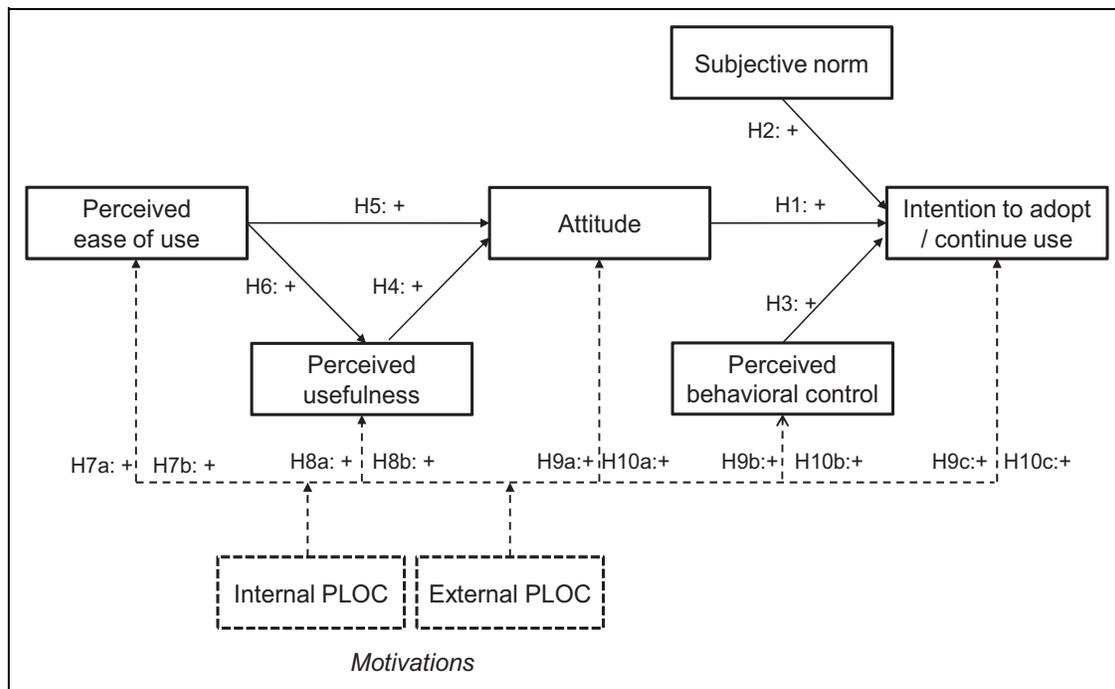
### The Theory of Planned Behavior

The TPB has proved to be a compelling social cognitive framework to explain situation-specific influences on intentional behaviors. Behavioral intention reflects the amount of effort an individual is willing to exert in pursuing a behavior and is consequently a strong predictor of actual behavior (Sheppard, Hartwick, and Warshaw 1988; Venkatesh et al. 2003). We refer to the consumer’s intention to adopt HEMS as the subjective probability that a person will perform a certain behavior in the near future or continue to perform a certain behavior. The TPB states that individual intention rests on three belief-based judgments: attitude toward the behavior, subjective norms, and perceived behavioral control (Ajzen 1991). Attitude refers to the degree to which an individual assesses a behavior in question as favorable or unfavorable (Fishbein and Ajzen 1975). In our study, attitude is conceptualized as a consumer’s judgment of whether using HEMS is favorable or unfavorable.

Prior research has found ample support for the impact of attitudes on the intention to adopt information technologies (e.g., Hsu and Chiu 2004; Taylor and Todd 1995), self-service technologies (Curran, Meuter, and Surprenant 2003), or Green-IS (Kranz and Picot 2011). Thus,

*Hypothesis 1:* Consumers’ attitudes positively influence consumers’ intentions.

Subjective norms are important because human behaviors are embedded in a social context. Thus, they are highly susceptible to interactions with one’s environment (e.g., Childers and Rao 1992). The extent to which influential others’ expectations and pressure affect an individual’s behavior depends on the individual’s inclination to conformity. A subjective norm is defined as a “person’s perception that most people who are important to him think he should or should not perform the behavior in question” (Fishbein and Ajzen 1975, p. 302). In our



**Figure 2.** Conceptual framework.

context, the subjective norm implies that consumers use HEMS to get approval from friends, neighbors, or family members.

An important aspect of transformative services is that performing eco-friendly behaviors often means conforming to social norms (Bamberg 2003). In line with previous findings (e.g., Pavlou and Fygenson 2006; Venkatesh and Brown 2001), we assume that a consumer's subjective norm significantly affects the intention to adopt transformative services:

*Hypothesis 2:* Subjective norm positively influences consumers' intentions.

Perceived behavioral control reflects the extent to which an individual believes he or she has the ability to control internal and external factors that either enable or restrict performance of a certain behavior (Ajzen 1991). Venkatesh, Thong, and Xu (2012) recommend incorporating facilitating conditions when studying technology adoption in the consumer context. In this respect, behavioral control is a key determinant of consumers' adoption of self-service technologies (Zhu et al. 2007) and positively influences the intention to use such technologies (Collier and Sherrell 2010; Reinders, Dabholkar, and Frambach 2008). In our context, perceived behavioral control is related to the consumer's subjective degree of control over adopting and using transformative services such as HEMS. In line with prior research, we thus suggest that the greater the perceived behavioral control, the greater the intention to adopt these services (Lee and Kozar 2008). Hence,

*Hypothesis 3:* Perceived behavioral control positively influences consumers' intentions.

Perceived usefulness and perceived ease of use are at the core of several models aiming to explain the adoption of

information technologies (Venkatesh, Thong, and Xu 2012). Both are hypothesized to affect intention through attitude, and perceived ease of use is additionally presumed to directly influence perceived usefulness (Figure 2). Perceived usefulness is defined as the user's subjective probability that using a particular IT will increase his or her performance, while perceived ease of use reflects the amount of expected mental and physical effort necessary to use a system (Davis 1989). In the context of this study, perceived usefulness captures the degree to which a consumer believes that adopting HEMS enhances the effectiveness of energy management tasks, primarily related to monitoring and regulating energy consumption.

Constructs related to usefulness and ease of use have proved to be strong determinants of attitude in a variety of IS and marketing contexts, such as the adoption of mobile data services (Hong and Tam 2006), mobile services (Nysveen, Pedersen, and Thorbjørnsen 2005), online retailing (Childers et al. 2001), self-service technologies (Dabholkar and Bagozzi 2002; Weijters et al. 2007), or sales force automation technologies (e.g., Homburg, Wieseke, and Kuehnl 2010). Hence,

*Hypothesis 4:* Perceived usefulness positively influences consumers' attitudes.

*Hypothesis 5:* Perceived ease of use positively influences consumers' attitudes.

*Hypothesis 6:* Perceived ease of use positively influences perceived usefulness.

### The SDT and the OIT

Transformative services like HEMS not only result in benefits for users, such as lower expenditures or increased consumption

control, but also in 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 also Dholakia 2006).

Most 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). In contrast, the 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 (Deci and Ryan 2002; Ryan and Deci 2000b). People who perceive their actions as autonomously driven experience a sense of volition and choice, whereas people whose behaviors are linked to feelings of pressure perceive themselves as being controlled. Research shows that perceived autonomous motivation has a greater effect on behavior than motivation through control (e.g., Cadwallader et al. 2010; Chan and Lam 2011; Dholakia 2006; Malhotra, Galletta, and Kirsch 2008; Venkatesh 1999).

According to the SDT, motivation is endogenous since individuals volitionally initiate all behaviors (Ryan and Deci 2000b; Skinner 1953). This explanation contrasts with mechanistic motivation theories, which consider behaviors as being triggered either extrinsically by rewards or intrinsically when the activity itself is the reward (exogenous motivation). The SDT considers behavior as being motivated not directly by external stimuli but rather by the subjective psychological meaning of these stimuli: Behavior is not a result of expected rewards but rather an act of individual volition that may even be undermined by extrinsic rewards (Dholakia 2006; Pritchard, Campbell, and Campbell 1977).

Most studies on IT and service adoption draw on the mechanistic approach treating extrinsic motivation as perceived usefulness and considering intrinsic motivation as enjoyment or playfulness (see Gerow et al. 2012 for an overview; Venkatesh et al. 2003). This view neglects that the same external motivational stimuli can have different effects, which explains why some users more readily accept IT or services than other users do (Malhotra and Galletta 2003, 2004).

Other researchers highlight the importance of the degree to which individuals perceive their behavior as self-determined (Deci and Ryan 1985). In understanding the influence of self-determination on behavior, the OIT has proved to be valuable in different scientific areas (Deci and Ryan 2002) and in service research as well (e.g., Cadwallader et al. 2010; McGinnis, Gentry, and Gao 2008). The OIT specifies a taxonomy of individually experienced levels of autonomy that represents different qualitative types of motivation as the perceived locus of causality (PLOC): PLOC reflects the degree to which an individual experiences a behavior as initiated and endorsed by the self (Ryan and Connell 1989). *External* PLOC refers to extrinsic motivation, while *internal* PLOC is linked to intrinsic motivation. The degree to which individuals internalize external influences determines the PLOC they experience when performing

a behavior ranging from external to internal regulation. Regulation refers to an internalized value (e.g., an individual sense of autonomy) that controls behavior (Cadwallader et al. 2010). The more a value is 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. Internal regulation implies that people perceive themselves as the origin of their behavior.

We suggest that the different types of PLOC exert cumulative effects on behavioral intentions (Deci and Ryan 1985). Internal PLOC comprises feelings of volition, through which actors perceive themselves as the origin of spontaneous and instinctive behaviors occurring for reasons like enjoyment as well as self-determined actions taken in line with personal values and goals (Ryan and Connell 1989). By internalizing external regulations, individuals embrace the regulations as personally meaningful, which should be important in terms of the adoption of transformative services.

Prior work has shown that when individuals engage in a particular behavior because it yields enjoyment or is personally meaningful, they perceive a lower cognitive burden than when they engage in behaviors associated with feelings of coercion (Csikszentmihalyi 1990). In the context of transformative services, adoption can be expected to appear less burdensome or annoying since these services improve well-being and are therefore associated with positive feelings and values. On the basis of the motivation and technology adoption literature (Csikszentmihalyi 1975; Venkatesh and Speier 1999), higher degrees of intrinsic motivation and self-determination should have a favorable impact on the perceived level of effort and thus, increase ease of use.

In contrast, feelings of ease of use are less likely to occur when individuals perform an activity that is associated with feelings of coercion or pressure. Consumers find activities they perceive to be less meaningful and less autonomously initiated—as characterized by external PLOC—rather unappealing. Hence, the willingness to invest time and effort in performing these activities is presumed to be lower than for self-endorsed behaviors. However, consumers may still perceive less appealing and self-endorsed behaviors as important because of personally meaningful external incentives. In our context, external incentives could be financial, environmental, and societal benefits. If individuals consider these incentives to be personally significant, they may still perceive performing externally regulated behaviors as less burdensome. Thus,

*Hypothesis 7a:* Internal PLOC positively influences perceived ease of use.

*Hypothesis 7b:* External PLOC positively influences perceived ease of use.

OIT also implies that internal and external PLOC should directly affect perceived usefulness (Malhotra, Galletta, and Kirsch 2008). While some individuals may perceive usefulness solely in terms of its instrumental value, others may perceive it

in terms of the development of the self (Schwarz and Chin 2007). The latter perspective has recently attracted attention among service (Cadwallader et al. 2010; Chan and Lam 2011) and IS researchers (Bagozzi 2007; Benbasat and Barki 2007; Schwarz and Chin 2007). The OIT suggests that consumers can be expected to assess adoption of transformative services as more useful if adoption meets personally meaningful goals and fosters self-development (Deci and Ryan 1985, 2002).

Accordingly, internal PLOC should directly affect the perceived usefulness of HEMS. The rationale for this effect is that an individual's intrinsic motivation and self-determination to engage in a certain behavior should also increase its instrumentality (Dholakia 2006). Thus, individuals should also attribute performance-related characteristics to behaviors they perceive as personally meaningful and contributing to self-development (Malhotra, Galletta, and Kirsch 2008). Further, if external regulations are not perceived as coercive but rather as providing individually meaningful incentives, they are regarded as useful (Deci and Ryan 1985). That is, if transformative services provide compelling external incentives, such as self-fulfillment or monetary benefits, and external regulations are not perceived as coercive, consumers will evaluate these services as more useful (Deci and Ryan 1985). Thus,

*Hypothesis 8a:* Internal PLOC positively influences perceived usefulness.

*Hypothesis 8b:* External PLOC positively influences perceived usefulness.

### **Combining the Theory of Planned Behavior and SDT**

The TPB and SDT aim to predict behavior through different approaches. According to Vallerand's (1997), hierarchical model of motivation, the two theories can be distinguished in terms of their degree of generality. The TPB's constructs are bound to a specific target behavior at a future point in time, whereas SDT's internal and external PLOC refer 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 beyond that various behaviors in a particular context through more generalized motivations pertaining to broad life contexts (Cadwallader et al. 2010). The hierarchical model of motivation further proposes that motivation at the contextual level affects cognition and motivation at the situational level in a top-down fashion (Vallerand 1997). Thus, the motivational constructs at the contextual level (i.e., internal and external PLOC) are expected to be antecedents of the TPB's situational level constructs like attitude or perceived behavioral control (Vallerand 1997).

Integrating the TPB with SDT hence offers complementary explanations as to the underlying motivational processes of intentional behavior. Research in health and educational contexts has provided empirical support for this view, in that results suggest that different types of PLOC affect behavioral intention both directly (Standage, Duda, and Ntoumanis

2003; Wilson and Rodgers 2004) and indirectly through attitude and perceived behavioral control (Chatzisarantis et al. 2003; Hagger, Chatzisarantis, and Harris 2006). Individuals who are autonomously motivated to engage in a particular domain usually perceive their behavior in that context as personally meaningful 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. Further, behaviors motivated by internal PLOC tend to be associated with positive feelings of volition and autonomy (Melancon, Noble, and Noble 2011). In the case of transformative services, autonomously motivated consumers are more likely to experience adoption as meaningful to themselves and society and additionally to feel good while using related services:

*Hypothesis 9a:* Internal PLOC positively influences consumers' attitudes.

In addition, individuals who experience their behavior as being self-endorsed and relevant to themselves have a greater tendency to feel more confident about having the resources necessary to perform a target behavior. For example, Dholakia (2006) shows that self-determined consumers tend to show higher levels of perceived behavioral control. Literature in the health care domain has also provided support for the positive relationship between autonomous motivation and perceived behavioral control (e.g., Williams et al. 2004). In addition, autonomous motivations of individuals are positively related to their perceived self-efficacy (Xie, Bagozzi, and Troye 2008). The latter has a high conceptual overlap with perceived behavioral control (Ajzen 1991).

Turban et al. (2007) provide an explanation for these findings by showing that internal PLOC is positively related to the degree to which individuals actually use their cognitive faculties. This should lead to higher perceived behavioral control. Thus, we expect that adopting transformative services from a higher level of autonomous motivation will positively affect people's perceived competence about operating these services and their expectations about required abilities and potential barriers.

*Hypothesis 9b:* Internal PLOC positively influences perceived behavioral control.

Internal PLOC may lead consumers to adopt transformative services either because of intrinsic motivation or via the internalization of external regulations. In the former case, people are autonomously motivated because of curiosity (e.g., the ability to obtain detailed energy use information) or self-development (e.g., the ability to reduce home energy consumption). In the latter case, transformative services' characteristics should be important. If consumers internalize external regulations by federal institutions, nongovernmental organizations, or influential others that highlight the positive outcomes of

transformative services and as a result, perceive adoption as a self-determined choice, they should be more likely to adopt:

*Hypothesis 9c:* Internal PLOC positively influences consumers' intentions.

As outlined, OIT distinguishes between different degrees of perceived autonomy of extrinsically motivated behavior (Ryan and Deci 2000a). For example, an individual may adopt transformative services because of external contingencies such as avoiding punishment or obtaining rewards—extrinsic motivations that refer to controlled forms of behavior. However, an individual may adopt or use the same service because external regulations are personally important. Thus, if external motivations like financial rewards or social recognition for acting as an environmentally responsible person are personally important to consumers, they should still have a positive influence on attitude (Melancon, Noble, and Noble 2011). Thus,

*Hypothesis 10a:* External PLOC positively influences consumers' attitudes.

Externally regulated behaviors are controlled by externally governed constraints, such as rewards, prescriptions, and payments. We expect these external regulations to have a positive influence on consumers' perceived competence if the regulations are personally important and in line with personal values and principles. Thus, although perceived behavioral control over a behavior is not autonomously motivated, it should be positively affected by external PLOC:

*Hypothesis 10b:* External PLOC positively influences perceived behavioral control.

External PLOC represents extrinsic motivation in its most basic form. Individual behavior is then a result of external regulations (Ryan and Connell 1989), assuming that no contradiction exists between these external stimuli and individual values. Thus, individuals experience extrinsically motivated behaviors as controlled. In the case of transformative services, external stimuli could be financial rewards or recommendations by public institutions or one's social environment (Melancon, Noble, and Noble 2011). Although less sustainable and dependent on external regulation, consumer intentions are still contingent on these external factors, although presumably to a lower extent than on internal PLOC (Dholakia 2006). Thus, external PLOC should also have a positive impact on intention. Therefore,

*Hypothesis 10c:* External PLOC positively influences consumers' intentions.

## Research Design and Method

### Sample and Data Collection Procedure

We conducted a large-scale survey study in Germany. The goal of our study was to draw on a sample of both users (adopters)

and nonusers (potential adopters) of HEMS. To collect a representative sample of HEMS users, we collaborated with a major energy provider that gave us access to its customer database. We drew a random sample of 3,800 users who were invited via e-mail to participate in an online survey. To collect a sample of nonusers, we collaborated with a market research company that hosts a representative panel of German citizens. The recruitment process of the company ensured the representativeness of the sample. In all, 1,487 panel members were invited via e-mail to participate in the online survey if they were responsible for energy decisions in their household. We briefly illustrated the HEMS technology to establish a common understanding among all participants.

In both subsamples, we eliminated incomplete questionnaires and questionnaires with implausibly short handling time. We then used 537 complete questionnaires from nonusers for further analyses, resulting in a response rate of 41.6%.<sup>1</sup> Participants ranged from ages 20 to 80 (mean: 49,) 50.7% of which were male. We used 462 complete questionnaires from users for further analyses (response rate: 16.1%). Participants ranged from ages 18 to 89 (mean: 54,) 88.3% of which were male. The high percentage of male respondents in the user sample can be explained by the fact that the majority of early adopters of HEMS at this energy provider were multiperson households ( $M_{\text{number of occupants}} = 3.4$ ). When we asked for the person responsible for adopting HEMS, mostly men replied to our survey.

Given the response rate and the approach of the two samples we investigated, we verified that our final sample was adequate. We checked to make sure that the final sample did not suffer from the threat of a potential nonresponse bias and that we had obtained qualified responses from our participants (Rogelberg and Stanton 2007). First, we observed no significant differences when comparing the means of all variables for early and late respondents. Second, we assessed participants' personal interest in new technologies and their willingness to pay for energy innovations through 2 items.

### Measurement of Constructs

We followed standard psychometric scale development procedures. Tables 1 and 2 and the Appendix show all scales used together with descriptive statistics and psychometric properties.

We assessed most items on 7-point Likert-type rating scales ranging from *strongly disagree* (1) to *strongly agree* (7). We relied on existing scales as much as possible, but developed some new instruments (e.g., external and internal PLOC) and adapted others to a new context. To validate these instruments, we conducted three qualitative and quantitative pilot studies following Moore and Benbasat (1991). In our final quantitative pretest, we tested the questionnaire with a larger sample ( $n = 110$ ). Although the pilot study sample was small, the computed reliabilities of the scales were appropriate for use in a larger study (Brown and Venkatesh 2005). In the final model, we measured our dependent variable, the customer's intentions, with a reflective 3-item scale based on Davis, Bagozzi, and

**Table 1.** Correlations and Measurement Information: Nonuser Sample.

Variable	Range	M	SD	CA	CR	AVE	1	2	3	4	5	6	7	8
1 Consumers' intentions	1-7	5.01	1.83	.93	.96	.88	1.00							
2 Consumers' attitudes	1-7	5.92	1.65	.95	.97	.92	.71	1.00						
3 Perceived behavioral control	1-7	4.79	1.86	.75	.85	.66	.20	.11	1.00					
4 Subjective norms	1-7	2.32	1.62	.78	.87	.69	.26	.24	.09	1.00				
5 Perceived ease of use	1-7	5.02	1.62	.84	.90	.76	.30	.25	.60	.10	1.00			
6 Perceived usefulness	1-7	5.97	1.54	.92	.94	.81	.60	.61	.10	.23	.28	1.00		
7 Internal PLOC	1-7	4.97	1.94	.87	.91	.66	.69	.65	.13	.37	.31	.60	1.00	
8 External PLOC	1-7	5.32	1.86	.69	.82	.61	.57	.63	.00	.27	.20	.55	.63	1.00

Note: AVE = average variance extracted; CA = Cronbach's  $\alpha$ ; CR = composite reliability; SD = standard deviation; PLOC = perceived locus of causality. CA, CR, and AVE cannot be computed for formative measures.

**Table 2.** Correlations and Measurement Information: User Sample.

Variable	Range	M	SD	CA	CR	AVE	1	2	3	4	5	6	7	8
1 Consumers' intentions	1-7	4.35	1.65	.85	.91	.77	1.00							
2 Consumers' attitudes	1-7	5.41	1.50	.94	.96	.89	.54	1.00						
3 Perceived behavioral control	1-7	4.26	1.63	.83	.90	.75	.46	.31	1.00					
4 Subjective norms	1-7	1.87	1.30	.77	.86	.67	.05	.00	.02	1.00				
5 Perceived ease of use	1-7	4.43	1.55	.88	.92	.80	.56	.38	.69	-.01	1.00			
6 Perceived usefulness	1-7	5.15	1.50	.90	.93	.77	.45	.42	.41	.07	.52	1.00		
7 Internal PLOC	1-7	4.60	1.65	.84	.89	.61	.53	.51	.40	.13	.49	.55	1.00	
8 External PLOC	1-7	4.18	1.81	.62	.78	.56	.36	.28	.19	.29	.28	.38	.49	1.00

Note. AVE = average variance extracted; CA = Cronbach's  $\alpha$ ; CR = composite reliability; SD = standard deviation; PLOC = perceived locus of causality. CA, CR, and AVE cannot be computed for formative measures.

Warshaw (1989).<sup>2</sup> We measured adoption intention for nonusers and continuance intention for actual users (see Bhattacharjee 2001; Kim and Oh 2011 and the Appendix). We used reflective measures for the customer's attitude toward technology (3 items), perceived usefulness (4 items), and perceived ease of use (3 items; Davis, Bagozzi, and Warshaw 1989). For the two scales capturing the internal and external PLOC, we drew on the measures of Ryan and Connell (1989) which have been adapted to the IT context by Malhotra, Galletta, and Kirsch (2008). In the final model, we measured internal PLOC with a reflective 5-item scale and external PLOC with a reflective 3-item scale. We measured perceived behavioral control with a reflective 3-item scale adapted from Ajzen (1991) and Taylor and Todd (1995), and subjective norm with a reflective 4-item scale adapted and extended from Ajzen (1991) and Venkatesh, Thong, and Xu (2012).

We assessed reliability and validity for each reflective measure using the Partial least squares (PLS) approach (e.g., Brown and Venkatesh 2005; Chin 1998, 2001; Gefen and Straub 2005). We assessed the convergent validity of our items on the basis of three criteria. First, each item should significantly load on the respective construct (.70). Second, composite reliabilities should exceed the threshold of .70. Third, the average variance extracted (AVE) for each construct should exceed .50. Results show that all items (except for one) had significant loadings of .70 or higher on their respective construct. The composite reliabilities of all constructs are higher than .70 and the AVEs of all constructs largely exceed .50. Tables 1 and 2 summarize construct information of both samples.

We assessed discriminant validity between the reflective measures using the criterion of Fornell and Larcker (1981). For all constructs, the squared correlations between two constructs are lower than the corresponding AVEs. Thus, discriminant validity is established.

## Results

### Hypothesis Testing

In both subsamples, we tested the hypothesized effects in our model using SmartPLS version 2.0.M3 (Ringle, Wende, and Will 2005). We used PLS-based instead of covariance-based (CB) structural equation modeling (SEM) for three reasons. First, PLS-SEM better predicts and identifies key "driver" constructs (Hair, Ringle, and Sarstedt 2011; Völckner et al. 2010). Second, using PLS is not constrained by model identification concerns, even if models become complex (Hair, Ringle, and Sarstedt 2011). Third, studies show that the so-called PLS-SEM bias resolves at large sample sizes and a large number of indicators. Differences of CB-SEM and PLS-SEM are at very low levels under the consistency "at large" argument (e.g., Reinartz, Haenlein, and Henseler 2009).<sup>3</sup>

We estimated the significance of the parameter estimates using bootstrapping with  $n = 5,000$  samples. In general, results show that our model of the consumer's intention to adopt HEMS receives support. In particular, the model explains 55% (non-users) and 30% (users) of the variance of the attitude toward

**Table 3.** Results of Model Estimation and Model Comparison.

Path	Sample		Sample Comparison	
	User Sample Path Coefficient	Nonuser Sample Path Coefficient	t-value	p (two-tailed)
Consumers' attitudes → Consumers' intentions (Hypothesis 1)	.32***	.42***	1.26	.21
Subjective norm → Consumers' intentions (Hypothesis 2)	-.01	.00	.40	.69
Perceived behavioral control → Consumers' intentions (Hypothesis 3)	.25***	.11***	<b>2.60</b>	<b>.01</b>
Perceived usefulness → Consumers' attitudes (Hypothesis 4)	.17***	.26***	1.17	.24
Perceived ease of use → Consumers' attitudes (Hypothesis 5)	.12**	.03	1.47	.14
Perceived ease of use → Perceived usefulness (Hypothesis 6)	.32***	.10*	<b>2.95</b>	<b>.00</b>
Internal PLOC → Perceived ease of use (Hypothesis 7a)	.46***	.31***	<b>2.06</b>	<b>.04</b>
External PLOC → Perceived ease of use (Hypothesis 7b)	.05	.00	.61	.54
Internal PLOC → Perceived usefulness (Hypothesis 8a)	.33***	.38***	.79	.44
External PLOC → Perceived usefulness (Hypothesis 8b)	.13***	.29***	<b>2.22</b>	<b>.03</b>
Internal PLOC → Consumers' attitudes (Hypothesis 9a)	.35***	.31***	.59	.55
Internal PLOC → Perceived behavioral control (Hypothesis 9b)	.40***	.22***	<b>2.26</b>	<b>.02</b>
Internal PLOC → Consumers' intentions (Hypothesis 9c)	.22***	.34***	<b>1.69</b>	<b>.09</b>
External PLOC → Consumers' attitudes (Hypothesis 10a)	.01	.29***	<b>3.83</b>	<b>.00</b>
External PLOC → Perceived behavioral control (Hypothesis 10b)	-.01	-.14**	1.57	.12
External PLOC → Consumers' intentions (Hypothesis 10c)	.12***	.08	.59	.56

Note. PLOC = perceived locus of causality.

Significance levels: \*\*\* $p < .01$ . \*\* $p < .05$ . \* $p < .10$ .

HEMS and 60% (nonusers) and 45% (users) of the variance of the intention to adopt HEMS and for continuance intention, respectively. Table 3 shows the results of our model estimation.<sup>4</sup>

Results show a positive and significant effect of attitude on the consumer's intention ( $\beta_{\text{nonusers}} = .42, p < .01$ ), confirming Hypothesis 1, which is also confirmed for actual users' continuance intentions ( $\beta_{\text{users}} = .32, p < .01$ ). The effect of the subjective norm on consumers' intentions is not significant for either nonusers or users ( $\beta_{\text{nonusers}} = .00, p > .10$ ;  $\beta_{\text{users}} = -.01, p > .10$ ). Thus, we find no support for Hypothesis 2. However, Hypothesis 3 is supported: Perceived behavioral control positively affects the consumer's intention ( $\beta_{\text{nonusers}} = .11, p < .01$ ;  $\beta_{\text{users}} = .25, p < .01$ ). In line with Hypothesis 4, perceived usefulness positively affects consumers' attitudes ( $\beta_{\text{nonusers}} = .26, p < .01$ ;  $\beta_{\text{users}} = .17, p < .01$ ). Hypothesis 5 posited that perceived ease of use would positively influence the consumer's attitude. While this supposition is confirmed in the user sample ( $\beta_{\text{users}} = .12, p < .05$ ), it does not hold true for nonusers ( $\beta_{\text{nonusers}} = .03, p > .10$ ). In line with Hypothesis 6, perceived ease of use positively affects perceived usefulness in both of our subsamples ( $\beta_{\text{nonusers}} = .10, p < .10$ ;  $\beta_{\text{users}} = .32, p < .01$ ) but is only marginally significant for the nonusers.

With respect to the role of PLOC, internal PLOC positively affects the perceived ease of use ( $\beta_{\text{nonusers}} = .31, p < .01$ ;  $\beta_{\text{users}} = .46, p < .01$ ), whereas the effect of external PLOC is not significant ( $\beta_{\text{nonusers}} = .00, p > .10$ ;  $\beta_{\text{users}} = .05, p > .10$ ). Thus, while we find support for Hypothesis 7a, we must reject Hypothesis 7b in both subsamples. Internal PLOC has a positive effect on perceived usefulness ( $\beta_{\text{nonusers}} = .38, p < .01$ ;  $\beta_{\text{users}} = .33, p < .01$ ). This finding also holds true for external PLOC ( $\beta_{\text{nonusers}} = .29, p < .01$ ;  $\beta_{\text{users}} = .13, p < .01$ ). Thus, we find support for Hypothesis 8a and Hypothesis 8b.

Concerning the role of the consumer's PLOC in relation to the TPB constructs, we hypothesized that internal PLOC positively affects the consumer's intention ( $\beta_{\text{nonusers}} = .34, p < .01$ ;  $\beta_{\text{users}} = .22, p < .01$ ), attitude ( $\beta_{\text{nonusers}} = .31, p < .01$ ;  $\beta_{\text{users}} = .35, p < .01$ ), and perceived behavioral control ( $\beta_{\text{nonusers}} = .22, p < .01$ ;  $\beta_{\text{users}} = .40, p < .01$ ). Thus, we find support for Hypothesis 9a–c. The effect of external PLOC on the TPB constructs is mixed. While its effect on intention is significant in the user sample, it is not significant for nonusers ( $\beta_{\text{nonusers}} = .08, p > .10$ ;  $\beta_{\text{users}} = .12, p < .01$ ). Further, external PLOC has a significant effect on attitude in the nonuser case but not for users ( $\beta_{\text{nonusers}} = .29, p < .01$ ;  $\beta_{\text{users}} = .01, p > .10$ ). Finally, external PLOC has a significant negative effect on perceived behavioral control in the nonuser sample but not in the user case ( $\beta_{\text{nonusers}} = -.14, p < .05$ ;  $\beta_{\text{users}} = -.01, p > .10$ ). Thus, we find support for Hypothesis 10a in the user sample but not in the nonuser sample. Hypothesis 10b has to be rejected for the nonuser case (negative influence) and also for the user case (insignificant influence). Finally, we find support for Hypothesis 10c in the user sample whereas for the nonuser sample it has to be rejected.

Since the independent and the dependent variables in our models were assessed by a single informant, common method bias presents a potential risk (Podsakoff et al. 2003). To evaluate the risk of common method variance, we conducted the marker variable test (Rönkkö and Ylitalo 2011). As marker variable, we selected the personal value of success because it was theoretically unrelated with at least one of our variables. Then, we corrected all bivariate correlations between our model variables for the lowest positive correlation with the marker variable ( $r = .04$ ). All significant zero-order correlations between our variables remain significant after correcting for this proxy for common method variance.

### Comparison of Users and Nonusers

We conducted an exploratory test of whether significant differences emerge when assessing the intention to adopt or continue using HEMS of nonusers versus users. In particular, using the *t*-test suggested by Chin (2000), we tested whether the parameter estimates obtained for the samples significantly differed. Table 3 shows the results of the model comparison.

In general, the results significantly differ for 7 of the 16 hypothesized relationships. First, perceived ease of use is a stronger determinant of perceived usefulness for users than for nonusers ( $\beta_{\text{users}} = .32$ ,  $\beta_{\text{nonusers}} = .10$ ;  $t = 2.95$ ,  $p < .01$ ). Although not significant, the same holds true for the direct effect on consumers' attitudes ( $\beta_{\text{users}} = .12$ ,  $\beta_{\text{nonusers}} = .03$ ;  $t = 1.47$ ,  $p > .10$ ). Second, external PLOC is a more important driver of perceived usefulness for nonusers than for users ( $\beta_{\text{users}} = .13$ ,  $\beta_{\text{nonusers}} = .29$ ;  $t = 2.22$ ,  $p < .05$ ). The same holds true for the effect of external PLOC on consumers' attitudes ( $\beta_{\text{users}} = .01$ ,  $\beta_{\text{nonusers}} = .29$ ;  $t = 3.83$ ,  $p < .01$ ). Thus, extrinsic motivation is less important for actual users than for potential adopters. This finding is also reflected by the fact that internal PLOC is a stronger determinant of perceived ease of use for users than for nonusers ( $\beta_{\text{users}} = .46$ ,  $\beta_{\text{nonusers}} = .31$ ;  $t = 2.06$ ,  $p < .05$ ). The same holds true for the effects of internal PLOC on perceived behavioral control ( $\beta_{\text{users}} = .40$ ,  $\beta_{\text{nonusers}} = .22$ ;  $t = 2.26$ ,  $p < .05$ ). However, the opposite result was observed for the effect on consumers' intentions, which seems to play a slightly more important role for the nonusers ( $\beta_{\text{users}} = .22$ ,  $\beta_{\text{nonusers}} = .34$ ;  $t = 1.69$ ,  $p < .10$ ). Finally, perceived behavioral control is a more important determinant of the consumer's intentions for users than for nonusers ( $\beta_{\text{users}} = .25$ ,  $\beta_{\text{nonusers}} = .11$ ;  $t = 2.60$ ,  $p < .01$ ).

### Discussion

The goal of this study was to develop and test a comprehensive model of consumers' intentions to adopt transformative services. Service research has highlighted the crucial role of transformative services not only for sustainable production and consumption (Ostrom et al. 2010) but also as an enabler of a "society-driven innovation".

We conducted our analysis in the energy sector and focused on HEMS, which are facilitated by SMT. We tested our model with survey data from 462 users and 537 nonusers of HEMS in Germany. In general, we find strong empirical support for our model. In particular, results show that endogenous motivational states have important direct effects on nonusers' adoption and users' continuance intentions. Our study contributes to both service and IS research in three major ways.

First, we contribute to transformative service research, which to the best of our knowledge has so far been conceptual in nature (Ostrom et al. 2010). A key characteristic of transformative services is to deliver services in a sustainable manner—that is, preserving health, society, and the environment. Our results suggest that consumers' intrinsic motivations tend to be more important for the adoption of transformative services

than internalized external pressures and social norms. Prior work has shown that social norms can be an important determinant of pro-environmental behavior (Goldstein, Cialdini, and Griskevicius 2008). However, our results imply that messages that are too assertive or "pushy" are problematic, notably when consumers lack initial inclination to that behavior (Kronrod, Grinstein, and Wathieu 2012). More specifically, our results show that the *type* of motivation is more important than the amount. Our study shows that although not intrinsic, the internalization of social values such as environmentalism can influence behavior as powerfully as intrinsic motivation. We found that internal PLOC was a stronger predictor of adoption than external PLOC. This finding is in line with prior research on the effects of external rewards on relational marketing outcomes (Dholakia 2006; Melancon, Noble, and Noble 2011) as well as work on the adoption of e-learning systems (Malhotra, Galletta, and Kirsch 2008).

Second, our study shows that the SDT and TPB provide complementary explanations regarding the motivational process that underlies volitional behaviors. Although the TPB and SDT are each well studied, this investigation is the first to integrate these theories to understand the adoption of transformative services by consumers. Our findings show that motivations at the contextual level (internal and external PLOC) are influential antecedents of the TPB's belief-based constructs at the situational level (Vallerand 1997). More specifically, internal PLOC is a strong predictor of attitude and perceived behavioral control for both nonusers and users of HEMS. This result further underscores the pivotal role of internalized values and perceived autonomy in predicting behavioral intentions (see also Cadwallader et al. 2010; Hagger, Chatzisarantis, and Harris 2006). External PLOC, however, only significantly affects the TPB's belief-based constructs for nonusers. This finding indicates that for evaluative judgments on the favorability and control of a target behavior, nonusers depend more on external regulations like external rewards or referrals. The negative (nonuser sample) and insignificant (user sample) effect of external PLOC on perceived behavioral control was unexpected. Seemingly, the more nonusers perceive external regulations as coercive and controlled, the lower they perceived behavioral control regarding HEMS adoption. An explanation for this finding may be that nonusers expect extrinsically motivated behaviors to require more competence and effort to control potential inhibiting factors. For actual users in comparison, the results suggest that external regulations do not influence perceptions on their individual ability to control HEMS.

Third, our findings support the basic relationships proposed by classical models on technology acceptance (Davis, Bagozzi, and Warshaw 1989). However, these findings have to be interpreted in light of the underlying motivational effects of internal and external PLOC. In particular, our results show substantial effects of consumers' internal PLOC on perceived usefulness and ease of use of HEMS. This finding underscores the notion that if individuals experience their behavior as self-determined, they will perceive it as easier to perform (see also McGinnis, Gentry, and Gao 2008). In addition, when people identify with values associated with a specific behavior, they regard it as more useful (Malhotra, Galletta, and Kirsch 2008).

### *Practical Implications*

Our results imply that to increase the adoption of transformative services, companies and policy makers generally need to ensure that consumers do not feel limited in their choices and way of living. The success of innovative transformative services depends on moving consumers' PLOC from external to internal regulation. In this respect, marketers should seek to establish congruence between the values inherent to transformative services and those of their target group. This prerequisite implies that, rather than stressing assertive social norms to reach a larger clientele, marketers have to emphasize transformative services' inherent individual and collective benefits that address widely accepted values and norms.

This study also provides practical implications for the energy context. Our study demonstrates that users who feel they are adopting HEMS voluntarily are more likely to adopt them. Thus, providers of HEMS first have to understand which extrinsic and intrinsic motivations are important to their target groups. Next, they have to carefully align their marketing activities with these motivations. For instance, to market its HEMS, a German energy supplier targets innovative consumers with the promotional slogan "One step ahead" to position itself as a leader in innovation. However, marketers have to consider that "visionary" early users are driven by distinct values than the more "pragmatic" group of nonusers. As our study shows, external PLOC is more important for inexperienced users. Hence, reaching the mainstream customer requires providing meaningful extrinsic motivations, which have to be complementary to intrinsic motivations and to users' feelings of autonomy and volition.

### *Limitations and Further Research*

Besides its contributions, this study has limitations that should be addressed by future research. First, this study investigated only one country. Future research should thus account for cultural and regional differences to validate our results. Second, the cross-sectional design of the data limits our findings in at least two ways (Rindfleisch et al. 2008): user perceptions of transformative services may change significantly over time and the posited causal relationships can only be inferred. Third, we focused on a specific category of transformative services. The fact that the installation of the enabling technology (SMT) might become mandatory in most Western countries may limit the generalizability of the findings regarding user perception of volition, autonomy, or external pressure. Fourth, our model could be extended through an investigation of moderators on the effects of external and internal PLOC to answer the questions of when and how the effects of these psychological states differ. In addition, studying the relationships between subjective norms and external and internal PLOC seems to be promising. Finally, future research could compare whether consumers distinguish between individual and collective benefits and how important the latter are to predicting the adoption of transformative services.

A key goal of adoption research is to identify and understand how managerially controllable antecedents influence consumers' adoption intentions. By disentangling extrinsic and intrinsic motivations, our research provides new evidence on how different endogenous psychological states influence sustainable service adoption. Thus, our study serves as a starting point for further research on the role of users' endogenous motivations to adopt transformative services and information technologies.

## Appendix

### Scale Items for Construct Measures.

Construct (Source)	Items	Factor Loadings (Nonuser /User)
Consumers' attitude (Davis et al. 1989)	I assume that it is a good idea to use HEMS.	.96 / .95
	I think that it is reasonable to use HEMS.	.95 / .93
	All in all, I think it is a bad idea to use HEMS.*	
Adoption intention (Davis et al. 1989)	I like the idea of using HEMS.	.96 / .94
	I can imagine using HEMS regularly in my household.	.86
	I plan to use HEMS in the future.	.90
Continuance Intention (Bhattacharjee 2001)	I intend to use HEMS in everyday life.	.88
	I will always try to use HEMS in my daily life.	.91
	I plan to continue to use HEMS frequently.	.95
Perceived ease of use (Davis et al. 1989)	I will always try to use HEMS in my daily life.	.95
	Learning to operate HEMS would be easy for me.	.88 / .91
	I would find it easy to use HEMS to do what I want to do.	.85 / .89
Perceived usefulness (Davis et al. 1989)	It would take me some time to become skillful at using HEMS.*	
	I would find it easy to use HEMS.	.87 / .89
	Using HEMS would help me to better survey my energy consumption.	.92 / .89
Internal PLOC (Ryan and Connell 1989)	Using HEMS would make it easier for me to lower my energy consumption.	.89 / .85
	Using HEMS would be useful to regulate my energy consumption more efficiently.	.89 / .90
	Using HEMS would help me to faster survey my energy consumption.	.89 / .87
External PLOC (Ryan and Connell 1989)	I use the system ...	
	... because I want to help protect the environment.	.79 / .70
	... because I personally like using HEMS.	.87 / .86
	... because I think it is personally important to myself.	.74 / .74
	... because I want to learn how to use HEMS.	.79 / .77
Subjective norm (Ajzen 1991; Venkatesh 2012)	... because I enjoy using HEMS.	.87 / .84
	I use the system ...	
	... because it is recommended by my energy supplier.	.67 / .45
	... because it is recommended by governmental institutions.*	
	... because using HEMS offers me financial incentives.	.76 / .85
Perceived behavioral control (Ajzen 1991; Taylor and Todd 1995)	... because the European Union recommends using HEMS.*	
	... because I can avoid price peaks in peak load times.	.90 / .88
	People who are important to me think that I should use HEMS.	.77 / .84
Perceived behavioral control (Ajzen 1991; Taylor and Todd 1995)	People who influence my behavior think that I should use HEMS.	.86 / .88
	People whose opinions that I value prefer that I use HEMS.	.86 / .73
	I would be able to fully operate HEMS on my own, if I wanted to.	.80 / .91
Perceived behavioral control (Ajzen 1991; Taylor and Todd 1995)	I have the knowledge and time it takes to use HEMS.	.86 / .90
	I have control over using HEMS.	.77 / .78

Note: \*Items dropped as they had low factor loadings on respective constructs.

### Acknowledgements

The authors would like to thank the major German energy provider for providing access and grants to support the data collection.

### Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

### Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

### Notes

1. As this panel consists of German citizens who form a representative subsample of the German population and are especially recruited for this panel, the response rate is higher than that of the user sample.
2. After assessing our measurement model, we excluded items with dangerously low factor loadings, resulting in the final measures indicated in the Appendix.
3. We also estimated our model in the user and nonuser sample using CB-SEM (Mplus 6.0). Results show that hypothesis testing was not affected in 15 of the 16 cases in both samples and the implications of our results were not affected by the method used.

4. We also estimated a trimmed model excluding nonsignificant paths. Results show that trimming the models does not alter the significant path estimates in our model.

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