# Consumers´ acceptance, adoption and behavioural intentions regarding environmentally sustainable innovations

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**Diffusion of sustainable product-service integrated innovations is critical for protecting the environment. Past research indicated that post-purchase behaviour is the key success factor of an ecological innovation. Therefore, it was our objective to explain post-adoption behaviour rather than the first purchase itself. Based on theory of reasoned action and theory of planned behaviour we proposed a technology acceptance model (TAM) for the adoption of environmentally sustainable innovations. The model consists of three layers which were consumer characteristics; attitude towards a service integrated eco-product and intended behaviour. Statistical data of a structural equation model (SEM) significantly support the notion that environmental sustainability did not constitute a major reason for the consumer to pay more. Other product aspects determine whether the consumer was willing to pay more for a certain product or not. Social contagion as word-of-mouth revealed to be critical in this process. Major findings contribute to existing green technology research and provide new insights into pro-environmental consumer behaviour.**

## INTRODUCTION

Consumers increasingly discover their personal responsibility toward the environment and engage in sensible green shopping behaviour. Hence, more and more consumers state that their buying decisions are directly influenced on how environmental friendly an innovation is (Straughan and Roberts, 1999). This behaviour provides reasonable opportunities for companies to differentiate themselves by adopting technologies and by developing new products that are genuinely environmental friendly.

However, being green alone is not enough to promote success. Eco-friendly aspects of new products and services alone do not necessarily support enduring market domination (Kalafatis et al., 1999). A closer understanding of consumer behaviour is needed to predict market acceptance of an environmentally sustainable innovation. It is the key question marketers' face when thinking about going green. Therefore, to overcome such challenge we propose a product-service integrated sustainable innovation. Following the requirements of Mont and Tukker (2006), we intend to explore the link between hard and soft issues such as technology and sociology (e.g. users´ acceptance of new technology) to contribute to existing product-systems innovation research. The present research shows several

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reasons, why consumers resist to accept new technologies. Bagozzi and Lee (1999) conceptually developed a process-model to explain this resistance. They distinguished between active and passive resistance as consequence of the initial contact. Based on the work of Rogers (1995) and Nabih et al. (1997), Binsack (2003) developed an empirically tested adoption process model where resistance is a negative evaluation of an innovation as result of a persuasion-phase of a superordinate innovation-decision-process. Within this model positive evaluation could be interpreted as technology acceptance (Nabih et al. 1997). Following this approach we propose resistance and acceptance on the attitude and intention level to be the same construct.

The various decision making procedures are considered heuristics that represent loosely coupled stages of cognitive, emotional, and volitional processes. Therefore our paper focuses on consumer behaviour after the initial trial of environmentally sustainable innovations. By investigating a case, where an eco-friendly product technology is integrated into a pre-existing service we hypothesise that marketing success of green product and service innovations can be operationalized by a revised technology acceptance model (cp. Davis, 1989). Thereby, we explore how attitude variables affect distinct key behaviour intentions that promote the market success of a sustainable integrated service-product. We separate the effects of consumer's perceived usefulness to protect the environment as original eco-attributes and its perceived usefulness to convenience of usage.

## Theoretical framework

In the following section we explain the overall model and underlying origins. Afterwards we derive specific hypotheses to model consumers' acceptance of service integrated eco-technologies.

## Basic model specification

To evaluate consumer acceptance, we developed an explanatory model based on a revised Technology Acceptance Model (TAM) originally devised by Davis (1989) with its origins in the Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB) (Ajzen, 1991).

TAM has successfully proven to provide major insights in innovation´s acceptance related consumer behaviour (Mathieson, 1991). Two salient beliefs are considered as important determinants of attitude towards usage: perceived usefulness and perceived

ease of use. Perceived usefulness describes how advantageous the consumer believes the usage of the product is. While, the perceived ease of use reflects how much effort the consumer believes the usage will cost (Davis, 1989). While TRA and TPB presume that the salient beliefs change in every situation, TAM is based on the assumption that the relevant beliefs (perceived usefulness and perceived ease of use) remain the same. Furthermore, the TAM does not include the perceived behavioural control and subjective norm as variables (Mathieson, 1991).

For the purpose of this paper we apply a modified TAM to explain the acceptance of environmentally sustainable innovations. The objective of our paper is to explain post-adoption behaviour of environmentally sustainable innovations rather than the initial purchase itself: See Figure 1

## Major antecedents of individual attitudes

Hart and Johnson (1999), state that the only way to maintain a customer is never to betray his trust. In our context this is important because innovative products claiming to be environmentally sustainable can be regarded as distrustful and with scepticism by customers (Shrum et al., 1995; Parasuraman, 2000). The degree of novelty seeking defines the consumer's desire to seek out new experiences (Hirschman, 1980). Such consumers tend to have a positive view on innovative technologies because they find pleasure in experiencing new products and services (Dabholkar and Bagozzi, 2002). This suggests that customers with a high degree of novelty seeking also use new technologies more often than other consumers. Furthermore, novelty seekers expect new technology to be reliable and associate its usage with no or lower risk than non-novelty seekers (De Matos and Rossi, 2008). The latter will require a longer relationship to generate trust. Consequently, a novelty seeker is expected to build up trust toward green innovations in a fast, easy and positive attitude. Hence, it is hypothesised that:

H1: Novelty seeking positively influences the development of trust towards an environmentally sustainable innovation.

While trust illustrates that the consumer perceives the used technology to be reliable and safe, perceived usefulness addresses the ecological dimension, whether the consumer believes the service integrated eco-technology is capable of sustaining the environment or not. In our model beliefs that are of interest are novelty seeking and ecological attitude. These personal characteristics influence the perception and evaluation of every
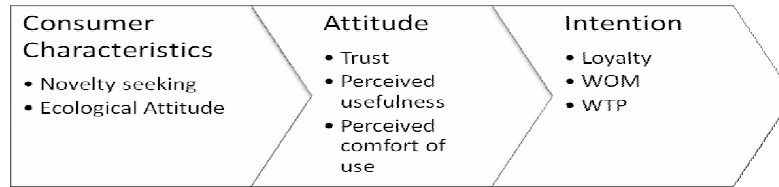
**Figure 1:** Basic model of technology acceptance

product category. The meaning and relative importance of a product attribute has to be measured anew for every product category and person.

Research suggests that environmentally conscious consumers are well educated and would appreciate a service or product that is environmentally sustainable (Bang et al., 2000). Since perceived usefulness is a belief concerning behavioural consequences and ecological attitude is a personal norm, such results strengthen the assumption of a positive relationship between the two constructs. Therefore, it is assumed:

H2: Ecological attitude has a positive effect on how useful an environmentally sustainable innovation is perceived by the consumer.

## Antecedents of behavioural intention and WTP

The belief, perceived comfort of use (like perceived usefulness) reflects how effortless a consumer believes the usage of a technology is (Davis, 1989). Research frequently identifies comfort as a determinant of ecologically conscious behaviour (Kollmuss and Agyeman, 2002): For example McCarty and Shrum (1997) show that perceived inconvenience is the only significant (negative) determinant of recycling behaviour. It also has strong influence on how important recycling is perceived. To sum up from their findings they pronounce changing this perception to be crucial to enhance recycling behaviour. Osterhus (1997), obtained a comparable result specifically for environmentally conscious behaviour. Worries about a decrease in comfort was the most important determinant of behaviour. Bhate and Lawler (1997), showed that the consumption of environmental friendly products strongly depends on how comfortable the purchase process is. Hence, the following hypothesis is plausible:

H3: Perceived comfort of use increases the consumer's willingness to pay more for an environmentally sustainable innovation.

Numerous studies support the notion that customer satisfaction is a strong predictor of loyalty (Cronin et al., 2000; Lam et al. 2004). It is necessary to

distinguish between satisfaction and usefulness. Perceived usefulness stems from a rational evaluation of the product whereas satisfaction is how customers' expectations and desires are met and/or exceeded (Spreng et al., 1996).

Ecological attitude expresses the desire to aid the environment and novelty seeking expresses the desire to try out new things (Roberts, 1995). Consequently, an innovative and environmentally sustainable product will satisfy consumers with high novelty seeking and high ecological attitude which in return will positively affect loyalty (Anderson and Sullivan, 1993).

Environmentally conscious consumers often seek information which enables them to identify environmentally sustainable products (Bloemer et al., 1999). The same information is used to form beliefs about the product which in return influences loyalty (Mellens et al., 1996). An analogous assumption holds for novelty seeking because this character trait actually describes the extent a person searches for new information and products (Hirschman, 1980). A consumer who has a high degree of novelty seeking will acquire further information about the product and thus more likely build up loyalty (Mellens et al., 1996). Therefore, it can be concluded that:

H4a: The loyalty a consumer develops towards an environmentally sustainable innovation is positively affected by his degree of novelty seeking.
H4b: Ecological attitude positively affects building up loyalty towards an environmentally sustainable innovation.

## Consequences of initial purchase actions and social contagion (WOM)

Numerous researches have been conducted in exploring the relationship between loyalty and WOM and it mutually agrees on the importance of WOM for achieving long-lasting marketing success in terms of market dispersion (Dick and Basu, 1994; Westbrook, 1987). According to Westbrook (1987), emotional experiences are the strongest determinants of a consumer's willingness to engage in WOM. Due to the emotional nature of loyalty, it is proposed to have

an impact on WOM (Dick and Basu, 1994). This is widely accepted and supported in empirical studies (e.g. Gounaris and Stathakopoulos, 2004).

Hence, empirical findings strongly suggest a positive relationship between loyalty and WOM and are further substantiated by the argumentation of Reichheld (2003). According to him, a consumer undertakes a risk when recommending a product to another consumer. If the recommendation leads to disappointment, the consumer stands to damage his reputation. Therefore, the consumer must either have good reason to embark on that risk or believe there is no risk. Hence, we conclude, that:

H5: Loyalty positively affects the amount of WOM a consumer spreads after adopting an environmentally sustainable innovation.

The consequences of trust in consumer marketing have also not received much attention until recently (Sichtmann, 2007; Chen, 2010). It is obvious that the theoretical foundation of trust being a determinant of WOM is very similar to the impact loyalty has on WOM. This could be because trust is considered an antecedent of loyalty which therefore mediates on the effect trust might have on WOM (Chaudhuri and Holbrook, 2001). Recommending a product usually involves taking a risk, because one's reputation might suffer if the expectations arising from this recommendation are not met. This would be a valid reason not to generate WOM. Trust reduces the perceived risk of recommending a product, because the product is expected to perform well (Sichtmann, 2007). Especially with technological innovations such reasoning is plausible. Several studies show trust to be particularly important for the acceptance of environmentally sustainable innovations (Shrum et al., 1995; Parasuraman, 2000). Besides from fear of damaging their reputation, only few people are believed to recommend a technology they do not perceive as safe. Concluding from this line of argument, we hypothesise:

H6: Trust has a direct impact on a consumer's intention to engage in positive WOM.

Davis (1989) pronounces perceived usefulness to be the most important determinant of behavioural intention concerning technology acceptance which is empirically confirmed (e.g. Mathieson, 1991; Gefen et al., 2003). Our model explains the formation of WOM based on perceived usefulness to aid the environment.

Our model regards ecological attitude as the single determinant of usefulness. Consequently, any connection between perceived usefulness and behaviour would reflect the distinctive characteristics of environmentally conscious consumers. Hence their characteristics should be considered.

Environmentally conscious consumers can be described as well informed consumers and opinion leaders regarding ecological products. Such consumers are also known to be very sceptical about new products (Shrum et al., 1995). Concluding from this it seems coherent that the consumer will evaluate an environmentally sustainable innovation carefully before recommending it. If he deems the innovation useful for protecting the environment, the ecological conscious consumer is expected to be motivated encouraging dispersion of that product. Otherwise he might even advise other consumers against an adoption of the product (Shrum et al., 1995).Therefore it is expected that:

H7: Perceived usefulness serves as a mediator for the effect of ecological attitude on WOM.

Bang et al. (2000), state that concern for the environment (ecological attitude) and beliefs about positive consequences (perceived usefulness) have a significant impact on WTP for renewable energy. Similar results can be found within a wide range of studies (Roe et al. 2001; De Pelsmacker et al., 2005).

Hence, research shows that there are consumers who are willing to pay more if the environment benefits from it. Such consumers feel a deep responsibility to aid the environment and are highly outgoing and communicative (Laroche et al., 2001). This characterisation of consumers committed to environmental protection corresponds with other studies (Roberts, 1995; Shrum et al., 1995). Consumers who are dedicated sufficiently to the green cause to pay a premium seem to be the ones who frequently engage in WOM. Consequently, we hypothesise that only consumers' who are willing to recommend the environmentally sustainable innovation might also be willing to pay more:

H8: The intention to engage in positive WOM serves as single mediator for any personal characteristic or belief a consumer holds towards paying more for an environmentally sustainable innovation.

## METHODOLOGY

In the following section we are introducing the data collection process and the process of analytical multivariate analysis we used to examine the technology acceptance modelling process.

### Data collection

We used a randomized sample of 105 first-time users

of a service-integrated eco-technology fulfilling the minimum requirement for maximum likelihood estimations following e.g. Bollen (1989). They were asked to participate in a survey after their tour with the new fuel cell-operating touristic vessel exclusively operating as an EU-funded innovation project since 2010. Subjects were instructed to evaluate the concept of the fuel-cell vessel as an innovative solution for touristic services. Initially the clients were asked to answer the following demographic questions: gender, age, people in household, education as well as income. We derived descriptive statistics of these variables. Demographic variables were grouped and were proved regarding major biases. The age distribution of the respondents shows the following balanced structure: age: 18-24 years = 12.6 %; 25-34 years = 36.9 %; 35-64 years = 38.8 %; from 64 years = 7.8%, n.a.: 3.9 %, income structures as well as gender distribution were nearly equally distributed (stratified sampling procedure).

## Measurements

Our measurement items were adopted from prior developed and tested research. In some cases items were modified to fit the product-service context of our study. The final items for each construct are summarized as follows.

## Exogenous independent variables

Novelty seeking is a construct to unveil consumer attitude toward new products and brands. It is measured by a three-item likert scale from Manning et al. (1986). Ecological attitude is the tendency a consumer has to engage in ecologically conscious behaviour. Ecological consumer behaviour could be conceptualised into ecological knowledge, attitude and behaviour. We use a scale adopted from Roberts (1995), in which we combine several facets of ecological attitude. The perceived comfort of use has shown to be particularly central in the adoption of environmentally sustainable behaviour. Comfort of use is measured by a three-item scale and involves items regarding the mentioning of different aspects regarding the comfort of a new product (Davis 1989). Items were selected due to the relevance in the context of product-service integration in the transportation market.

## Mediating variables

Several studies were revealed to generate valuable items regarding the case of service integrated eco-

technology. Loyalty and trust items were adopted from McMullan (2005). Loyalty is a sincerely held commitment to a product or brand which results in constant repurchase of this particular product or brand. Trust is the confidence one has in the reliability and integrity of his exchange partner. Perceived usefulness is directed at sustaining the environment. Usefulness items were developed based on the original article from Davis (1989).

## Dependent variables

Word of mouth is informal communication which is directed at other consumers and consists of information about the characteristics of a product. The impact on willingness to pay more also seems to be an important question to address, since this knowledge is imperative for pricing a product. Dependent variables were operationalized by established scales from consumer research literature. Word-of-mouth intention is a four-item likert scale adopted from Price and Arnould (1999). Intention to pay more is also a likert-scale from Stones et al. (1995). The used items comprise the customer's willingness to pay more for value-added services. The items were adjusted regarding the case of service integrated eco-technology shipping experience.

## RESULTS

The following section examines the validity of used constructs and presents the results of structural equation modelling.

Beginning with an exploratory factor analysis for all our items, we used the principal component method to extract the relevant constructs for our model. The extracted constructs and their corresponding items are shown in the appendix. Internal consistency and factor loadings were proved in this step. The results are also shown in the appendix. Summing up, values ranged from good (construct 'Intention to pay more') with cronbachs' alpha of 0.929 to acceptable (for the construct "Eco attitude" (alpha: 0.696)) (Nunnally and Bernstein, 1994). Only the construct novelty seeking did not really fit the criteria of first order (0.457). We then conducted a confirmatory factor analysis (CFA) on the eight constructs, with each indicator (item) specified to load on its hypothesized latent factor. We built the measurement model based on our derived hypotheses and the revealed correlations between the exploratory factor analysis. We yielded a chi-square of 321.9 at 263 degrees of freedom (Chi²/DF=1.224) and a Comparative Fit Index (CFI) of 0.954. Following Hu and Bentler (1998), this value
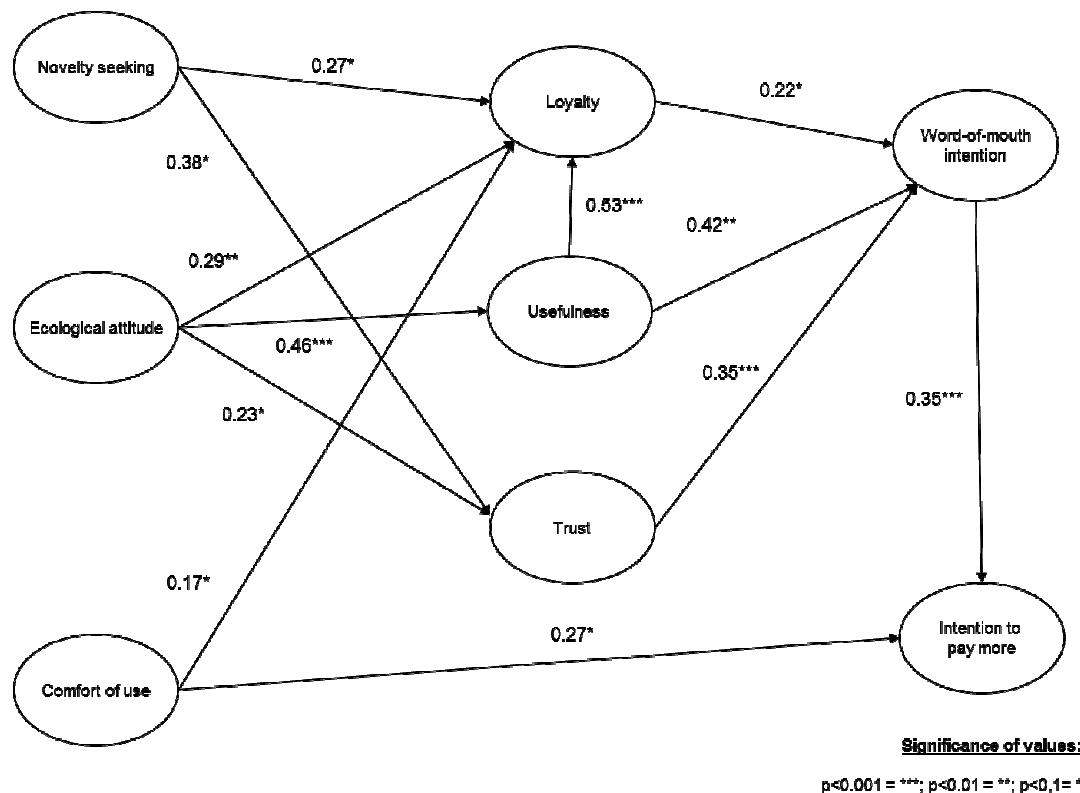
**Figure 2:** Standardized path coefficients of structural equation modelling

showed for an acceptable comparative fit of the model. The Root Mean Square Error of Approximation (RMSEA = 0.047) had a good value according to Browne and Cudeck (1993). The SRMR had a value of 0.0926 and could also be accepted as a good value (Hu and Bentler, 1998). The Tucker Lewis Index (TLI) was on an acceptable level (0.947) according to Hu and Bentler (1998) who report a value of greater than 0.95 as a good value, see Figure 2.

Results reflected the basic assumptions made in theoretical framework section. Our focal dependent variable was the intention to pay more for the product-service integration in the sustainable marketplace. The key variables to influence the customer's willingness to pay were comfort of use (0.27*, H3 √) as well as word-of-mouth intention (0.35***, H8 √). The higher the perceived usefulness of the service-product was, the higher was the word-of mouth intention (0.42**, H7 √). This implicated that the higher perceived usefulness was, the higher was loyalty toward the service integrated eco-technology (0.53***, additional finding). Hence, loyalty constituted a mediating variable from usefulness toward word-of mouth intention (0.22*, H5√). Trust into the technology emphasized a key variable to promote the product-service via word-of-mouth

(0.35***, H6 √). The higher the level of these variables was, the more likely it was, that the customer will turn into a net promoter of the sustainable technology product-service integration.

Comfort of use of the examined product service integration constituted both a direct and an indirect impact construct to boost intention to pay more. Indirectly there was a low but significant impact onto the loyalty of the product-service integration (0.17*, additional finding). Furthermore, ecological attitude constituted the key independent variable to explain trust, perceived usefulness and loyalty toward the service integrated eco-technology. Ecological attitude showed the major impact toward the construct of perceived usefulness (0.46***, H2 √). This was not astonishing because the construct reflected the perceived usefulness of the technology in a broad context of appliance. The impact of ecological attitude on loyalty (0.29**, H4b√) and trust (0.23*, additional finding) toward the service-product was slightly lower but still valuable. Hence, ecological attitude might have served as a key determinant variable to arrange strategic and operative marketing activities to promote product-service adaption in the field of sustainable tourist-service offerings. Finally, novelty seeking served as key construct to explain trust toward the technology of the service integrated

**Table 1:** Prove of hypothesis

| Hypothesis | Path | | Stand. Coeff. | Accepted |
|---|---|---|---|---|
| | **From** | **To** | | |
| H₁ | Novelty Seeking | Trust | .38* | yes |
| H₂ | Eco Attitude | Usefulness | .46*** | yes |
| H₃ | Comfort of Use | WTP | .27* | yes |
| H₄ₐ | Novelty Seeking | Loyalty | .27* | yes |
| H₄ᵦ | Eco Attitude | Loyalty | .29** | yes |
| H₅ | Loyalty | WOM | .22* | yes |
| H₆ | Trust | WOM | .35*** | yes |
| H₇ | Usefulness | WOM | .42** | yes |
| H₈ | WOM | WTP | .35*** | Yes |
| n.a. | Usefulness | Loyalty | .53*** | - |
| n.a. | Comfort of Use | Loyalty | .17* | - |
| n.a. | Eco Attitude | Trust | .23* | - |

eco-technology (0.38*, H1 √). Novelty seekers were open-minded toward any kind of new technology and product-service innovation. Nevertheless, trust in the field of hydrogen operated technologies was a key determinant to enhance adaption of this technology because of the perceived aligned risks of the hydrogen technology. In addition, novelty seeking enhanced the probability of being loyal toward the product-service bundle (0.27*, H4a √).

Overall our derived hypothesises could be verified. Moreover we found some additional effects that were not supposed: The effect of usefulness on loyalty is a mediating effect uncovered trough analytical procedures (nested model comparison). This effect is valuable (.53*) and shows that addressing the usefulness of the new concept is a key success factor for technology acceptance. The effect of ecological attitude on trust is non-intuitive and was not investigated in literature yet. We suggest further research on this relationship. Last, the effect of comfort of use on loyalty is beneath the cut-off value of .20 guaranteeing reasonable path interpretations (Weiber and Mühlhaus 2009), therefore we do not further examine this effect, see Table 1

**DISCUSSION AND IMPLICATIONS**

**Discussion**

Results show that our revised technology acceptance model could uncover the general acceptance structure of sustainable product and service innovations. In the examined case of sustainable product-service integration in the hydrogen market we figured out that willingness to pay more for sustainable service offerings is dependent on word-of

mouth intention as well as comfort of use. These effects are universal and reflect three general findings regarding adoption of sustainable product and service innovations:

- Service-products integration offerings in the field of sustainable technologies need to fulfil special needs of the customers. This is essential as these technologies are naturally interconnected with higher prices.
- Service-products offerings need to address indirectly consumer needs based on their personal characteristics. In our case we found that ecological attitude serves as a key characteristic to address trust, perceived usefulness and loyalty of the product-service bundle. Word-of-mouth intention constitutes the key construct to uncover customers willingness to pay more for these eco-friendly product-service offering.
- We outlined the effect that comfort of use interconnected with perceived usefulness is of major importance for long-lasting marketing success.

We have not examined consumer's choice to uncover utility-requirements regarding the concrete product-service characteristics. Probably a conjoint analysis may help to identify relevant product and service aspects in generating a target group specific sustainable solution in the future. Possible outcomes regarding cluster analysis based on conjoint data could be integrated in the technology acceptance model. Results may unveil key determinants of ecological product and service innovation. This is relevant to gain more word-of mouth (net promoter) and higher intention to pay more for sustainable

product usage and ecological product-service.

## Implications

Our results show that technology acceptance modelling is a valuable methodological approach to gain insights into consumer behaviour of sustainable technologies in the product-service offering. Major implications regarding future scientific research might be adapted to our technology acceptance model in a wider range of sustainable product solutions and service innovations.

Results are of practical relevance for product and service companies operating in the field of sustainable technologies. The intention to pay more is directly influenced by the comfort of use. Novelty seeking and ecological attitude directly affect loyalty, usefulness and trust, which serve as mediating variables towards the dependent variable word of mouth. Finally, word of mouth acts as a key success factor for the dissemination and communication of marketing strategy.

We hope that our findings might be valuable to gain an extended view toward the adoption and diffusion of sustainable product and service innovations. Several studies have shown the relevance of structured roll-out cycles to launch (sustainable) service-products in the marketplace. From our point of view there might be helpful numerous structural efforts: (a) Cluster initiatives, (b) research grants for sustainable energy production and (c) strategic joint ventures from energy suppliers and service vendors.

Finally, our results lead us to the research implications that the dissemination of service integrated eco-products should be defined as structured roll-out cycle. This roll-out cycle consist of three parts to be integrated: adaptor-, company- and product related factors. The basic idea is to address several factors which are related to the adoption of new products (Rogers, 1995). In our study, we only focused on adaptor-related factors and on technology adoption modelling. A second step analysing the market structure and consumer profiling should serve as a basis for all company and product related activities. Following such a holistic concept screen, product related activities like green services initiatives could be conceptualised properly. At the end there might be a valuable service-product integrated eco-innovation with high market potential. Hence, our proposed lifecycle should serve as a structure for all roll-out strategies.

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