View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Cronfa at Swansea University

Cronfa - Swansea University Open Access Repository

This is an author produced version of a paper published in :
International Journal of Technology Management & Sustainable Development

Cronfa URL for this paper:
http://cronfa.swan.ac.uk/Record/cronfa21506

Paper:
Kapoor, K., Dwivedi, Y. & Williams, M. (2014). Examining consumer acceptance of green innovations using innovation characteristics: A conceptual approach. *International Journal of Technology Management & Sustainable Development, 13*(2), 135-160.

http://dx.doi.org/10.1386/tmsd.13.2.135_1

This article is brought to you by Swansea University. Any person downloading material is agreeing to abide by the terms of the repository licence. Authors are personally responsible for adhering to publisher restrictions or conditions. When uploading content they are required to comply with their publisher agreement and the SHERPA RoMEO database to judge whether or not it is copyright safe to add this version of the paper to this repository.
http://www.swansea.ac.uk/iss/researchsupport/cronfa-support/

Examining Consumer Acceptance of Green Innovations Using Innovation Characteristics: A Conceptual Approach

Kawaljeet Kaur Kapoor
School of Management, Swansea University, Wales, United Kingdom

Yogesh K. Dwivedi*
School of Management, Swansea University, Wales, United Kingdom

Michael D. Williams
School of Management, Swansea University, Wales, United Kingdom

Abstract

In the wake of global warming and environmental preservation, all processes and actions are now being directed along the lines of creating a greener environment. *Household solar equipments* are one such initiative, whereby people around the world are being encouraged to adopt green innovations even within homes. Recent emphasis is particularly along the usage of solar energy for home lighting, heating, and cooking. To achieve increased adoption of these green innovations, it is important to understand the behaviours of various factors that may influence consumers in forming favourable intentions towards such innovations. This article aims to develop a theory-based conceptual framework for examining user adoption of household solar innovations. Attributes from Rogers' *diffusion of innovations* theory, Tornatzky and Klein's *meta-analysis*, and Moore and Benbasat's *perceived characteristics of innovating* theory will be used to design the intended framework for examining the adoption of household solar and other green innovations.

Keywords adoption, intention, conceptual framework, innovation-attributes, solar

1. Introduction

Given the millions of years they take to form, the non-renewable energy sources such as coal, petroleum, natural gas, and others are fleetingly on their way to extinction. Many developing countries are suffering electricity shortage owing to the same. At the same time, the world is fighting for a less carbon and a much greener environment. Both developed and developing nations are looking at the renewable forms of energy, such as solar, as an attractive solution directly available to combat the aforementioned issues (Islam, 2014). Needing no much introduction, solar panels use direct energy from the sun to convert it into usable form of electricity available for everyday usage. In the interest of world welfare, countries are being encouraged to exercise effective measures towards reducing carbon footprint. Many countries are introducing new policies and subsidies at consumer and organizational levels to encourage widespread adoption of green innovations (Olson, 2014). Literary evidences suggest that despite the monetary aid, the acceptance rates of such solar innovations across countries is very low (Bauner and Crago, 2013).

Since recently researchers are investing particular interest in studying the diffusion of eco-friendly innovations (Karakaya et al., 2014). Consumers are being encouraged to integrate solar equipments in their everyday living. Any product or idea offering new and improved ways of doing things is recognized as an innovation (Ching and Ellis, 2004; Damiano, 2011). A typical example would be the use of solar equipped energy systems within households.

Solar innovations are being unanimously promoted by governments, policymakers, and industry leaders, all aimed at the betterment of world environment (Kim et al., 2014). Household/residential solar has been recognized as a potential consumer market, with solar water heaters being the most used solar equipment (Islam, 2014; Li et al., 2013). Literature and media reports have identified high set-up costs, lack of consumer awareness, climate conditions, limited land, and absence of trained professionals in the solar industry as some of the many challenges to the adoption of green innovations (Bauner and Crago, 2013; EAI, 2014). This study will concentrate on individual adoption of household solar; factors influencing consumer adoption of such green innovations will be examined.

Household solar mostly constitutes of home lighting, water heating, and cooking systems (Solar-panels, 2012). The home lighting systems are easy to install, with no wiring or extension required. Available as torches, lanterns, garden/in-house/security lights, they come with a competitive initial cost, however, they have zero maintenance cost and are economically feasible in the long run (Solar-lighting, 2012). With the solar panel transferring heat to the water in the pipes and heating the water stored in a water tank, the solar water heaters are used as a substitute for electric water heaters. These claim to cut down the monthly electricity bill by almost half the usual amount (Solar-heating, 2012). Available as cookers, kettles, bowls, and grills, the solar cooking systems use reflective mirrors to converge sunrays for initiating cooking. With no gas/burning involved, these systems have no operating costs, fire hazard possibilities, deforestation, or any other environment polluting aspects involved (Solar-lighting, 2012).

Not all innovations are successful. Over 30 years of research comes to a commonly agreed conclusion that one third of all innovations fail (Cooper and Kleinschmidt, 1987; Poolton and Barclay, 1998; Suwannaporn and Speece, 2003). It is therefore important to understand what factors potentially cause such innovation failures, which in effect are expected to better the chances of innovation success. Contemporary research houses plenty studies investigating the acceptance of modern-day innovations (Dwivedi et al., 2013; Kapoor et al., 2014ab; Williams et al., 2009). Degree of consumer satisfaction is directly related to innovation-adoption (Mishra and Shekhar, 2013). The marketers and implementers of an innovation are interested in recognizing the key characteristics that play an influential role in accelerating innovation-adoption (Lockett and Littler, 1997).

This study will be presenting valid theoretical formulations for examining the impacts of different characteristics on the adoption of household green innovations. According to Earp and Ennett (1991), a conceptual model helps summarize and integrate the acquired knowledge to define concepts, explain casual linkages, and make relevant propositions, which is conceptualizing the literature on the basis of existing theoretical foundations (Lucarelli and Brorstrom, 2013). This article will thus be proposing a conceptual model for studying the adoption of green innovations. A review of the existing literature on innovation-adoption models and innovation-attributes currently being used for examining the different technological innovations will be undertaken. A set of innovation-attributes appropriate for studying the green innovations' acceptance will be chosen, and the theoretical justifications behind their selection will be presented. This will be followed by the formulation of relevant propositions for testing and validating the conceptual model proposed in this study. Towards the end, discussions, implications, and conclusions will be highlighted.

2. Extant Models for Examining Innovation-Adoption

The rise of competition in today's world, especially consumer markets, has brought to the limelight the concept of innovations. The success of these innovations can be measured by running an analysis of their adoption in the target markets. The literature is rich with many theoretical models mostly developed from the psychology and sociology theories which assist in making such analyses (Venkatesh et al., 2003; Venkatesh et al., 2012), such as - Diffusion of Innovations theory (DOI) (Rogers, 1962), Theory of Reasoned action (TRA) (Fishbein and Ajzen, 1975), Theory of Planned Behaviour (TPB) (Ajzen, 1985; Ajzen and Fishbein, 1980), Technology Acceptance Model (Davis, 1989), decomposed Theory of Planned Behavior (Taylor and Todd, 1995), extended Technology Acceptance Model (TAM) (Venkatesh and Davis, 2000), and Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003).

Of all the aforementioned theories, Rogers' diffusion of innovations theory is very well established and the most used theory (Tornatzky and Klein, 1982; Kapoor et al., 2013). According to Rogers (2003), the following five attributes that came to be recognized as *perceived attributes of innovations* – relative advantage, compatibility, complexity, trialability, and observability were the most essential for examining innovation-adoptions. The existing literature in the field of innovations is a proof of the many studies using one or more of Rogers' innovation-attributes. For instance, Hester and Scott (2008) study the literature to emphasize the need for implementations of Wiki technology to consider user perceptions of Wiki organizational compatibility, relative advantage, and complexity; Greenhalgh et al (2004) address issues of spreading and sustaining innovations in the health service industry via a systematic review; in addition to Rogers' authoritative review, all five attributes are detailed on the basis of a review of the then recent empirical studies; Legare et al (2008) systematically review perceptions of health professionals, where Rogers' attributes are addressed as barriers and facilitators in implementing the decision making process.

Diffusion of innovations theory is possibly the principal theoretical perspective on technology adoption at both individual and organizational levels, offering a conceptual framework for discussing adoption at a global level (Dillon and Morris, 1996). Rogers (2003) synthesizes 60 years of innovation-adoption research. He distils this very rich accumulation of informative material into a set of principles explaining the propagation of an innovation into a social system. In doing so, he surveyed several hundred innovation studies to identify the aforementioned five characteristics of innovation that impact the diffusion of an innovation (Moore and Benbasat, 1991). This theory is regarded as one of the most popular adoption models and theoretical frameworks used for studying the acceptance and diffusion of new technological innovations (Greenhalgh et al., 2004; Sahin, 2006; Sherry and Gibson, 2002). This theory finds extensive usage in studying the acceptance of innovations ranging from agriculture to organizational innovations (Tornatzky and Klein, 1982). According to Roman (2003), this theory stands as a prolific ground for conceptual and methodical creativity as it cuts across numerous social science disciplines, and is being applied across very different contexts (Downs and Mohr, 1976; Rogers, 2003). Secondly, Rogers (2003) explained that the *perceived attributes of innovations* are an important explanation of the adoption rate of an innovation, and that most of the variance in the rate of innovation-adoptions, (49%-87%) is explained by these five *attributes of innovations*. Thirdly, Rogers (2003) proposed that these five characteristics were chosen on the basis of past writing, research, and the desire for maximum generality (across sundry innovations) and succinctness. Lastly, all of the above identified innovation-adoption models used more or less the similar types of innovation-attributes. The TPB model is an extension of the TRA model, and decomposed TPB shares

similarities with TAM; TAM is also regarded as an adaptation of TRA; the TAM attributes are similar to two of Rogers' DOI attributes (relative advantage and complexity).Therefore, Rogers' Diffusion of Innovations theory was selected as the base point for this study.

In addition to Rogers' DOI theory, two other pieces of work that were substantially recognized when it came to the attributes affecting intention and adoption of different innovations were – (a) *meta-analysis* by Tornatzky and Klein (1982), where 30 attributes (five of which were Rogers') were identified; and (b) *perceived characteristics of innovating* theory by Moore and Benbasat (1991), where five attributes (two of which were Rogers') were identified. After Rogers, Tornatzky and Klein's meta-analysis from 1982 was marked as a significant contribution in this field of innovation-diffusion. They examined IT innovations by discussing the use of Rogers' innovation-attributes in the IT world. In addition to Rogers' five attributes, they identified 25 innovation-attributes in use then. Since Tornatzky and Klein had picked these innovation-attributes from the publications in the field of innovations, it was clear that these attributes had marked their presence in the innovation literature, and had gained recognition as the innovation-attributes that influenced the adoption of varied innovations. Therefore, these other 25 attributes were deemed appropriate for this study, and included to be studied under this review. Tornatzky and Klein (1982, p28) state "innovation characteristics research describes the relationship between attributes/characteristics of an innovation and adoption/implementation". It therefore becomes important to study these innovation-attributes as they can greatly impact adoption decisions.

It is important to note that there have been very few studies dealing with the review of studies investigating the impact of innovation-attributes. After Tornatzky and Klein's meta-analysis in 1982, Moore and Benbasat presented their findings in this area in 1991, where they focussed on developing an instrument to measure individual perceptions of adopting IT innovations. They studied eight attributes, five of which were either from Rogers', or from Tornatzky and Klein. However, three attributes were exclusively identified by them – *image, voluntariness,* and *result demonstrability*, all of which found their basis on Rogers' attributes. In total, this study was interested in these 33 innovation-attributes, and their influences on adoption and adoption intention aspects of an innovation. To ensure that these 33 innovation-attributes were still in use in the recent literature, a literature search had to be undertaken. Many screenings later, it was found that nineteen of these 33 attributes were either no longer in use by the recent studies, or had been utilized by five or less publications. Such attributes were eliminated, and the 33 innovation-attributes were eventually narrowed down to fourteen innovation-attributes, which had been in active use by the studies published on innovations in the last fifteen years; in addition to Rogers' five attributes, the other nine attributes shortlisted here were – cost, risk, ease of use, image, visibility, voluntariness, result demonstrability, social approval, and communicability.

3. Reviewing the Literature on Green Innovations

Labay and Kinnear (1981) distinguishingly study the factors that the adopters and non-adopters consider while making an active solar energy system adoption decision. Faiers et al (2007) differentiate pragmatic consumers from the innovators in studying the adoption of domestic solar to show that the latter type of consumers overlooked observability and proceeded towards the implementation aspect. In a study on household electricity generation using solar cells, Islam and Meade (2013) showed that technology awareness was an important factor in influencing the probability of adoption, and Islam (2014) also added an aspect of energy cost/price to the list of influential factors. The existing literature houses studies on the overall solar energy power generation in India (Sasikumar and

Jayasubramaniam, 2013), potential of solar water heating systems in India (Purohit and Michaelowa, 2008), energy transition in rural India (Rehman et al., 2010), carbon abatement potential for solar systems in Indian homes (Chaurey and Kandpal, 2009), potential for solar cookers in India (Purohit and Purohit, 2007), and others. An interesting observation made was that this was all the literature available on the adoption of domestic solar systems in India, and of all the available studies, none examined their adoption in the empirical context.

Woersdorfer and Kaus (2011) study the adoption of thermal solar systems in north western Germany to show that the peer behavior does act as a trigger in its diffusion. Shih and Chou (2011) examined the consumers' willingness to pay for leasing solar power, and found that reliability, subsidies, and price were significantly associated with the willingness to pay for a short lease period. Chen (2014) explores the effects of innovativeness, lifestyles, and value added on the adoption of residential solar in a Taiwanian context. Olson (2014) offers a framework for examining the different diffusion prospects of green innovations across environmental and financial comparisons. The above summarized publications are a few of the many existing studies that have contributed towards the better understanding of the acceptance of green innovations across varied contexts. The existing literature shows that there exists a continuous potential for empirically evaluating the acceptance of green innovations with the moving time. It is also very important to take note that the home green innovations are still gaining recognition across the consumer markets, and the managers and implementers of these green equipments have been introducing changes in the usage and purchase policies on a continuous basis. Therefore, there exists a need for undertaking empirical investigations on the potential factors that may act as the promoters or barriers to the adoption and diffusion of these household solar innovations. The primary aim of this study is therefore to create a conceptual framework that will examine the role of different innovation-attributes in the adoption of such green innovations.

4. Conceptual Framework

Technological innovation creates uncertainty about the consequences of its use in the minds of potential adopters, which is alleviated upon seeking answers to the questions like – what is the innovation, what are its consequences, advantages/disadvantages, how and why does it work?; all of which can be measured using the five innovation-attributes (Rogers, 2003). With this study, additional nine attributes will be used to address the aforementioned concerns (table1).

Table 1: Innovation-attributes, their definitions, and sources.

Attributes	Definitions	Sources
Relative Advantage	Degree to which an innovation is better than the idea it supersedes	Rogers (2003)
Compatibility	Degree to which an innovation is consistent with existing values, past experiences and needs of potential adopters	Rogers (2003)
Complexity	Degree to which an innovation is relatively difficult to understand/use	Rogers (2003)
Trialability	Degree to which an innovation may be experimented with on a limited basis	Rogers (2003)
Observability	Degree to which the results of an innovation are visible to others	Rogers (2003)
Cost	Costs associated with the use of an innovation.	Tornatzky and Klein (1982)
Risk	Multidimensional component involving performance, financial, social, physical,	Tornatzky and Klein (1982)

	psychological, and other types of risks	
Ease of use	Degree to which an individual believes that using a system is free of physical/mental effort	Davis (1986); Moore and Benbasat (1991)
Image	Degree to which the use of an innovation is perceived to enhance one's image in society	Tornatzky and Klein (1982)
Visibility	Degree to which the use of a particular innovation is apparent	Tornatzky and Klein (1982)
Voluntariness	Degree to which use of an innovation is perceived as being voluntary/free will	Tornatzky and Klein (1982)
Result Demonstrability	Tangibility of the results of using an innovation, including their observability and communicability	Moore and Benbasat (1991)
Social Approval	Nonfinancial aspect of reward	Tornatzky and Klein (1982)
Communicability	Degree to which an innovation can be clearly and easily understood	Tornatzky and Klein (1982)

It would be of worth to note at this point that there exists extensive similarity between two of the shortlisted innovation-attributes – complexity and ease of use. Both attributes are measuring the same thing, but in opposite directions. It would therefore be appropriate to consider them as one. However, placing consideration in the fact that they have been identified differently by different theories, it was considered more appropriate to treat them as two exclusive attributes, and hence the different sets of propositions for both. This section will continue with exclusively discussing each of the fourteen innovation-attributes to make the associated propositions.

4.1 Relative Advantage

With relative advantage, the potential adopters are essentially weighing the advantages and disadvantages associated with the use of an innovation against the alternative technology that they are currently using. Solar equipments turn out to be cost effective in the long run, saving electricity costs and contribute towards a greener environment, saving up resources that could soon become extinct. According to Pannell et al (2006), in the long run, relative advantage determines the ultimate level of adoption for most innovations. Literature on green innovations have reported a significant influence of relative advantage on users' behavioral intentions; for instance – study on adoption of electronic indicator for capturing the household energy use by Vollink et al (2002), study on adoption of domestic solar power systems by Faiers et al (2007), study on residential renewable energy systems adoption by Tapaninen et al (2009b), and the study on green practice adoption by Chou et al (2012). As previously stated, these home solar equipments clearly bear advantages over the conventional form of electricity that is in present use by most homes. It is thus expected that this attribute will have a substantial impact on users' adoption decision. The proposition made for examining the impact of relative advantage was –

Proposition 1: *Relative advantage of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.2 Compatibility

Claudy et al (2011) point out that since heating and electricity production is separate from the daily practices of the people, the potential adopters may be concerned/worried that the adoption of a microgeneration technology such solar energy systems would need them to alter their daily habits. When any innovation fits with the lifestyles of the potential adopters, staying in line with their preferences, matching with the similar technologies that these

potential adopters may have adopted in the recent past, it becomes seemingly more appealing to them (Rogers, 2003). Past studies on green innovations have found that compatibility significantly influences the use intentions of the potential adopter; for instance – green electricity study by Ozaki (2011), energy conservation interventions adoption study by Vollink et al (2002), solar energy systems adoption studies by Labay and Kinnear (1981) and Faiers et al (2007). Claudy et al (2011) in studying the adoption of microgeneration technologies reported that compatibility had a positive influence on the potential users' willingness to pay. A study on photovoltaic system adoption, which operates on solar cells, suggested that the apparent fact that such a system shares a fair share of compatibility with the existing norms tends to become capable of self demonstrating how simple such a photovoltaic system is to use (Muller and Rode, 2013). The same argument can be applied in the present case. Being compatible implies not requiring making changes, in turn implying known usage ease/difficulty level, in turn minimizing consumer apprehensions towards product adoption. Therefore, the above stated is expected to lead the consumers towards forming positive use intentions. The proposition made for examining the impact of this attribute thereby was –

Proposition 2: *Compatibility of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.3 Complexity

In using any given technological innovation, an individual's knowledge about that innovation, and the related skills required to use that innovation often determine the perception of complexity associated with the use of that innovation for that individual. The more comfortable an individual will be with using a given innovation, the more attracted will they be towards that innovation (Rogers, 2003). A simple equipment design and user-friendly interface will be more appealing to the potential adopters. Arkesteijn and Oerlemans (2005) found that the perception of ease of using green power in households increased the potential users' adoption probability. Rogers (2003) while explaining this attribute in his book exemplified a simple case of the first adopters of home computers in the US. He very logically divides the consumers into hobbyists and other adopters; he puts forth how for the hobbyists, even the first home computers did not appear complex at all, but a normal consumer, short of the technical knowledge, found even the basic computer highly difficult to use. Studies on green innovations have reported significant influences of reduced complexity on the users' adoption intentions (Chou et al., 2012; Faiers et al., 2007; Labay and Kinnear, 1981; Vollink et al., 2002). The proposition made for examining the impact of this attribute thereby was –

Proposition 3: *Complexity associated with the use of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.4 Trialability

Generally the household/domestic solar power systems are not considered to be trialable due to their nature (Faiers and Neame, 2006), and owing to this very valid reason some studies on green electricity tend to omit this attribute from their analyses. Tapaninen et al (2009a) also reiterate the idea of lack of trialability being typical of long-term commitment investments such as bio energy systems. However, there are evidences of some studies in the field of green innovations that have hypothesized for this attribute to significantly influence the adoption intentions of the potential users (Faiers et al., 2007, Labay and Kinnear, 1981;

Vollink et al., 2002). As Claudy et al (2011) suggest, despite the fact that the microgeneration technologies such as household solar equipments are impossible to be tried out prior to their adoption, the interested house owners might have the chance to see the working of these equipments at a neighbours', friends', or acquaintances' homes helping them in making a more informed decision. Therefore, this attribute will be studied in the household solar context to find out if and how the lack of trialability affects the use intentions of the potential consumers; the proposition made for examining the impact of this attribute thereby was –

Proposition 4: *Trialability of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.5 Observability

When it comes to observability, the underlying idea is that the innovation under consideration is already in use amongst the target masses and the outcomes/results of using that innovation are available to be observed or seen by the potential users. There are numerous studies on green innovations that have given significant consideration to this innovation attribute. Whilst some studies, [for instance, renewable energy systems adoption-study by Tapaninen et al (2009a) and solar energy systems adoption-study by Labay and Kinnear (1981)] observed a non-significant effect of observability on behavioral intention, other studies [for instance, domestic solar power systems adoption-study by Faiers et al (2007), residential microgeneration technologies adoption-study by Claudy et al (2011), and green practices adoption-study by Chou et al (2012)] reported a significant influence of this attribute on the consumers' use intentions. Labay and Kinnear (1981) in discussing this non-significance of observability in the solar systems context explain that the more the consumers familiarize themselves with such innovations, the lesser a novelty it becomes, and hence perceptions change to it being less observable by others. The more important thing here is just looking at installed equipments outside a house, or in a society, does not curb the uncertainties of the potential consumers towards solar equipments. The proposition thus made for examining and confirming the direction of influence for this particular attribute was –

Proposition 5: *Observability of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.6 Cost

With the solar lighting, heating, and cooking systems in prime focus for the current study, some research into the costs of these systems revealed that these systems come with competitive initial costs (Solar-panels, 2012); it is claimed that the solar lighting systems have no maintenance costs which proves to be cost effective in the long run (Solar-lighting, 2012). When it comes to the solar heating systems, Mills and Schleich (2009) have identified that residential and geographic characteristics play a very significant role in identifying the costs alongside the high installation cost, such as heater size, family size, household size, building size, and so on. Solar cooking systems, although not low cost, considering they are a one-time investment, are fairly reasonably priced (Solar-cooking, 2012). Ozaki (2011) found that costs of adopting green electricity is mostly seen as a problem, and that it is an important factor determining the adoption of such innovations. Durham et al (1988) reported that costs and the following economic benefits are highly significant factors in the adoption decision of the household solar energy systems. Mills and Schleich (2009) also reported that cost is an important determinant of adoption. Sawyer (1982) reported that high initial costs act as a barrier to solar energy systems adoption. Sardianou and Genoudi (2013) in their study on

adoption of residential renewable energies reported a negative effect of cost on use intentions. Therefore, cost was included to be studied in the household solar context. The propositions made for examining the impact of this attribute thereby were –

Proposition 6a: *Lower cost associations with the use of solar equipments are expected to positively influence the behavioral intentions of the consumers.*

Proposition 6b: *Lower cost associations with the use of solar equipments are expected to positively influence its adoption.*

4.7 Risk

The potential users' uncertainty about the quality of green electricity often causes anxiety and comes in the way of their adoption decisions (Ozaki, 2011). The expected probable social or economic loss resulting from the adoption of a given innovation is what constitutes perceived risk (Labay and Kinnear, 1981; Rogers and Shoemaker, 1971). Past studies have found that lower risks positively impact users' behavioral intentions; for instance – solar energy systems adoption study by Labay and Kinnear (1981); another study on microgeneration technologies adoption by Claudy et al (2011) divided the risks into performance and social risks and reported that it had a negative impact on potentials users' willingness to pay. Campbell and Goodstein (2001) and Manning et al (1995) vouch for the idea that the perception of risk motivates the consumers to gain more information on the innovation, rather than having to do much with impacting the adoption decision of that innovation. The solar systems have not been particularly been in news for any reported hazard, their benefits are well known to the world, hence their fond reference as the eco-friendly green systems, their maintenance is often claimed to be minimal, they have a longer life span, their cost effectiveness, all leave not much room for risk. It will thus be very interesting to understand the behaviour of risk in this context. The proposition made for examining the impact of this attribute thereby was –

Proposition 7: *Lower risk associations with the use of solar equipments are expected to positively influence the behavioral intentions of the consumers.*

4.8 Ease of Use

Velayudhan (2003) in studying the diffusion of solar lantern found in their study that the ease or convenience of using the solar lantern was not a significant reason for the consumers to purchase/adopt them. Ozaki (2011) in studying the adoption of green innovations also suggested that ease of use did matter to a certain extent. Webb and Stuart (2007) in their study on solar cookers exemplify a widely adopted design in China because of its ease of use. The use of household solar equipments typically begins with the installation of the solar panels (heating, lighting), which is generally executed by the vendors from whom these equipments are purchased. Consumers only have to turn on a switch/button to start using the harnessed electricity. In order to determine if the users found their interaction with, and the operability of the household solar equipments (solar heaters, solar lighting, and solar cookers) fairly easy, and if yes, then to what degree this ease of using the aforementioned equipments contributed towards their adoption, the proposition made was –

Proposition 8: *Ease of using solar equipments is expected to positively influence their adoption.*

4.9 Image

The literature housed extremely limited evidences of image being statistically analyzed as an innovation-attribute in the studies examining the diffusion of green innovations. Arkesteijn and Oerlemans (2005) suggest that the limited visibility of green electricity makes gaining social status almost impossible, and they report a non-significant impact of image on behavioral intentions. However, it is interesting to note that studies have often found high starting costs to be closely associated with the adoption of solar energy systems (Sawyer, 1982; Ozaki, 2011). In extension to this fact, a study suggested that the adoption of more expensive technologies is often perceived as a medium to move up the social status ladder (Masera et al., 2000). In simpler terms, an innovation that is expensive is expected to improve one's image, once owned. Green innovations have always been marked to be high cost investments. It should thus be interesting to observe if this high cost innovation diverts consumer interests along the lines of improved social image towards its adoption. To delve further into the perceptions of the significance of image in the adoption of green innovations, the proposition made was –

Proposition 9: *Better image associations with the use of solar equipments are expected to significantly influence the behavioral intentions of the consumers.*

4.10 Visibility

Visibility of an innovation tends to encourage peer discussions of that innovation, which collectively contributes towards achieving a better adoption rate for that innovation (Rogers, 2003). Arkesteijn and Oerlemans (2005) in examining the adoption of green power by Dutch households suggest that owing to its product characteristics, green power suffers very limited overall visibility. Contrary to the made claim, along an alternate plane, Wustenhagen et al (2007) suggest that the fact that solar energy is harnessed in extremely close proximities of the consumer location, like their rooftops, backyards, or patios, there exists increased visibility of these solar equipments. The solar panels for lighting and heating are visible equipments, which can contribute positively towards consumer intentions. A point to be noted here is that of localization. Although very clearly visible, the spread of visibility extends only as far as that neighbourhood or locality in which the house with these solar panels is situated. Nevertheless, with an aim to statistically analyze the influence of this attribute in the household solar equipments adoption context, the following proposition was made –

Proposition 10: *Visibility of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.11 Voluntariness

Aubert and Hamel (2001) in explaining the influence of voluntariness pointed at the fact that the innovations introduced on a voluntary basis tend to receive more acceptance than those that are mandated; On the other hand, mandating innovation-adoptions have a tendency of only introducing resistance to adoption. Scheraga et al (2000) mention the voluntary participation of the users in the implementation of a new technology as an important success factor. Moore and Benbasat (1991) explain in their study that many studies tend to plainly assume that just because the innovations that they are examining are not mandatory, they have voluntary adopters for those innovations, but this may not always be the case; since it is not often the actual voluntariness, but the perception of voluntariness that in actuality

influences the behavior (Moore and Benbasat, 1991). As mentioned in a study by Karahanna et al (1999), voluntariness is a form of social influence; that is, in a particular social setting, an individual may in some way feel compelled to use a particular innovation. Studying the influence of this attribute on green innovation-adoption thus seemed fitting, and it was thereby included to be examined in this study. There are very few studies discussing the impact of voluntariness in the adoption of green innovations. It is important to measure the degree of perceived voluntariness to arrive at an overall, more substantial conclusion for its effect in this context. The recorded influences of this attribute across different innovations vouch for its significant effect. The following proposition was thus made –

Proposition 11: *Voluntariness associated with the use of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.12 Result Demonstrability

Mlecnik (2012) in studying the zero-energy housing discusses the importance of demonstrability and mentions that increased demonstrability will significantly increase the rate of adoption. Egmond et al (2006) in discussing the energy related innovation adoptions in housing societies mention that such innovations are compared with their alternatives mostly on the basis of demonstrable results. The literature is very poor when it comes to looking for statistical evidences on the behavior of this attribute in the green innovations context. However, as mentioned above, a couple of studies have regarded its importance in the adoption of such green innovations. Result demonstrability has been widely regarded and studied for its influence on the user intentions across different innovations. In order to learn about its behaviour in the green innovations context, the following proposition was made –

Proposition 12: *Result demonstrability of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.13 Social Approval

The members of a social system generally tend to display a sense of belonging by being a part of the activities that are regarded as a norm within their social system (Ozaki, 2011). Social interaction and information exchange can play critical roles in promoting an innovation, and in turn motivating individuals to adopt that innovation (Bandura, 1986). Ozaki (2011) found that social influence had a very positive impact on the behavioral intentions of the users towards the adoption of green innovations. As Fisher and Price (1992) suggest, the immediate adoption of innovations is considerably influenced by the social benefits that come with the use of that innovation. Mallet (2007) also emphasizes on the social acceptance of renewable energy related innovations. Wustenhagen et al (2007), in studying the same subject mention that social acceptance may be behaving as a hindering factor in achieving increased renewable energy adoption across most countries. Claudy et al (2011) in studying the diffusion of microgeneration technologies (solar panels, solar water heaters, wood pellet boilers, and micro wind turbines) found that social influence positively affected the consumers' willingness to adopt these technologies. Therefore, to explore this attribute in the household solar equipments adoption context, the following proposition was made –

Proposition 13: *Social approval of solar equipments is expected to positively influence the behavioral intentions of the consumers.*

4.14 Communicability

Fliegel and Kivlin (1966) in studying the innovation-attributes suggested that in general, the communicability of an innovation tends to have a substantial bearing on its diffusion in the target environment. Dorf (1984) in studying the commercialization of solar energy technologies state that if an innovation is difficult to communicate, except amongst the technology experts, the rate of adoption of that innovation will become extremely slow; they also add to say that the innovation that receives rapid communication of its benefits and effectiveness amongst friends and colleagues will be more easily and quickly adopted. Studies on the adoption of sustainable innovations (Berardi, 2012), photovoltaic installations in buildings (Horne et al., 1999) emphasize on the importance of communicability and make suggestions on improvising this aspect for increasing adoption. Not many studies have derived statistical findings for this attribute, and therefore for studying the behavior of this attribute in this study, it was propositioned in the following manner –

Proposition 14: *Communicability of solar equipments is expected to significantly influence the behavioral intentions of the consumers.*

4.15 Behavioral Intention

Some innovation adoption models such as the theory of reasoned action and the theory of planned behavior regard intention as the best predictor of behavior or actual use (Ozaki, 2011). As Islam and Meade (2013) put it, the assumption that behavioral intentions are the accurate predictors of potential users' actual behaviors has been acknowledged by several authors. In the past, studies on residential solar technologies (Michelsen, C. C. and Madlener, R., 2011; Warkov and Monnier, 1985) and sustainable technology (Sopha and Klockner, 2011) have regarded behavioral intention as the immediate predictor of adoption. By plain logic, favourable and positive intentions formed towards the use of a product/system are expected to lead towards the actual use/acceptance of that product/system. The proposition made for examining the impact of this attribute thereby was –

Proposition 15: *Behavioral intention is expected to significantly influence the adoption of solar equipments.*

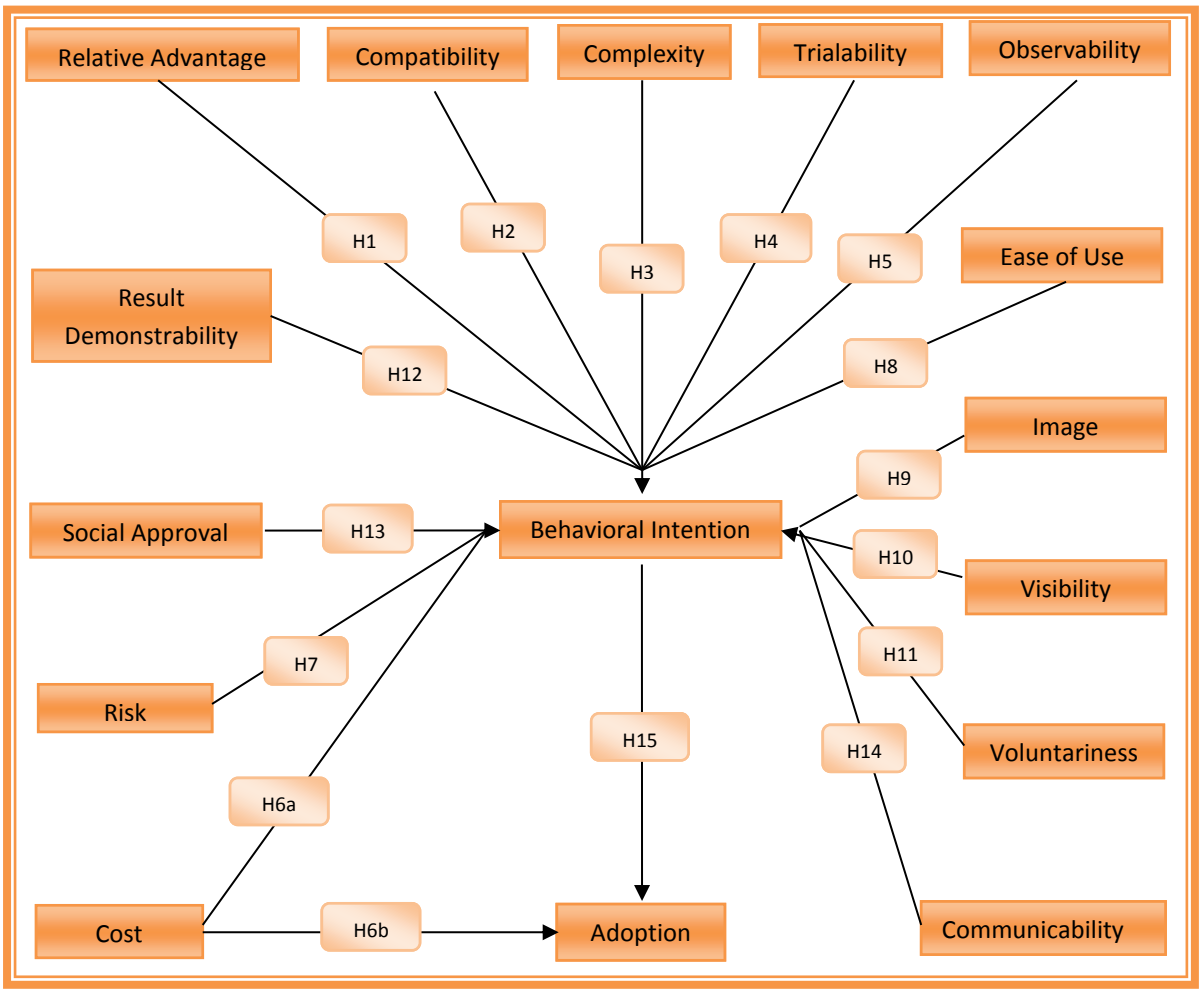

Figure 1: Proposed Conceptual Model for Green Innovations (Source: Adapted from Davis, 1986; Moore and Benbasat, 1991; Rogers, 2003; Tornatzky and Klein, 1982)

5. Discussions and Implications

The conceptual model proposed within this article is directed at bringing to the fore the few important aspects associated with the adoption of household solar innovations, and their usefulness for both the academicians and the implementers/mangers of such innovations. The researchers in this area can use the framework proposed in this study to undertake empirical examinations for investigating the adoption of green innovations.

From the academic perspective, we propose to evaluate the behaviour of these innovation-attributes not just on the *adoption* aspect, or just the *intention* aspect, but taking into consideration all the past evidences, we propose to study the influence of these innovation-attributes on both adoption and intention. Proposing an examination of the influences of fourteen noteworthy innovation-attributes on the use intentions and adoption of household solar equipments, this conceptual model serves as a potential foundation, or a base point that the future researchers could use to build upon and modify, as suited, by undertaking empirical investigations for the influence of these factors on the adoption of green innovations. With increasing awareness of the people to adopt greener ways of living and the consumers' increasing willingness to contribute their bit towards saving the planet and protecting the environment, this article is contributing a base model for exploring the adoption factors of a critical innovation of today's time. For the acceptance of solar equipments, a sound

understanding of the factors that steer their diffusion and actual adoption is necessary; which is exactly what this study attempts to offer to the practitioners of this innovation - a solution, that although for now is partial, in the form of a proposed model defining relationships to be empirically tested for determining the strongest adoption factors impacting the adoption of such green innovations.

Given that this is a conceptual article, the practical implications it has to offer are rather limited. However, the managers and implementers of such innovations can consider the following insights that were extracted whilst reviewing the influences of the fourteen shortlisted innovation-attributes reported by the past studies. Along the lines of explaining sustainable mobility, Huetink et al (2010) suggest that compatibility will become the assessment of the extent to which adopting solar innovations within homes will demand the users to change their lifestyles to incorporate the use of these equipments. This solar harnessed power except for the way it is harnessed, which is more of an automatic process that the solar panels are responsible for, is expected to be available in a similar form as that of the regular electricity. When it comes to ease of use, studies tend to suggest that the real influence of this attribute can be examined only when the direction in which it is being measured is clearly identified (Carter and Belanger, 2004). While studying this factor in the green innovations' context, the studies should clearly identify what aspect of ease in using these solar equipments (or other green products) they are trying to measure. A commonly proposed implication for this attribute is of an easy to use innovation and cultivation of an environment that fosters it to be critical to favourably influence adoption rates of different innovations (Chau, 1996).

As mentioned earlier in the article, any close to the idea of trialability is the possibility where the consumers might get a chance to see solar systems in use in their neighbourhood (Claudy et al., 2011), like in the cases of solar heaters and panels, since they are fairly larger in size and visible to the eye from afar as they are to be exposed to the sunlight in the open. Solar cookers might not even get into that visibility zone. As explained by Labay and Kinnear (1981), solar equipments do not allow a less involved risk-proof trial period, and instead come tagged with a long term commitment. This could make the consumers feel distant from the idea trialability in the household solar context. The managers of these solar equipments might want to place specific consideration on how this attribute might affect consumers' adoption decisions. Rogers (2003) explains that diffusion has a special character when it comes to the newness of the idea in the message content, in that, a certain degree of uncertainty and *perceived risk* is present in the diffusion process. Risk is recommended to be broken down into specific desired risk aspects to be evaluated, and not to be measured and relied upon as a general risk component, for instance, breaking down the risk component into evaluating the security and privacy risks in particular (Tanakinjal et al., 2010). It is essential for both the researchers and the implementers of green innovations to explore the different facets of risk, such as – physical, psychological, performance, social, time related, financial (Jacoby and Kaplan, 1972), and their effects on consumers' adoption decisions.

Moore and Benbasat (1991) in talking about cost as an innovation-attribute say that the actual cost price of an innovation is a primary attribute, but the perception of the *associated cost* becomes the secondary attribute; they further explain that what seems expensive to one consumer may be perceived as inexpensive by another depending on their relative levels of income, which leads them to conclude that cost has the greatest influence on consumers' buying behaviour (Moore and Benbasat, 1991). In addition, studies are often found suggesting economic resource allocations that are assumed to leverage increased sales, and

typically, the reduced cost associations to the use of an innovation always attracts more consumers (Zhu et al., 2006; Damanpour and Scheider, 2009; Shin, 2010). Another worthwhile suggestion in the lead was that the cost of using an innovation should be lesser than or equal to the systems it is superseding (Vrechopoulos et al., 2001). Green innovations, as also mentioned earlier, have a longer lifespan and despite their high initial costs, they are expected to work out to be cost effective in the longer run.

There have been interesting interpretations of image in the literature when it comes to green innovations. According to Otte (2013), solar cookers in the developing countries are particularly introduced for the poor, where they are encouraged to use them for their living. They further explain that due to the solar cookers' association with the poor, the other consumers might have refrained from using solar cookers as they now saw it as a cooking alternative for the poor which would lower their image (Otte, 2013). The implementers of this system might want to bear in mind if any such indirect image associations were/are in any way hindering the adoption of any of these solar equipments. Visibility was found to be an attribute essential for targeting the late majority type of consumers, wherein observing the use an innovation influenced them for adoption (Hsu et al., 2007; Occhiocupo, 2011). Advertising the benefits of using that innovation to increase its visibility was also reported as an efficient tactic for attracting more consumers (Slyke et al., 2005). There are studies in the existing literature that discuss the drawbacks and impacts of limited visibility of renewable/new forms of energy, in turn suggesting for achieving better visibility (Costanzo et al., 1986; Ball et al., 1999; Wustenhagen et al., 2007). A study on adoption of solar lanterns made suggestions of distributing the lanterns to users such as doctors, commercial establishments, and others, who are more likely to keep these solar lanterns in visible locations, which in turn is aimed at attracting more adopters (Velayudhan, 2003).

Whilst voluntariness was assumed to function through the compliance processes (Karahanna et al., 1999), positivity about an innovation from social groups and indirect social pressures were found to be significantly influencing adoption intentions (Lee-Partridge and Ho, 2003; Bernstein and Singh, 2008). Moving on the localization issues, as explained within section 4.10, they might also cause hindrances in the result demonstrability of the green equipments. If their visibility becomes restricted, the chances of demonstration of the outcomes of using them for others to see might become meek (Rogers, 2003). This might be another aspect seeking attention of the managers of such innovations. According to the existing literature (Lu et al., 2005; Montazemi and Saremi, 2013), the innovations that involve a high level of uncertainty, or innovations whose consumers are less risk tolerant tend look for assurance in society. If the consumers of green innovations see these as high risk investments, then the usage approval from peers in the society/social circles might turn out to be a saviour attribute in favourably steering consumer intentions.

All of these above summarized influences can be effectively tested in the green innovations context only by empirically examining the proposed conceptual framework in this study. To further add, people can still continue using the normal electricity for heating, lighting and cooking purposes in the interest of saving the high installation charges that come with the solar equipments, and even possibly the other issues associated with purchasing and installing these equipments. To make the adoption of these green products more easier for the consumers, it is important for the managers of this innovation to ensure that these products are easily available in the market for the consumers to look and have a feel of; also, at the same time, the high first time charges somehow need to be favourably lowered via subsidies or other methods to make these green products also appear economically friendly to the

potential consumers. Apart from the cost, there are many other factors whose influences need to be determined to learn which of them are most appealing, or of no interest to the consumers. Reiterating, this can be achieved only by empirically examining and validating the conceptual model proposed in this study. Given the importance behind the adoption of household solar equipments, the opportunities in terms of research, business processes, and consumer behaviour are enormous today. Thereby, the testing and validation of the conceptual model proposed in this article for investigating the adoption of household solar equipments, sets in motion the theory and research on one of the much needed and essential innovations of today's world.

6. Conclusions

This article is an attempt to build on the existing understanding of the different relationships that the shortlisted fourteen innovation-attributes (independent variables) share with the chosen dependent variables (behavioural intention and adoption) for this study on the adoption of green innovations. Rogers (2003) in the last edition of his book recommends moving beyond the existing models of research so as to potentially broaden the conceptions of the process of *diffusion of innovations*. In accordance with his made recommendation, the conceptual framework proposed in this article, instead of using one of the many already existing models (that have been identified and discussed in section 2 of this article) attempts to integrate attributes from three well recognized pieces of work in the field of innovation-diffusion, which are – Rogers' *diffusion of innovations* theory, Tornatzky and Klein's *meta-analysis*, and Moore and Benbasat's *perceived characteristics of innovating* theory.

Every hypothesized path in the conceptual models is based on past evidences (literature). Each relationship specified in the model has been empirically advocated to be a potentially significant relationship for green innovations by some or many of the existing publications. This shows that each relationship was carefully conceptualized on the basis of coherent reasoning, enhancing their importance, with each of them originating from strong groundings in the available literature. These conceptualized paths brought together to assess green product adoption are in effect a contribution to the literature. The model is now available to the researchers to be applied, compared, contrasted, and refined over time across different settings to eventually improvise and build the database for green innovations and their diffusions. The applicability of this framework is anticipated to be worldwide, that is, these models find their basis on the extensive extant innovation-adoption-diffusion literature available on innovations being implemented and diffused across the world, making them accountable for green innovations across varied countries, cultures, and societies.

The framework presented in this article is an attempt to offer the researchers on green innovations, and the planners of such innovations, with an organized and theoretically sound medium that can be used to empirically examine the adoption of green innovations (household solar equipments); all of which will help gain a constructive understanding of what leads the customers to adopt such environment friendly green products. This framework is not limited to the household solar equipments, and can be easily fit to study any green innovation. This conceptual framework is the first step in designing a sound methodology that the researchers and the stakeholders of green innovations can employ to assist them with building a plan that attracts maximum number of consumers towards the use of such environment friendly green products. Clearly, the biggest drawback of this article is the lack of empirical support. Most work remains incomplete for this study in terms drawing quantitative evidences from the active and potential consumers of household solar innovations. The direction that the authors of this study will take next is to apply this

conceptual framework by targeting an appropriate respondent group for testing the made propositions, and supporting the proposed arguments with valid statistical findings.

References

Ajzen, I. and Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Engle-wood-Cliffs, N.J.: Prentice-Hall.

Ajzen, I. (1985). 'From intentions to actions: A theory of planned behavior', in J. Kuhl and J. Beckman, (eds), *Action-control: From cognition to behavior*. Heidelberg, Germany: Springer. pp. 11–39.

Arkesteijn, K. and Oerlemans, L. (2005), 'The early adoption of green power by Dutch households: An empirical exploration of factors influencing the early adoption of green electricity for domestic purposes', *Energy Policy*, 33:2, pp. 183-196.

Aubert, B.A. and Hamel, G. (2001), 'Adoption of smart cards in the medical sector: the Canadian experience', *Social Science and Medicine,* 53:7, pp. 879–894.

Ball, R., Cullen, R. and Gan, C. (1999), 'The diffusion of energy efficiency innovations among residential energy consumers,' *New Zealand Economic Papers*, 33:1, pp. 115-135.

Bandura, A. (1986). *Social Foundations of Thoughts and Action: a Social Cognitive Theory*. Prentice-Hall: Englewood Cliffs, NJ.

Bauner, C. and Crago, C. (2013), 'Adoption of Residential Solar Power Under Uncertainty: Implications for Renewable Energy Incentives', in *proceedings of 2013 Annual Meeting, August 4-6, 2013, Washington, DC* . Agricultural and Applied Economics Association.

Berardi, U. (2012), 'Sustainability assessment in the construction sector: rating systems and rated buildings', *Sustainable Development*, 20:6, pp. 411-424.

Bernstein, B. and Singh, P. J. (2008), 'Innovation generation process: Applying the adopter categorization model and concept of "chasm" to better understand social and behavioral issues,' *European Journal of Innovation Management*, 11:3, pp. 366-388.

Campbell, M. C. and Goodstein, R. C. (2001), 'The Moderating Effect of Perceived Risk on Consumers' Evaluations of Product Incongruity: Preference for the Norm', *Journal of Consumer research*. 28:3,pp. 439-449.

Carter, L. and Bélanger, F. (2004), 'The Influence of Perceived Characteristics of Innovating on e-Government Adoption', *Electronic Journal of e-Government,* 2:1, pp. 11-20.

Chau, P. Y. K. (1996), 'An empirical investigation on factors affecting the acceptance of CASE by systems developers', *Information & Management,* 30:6, pp. 269-280.

Chaurey, A. and Kandpal, T. C. (2009), 'Carbon abatement potential of solar home systems in India and their cost reduction due to carbon finance', *Energy Policy*, 37:1, pp. 115-125.

Chen, K. K. (2014), 'Assessing the effects of customer innovativeness, environmental value and ecological lifestyles on residential solar power systems install intention', *Energy Policy*, 67:1, pp. 951-961.

Ching, H. L. and Ellis, P. (2004), 'Marketing in cyberspace: what factors drive e-commerce adoption?' *Journal of Marketing Management*, 20:3-4, pp. 409-429.

Chou, C. J., Chen, K. S. and Wang, Y. Y. (2012), 'Green practices in the restaurant industry from an innovation adoption perspective: Evidence from Taiwan', *International Journal of Hospitality Management*, 31:3, pp. 703-711.

Claudy, M. C., Michelsen, C. and O'Driscoll, A. (2011), 'The diffusion of microgeneration technologies – assessing the influence of perceived product characteristics on home owners' willingness to pay', *Energy Policy,* 39:3, pp. 1459–1469.

Cooper, R. G. and Kleinschmidt, E. J. (1987), 'What Makes a New Product a Winner: Success Factors at the Project Level', *R&D Management*, 17:3, pp. 175-189.

Costanzo, M., Archer, D., Aronson, E. and Pettigrew, T. (1986), 'Energy conservation behavior: The difficult path from information to action,' *American Psychologist*, 41:5, pp. 521-526.

Damanpour, F. and Schneider, M. (2008), 'Characteristics of Innovation and Innovation Adoption in Public Organizations: Assessing the Role of Managers', *Journal of Public Administration Research*, 19:3, pp. 495-522.

Damiano Jr, R. J. (2011), 'What is Innovation?', *Innovations: Technology and Techniques in Cardiothoracic and Vascular Surgery*, 6:2, 65-75.

Davis, F. D. (1986), 'A Technology Acceptance Model for Empirically Testing New End User Information Systems: Theory and Results', Ph.D. thesis, Massachusetts Institute of Technology.

Davis, F. D. (1989), 'Perceived usefulness, perceived ease of use, and user acceptance of information technology', *MIS Quarterly*, 13:3, pp. 319-340.

Dorf, R. C. (1984), 'Managerial and economic barriers and incentives to the commercialization of solar energy technologies', *Engineering Management International*, 2:1, pp. 17-31.

Downs, G. W. and Mohr, L. B. (1976), 'Conceptual Issues in the Study of Innovation', *Administrative Science Quarterly*, 21:4, pp. 700-714.

Dillon, A. and Morris, M. G. (1996), 'User acceptance of new information technology: theories and models', *Annual Review of Information Science and Technology*, 14:4, pp. 3-32.

Durham, C. A., Colby, B. G. and Longstreth, M. (1988), 'The Impact of State Tax Credits and Energy Prices on Adoption Of Solar Energy Systems', *Land Economics*, 64:4, pp. 347-355.

Dwivedi, Y. K., Ramdani, B., Williams, M. D., Mitra, A., Williams, J. and Niranjan, S. (2013), 'Factors influencing user adoption of Web 2.0 applications', *International Journal of Indian Culture and Business Management*, 7:1, pp. 53-71.

EAI. (2014). India Solar Energy. http://www.eai.in/ref/ae/sol/sol.html. [Accessed 06 March 2014].

Earp, J. A. and Ennett, S. T. (1991), 'Conceptual models for health education research and practice', *Health Education Research*, 6:2, pp. 163-171.

Egmond, C., Jonkers, R. and Kok, G. (2006), 'A strategy and protocol to increase diffusion of energy related innovations into the mainstream of housing associations', *Energy Policy*, 34:18, pp. 4042-4049.

Engel, J. F., Blackwell, R. D. and Miniard, P. W. (1995). *Consumer Behavior*. Fort Worth, TX: Dryden Press.

Faiers, A. and Neame, C. (2006), 'Consumer attitudes towards domestic solar power systems', *Energy Policy*, 34:14, pp. 1797-1806

Faiers, A., Neame, C. and Cook, M. (2007), 'The adoption of domestic solar-power systems: Do consumers assess product attributes in a stepwise process?', *Energy Policy*, 35:6, pp. 3418-3423

Fishbein, M. and Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, Mass: Addison-Wesley.

Fisher, R. J. and Price, L. L. (1992), 'An investigation into the social context of early adoption behaviour', *Journal of Consumer Research*, 19:1, pp. 477–486

Fliegel, F.C., and Kivlin, J. E. (1962), 'Farm Practice Attributes and Rate of Adoption', in *Innovation Characteristics and Innovation Adoption-Implementation: A Meta-Analysis of Findings*, Tornatzky, L.G., and Klein, K.J. (1982). *IEEE Transactions on Engineering Management,* 29:1, pp. 28-43

Fliegel, F. C. and Kivlin, J. E. (1966), 'Attributes of innovations as factors in diffusion', *American Journal of Sociology'*, 72:3, pp. 235-248

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P. and Kyriakidou, O. (2004), 'Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations', *The Milbank Quarterly,* 82:4, pp. 581-629.

Hester, A.J. and Scott, J.E. (2008), 'A conceptual model of wiki technology diffusion', *in Proceedings of the 41st Hawaii International Conference on System Sciences*.

Horne, M., Hill, R. and Giddings, R. (1999), 'Visualization of photovoltaic clad buildings', *Building Research & Information*, 27:2, pp. 96-108.

Hsu, C-L., Lu, H-P. and Hsu, H-H. (2007), 'Adoption of the mobile Internet: An empirical study of multimedia message service (MMS),' *Omega,* 35:6, pp. 715-726.

Huetink, F. J., der Vooren, A. V. and Alkemade, F. (2010), 'Initial Infrastructure Development Strategies for the Transition to Sustainable Mobility', *Technological Forecasting and Social Change*. 77:8, pp. 1270-1281.

Islam, T. and Meade, N. (2013), 'The impact of attribute preferences on adoption timing: The case of photo-voltaic (PV) solar cells for household electricity generation', *Energy Policy*, 55:1, pp. 521-530.

Islam, T. (2014), 'Household level innovation diffusion model of photo-voltaic (PV) solar cells from stated preference data', *Energy Policy*, 65(1), pp. 340-350.

Jacoby, J. and Kaplan, L. B. (1972), 'The Components of Perceived Risk', in Honey, in *Have You Seen Our Hamster Consumer Evaluations of Autonomous Domestic Products,* Rijsdijk, S.A., and Hultink, E.J. (2003). *Journal of Product Innovation Management*. 20:3, pp. 204–216.

Kapoor, K., Dwivedi, Y. K. and Williams, M. D. (2014), 'Rogers' Innovation Adoption Attributes: A Systematic Review and Synthesis of Existing Research', *Information Systems Management*, 31: 1, pp. 74-91.

Kapoor, K., Dwivedi, Y. K. and Williams, M. D. (2014), 'Exploring Diffusion of Innovation Adoption Attributes: A Cross Disciplinary Literature Analysis', *International Journal of Indian Culture and Business Management*, 8:3, pp. 300-328.

Kapoor, K., Dwivedi, Y. K. and Williams, M. D. (2013), 'Role of Innovation Attributes in Explaining the Adoption Intention for the Interbank Mobile Payment Service in an Indian Context', in *Grand Successes and Failures in IT Public and Private Sectors*, pp. 203-220. Springer Berlin Heidelberg.

Karahanna, E., Straub, D. W. and Chervany, N. L. (1999), 'Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs', *MIS Quarterly*, 23:2, pp. 183-213.

Karakaya, E., Hidalgo, A. and Nuur, C. (2014), 'Diffusion of eco-innovations: A review', *Renewable and Sustainable Energy Reviews'*, 33:1, pp. 392-399.

Kim, H., Park, E., Kwon, S. J., Ohm, J. Y. and Chang, H. J. (2014), 'An integrated adoption model of solar energy technologies in South Korea', *Renewable Energy*. 66:1, pp. 523-531.

Labay, D. G. and Kinnear, T. C. (1981), 'Exploring the consumer decision process in the adoption of solar energy systems', *Journal of Consumer Research*, 8:3, pp. 271-278.

Legare, F., Ratte´, S., Gravel, K. and Graham, I.D. (2008), 'Barriers and facilitators to implementing shared decision-making in clinical practice: Update of a systematic review of health professionals' perceptions', *Patient Education and Counseling,* 73:1, pp. 526–535.

Lee-Partridge, J. E. and Ho, P. S. (2003), 'A retail investor's perspective on the acceptance of Internet stock Trading', in *proceedings of the 36th Annual Hawaii International Conference,* pp. 11-15.

Lockett, A. and Littler, D. (1997), 'The adoption of direct banking services. Journal of Marketing Management', 13:8, pp. 791-811.
Lu, J., Yao, J. E. and Yu, C. S. (2005), 'Personal Innovativeness, Social Influences and Adoption of Wireless Internet Services via Mobile Technology', *The Journal of Strategic Information Systems*. 14:3, pp. 245-268.
Lucarelli, A. and Brorstrom, S. (2013), 'Problematising place branding research: A meta-theoretical analysis of the literature', *The Marketing Review*, 13:1, pp. 65-81.
Mallett, A. (2007), 'Social acceptance of renewable energy innovations: the role of technology cooperation in urban Mexico', *Energy Policy*, 35:5, pp. 2790-2798.
Manning, K. C., Bearden, W. O. and Madden, T. J. (1995), 'Consumer Innovativeness and the Adoption Process', *Journal of Consumer Psychology*, 4:4, pp. 329-345.
Masera, O. R., Saatkamp, B. D. and Kammen, D. M. (2000), 'From linear fuel switching to multiple cooking strategies: a critique and alternative to the energy ladder model', *World development*, 28:12, pp. 2083-2103.
Michelsen, C. C. and Madlener, R. (2011), 'Homeowners preferences for adopting residential heating systems: A discrete choice analysis for Germany', *Energy Economics (forthcoming)*.
Mills, B. F. and Schleich, J. (2009), 'Profits or preferences? Assessing the adoption of residential solar thermal technologies', *Energy Policy*, 37:10, pp. 4145-4154.
Mishra, P. K. and Shekhar, B. R. (2013), 'Consumer behaviour, customer satisfaction vis-a-vis brand performance: an empirical study of dairy food supply chain in India. International Journal of Indian Culture and Business Management', 7:3, pp. 399-412.
Mlecnik, E. (2012), 'Defining nearly zero-energy housing in Belgium and the Netherlands,' *Energy Efficiency*, 5:3, pp. 411-431.
Moore, G. C., Benbasat, I. (1991), 'Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation,' *Information Systems Researc*h, 2:3, pp. 192-222.
Montazemi, A. R. and Saremi, H. Q. (2013), 'Factors Affecting Internet Banking Pre-Usage Expectation Formation', in *Proceedings of the System Sciences (HICSS), 2013 46th Hawaii International Conference*. *IEEE*.
Muller, S. and Rode, J. (2013), 'The Adoption of Photovoltaic Systems in Wiesbaden, Germany', *Economics of Innovation and New Technology*. 22:5, pp. 519-535.
Occhiocupo, N. (2011), 'Innovation in foodservice: the case of a world leading Italian company', *The Marketing Review*, 11:2, pp. 189-201.
Olson, E. L. (2014), 'Green Innovation Value Chain analysis of PV solar power', *Journal of Cleaner Production*, 64:1, pp. 73-80.
Otte, P. P. (2013), 'Solar Cookers in Developing Countries - What is Their Key to Success?', *Energy Policy*, 63:1, pp. 375-381.
Ozaki, R. (2011), 'Adopting sustainable innovation: what makes consumers sign up to green electricity?' *Business strategy and the environment*, 20:1, pp. 1-17.
Pannell, D. J., Marshall, G.R., Barr, N., Curtis, A., Vanclay, F. and Wilkinson, R. (2006), 'Understanding and Promoting Adoption of Conservation Practices by Rural Landholders', *Australian Journal of Experimental Agriculture*. 46:11, pp. 1407–1424.
Poolton, J. and Barclay, I. (1998), 'New Product Development from Past Research to Future Applications', *Industrial Marketing Management*, 27:3, pp. 197-212.
Purohit, P. and Michaelowa, A. (2008), 'CDM potential of solar water heating systems in India', *Solar Energy*, 82:9, pp. 799-811.
Purohit, I. and Purohit, P. (2007), 'CDM potential of box type solar cookers in India', *International Journal of Ambient Energy*, 28:1, pp. 27-38.

Rehman, I. H., Kar, A., Raven, R., Singh, D., Tiwari, J., Jha, R. and Mirza, A. (2010), 'Rural energy transitions in developing countries: a case of the Uttam Urja initiative in India', *Environmental Science & Policy*, 13:4, pp. 303-311.

Rogers, E. M. (1962). *Diffusion of Innovations*. Glencoe: The Free Press.

Rogers, E. M. (1995). *Diffusion of Innovations*. 4th edition. New York: The Free Press.

Rogers, E. M. (2003). *Diffusion of Innovations*. 5th edition. New York: The Free Press.

Rogers, E. M. and Shoemaker, F. F. (1971). *Communication of Innovations*. New York: Free Press.

Roman, R. (2003), 'Diffusion of Innovations as a Theoretical Framework for Telecenters', *International Technologies and International Development*, 1:2, pp. 53-66.

Sahin, I. (2006), 'Detailed Review of Rogers' Diffusion of Innovations Theory and Educational Technology-Related Studies Based on Rogers' Theory', *The Turkish Online Journal of Educational Technology*, 5:2, pp. 14-23.

Sardianou, E. and Genoudi, P. (2013), 'Which factors affect the willingness of consumers to adopt renewable energies?', *Renewable Energy*, 57:1, pp. 1-4.

Sasikumar, N. and Jayasubramaniam, P. (2013), 'Solar Energy System in India', *Journal of Business and Management*, 7:1, pp. 61-68.

Sawyer, S. W. (1982), 'Leaders in change: Solar energy owners and the implications for future adoption rates', *Technological Forecasting and Social Change*, 21:3, pp. 201-211.

Scheraga, C. A., Tellis, W. M. and Tucker, M. T. (2000), 'Lead users and technology transfer to less-developed countries: analysis, with an application to Haiti', *Technology in Society*, 22:3, pp. 415-425.

Sopha, B. M. and Klöckner, C. A. (2011), 'Psychological factors in the diffusion of sustainable technology: A study of Norwegian households' adoption of wood pellet heating', *Renewable and Sustainable Energy Reviews*, 15:6, pp. 2756-2765.

Shih, L. H. and Chou, T. Y. (2011), 'Customer concerns about uncertainty and willingness to pay in leasing solar power systems', *International Journal of Environmental Science & Technology*, 8:3, pp. 523-532.

Shin, D-H. (2010), 'MVNO services: Policy implications for promoting MVNO diffusion', *Telecommunications Policy*, 34:10, pp. 616–632.

Sherry, L. and Gibson, D. (2002), 'The Path to Teacher Leadership in Educational Technology', *Contemporary Issues in Technology and Teacher Education*. 2:2, pp. 178-203.

Slyke, C. V., Belanger, F., and Hightower, R. (2005), 'Understanding Gender-Based Differences in Consumer E-Commerce Adoption', In *SAIS Proceedings*, pp. 24-29.

Solar-cooking. (2012). Solar Cooking Systems. http://www.solarpanelsindia.com/solar-cooking-systems.php. Accessed 12 June 2012.

Solar-heating. (2012). Solar Heating Systems. http://www.solarpanelsindia.com/solar-water-heaters.php. Accessed 12 June 2012.

Solar-lighting. (2012). Solar Lighting Systems. http://www.solarpanelsindia.com/solar-lighting-systems.php. Accessed 12 June 2012.

Solar-panels. (2012). Solar panels – An amazing way to use solar energy. http://www.solarpanelsindia.com/. Accessed 12 June 2012.

Suwannaporn, P. and Speece, M. (2003), 'Marketing Research and New Product Development Success in Thai Food Processing', *Agribusiness*, 19:2, pp. 169-188.

Tanakinjal, G.H., Deans, K.R. and Gray, B.J. (2010), 'Third Screen Communication and the Adoption of Mobile Marketing: A Malaysia Perspective', *International Journal of Marketing Studies,* 2:1, pp. 36-47.

Tapaninen, A., Seppanen, M. and Makinen, S. (2009a), 'Characteristics of innovation: a customer-centric view of barriers to the adoption of a renewable energy system', *International Journal of Agile Systems and Management*, 4:1, pp. 98-113.

Tapaninen, A., Seppänen, M. and Mäkinen, S. (2009b), 'Characteristics of innovation in adopting a renewable residential energy system', *Journal of Systems and Information Technology*, 11:4, pp. 347-366.

Taylor, S. and Todd, P. (1995), 'Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions', *International journal of research in marketing*, 12:2, pp. 137-155.

Teo, T. S. H. and Pok, S. H. (2003), 'Adoption of WAP-enabled mobile phones among Internet users', *Omega*, 31:6, pp. 483-498.

Tornatzky, L.G., and Klein, K.J. (1982), 'Innovation Characteristics and Innovation Adoption-Implementation: A Meta-Analysis of Findings', *IEEE Transactions on Engineering Management,* 29:1, pp. 28-43.

Velayudhan, S. K. (2003), 'Dissemination of solar photovoltaics: a study on the government programme to promote solar lantern in India', *Energy policy*, 31:14, pp. 1509-1518.

Venkatesh, V. and Davis, F. D. (2000), 'A theoretical extension of the technology acceptance model: Four longitudinal field studies,' *Management Science*, 46:2, pp. 186–204.

Venkatesh, V., Morris, M. G., Davis, G. B. and Davis, F. D. (2003), 'User acceptance of information technology: Toward a unified view', *MIS quarterly*, 27:3, pp. 425-478.

Venkatesh, V., Thong, J. and Xu, X. (2012), 'Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology,' *MIS Quarterly*, 36:1, pp. 157-178.

Vollink, T., Meertens, R. E. E. and Midden, C. J. (2002), 'Innovating 'diffusion of innovation' theory: Innovation characteristics and the intention of utility companies to adopt energy conservation interventions', *Journal of Environmental Psychology*, 22:4, pp. 333-344.

Vrechopoulos, A. P., Siomkos, G. J. and Doukidis, G. I. (2001), 'Internet shopping adoption by Greek consumers', *European Journal of Innovation Management*, 4:3, pp. 142-153.

Warkov, S. and Monnier, E. (1985), 'Social Science Research on Residential Solar Technology in the United States and France', *International Journal of Comparative Sociology*, 26:3-4, pp. 240-245.

Webb, D. and Stuart, K. (2007), 'Benefiting Remote Tibetan Communities with Solar Cooker Technology,' *Practicing Anthropology*, 29:2, pp. 28-31.

Williams, M.D., Dwivedi, Y.K., Lal, B. and Schwarz, A. (2009), 'Contemporary trends and issues in IT adoption and diffusion research', *Journal of Information Technology*, 24:1, pp 1-10

Woersdorfer, J. S. and Kaus, W. (2011), 'Will nonowners follow pioneer consumers in the adoption of solar thermal systems? Empirical evidence for northwestern Germany', *Ecological Economics*, 70:12, pp. 2282-2291.

Wustenhagen, R., Wolsink, M. and Burer, M. J. (2007), 'Social acceptance of renewable energy innovation: An introduction to the concept,' *Energy policy*, 35:5, pp. 2683-2691.

Zhu, K., Dong, S., Xu, S. X. and Kraemer, K. L. (2006), 'Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies', *European Journal of Information Systems*, 15:6, pp. 601-616.