Behavioural Theories and Purchase Intention of Renewable Energy Technologies—A Meta-Analysis

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Abstract

Theory of planned behaviour (TPB) and technology acceptance model (TAM) are two behavioural theories that have been widely applied to understand the association between their constructs and purchase intention (PI) of renewable energy technologies (RETs). There is a need to synthesise these studies to understand the overall strength of association between their constructs and PI of RETs. With this objective in view, we conducted a meta-analysis of 41 studies that applied TPB and TAM or both to understand the PI of RETs. The results showed that all the constructs of TPB and TAM have a medium to large association, with perceived utility and attitude showing the strongest relationship with $r = 0.536$ and 0.487, respectively. To explore the reasons for heterogeneity in studies, moderator analysis was done by considering Hofstede's cultural dimension of individualism, the economic development level of the countries, and sample-related moderators such as the educational qualifications of the respondents. Moderator analysis gave mixed results.

1. Introduction

Decisions pertaining to fuels to be used for the generation of electricity have implications for the global economy and also for the environment (Ahmad and Tahar, 2014). A special report by International Energy Agency (2021), mentions that in order to achieve the net zero emissions target, it is necessary to scale up solar and wind energy technologies rapidly reaching annual additions of 630 gigawatts (GW) of solar photovoltaics (PV) and 390 GW of wind by 2030. The report further adds that achievement of net zero targets would mean a decline in the use of fossil fuels and an energy sector that is based largely on renewable energy. However, these targets would remain unachievable without support from citizens. It is necessary that people adopt renewable energy technologies (RETs) on a large scale.

Extant literature has dwelt at length on the significance of renewable energy sources and the need for their adoption. Gençer and Agrawal (2018) and Islam (2014) mention that many countries are turning towards renewable energy. Research on factors that determine the adoption of renewable energy is

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focussed on drivers of purchase intention (PI) of RETs of either a particular RET such as solar rooftop, solar PV or of RETs in general (Abreu, Wingartz, and Hardy 2019; Alam et al. 2021; Jabeen et al. 2019; Kardooni, Yusoff, and Kari 2016; Masukujjaman et al. 2021). These studies have given significant insights to policy makers and marketers of RETs, which would help them in attuning their policies in light of the findings of these studies.

Another important feature of these studies is that they have applied behavioural theories that explain the human behaviour towards PI of products and services. Some of these theories are theory of planned behaviour (TPB) propounded by Ajzen (1991), technology acceptance model (TAM) propounded by Davis (1989), Roger's theory of innovation diffusion. Alipour et al. (2021) in their study on review of theories that explain the adoption behaviour of solar PV by residents mention that these theories signify a psychological understanding of human behaviour. These theories are built on a model which consists of constructs that are linked with each other and finally culminate in a particular final behaviour (Alipour et al. 2021).

These studies based on behavioural theories with different constructs have given different conclusions. For instance, Abreu et al. (2019), in their study on the adoption of rooftop solar, found attitude (ATT) and subjective norms (SN), which are important constructs of TPB, to be significant determinants of intention to adopt rooftop solar but they did not find perceived behavioural control (PBC), which is the third construct of TPB to be significant. Alam et al. (2014) in their study on the usage intention of renewable energy found PBC to be significant. Murray (2012) in his study on intention to purchase solar panels found all three constructs of TPB to be the significant determinants of PI. In case of studies that have applied TAM, Ahmad et al. (2017) in their study on public acceptance of solar PV technology found both the constructs of TAM: perceived ease of use (PEOU) and perceived utility to be the significant determinants of PI of solar PV technology, whereas Alam et al. (2021) in their study on solar PV acceptance and Cheam, Lau, and Wei (2021) in their study on intention to adopt solar PV found PEOU not to be a significant determinant of PI of RETs.

These heterogeneous conclusions do not give a holistic understanding of the strength of the association between the constructs of the models and PI of RETs. Therefore, there is a need to synthesise these studies. Meta-analysis is an important technique of synthesising various studies. As a technique, it helps in resolving conflicts in the conclusions of various studies, more so, in evaluating the relationship between two variables (Cui, Xiao, and Wang 2019). We have meta-analysed 41 research papers that applied either TPB or TAM or both, to understand the factors determining PI of RETs. We attempt to answer the question: Do the constructs of both theories show a high predictive power with respect to PI of RETs? We also perform moderator analysis to explore the reasons for heterogeneity in studies to find out whether there is a significant moderating relationship between the constructs of the model and PI of RETs. For the purpose of moderator analysis, we consider Hofstede's cultural dimension of individualism, the level of economic development of the countries and study characteristics, such as the education level of the respondents and the region: whether urban or rural, where the study was undertaken.

The rest of the study is organised as follows: Section 2 discusses the theoretical model, Section 3 explains the research methodology, Section 4 presents the findings and Section 5 discusses the findings and policy implications, draws conclusions and gives future research directions.

2. Theoretical Models and Hypothesis

2.1. Theory of Planned Behaviour (TPB)

TPB is one of the most influential works and has been applied in studies that explored pro-environmental behaviour of buyers (Shalender and Sharma 2020). It has strong explanatory power for individual

intentions and behaviour (Huang and Ge 2019). It has been widely used in studies on the adoption of energy-efficient appliances by households (Ali and Yadav 2019; Hua and Wang 2019, Tan et al. 2017), in studies on the adoption of electric vehicles (Haustein and Jensen 2018; Huang and Ge 2019), in studies on pollution reduction intentions (Shi, Wang, and Guo 2017). TPB maintains that ATT, SN and PBC are the factors that determine the PI of products and intention in turn determines the actual purchasing behaviour. ATT refers to a negative or positive evaluation of a particular behaviour by an individual. For example, in case of the adoption of RETs, ATT refers to a person's viewpoints, which might be optimistic or pessimistic, about the usage of RETs (Jabeen et al. 2019). SN is described by Ajzen (1991), as perceived societal stress about doing or not doing a particular behaviour. It refers to how consumers get influenced by important others, such as friends, neighbours, relatives and peers. Prior research mentions that SN is an important factor that affects energy-saving behaviour, such as acceptance of green electricity (Kowalska-Pyzalska 2018), energy saving behavioural intention at work (Pollard 2015). In case of studies on the adoption of RETs also, it is proved that there is a positive and statistically significant association between SN and PI of RETs (Alam et al. 2021; Halder et al. 2016), which means if the people who matter to them buy renewable energy, it will have a favourable impact on PI of consumers. The third construct of TPB, PBC is individual's perceived ease or difficulty in performing a specific behaviour (Tan et al. 2017). In studies on energy-saving intentions, PBC is found to have a positive and strong correlation with energy-saving intentions (Alam et al. 2014; Wang et al. 2014). Even other meta-analysis studies that tried to find the predictive power of TPB with respect to pro-environmental behaviour, proved that TPB constructs have high predictive validity (Morren and Grinstein 2016). Therefore, this meta-analytic review proposes the following hypothesis:

H_1: There is a significant positive correlation between ATT and PI of RETs.
H_2: There is a significant positive correlation between SN and PI of RETs.
H_3: There is a significant positive correlation between PBC and PI of RETs.

2.2. Technology Acceptance Model (TAM)

TAM consists of two constructs. PEOU, which refers to a person's belief in how simple it is to operate a particular device and he is skilled in doing so (Davis 1989), and Perceived Usefulness (PU), which refers to the conviction of a person that his output is improved using a specific program (Davis 1989). Since the time the model was conceptualised, it has been tested and has been the most widely applied model of user acceptance (Ma and Liu 2004). Whittle, Jones, and While (2020) in their study on identifying predictors of intentions to use home energy management system applied TAM. Bandara and Amarasena (2020) in their study on the intention to use solar technology proved that PEOU has a significant impact on solar technology adoption. Venkatesh et al. (2003) in their study on user acceptance of information technology proved that PU is one of the best predictors of behavioural intention to adopt. Ahmad et al. (2017) in their study proved that PEOU and PU play a significant role in PV adoption. King and He (2006), in their meta-analysis, proved the robustness and predictive validity of TAM. So we set the following hypothesis:

H_4: There is a significant positive correlation between PEOU of use and PI of RETs.
H_5: here is a significant positive correlation between PU and PI of RETs.

In studies on the adoption RETs both TPB and TAM have been combined (Alam et al. 2021). Hence, we have considered both the models for this meta-analysis to test their predictive validity in the context of PI of RETs.

2.3. Moderator Analysis

In meta-analytic reviews scholars tend to use the technique of moderator analysis, to identify the presence of a third factor (Dieckmann, Malle, and Bodner 2009). Moderator analysis in meta-analytic review is done to find out the reasons for the presence of heterogeneity in studies. Extant literature shows that researchers have used different types of moderators. For instance, sample moderators, which refer to certain characteristics related to the sample of the studies included in the meta-analysis, such as gender composition, type of sample, method of data collection, and analytical model used. Cultural moderators, which refer to specific features of the culture, where the study was conducted. Nardi et al. (2018) in their meta-analysis of TPB studies as applied to the prediction of food choice, considered three types of moderators: Hofstede's (2001) six cultural dimensions as cultural moderators, methodological moderators under which they considered study characteristics such as gender, age and sample size and situational moderators such as the origin of food. Liao, Liu, and Liu (2021) in their meta-analysis of environmental innovation and firm performance considered the economic development level of a country, industry diversity and data types as moderators. In this meta-analysis, we broadly categorise studies into methodological moderators and country/cultural moderators. The moderator analysis is done for the association between TPB constructs and PI of RETs. It is not done for TAM constructs since the number of studies is less for performing moderator analysis.

2.3.1. Methodological Moderators

The methodological moderators considered in this study are the education level of the respondents of the studies and the region where the study was undertaken: urban or rural region.

The education of respondents as a determinant of PI of RETs has been studied by researchers. Claudy, Michelsen, and Driscoll (2011) found that home owners with high to medium levels of education prefer solar panels. We assume that the education levels of respondents moderate the relationship between TPB constructs and PI of RETs and that the intention is stronger among the respondents who are more educated. Therefore, we set the hypothesis:

H_6:   The relationship between TPB constructs and PI of RETs is moderated by the education of respondents and the PI is stronger among the respondents who are more educated.

Research has also proved that those who live in urban areas have a higher PI of RETs. For instance, Claudy et al. (2011) found that those living in urban areas have a higher willingness to pay for solar panels. So, we set the following hypothesis:

H_7:   The relationship between TPB constructs and PI of RETs is moderated by the region of respondents and the PI is stronger among the respondents who live in urban areas.

2.3.2. Country/Cultural Moderators

Nardi et al. (2018) refer to cultural moderators as characteristics of the country of data collection. Characteristics of country and national culture play a role as moderators in explaining pro-environmental behaviours (Morren and Grinstein 2016). Research by Arvola et al. (2008) shows that there is a variation in environmental behaviour when accounting for the TPB framework. In meta-analytic reviews of TPB studies, Hofstede and Bond's (1984) cultural dimensions have often been applied (Hassan, Shiu, and Parry, 2016; Morren and Grinstein 2016; Pettifor et al. 2017). In this meta-analysis, we consider one national culture-level moderator, that is, Hofstede's individualism/collectivism dimension and one country-level moderator: the degree of economic development of the country.

According to Triandis (1990), the individualism/collectivism dimension of Hofstede is considered as a most important dimension in social psychology literature. According to Hofstede (2001), individualism

refers to the degree to which people prefer to act as individuals rather than acting as members in a group. There have been conflicting findings in case of individualism/collectivism dimension with regard to pro-environmental behaviour. According to Bagozzi et al. (2000), people who have individualistic ATT are not likely to have much concern for the environment and may not have a positive ATT towards the environment and therefore intention to behave environmentally may be strong in collectivistic countries. Study by Cho et al. (2013) gives the same view. However, a large body of literature maintains that individualistic countries for their own personal gains may adopt environmental behaviour (Griskevicius et al. 2010; Soyez 2012; Stern and Dietz 1994). Even Morren and Grinstein (2016), in their meta-analysis, found positive relationship between ATT and intention to behave pro-environmentally. Therefore, we set the hypotheses:

H_8:   The relationship between ATT and PI of RETs is moderated by the individualism/collectivism dimension and the relationship between the two is stronger in individualistic countries.

The relationship between SN and intention to behave environmentally is also documented in the literature. McCarty and Shrun (1994) mention that when it comes to the environment, collectivists tend to be more cooperative than individualists. Therefore, we set the hypothesis:

H_9:   The relationship between SN and PI of RETs is moderated by the individualism/collectivism dimension and the relationship between the two is stronger in collectivist countries.

In individualistic cultures, people firmly believe that they are responsible for their achievements and destiny therefore they feel that they should rely on self to adopt a particular behaviour (Morren and Grinstein 2016). Individuals in such cultures feel that it is easy to adopt pro-environmental behaviour and that their control beliefs related to performing a pro-environmental behaviour such as adopting green technologies are very strong, So we hypothesise the following:

H_{10}:   The relationship between PBC and PI of RETs is moderated by the individualism/collectivism dimension and the relationship between the two is stronger in individualistic countries.

Studies have also tried to find out whether the economic development of a country, measure in terms of indicators, such as GDP, is positively associated with pro-environmental behaviour. Morren and Grinstein (2016) mention that many studies have found that countries that have scored high on development have more willingness to pay for environmental products than the countries scoring low on development. Mikuła, Raczkowska, and Utzig (2021) also confirm the positive correlation between pro-environmental behaviour and economic development. They mention that the tendency to desire a better-quality environment increases with increase in income. So, we set the following hypothesis:

H_{11}:   Economic development of a country moderates the relationship between ATT and PI of RETs and the relationship between the two is stronger in developed countries.

In case of the relationship between SN and pro-environmental behaviour, literature mentions that in developed countries because of materialistic values there is more social pressure for consumption, which in turn may weaken the link between SN and intention to behave environmentally (Morren and Grinstein 2016). Conversely, this means developing countries are less materialistic and therefore would adopt more sustainable behaviour. Therefore we set the following hypothesis:

H_{12}:   Economic development of a country moderates the relationship between SN and PI of REITs and the relationship between the two is stronger in developing countries.

In case of the association between PBC and pro-environmental behaviour extant literature mentions that developed countries have better access to green technologies, which strengthens their intention to behave pro-environmentally. Environmental behaviour is more financially demanding because of which less developed countries may find it difficult to buy green technologies and are more concerned with solving economic problems, and are less concerned with the environment (Mikula et al. 2021). Therefore,

the control beliefs of adopting green technologies are stronger in developed countries than in developing countries. Therefore, we hypothesise the following:

H_{13}: Economic development of a country moderates the relationship between PBC and PI of RETs, and the relationship between the two is stronger in developed countries.

3. Research Methodology

3.1. Meta-Analysis

Borenstein et al. (2009) define meta-analysis as statistical combination and summarisation of results from multiple studies. Glass (1976) refers to meta-analysis as a method of synthesising studies, which provides an opportunity to view a particular research by combining results of many quantitative empirical studies. It is now a widely recognised tool that has become indispensable for integrating results of various studies on a particular topic (Eden 2002). In meta-analysis, a comparable metric is identified, which is called effect size, which then is weighted according to the sample size (Pettifor et al. 2017). In this meta-analysis, comparable metric is the correlation coefficient (r). That is, the correlation coefficient between constructs of TPB, TAM and PI of RETs. The objective of this study is to find out the predicative validity of TAM and TPB with respect to PI of RETs, which can be known by finding out the overall strength of association between the constructs of TPB and TAM, which is possible when the results of all the studies are synthesised. Hence, meta-analysis.

3.2. Criteria for Including the Studies and the Process of Inclusion

The main criteria for including the studies in this analysis is that the studies should have focussed on either TPB or TAM as applied to PI of RETs. The studies should have reported the bivariate relationship (r), between the constructs of TPB or TAM and PI of RETs and should have also reported sample sizes. In the process of search of the relevant studies, keywords, such as 'theory of planned behaviour', 'technology acceptance model', 'renewable energy', 'renewable energy technologies' and 'purchase intention', were used and entered into electronic databases, such as JSTOR, EBSCO, google scholar and ABNInform. The search process led to many matching titles. As a first step, the abstracts of the studies were read by the authors. Studies that focussed on PI of RETs but applied other behavioural theories, such as value belief norm theory and innovation diffusion theory, were excluded because the focus of analysis is only on TPB and TAM. Studies that focussed on adoption of RETs but were literature review studies were excluded. Studies that applied TPB but focussed on energy-saving intentions in general were excluded as energy-saving intentions could mean many ways of saving energy and not just by RETs. As a second step, the papers were read in detail. Studies that neither reported effect size 'r' nor 'β' were excluded. After all the exclusions, we were left with 41 studies, which were included in the meta-analysis.

3.3. Computation and Analysis

For all the computations, comprehensive meta-analysis (CMA) software, version 3 was used. Calculation of effect size was the first step in computation, which is done by pooling the effect sizes of all the studies included in the analysis. As mentioned, 'r' is the effect size in this analysis. There are two types of effect

Table 1. Basic Details of the Studies Included in the Analysis.

Name of the Author/Study	Year	Sample Size	Country
Abreu et al.	2019	400	US
Ahmad et al.	2017	663	Malaysia
Alam et al.	2014	200	Malaysia
Alam et al.	2021	382	Malaysia
Ali et al.	2020	435	Pakistan
Ali and Yadav	2019	229	India
Aziz et al.	2017	211	Malaysia
Bandara and Amarasena	2018	384	Sri Lanka
Cheam et al.	2021	200	Malaysia
Chen, Xu, and Frey	2016	655	China
Conradie et al.	2021	727	Belgium
Feng	2012	273	Taiwan
Halder et al.	2016	532	India
Irfan et al.	2021	349	Pakistan
Jabeen et al.	2019	230	Pakistan
Korcaj, Hahnel, and Spada	2015	200	Germany
Li, Li, and Wang	2013	465	China
Liobikienė, Dagiliūtė, and Juknys	2021	1.005	Lithuania
Litvine and Wüstenhagen	2011	1,163	Switzerland
Lundheim	2019	697	Norway
Lundheim et al.	2021	557	Nordic
Masukujjaman et al.	2021	300	Bangladesh
Mkhize	2021	237	South Africa
Murray	2012	238	Australia
Kowalska-Pyzalska	2018	502	Poland
Rahman and Elinda	2016	501	Pakistan
Reyes-Mercado and Rajgopal	2017	291	Mexico
Rezaei and Ghofranfarid	2018	280	Iran
Shakeel and Rahman	2018	244	Pakistan
Tanveer et al.	2021	683	Pakistan
Tsaur and Lin	2018	483	Taiwan
Wall et al.	2021	388	Thailand
Wang et al.	2019	972	China
Wojuola and Alant	2017	421	Nigeria
Wolske, Stern, and Dietz	2017	904	USA

(Table 1 continued)

Name of the Author/Study	Year	Sample Size	Country
Yan et al.	2019	230	Pakistan
Yang, Danwana, and Yassaanah	2021	1068	Ghana
Yee, Al-Mulali, and Ling	2021	204	Malaysia
Yun and Lee	2015	753	USA
Zhou and Abdullah.	2017	450	Pakistan
Zulu, Zulu, and Chabala	2021	961	Zambia

Source: The authors.

size models. Fixed and random effect model. The assumption of the fixed effect model is that all the studies are homogenous and any variability in the study is due to sampling error or within-study variability. The random effect model is based on the assumption that the studies are heterogeneous and variability in studies is caused by not only within-study variability but also because of between-study variability, which could be due to differences, such as differences in research design, type of sample, etc. Ideally, random effect model should be preferred over a fixed effect model because it is not likely that between studies variability does not exist (Field 2001; Hunter and Schmidt 2004). This decision is also based on Q and I^2 statistics which the CMA software generates. A large Q and I^2 would mean the variability in studies is not only due to within-study but also due to between-study variability and therefore a random effect model needs to be used (Higgins et al. 2003). In this analysis, as Q and I^2 were large we used a random effect model. A large Q and I^2 prompted us to do moderator analysis also.

The analysis of effect size was based on recommendations of Cohen (1988), according to which if r is between 0.10 and 0.30, it is small effect size, if it is between 0.30 and 0.50, it is medium effect size and if it more than 0.5, it is large effect size.

In order to know whether the findings are robust, publication bias analysis is made, which is another very important step in a meta-analytic review. Fail-safe N text is sued for this purpose, which represents the number of missing studies averaging a Z-value of zero that should be added to yield a statistically insignificant overall effect size (Rosenthal 1984)

4. Results

Results are divided into three parts. The first part is, an analysis of the association between TPB constructs, TAM constructs, which are the independent variables and PI of RETs, which is dependent variables. The second part is the analysis of publication bias and the third part is the moderator analysis.

4.1. Effect Size Analysis

Table 2 gives the effect size analysis of the association between TPB, TAM constructs and PI of RETs. The association between the TPB constructs and PI of RETs is medium to almost large. The strongest relationship was that of ATT ($r = 0.487$, $p < .001$), followed by SN and PI ($r = 0.393$, $p < .01$) and PBC (0.313, $p < .001$). Therefore H_1, H_2 and H_3 are accepted. The meta-analytic review thus proves the robustness of TPB constructs in predicting the PI of RETs. The Q value for ATT, SN and PBC are

Table 2. Effect Size Analysis of TPB and TAM Constructs.

Dependent Variables	Independent Variables	Number of Studies	Number of Samples (K)	Heterogeneity					Model	Effects and a 95% Confidence Interval			Double-Tail Inspection	
				Q	Df (Q)	p-Values	I-Squared	Tan-Squared		Point Estimation	Lower Limit	Upper Limit	Z	P
PI of RETs	ATT	27	12152	1731.1	26	0	98.498	0.139	Random	0.487	0.372	0.588	7.365	0
	SN	29	14807	988.431	28	0	97.167	0.068	Random	0.393	0.308	0.472	8.401	0
	PBC	25	11641	1119.53	24	0	97.856	0.093	Random	0.313	0.2	0.418	5.238	0
	PU	13	5788	376.056	12	0	96.809	0.069	Random	0.536	0.425	0.632	8.08	0
	PEOU	16	7171	645.058	15	0	97.675	0.096	Random	0.389	0.251	0.512	5.216	0

Source: The authors.

(1285.949, $p < .001$), (919.155, $p < .001$) and (1118.91, $p < .001$), respectively. Therefore H_1, H_2 and H_3 are accepted. The high Q statistics in case of all three constructs points to the presence of heterogeneity, which is reinforced by I^2 statics, which is above 90%. The presence of heterogeneity compels us to perform moderator analysis to find out the possible moderating effects between TPB constructs and PI of RETs.

The association between TAM constructs and PI is also medium to large. The association between PU and PI of RETs is very strong ($r = 0.540$, $p < .001$) followed by the association between PEOU and PI of RETs ($r = 0.40$, $p < .001$). Therefore, the meta-analytic review also proves that TAM constructs, like that of TPB constructs, have medium to high predictive power in predicting the PI of RETs. H_4 and H_5 are accepted. Even Q statistics and I^2 statistics are very large in this case also. However, moderator analysis is done in the case of TAM constructs due to the relatively small number of studies.

4.2. Publication Bias Analysis

Analysis of publication bias is a very significant step in meta-analysis since it shows whether there was any bias in selecting the studies included in the meta-analysis. The bias could happen because of a number of reasons, such as studies only with significant results are included or it could be possible that some studies that meet our inclusion criteria might have escaped our search and therefore might not have been included (Borenstein et al. 2009). One of the tests to analyse publication bias is, fail-safe N of Rosenthal (1984), according to which we need to compute the number of studies that we need to retrieve and incorporate in the studies to make p-value significant. This value needs to be compared with a critical value, which is calculated by using the formula, K5+10, where K refers to the number of studies. The fail-safe N in case of ATT-intention is 9,770, which is more than the critical value of 135 ($K = 25$), in case of SN-intention it is 5,081, which is more than the critical value of 150 ($K = 28$), in case of perceived behavioural control, it is 5,374 which is more than the critical value of 130 ($K = 24$). Therefore, in case of selection of all the studies of TPB, there is no publication bias. The fail-safe N in case of perceived utility is 6,774, which is more than the critical value of 75 ($K = 13$) and in case of PEOU, it is 5,264, which is more than the critical value of 85 ($K = 15$). Therefore, even in case selection of studies of TAM constructs, there is no publication bias and hence the findings are robust.

4.3. Moderator Analysis

Table 3 presents the results of moderator analysis for each of the TPB and TAM constructs, taking economic development, individualism, educational qualifications of the respondents of the study, region, where the study was conducted, that is, whether urban or rural.

In case of ATT-intention relationship, only the region turned out to be a significant moderator with R^2 of 13%. The effect size analysis of significant moderators shows that urban showed a greater relations strength (0.526) than rural (0.141), which means our assumption that people living in urban areas have a greater PI of RETs than those living in rural areas. So in case of ATT–intention relationship H_7 is accepted. All other moderators in case of ATT–intention relationship did not show any significant moderating effects. Therefore, H_6, H_8, H_9 and H_{12} are rejected.

In case of subjective norms and intention relationship individualism dimension showed a slight moderating effect, with R^2 of 14%. The effect size analysis shows that countries low on individualism

Table 3. Moderator Analysis.

		ED	IND	REG	EDU
Dependent Variable(ES)	K	Q-Stats (*df*) R^2	Q-Stats (*df*) R^2	Q-Stats (*df*) R^2	Q-Stats (*df*) R^2
ATT-INT	25	n.s.	n.s.	14.559(1)13%***	n.s.
SN-INT	28	6.874(1)31%**	2.631(1)14%*	n.s.	n.s.
PBC-INT	24	n.s.	n.s.		n.s.
PU-INT	13	nc	nc	17.152(1)19%**	n.s.
PEOU-INT	15	n.s.	n.s.	n.s.	n.s.

ED = economic development, IND = individualism, REG = region, EDU = educational qualifications of the respondents, CLI = climate, ATT = attitude, SN = subjective norms, PBC = perceived behavioural control, Q stats = chi-square distribution, *df* = degrees of freedom, R^2 = proportion of true variance explained by the model, a significant Q stat means the moderator is significant in moderating the relationship between various constructs and PI of REITs. K = number of studies. ***p < .01, **p < .05, *p < .1. n.s. = non-significant, nc = not calculated.

Source: The authors.

show a greater relational strength (0.456) than countries high on individualism (0.323). So our assumption that SN drive the PI of RETs in collectivist countries is correct. Therefore, H_{10} is accepted. The other moderator that proved to be significant in case of SN-intention is, economic development, with R^2 of 31%. The effect size analysis shows that the less developed countries showed a greater relational strength (0.496) when compared to developed countries. Our assumption that in developing countries SN drive the intention to purchase RETs is correct. Therefore, H_{13} is accepted.

In case of perceived-behavioural control, none of the moderators proved to be significant.

5. Discussion, Conclusion, Implications and Future Research Directions

5.1. Discussion and Conclusion

Compulsions of behaving pro-environmentally is engaging the attention of all nations and is prompting them to encourage the adoption of RETs. In the interests of ensuring a better world environment, countries are adopting renewable forms of energy (Gençer and Agrawal 2018). There is also a growing research interest to find out the factors that have a significant positive impact on the adoption of RETs. Researchers have applied various behavioural theories to understand and to give suggestions to policy makers, which would help them to craft policies for the successful adoption of RETs. For instance, Alipouir et al. (2021) in their study list out 13 forms of theories that have been employed in various studies. TPB and TAM are among them. Studies that have applied TPB and TAM have been growing. This study meta-analysed 41 studies that applied TPB and TAM or both to understand the factors that have strong positive linkages with PI of RETs. Although meta-analysis in the context of pro-environmental behaviour within the TPB framework has been done before (Lanzini and Khan 2017; Morren and Grinstein 2016), this meta-analysis is the first of its kind within the TPB and TAM framework, as applied to PI of RETs.

The results showed a medium to strong association between the TPB and TAM constructs and PI of RETs. Among the TAM constructs, perceived utility showed a greater association with an effect size of 0.540. This is consistent with the findings of studies that have applied the TAM model, with respect to the acceptance of

new technologies. All these studies have proved that perceived utility has been a powerful and significant factor in predicting intention to use new technology (Kardooni et al. 2016; Liang and Yi-Hsuan 2009; Venkatesh et al. 2003). PEOU showed an association of 0.404, which although not as high as perceived utility, but nevertheless, it has a medium association, which proves that it is also an important predictor. Among the TPB constructs, ATT proved to be the strongest determinant with an effect size of 0.487. Therefore, among the TPB constructs, ATT has high predictive power. SN and PBC with an effect size of 0.406 and 0.318 proved to be the second and the third important determinant of PI RETs. Results proved that both models have high to medium predictive power with respect to the PI of RETs. Our findings are consistent with that of Morren and Grinstein (2016) who in their meta-analysis of TPB studies as applied to pro-environmental behaviour found that TPB constructs have a medium to high predictive power. The effect sizes of their study are much bigger when compared to that of our study. This probably proves the fact that TPB is a good predictive model, when it comes to predicting pro-environmental behaviour.

Moderator analysis showed that among the sample-related moderators, in case of ATT-intention association, region proved to be a significant moderator with people in urban areas showing a bigger relational strength. This is again consistent with findings of studies that there is a disparity between urban and rural energy use (Mulder and Tembe 2008; Yaddo, Gormally, and Cruickshank 2011). Education did not show any moderating effect for any of the associations. This finding is surprising considering the fact that studies have proved a positive and significant relationship between education level and willingness to adopt renewable energy (Kowalska-Pyzalska 2018).

In case of country/cultural moderators, economic development proved to be a significant moderator in case of SN–intention relationship, with collectivist countries showing a higher relational strength, which was as per our assumption. This finding is contrary to the finding of Morren and Grinstein (2016) who in their meta-analysis of pro-environmental behaviour did not find economic development as a significant moderator in case of subjective norms and intention to behave pro-environmentally but is consistent with their findings that economic development is not a significant moderator in case of ATT and pro-environmental intention and PBC and pro-environmental intention. Compulsions of reducing the generation of electricity through fossil fuels and adopting renewable energy for greening their economies is probably compelling even developing economies to adopt RETs. The developing economies are also finding it easy to adopt RETs as there is policy support in the form of giving concessional credit for buying RETs. Governments in these countries are making RETs easily available. The cumulative effect of all these is strong behavioural and control beliefs of people, which is why the ATT and PBC are probably uniform whether developed or developing economies.

In case of individualism/collectivism dimension except the slight moderation effect of SN–intention association, it did not show any moderating effect in case of the other two associations. This is contrary to the findings of Morren and Grinstein (2016) who found that this dimension was a significant moderator for ATT and intention to behave environmentally. This finding again can be attributed to the fact that the acceptance of RETs has become so universal that countries whether individualistic or collectivist are adopting it. Soyez (2012) mentions that in individualistic countries people because of personal gain adopt pro-environmental behaviour for egoistic reasons. In collectivist countries because of the ATT of caring for others the tendency to behave pro-environmentally is strong. This could be the possible explanation for individualistic and collectivistic countries showing similar behaviour when it comes to the adoption of RETs.

5.2. Policy Implications

This meta-analysis gives significant insights to the policy makers in the domain of environment and energy sectors and also to manufacturers of RETs. The fact that both TPB and TAM constructs proved to be good predictors of PI of RETs shows that the policy makers should understand that psychological factors are very important determinants of the adoption of RETs. PU and ATT proved to be the strongest determinants of PI. This finding has an important implication for policy makers. A favourable ATT towards RETs would mean that policy makers would find it easier to promote RETs. A high PU of RETs also means the perception of people regarding the utility of RETs is very favourable and that they understand the benefits that would accrue to them by using RETs. This finding is of significance for policy makers who are pursuing the avowed goal of replacing fossil fuels with renewable sources of energy for generating electricity. Manufactures of RETs should advertise the utility of various RETs so that the perception of the utility of adoption of renewable energy becomes even more favourable. SN has shown a medium association with PI of RETs. After ATT and PU it is third in terms of association with PI. Policy makers need to understand the significance of influence of peers, neighbours, friends and relatives who can mould the opinion of the people to make it more favourable for purchasing RETs. They need to advertise the benefits of adopting RETs through people who already have RETs. This should happen even more in developing economies, as results have shown that SN have greater relational strength with respect to PI, in developing economies.

The fact that the ATT towards the adoption of renewable energy is uniform across developed and developing economies and also across individualistic or collectivist societies is an important insight for manufacturers of RETs because they can implement uniform sales promotion policies with an objective to make the ATT of the people towards RETs more favourable. Thus, they can be more focussed as they need not have myriad policies depending upon cultures and the state of development of countries. This would further enhance international policy support to meet the ambitious climate targets set during COP26.

PEOU and PBC have shown a medium association with PI. This is also an important insight for policy makers and equipment manufacturers because it calls their attention to strengthen the perception of people regarding the ease of installing and buying RETs. Equipment manufacturers in their sales promotion drives need to tell the people that it is easy to install RETs. Policy makers within the government need to make efforts to bring down the costs of RETs through financial support to equipment manufacturers. IEA in its report (2021) observes that energy and shipping prices of producing and transporting solar PV modules and wind turbines are rising. This could become a barrier for bringing down the costs of RETs. Finally, there is also a need to spread the awareness of benefits in rural areas by policy makers, since the results show that the association between ATT-intention is weaker in rural areas when compared to that of urban areas. This calls for educating the people in rural areas regarding the benefits of RETs, through promotional drives, which are easily comprehensible for people of rural areas.

5.3. Limitations and Future Research Directions

One limitation of the study is that it does not test the robustness of the association between PI and actual purchase behaviour. This is because of the reason that very few studies have focussed on the association between PI and actual purchase behaviour. There is also a need to consider other behavioural theories such as Roger's innovation theory and Schwartz's norm activation model to test the robustness of their constructs in predicting PI of RETs. This would give a much more comprehensive view of the robustness

of all behavioural theories that have been applied to study the PI of RETs. Another limitation of this study is that it considers only four moderators. Considering other sample moderators, such as the gender composition of respondents and their income, will help us to understand whether they show significant moderating effects. The same is the case with other countries/cultural moderators. Apart from individualism, using Hofstede's other five dimensions: masculinity, uncertainty avoidance, long-term orientation, power distance and indulgence as moderators could give better insights.

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