Energy conservation behavioural intention: attitudes, subjective norm and self-efficacy

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Abstract. This paper examines the influence of attitude towards energy conservation at home, the attitude in the campus, subjective norm, and self-efficacy on energy conservation behavioural intention among students in a private university using the Theory of Planned Behaviour (TPB). Data was collected from about 194 students using a questionnaire developed from current literature on TPB. Data analysis using Smart PLS version 3.2.4 found that attitude towards energy conservation at home has an indirect significant influence on attitude towards energy conservation behavioural intention via the mediating effect of attitude towards energy conservation in the campus. Self-efficacy and subjective norm are also positively related to energy conservation intention. The study also indicates the suitability of the TPB in predicting behavioural intention through attitudes, subjective norms, and self-efficacy. Results suggest that energy education is vital in creating a positive attitude towards energy conservation while facilities managers in institutions need to formulate appropriate policies and regulations to inculcate the right attitude and behaviour towards energy saving.

1. Introduction

The private university in which this study was conducted has been facing escalating electricity bills for a number of years even when student intakes have remained constant over the same period. The university management in its initial response to address the escalating bills was to introduce LED lightings in classrooms and offices as well as in the hostels. While the results of these changes did see some savings, the management felt that more could be done to reduce the electricity bills. While innovative energy saving technology could be introduced into buildings, the responsibility still rests on the users of this technology to optimize its usage such that costs could be relatively lower than before the adoption of the new technology. On this account, it was decided to conduct a research to examine student attitude towards electricity conservation in the campus and how attitudes, subjective norm and self-efficacy could determine the level of intention to save energy on the campus.

Intentional studies in the literature have their underpinnings in the Theory of Reasoned Action (TRA) [1], and its extension the Theory of Planned Behaviour (TPB) [2] with the latter including perceived behavioural control or self-efficacy, as an addition to the attitude and subjective dimensions of the former. The TPB has been used to investigate determinants of intention to purchase a wide array of products/services such as green products, organic products, and hybrid cars as well as the intention

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to recycle, or to exercise [3]. Past studies have used TPB theory in energy-related behavioral studies [2], energy use and energy conservation behavior [4, 5]. This paper attempts to investigate intention to conserve electricity consumption among students in a university campus using a modified TPB. By doing so, this study aims to provide the university, researchers and policy makers an understanding of how attitudes, expectations of others and self efficacy could influence energy conservation intention.

2. Literature review - The Theory of Planned Behaviour (TPB)

The TPB [2] postulated that behaviour can be determined by an individual's beliefs and evaluations of the likely outcomes of the behavior, the normative expectations of significant others and motivation to comply with these expectations, and the individual's perceived ability to control the behavior. In combination, these factors could influence attitude toward the behaviour. When aggregated, attitudes, subjective norm, and self-efficacy could manifest into a behavioural intention. In short, the more positive the attitude and the stronger the subjective norm as well as the greater the self-efficacy in controlling the behaviour, the more inclined is the person's towards performing the said behavior.

2.1. Attitudes

The literature on intentional studies has shown that attitudes are often used to measure pro-environmental behaviour [6]. Past scholars working within the context of pro-environmental behaviour (attitude, values and belief) have reported that people with positive attitude and mindset are more prone towards pro-environment intention and behaviour [7]. Previous studies have also revealed pro-environmental behaviour being associated with energy conservation and consumption [8, 9 & 10]. To solve energy-related problem does not only require the use of technology but the behavior and attitude of each individual to solve the problems. Nair *et al.* [11] showed positive pro-environmental behaviour does not necessarily lead to an actual reduction in energy usage. It appears that even with new evaluation on renewable energy sources and awareness on climate changes, pro-environmental behaviour fails to limit the consumption of energy. Past researches explain that with constant change in attitudes, it has a very small impact on pro-environmental behaviour [7, 8]. The reason in changing attitudes on energy saving is more on minimizing cost (time, effort, money) rather than doing it for the welfare of the environment [9]. Wells *et al.* [6] however noted that attitudes associated significantly with a specific environmental behaviour will have an influence on that behaviour both at home and in the workplace.

2.2. Subjective Norms

Subjective norms refer to how influential the opinions of significant others in the live of an individual on the individual performing a certain behaviour [2, 12]. As one of the predictors of intention, subjective norms are influenced by beliefs and the thoughts of performing an act [13, 14]. This lead to individual act as per expected by their family, friends and the society. A study by Goldstein *et al.* [15] and Thaler & Sunstein [16] found social norm to be visible and salient in making a powerful impact on behavioural intention. These will prompt users to exhibit energy saving behavior and reduce energy consumption by 40 percent. For students living in campus dormitories, with utilities being part of accommodation provided, there is a lack of awareness of conserving energy and it poses a problem to the university [17, 18]. Another study conducted among students living in campus dormitories found subjective norms and peer influence can be used as an effective method of encouraging students to conserve energy consumption [18]. Costanzo *et al's*. [19] energy conservation model based on social-psychological constructs show that social influence, diffusion and reference groups including friends, family, and other social networks play significant roles in promoting and maintaining energy conservation. On a similar note, Stern ([20], p. 1229) opined that "the personal opinions and actions of one's friends may have a more powerful influence over household energy choices than expert advice, even if the latter is better informed".

2.3. Self-efficacy

According to Bandura [21] an individual's capabilities to act on certain behaviour defines his self-efficacy over that behaviour. Abrahamse and Steg [5] found that users are more inclined towards conserving energy if they realise that there is a negative outcome on the environment. Strong self-efficacy and internal locus of control suggest an ability to determine one's decisions, circumstances and behaviours strongly influenced by internal factors, such as one's own motivation and actions. On the other hand a low self-efficacy suggests a person's decisions and actions are being largely controlled by external factors beyond the person's control [5, 22].

2.4. Energy Conservation Intention
Intention refers to a person's subjective probability dimension that connects that person to a particular behaviour [23]. Energy saving intention is associated with TPB constructs which measure an individual's inclination towards saving energy and evaluating positively or negatively on energy saving [24]. Previous research has found that energy saving intention in households were significantly influenced by perceived behavioral control and positive attitudes towards energy conservation [5]. Furthermore, intentions to save energy are associated with cost/benefit considerations [5]. The TPB assumes socio-demographics variables influence intentions and behavior indirectly [25]. Extant literatures have recorded the use of TPB to examine energy-related behavioural intention [2], such as energy conservation [26] and energy use [27, 28].

3. Methods
A quantitative research approach in the form of a predictive study was used in this research. A total of 194 students constituted the sample. Data collection was by means of a survey questionnaire derived from the extant literature. The questionnaire for this research comprises of six parts. Part 1 consists of a profile of respondents; part 2 consists of student's attitude at home; part 3 consists of student's attitude on campus; part 4 consists of subjective norms; part 5 consists of self-efficacy and part 6 consists of intention to conserve energy consumption. The indicators for these constructs were adapted from Wells *et al.* [6] (attitude at home, attitude in campus) and Ajzen [2] (subjective norms, energy conserving intention), and Chen *et al.* [29] (self-efficacy) anchored on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). (Please see Appendix). The Smart PLS ver. 3.2.4 structural equation modeling technique was used to run a confirmatory factor analysis (CFA). This technique was used following the rationale given by Ringle *et al.* [30] who suggests that Smart PLS-SEM techniques should be used for testing an incremental theory. This rationale was also adopted by Yeap *et al.* [31]. While acknowledging that the TPB is a well-established model, the authors have decided to include two variations of attitudes, namely, attitude towards energy saving at home and attitude on the campus. In this sense, we are testing an incremental model hence justifying the use of Smart PLS. The study also conducted tests on convergent and discriminant validity of the proposed model.
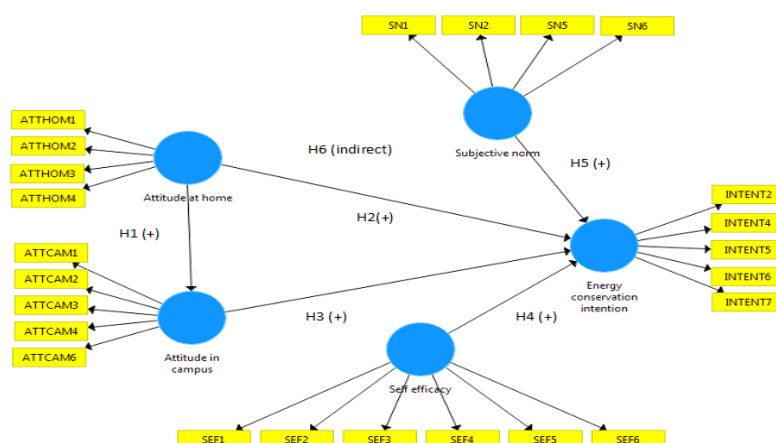
Figure 1. Research model of the study.

Based on the above literature review a research model was conceptualized for this paper (See Figure 1 which was adapted from Ajzen [2]). Subsequently, the following hypotheses were developed:

H1: The more positive the attitude towards conserving energy at home, the more positive is the attitudes toward conserving energy in campus.

H2: A more positive attitudes towards conserving energy at home will bring about a greater energy conservation intention in campus.

H3: The more positive the attitude towards conserving energy in campus, the greater is the energy conservation intention in campus.

H4: The higher the self-efficacy of students, the higher is their energy conservation intention in campus

H5: The higher the subjective norm among students, the higher is their energy conservation intention

H6: Attitude towards energy conservation in campus mediates the effect of attitude towards energy conservation at home on intention to conserve energy in the campus.

4. Results

4.1. Profile of the respondents

Table 1 indicates the respondents' profiles. Female students (58.2 %) slightly outnumbered male students (41.8 %). The majority of the respondents were between 18 to 23 years old (91.8 %). Most of the students staying in the hostel were Malaysians (91.2%), with Chinese ethnicity (58.8 %) forming the majority. About 43.3% of the students are pursuing diploma courses while 39.7% are doing degree courses. Overall about 91.2% of students are pursuing business courses.

Table 1. Profile of the respondents.

Profile	Frequency	Percent
Gender		
Male	81	41.8
Female	113	58.2
Age		
18-23 years	178	91.8
24-30 years	16	8.2
Nationality		
Malaysian	177	91.2
Non-Malaysian	17	8.8
Ethnicity		
Malay	19	9.8
Chinese	114	58.8
Indian	40	20.6
Others	21	10.8
Program		
Foundation	28	14.4
Diploma	84	43.3
Degree	77	39.7
Masters	5	2.6
Faculty		
Business	177	91.2

Science	17	8.8

4.2. Measurement model evaluation

The research model was tested using the SMART PLS ver 3.2.4 software [30]. Tests were conducted to determine the validity and reliability of the measures and to test the hypotheses [32]. The bootstrapping method was also used to test the significance of the path coefficients and the loadings [32]. Table 2 explained the convergent validity of measurement model. As suggested by Hair [32], both loadings and composite reliability (CR) were more than 0.7; and the average variance extracted (AVE) were more than 0.5. Items SN3, SN4, INTENT 3, ATTHOM5, ATTHOM6 and ATTCAM5 were omitted from the structural model because of loadings < 0.70. INTENT 1 was also omitted because of cross-loading with Attitude at the campus. Adopting the procedures of Fornell and Larcker [33] the discriminant validity of the measures was examined in Table 3. The diagonal values in bold represent the square roots of the AVEs (average variance extracted) and they are all greater than the correlations in the off diagonal section of the table [33]. Hence, Table 2 and Table 3 have established the convergent and discriminant validity of this study.

Table 2. Convergent validity.

Construct	Item	Loadings	[a] CR	[b] AVE
Attitude in campus	ATTCAM1	0.903	0.931	0.732
	ATTCAM2	0.887		
	ATTCAM3	0.866		
	ATTCAM4	0.864		
	ATTCAM6	0.749		
Attitude at home	ATTHOM1	0.790	0.903	0.699
	ATTHOM2	0.857		
	ATTHOM3	0.834		
	ATTHOM4	0.860		
Energy conservation intention	INTENT2	0.814	0.916	0.687
	INTENT4	0.840		
	INTENT5	0.727		
	INTENT6	0.890		
	INTENT7	0.864		
Self-efficacy	SEF1	0.798	0.924	0.670
	SEF2	0.834		
	SEF3	0.837		
	SEF4	0.851		
	SEF5	0.832		
	SEF6	0.753		
Subjective norm	SN1	0.807	0.872	0.631
	SN2	0.816		
	SN5	0.739		
	SN6	0.815		

[a]CR = Composite reliability = (square of the summation of the factor loadings)/ [(square of the summation of the factor loadings) + (square of the summation of the error variances)]

[b]AVE=Average Variance Extracted = (summation of squared factor loadings)/(summation of squared factor loadings) (summation of error variances)

Table 3. Discriminant validity.

	Attitude at home	Attitude in campus	Energy conservation intention	Self-efficacy	Subjective norm
Attitude at home	**0.836**				
Attitude in campus	0.632	**0.855**			
Energy conservation intention	0.441	0.673	**0.829**		
Self-efficacy	0.483	0.654	0.687	**0.818**	
Subjective norm	0.499	0.636	0.646	0.724	**0.795**

Diagonal values in bold are the square root of the average variance extracted (AVE). Values below the diagonals are correlations among the constructs.

Diagonal values (bolded) should be larger than the correlations in order to establish discriminant validity.

4.3. Evaluation of the structural model

This study evaluated the structural model by examining the R^2, Beta (β) and the corresponding t-values [31]. Bootstrapping procedure (refer Table 4) was applied to obtain t-values, report predictive relevance (Q^2) and effect sizes (f^2) [31]. There were four predictors for energy conservation intention, namely, attitude at home, attitude in campus, subjective norm and self-efficacy. Attitude at home (β = -0.045, $p > 0.05$) has no direct effect on energy conservation intention in campus. However attitude at campus (β = 0.359, $p < 0.01$), self-efficacy (β = 0.328, $p < 0.01$) and subjective norms (β = 0.202, $p < 0.01$) were positively related to energy conservation intention and together with attitude at home could explain about 58% of the variance in intention to conserve energy (R^2 = 0.578).

Table 4. Results of hypotheses testing.

Hypothesis	Relationship	Std. beta	Std. error	t-value	Decision	R^2	f^2	Q^2
H1	Attitude at home -> Attitude in campus	0.632	0.068	9.359***	Supported	0.400	0.666	0.283
H2	Attitude at home -> Energy conservation intention	-0.045	0.071	0.636	Not Supported	0.578	0.003	0.385
H3	Attitude in campus -> Energy conservation intention	0.359	0.104	3.460***	Supported		0.127	
H4	Self- efficacy -> Energy conservation intention	0.328	0.082	3.992***	Supported		0.105	
H5	Subjective norm -> Energy conservation	0.202	0.096	2.112*	Supported		0.041	

	intention				
H6	Attitude at home -> Attitude in campus-> Energy conservation intention	0.227	0.073	3.104**	Supported

* p < 0.05   ** p < 0.01   *** p < 0.001

The Preacher and Hayes' [34, 35] method of bootstrapping to identify indirect effect was applied to test H6. An indirect effect of attitude towards energy conservation at home on energy conservation behavioural intention via attitude in campus was identified (β = 0.227 was significant with a t-value of 3.104). Following the procedures of Preacher and Hayes [34, 35], mediation was present as the indirect effect, 0.227, at 95% confidence level with Boot CI: [LL=0.089, UL=0.379] shows that the lower limit (LL) and upper limit (UL) does not straddle a 0 in between. Hence, H6 was supported as the mediating effect is statistically significant.

Concomitantly, f^2 is used to measure the effect size for predictive regression equations, i.e. f^2 = 0.02 (small effect); 0.15 (medium); 0.35 (large) [32]. Table 4 indicates that effect size of relationships range from no effect (1 relationship), small (1 relationship), medium (2 relationships) to large effect size (1 relationship). Q^2 measures a model's predictive relevance (PR); if $Q^2 > 0$, then there is PR; if < 0, then no PR [32]. From Table 4, the two Q^2 values are more than 0 with 0.283 and 0.385 respectively, indicating that there is predictive relevance in the structural model.

5. Discussion and Conclusion
In this study, the predictors of energy conservation intention among students staying in a campus hostel were examined. The research instrument was adapted and developed from Ajzen [2], Wells et al. [6] and Chen et al. [29]. All three constructs of attitudes in campus, subjective norms and self-efficacy were significantly and positively related to energy conservation intention. However, attitude at home was found to have an insignificant influence on energy conservation intention in campus but has an indirect significant impact on intention to conserve energy via the mediating effect of attitude in campus. The findings in this study imply that attitude at campus was strongly influenced by attitude at home which unexpectedly was not translated into intention to conserve energy in campus. Energy conservation intentions are directly driven by attitude at campus, subject norms and self-efficacy.

The findings for attitudes at campus with energy conservation intention are consistent with past research findings by Kollmuss & Agyeman [8], Gaspar & Antunes [9] and Guerra Santin [10]. These researchers found that by having a positive attitude and mindset, the more prone their intention towards energy saving. For subjective norms, the findings are consistent with Goldstein et al. [15], Taler & Sunstein [16] and Hassan et al. [18] where family, friends and peers were found to influence and encourage students in conserving energy. The findings for self-efficacy towards energy conservation intention, is consistent with studies by Abrahamse & Steg [5], Costanzo et al. [21] and Stern [22]. Students believe on their own decision as well as their family and peers influence on energy conservation intention.

The finding of attitude on energy conservation in campus mediates the relationship between attitude at home and behavioural intention to conserve energy in campus is also supported by Wells et al. [6]. This result seems to suggest a spread effect of attitudes at home into the campus environment. However, a direct effect was not discernible on behavioural intention to save energy. A plausible reason could be that students do not see themselves as responsible to carry the financial burden of investment measures as well as non investment measures to save energy in the campus. In this context, the inculcation of positive attitudes on energy conservation in schools and campuses should start as early as possible. Facilities managers including university accommodation managers should take heed of this need to educate and inculcate good attitudes towards energy saving.

The above views lead us to recommend the following:

5.1. Environmental education

Using pedagogical approach, the education programmes should be concerned with raising awareness on the needs to conserve energy consumption in the campus. The programmes should focus on improving energy-related attitudes, behavioral intention and strategies for action. Moreover, the educational awareness on energy conservation can be incorporated into curriculum activities for students. Through these programmes, students do not only acquire knowledge and cognitive skills but also affective attitudes which could influence other students and their peers on reducing energy use. In this respect, Ntona *et al.* [36] suggested that the education programme could include two levels, namely (1) imparting knowledge on the usefulness and importance of energy resources and (2) scientific and technical knowledge on the optimum utilization of energy resources.

Specifically, environmental education should inculcate in students sensitivity towards caring of the environment and its resources and understanding of what and why energy crises occur. At the same time opportunities should be given to them to deliberate on courses of action and strategies to address energy crises in the future. More critical is the issue of developing the right attitudes, values nd acceptable practices toward energy conservation as the findings in this study have indicated that attitudes towards energy conservation in the campus have the biggest effect size on behavioural intention in energy saving.

Peers, friends and role models play an important role in influencing behavioral intention; to create energy awareness, students should be affiliated to environmental awareness clubs and non-governmental organizations (NGOs) outside the campus. The student representative councils (SRCs) need to promote awareness on energy saving. Hence, both clubs and SRCs can promote energy saving awareness by event sponsoring, fund raising as well as related activities.

5.2. Policies and regulations

A new approach on policies and hostel regulations related to conserving energy should be developed to motivate and promote energy awareness to on-campus students. This is to encourage the university community to participate in raising awareness as well as change their attitudes and behaviour in conserving energy. Specifically, student handbooks should clearly specify behaviour such as switching off lights, fans and air-conditioning in hostels and classrooms when not in use. Incentives in the form of rental discounts can be offered to hostel blocks which register the lowest monthly consumption consistently for 3 consecutive months could be introduced.

In addition, the university management dealing with students and accommodation must be student friendly at all times hence creating a conducive environment for students to appreciate and value the university's initiatives to conserve energy in all its facilities. It is believed that students, who were "angry" with the university administration because they felt that they have been shortchanged or mistreated by the accommodation office, have shown a negative attitude towards such energy saving initiatives.

The overall objective is to inculcate through these educational approaches and policies in institutional framework of lifelong learning that subsequently can bring about a comprehensive and integrated strategy towards promoting more positive energy conservation practices in campuses and work places.

6. Limitations and suggestions for future research

It is suggested that future research examine the perceptions of both private university and public university students as the latter's operating costs are funded by state funds and grants while the former has to source for funds on its own largely from students' fees. This disparity may have implications in influencing student attitudes towards energy saving in the campuses. Secondly, the sample of this study constitute only one private university hence the findings may be limited and

cannot be generalized to all private and public universities in the country. Thirdly, it would be interesting to examine the mediating effect of the affective attitude of students on energy conservation intention since both the attitudes examined in the study are cognitive or instrumental attitudes towards energy saving. Lastly, it is suggested that the study be extended to more campuses in the country so that a more representative sample could be selected. The results from such a study could give greater accuracy on information with regards to attitudes, subjective norm, and self-efficacy of students as predictors of energy conservation intention.

Appendix.

Constructs	Items	Source
Attitude at home	ATTHOM1. I believe reducing energy consumption in the home has an effect in tackling climate change. ATTHOM2. Reducing my home's energy consumption would help protect the environment. ATTHOM3. It is my responsibility to reduce energy consumption I use at home. ATTHOM4. It is important to conserve energy at home. ATTHOM5. Doing things like switching off air conditioning and lights when I am not in my room is important in reducing energy wastage. ATTHOM6. I try as far as possible to use natural lights from outside my windows instead of switching on my lights.	Adapted from Wells et al. [6]
Attitude in campus	ATTCAM1. Doing things like switching off lights, fans and air conditioning when not in use is important in reducing our campus' energy consumption. ATTCAM2. I believe that reducing energy consumption in the campus has an effect on climate change. ATTCAM3. It is every student's responsibility to reduce energy consumption in the campus. ATTCAM4. It is important to conserve energy consumption while staying and studying in the campus. ATTCAM5. I am still concerned about turning lights and air-conditioning on even though the university pays for the electricity bills. ATTCAM6. I am concerned about conserving energy even though new technologies will be developed to address the energy problems for future generation.	Adapted from Wells et al. [6]
Subjective norm	SN1. In general, people who are important to me would support my efforts to conserve energy consumption. SN2. People who are significant in my life think that I should conserve energy wherever possible. SN3. My close friends think I should not waste energy consumption. SN4. My close friends think I should join energy	Adapted from Ajzen [2]

	saving awareness campaign. SN5. The campus management expects of me to switch off all lights, fan and air-conditioning if not in use. SN6. I value the opinion of people who are significant in my life when it comes to making a decision on energy conservation.	
Self-efficacy	SEF1. I will be able to achieve most of the goals that I have set for myself concerning energy conservation. SEF2. When facing difficult decisions on energy conservation, I am certain that I will accomplish them. SEF3. In general, I think I can obtain energy conservation outcomes that are important to me. SEF4. I believe I can succeed at most any energy conservation endeavour to which I set my mind. SEF5. I am confident that I can perform effectively on many different tasks relating to energy conservation. SEF6. Compared to other people, I can do most energy conservation task very well.	Adapted from Chen et al. [29]
Energy conservation intention	INTENT1. I will try to conserve electricity consumption when I am in the campus. INTENT2. I intend to switch off lights and air-conditioning when not in use. INTENT3. I plan to open windows rather than turning on air-conditioning when it's hot. INTENT4. I will make sure to switch off the electrical-electronic equipment after each class session. INTENT5. I intend to join energy awareness campaign in campus. INTENT6. It is my responsibility to reduce energy resources I use in campus to save cost. INTENT7. I will encourage my classmates to conserve energy all the time.	Adapted from Ajzen [2]

Acknowledgements

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