The psychological determinants of energy saving behavior

Razlin Mansor¹, Low Sheau-Ting²

1Department of Real Estate, Faculty of Geo-information and Real Estate, University Technology Malaysia, Johor Bahru, 81310, Malaysia
2Centre for Real Estate Studies, Faculty of Geo-information and Real Estate, University Technology Malaysia, Johor Bahru, 81310, Malaysia

¹razlinmansor@yahoo.com
²sheauting@utm.my

Abstract. The energy sector represents the largest sources of emissions by far, accounting for almost 68% of greenhouse gases emission in the world. Buildings contribute to 32% of overall global final energy use. Energy saving behavior often influenced by monetary incentive shall not be generalized into an office building context whereby the users have no financial responsibility on its utilities expenses. At present, the challenge of how to encourage users towards energy saving behavior (ESB) is one of the emerging topics attracting the attention of researchers. Thus, this study focuses to identify the psychological determinants of ESB in buildings. Using behavioral changes as an adaptation approach, an extensive literature search was carried out on 72 published literatures to explore the existing ESB model to specify the psychological determinants of ESB within a building context. The result of the content analysis indicates that the ESB among building users was attributed by several psychological determinants: Attitude, Subjective Norm, Perceived Behavior Control, Habits, Motivation and Energy Knowledge. The findings may serve as an initial reference to the management progress in fostering ESB among users in a building context.

1. Introduction

In this age of an expanding world, climate change is considered as one of the major threats to our Mother Earth. Currently, it is reported that the energy sector’s greenhouse gases (GHG) emission is the main contributor to global warming. Due to the rising concern, scientists and policymakers have heightened the focus on mitigating climate change issues by reducing the total energy consumption in several sectors, such as transportation, buildings, industry and agriculture. The latest global CO₂ concentration recorded is significantly higher than the maximum safe concentration limit [1] and buildings are responsible for almost 32% of total global final energy use [2].

Many academic debates have discussed energy related-issues, especially on human behaviour changes, as these can help in reducing a significant amount of GHG emissions. According to [3], efficient energy use will require behavioural changes in order to improve the current practices of energy-saving among users. Over recent years, energy conservation has attracted considerable attention from social scientists as energy conservation behaviour is one of the vital components to address in energy saving action. According to [4],
improving energy saving behaviour among users can save energy consumption by approximately more than 10%. Moreover, changes in individual behaviour on energy consumption can also provide great beneficial effects on GHG emissions and reduce the negative consequences on the environment [5].

Occupants of a building play an important role in reducing energy consumption [6]. The willingness to adopt behaviour change towards energy saving habits is essential in energy conservation. Previous study has acknowledged that specific desired behaviour, such as energy conservation behaviour, is influenced by a set of psychological determinants. Furthermore, there are various psychological determinants that have been proven to significantly contribute to fostering energy saving behaviour, varying across the local context and culture. Some of the psychological determinants may have direct influence on individual intention to perform pro-environmental behaviour and some of the determinants may have indirect influence. Thus, this research aims to identify a set of psychological determinants influencing energy saving behaviour in building by reviewing the previous work that presents a range of psychological determinants used to foster energy saving behaviour in various contexts. The following section details the Theory of Planned Behaviour, which is adopted as the fundamental structure for the present study; then, the procedure of content analysis held is presented and a theoretical framework of psychological determinants to foster energy saving behaviour is proposed. Finally, a conclusion and the limitation of the present study is addressed.

2. Material and method

2.1. Theory of planned

Theory of Planned Behaviour (TPB) is a classical social-psychological model for human behaviour change developed by Ajzen in 1985, and which has been extended by the boundary condition based on the Theory of Reasoned Action (TRA). In detail, TPB consists of three psychological determinants, which are Attitude, Subjective Norm and Perceived Behaviour Control (PBC), as shown in Figure 1. The first predictor is attitude, which is defined as the beliefs, feelings and action tendencies of a person towards certain issues. The second predictor is subjective norm. This is based on the social pressure received from a specific reference group whereby the individual will try to comply. The final predictor is PBC, which refers to the individual’s perception on the difficulty to perform certain behaviour and their perceived control over the behaviour [7].

TPB has been widely used to investigate a range of pro-environmental behaviour. For example, [8] applied TPB as a theoretical model to predict communication channels for occupants in green buildings. Other than that, [9] has used the three predictive variables in TPB to investigate energy conservation behaviour among households in Ibadan City. Each of the psychological determinants may have different effects to influence individual intention towards conservation behaviour. The TPB model should be adopted with appropriate modifications based on the local context and scope. For instance, [6] has added living habits in predicting energy saving intention among residents in Beijing, as living habits can determine a person’s power to consume energy. Moreover, [10] has proposed personal norm as a predictor of residential energy consumption, as personal norm is related to the self-satisfaction of a person when performing certain behaviour.

![Figure 1. Path model for theory of planned behavior (TPB)](source: [11])
2.2. Psychological determinants of pro-environmental behavior

The significant role of psychological determinants in increasing pro-environmental behaviour has been acknowledged in previous study. In this context, psychological determinants can be explained as psychological variables that may contribute to foster individual intention towards energy saving behaviour. Energy conservation is one of the plausible alternative options to address the issue of growing energy consumption. According to [12], occupant’s behaviour change towards energy conservation can result in greater savings compared to the investment cost made for technological approaches. Thus, this study has conducted a systematic search on academic literature to explore and compile the psychological determinants used to foster pro-environmental behaviour within different scopes of study. All the key findings within energy conservation context have been summarised, as shown in Table 1.

Table 1. Summary of previous studies in identifying psychological determinants of energy conservation behavior

| Context                          | Psychological Determinants                                      | Source |
|----------------------------------|-----------------------------------------------------------------|--------|
| EC in institutions               | Personal Norm, Moral Norm                                       | [3]    |
| ES behaviour in office buildings | Attitude, SN, PBC, Personal Norm                               | [5]    |
| EC among Beijing residents       | Attitude, SN, PBC, Living Habit, Information, Knowledge         | [6]    |
| EC in workplace                  | Attitude, SN, PBC                                              | [7]    |
| EC in green buildings            | Attitude, SN, PBC                                              | [8]    |
| Household EC                     | Attitude, SN, PBC                                              | [9]    |
| Residential EC                   | Attitude, Motives, PBC                                         | [10]   |
| EC in buildings                  | Personal Norm, Social Norm                                      | [12]   |
| EC in laboratory                 | Attitude, Energy Knowledge                                     | [14]   |
| Household EC                     | Attitude                                                        | [15]   |
| Household EC                     | Habitual Activities                                            | [16]   |
| Household EC                     | Attitude, Knowledge, Habits                                    | [17]   |
| Hospital EC                      | Attitude, Social Norm, PBC, Habit                              | [18]   |
| Energy Behavioural Change        | Attitude, Habits, Knowledge                                     | [19]   |
| EC in university                 | Attitude, SN, Self-efficacy, Awareness, SN, Habit               | [20]   |
| Energy related behaviour in office buildings | Attitude, Self-efficacy, Awareness, SN, Habit                   | [21]   |
| Low carbon energy behaviour at work place | Social Norm                                                        | [22]   |
| ES behaviour in commercial buildings | Public Information                                             | [23]   |
| ES behaviour among social housing | Knowledge, Imageability, Perceived Control, Social Norm         | [24]   |
| ES in office buildings           | Attitude, SN, PBC, Habits                                      | [25]   |
| EC in workplace                  | Attitude, Awareness                                            | [26]   |
| Household EE                     | Attitude, SN, PBC, Environmental Concern                        | [27]   |
| Household ES                     | Habits, Social Norm, Environmental Concern                      | [28]   |
| Electrical EC                    | Attitude, Knowledge, Awareness                                  | [29]   |
| Residential EC                   | Environmental Concern, Motivation, Social Norm, Social Motivation | [30]   |
| EC at work                       | Attitude, SN, PBC, Environmental Concern                        | [31]   |
| Household EC                     | Attitude, SN, PBC, Values, Personal Norm                        | [32]   |
| Household ES behaviour           | Attitude, Personal Norm, PBC, Awareness                        | [33]   |
| Sustainability Energy Technology | Attitude, Social Norm, PBC, Personal Norm, Experience, Knowledge | [34]   |
| Energy associated behaviour      | Attitude, Norm                                                  | [35]   |
| ES behaviour                     | Social Norm, Personal Norm, Self-Efficacy, Attitude, PBC, Knowledge, Habit | [36]   |
| Household conservation behaviour | Environmental Value, Environmental Concern, Perceived Consumer | [37]   |

Note: Energy Efficiency (EE); Energy Conservation (EC); Energy Saving (ES); Subjective Norm (SN); Moral Norm (MN); Perceived Behaviour Control (PBC)
This theoretical search has extended the focus area to several pro-environmental behaviours, such as recycling behaviour, waste separation behaviour and water conservation behaviour, to ensure a wide variety of improvement in the TPB model that has been hypothesised were included in the review. Therefore, the extant literature search has found that several psychological factors, such as Attitude, Subjective Norm, Moral Norm, PBC, Habits, Environmental Norm, Self-efficacy, Knowledge, Social Norm, Personal Norm, Information and Past Behaviour, were positively correlated with a wide range of pro-environmental behaviour.

For instance, a study conducted by [38] found that Knowledge is one of the psychological determinants that showed a positive correlation with recycling behaviour among university students. A study by [39] indicated that household kitchen waste separation behaviour was influenced by several psychological determinants, including Attitude, PBC, Subjective Norm, Moral Norm and Responsibility. In addition, [40] acknowledged that Attitude, Belief and Habits among residents showed positive relationship with water conservation behaviour. Thus, the psychological determinants influencing the desired behaviour are varying across the local context and climate.

2.3. Methodology
This study adopts the TPB theoretical model as a basis in determining the psychological determinants of ESB, with some extension. A systematic search of relevant articles was undertaken on two databases (Web of Science and Scopus) via keywords or subject headings of Psychological factor of energy conservation behaviour and Psychological factor of pro-environmental behaviour. Considering the psychological determinants influencing other pro-environmental behaviour may have potential application in ESB context, the present study has extended the search to the broader domain of pro-environmental behaviour (recycling, waste separation and water conservation). The literature search was limited to the articles that were published from year 2005 to year 2017. The search only included works written in English. Generally, the primary objective was to review all previous works identifying the psychological determinants of energy saving behaviour. The overall search has identified a total of 72 journal articles that outlined several psychological determinants which have been hypothesised and significantly correlated with pro-environmental behaviour in various contexts. All the psychological determinants that successfully foster specific pro-environmental behaviour in previous studies have been reviewed and summarised. However, the main body of this article only presents the summary of general findings and other supporting evidence to ensure the focus and clarity of this study.

3. Result and discussion

3.1. Psychological factors of energy saving behavior
Based on the TPB theoretical model and related previous studies, the present study has identified six (6) psychological determinants which are commonly mentioned in previous studies and associated with energy saving behaviour in a buildings context. The determinants are associated with some underlying determinants that are likely to have indirect effects on the energy saving behaviour. Figure 2 illustrates the path model of Psychological Determinants of Energy Saving Behaviour. The psychological determinants include: Attitude, Subjective Norm, PBC, Energy Knowledge, Habit and Motivation. Further description of each psychological determinant is addressed in the following sub-sections.

3.1.1. Attitude
Attitude can be described as the subjective judgement of an individual to perform a certain behaviour, whether the action has positive or negative benefits. Previous study has acknowledged that individual intention to perform certain behaviour can be influenced by positive attitude. For example, [32] found that
positive attitude is more prone towards behavioural intention, especially within pro-environmental
behavioural contexts and [18] also mentioned that positive attitude of occupants in hospitals successfully
influenced their intention towards energy conservation behaviour.

In addition, Environmental Concern was found in previous study as one of the internal determinants,
which indirectly contribute to individual intention, because environmental concern will motivate individual
attitude to perform long-lasting energy saving behaviour. According to [41], people who are concerned
about environmental issues such as climate change will have positive impact to engage with pro-
environmental behaviour. Therefore, environmental concern is relevant in predicting individual attitude
towards energy saving behaviour. Environmental Beliefs is also included as an indirect determinant
influencing ESB. This is consistent with study by [42] which found stronger individual attitude was
influenced by environmental belief among households to engage in recycling behaviour. Environmental
belief is also known as the relationship between humans and nature, which encourages a person to conserve
the environment wisely.

![Path model of psychological determinants of energy saving behaviour](image)

**Figure 2. Path model of psychological determinants of energy saving behaviour**

### 3.1.2. Subjective norm

Subjective norm is defined as a social pressure from a reference group of a person, which can influence that
person to perform certain behaviour. Recent studies have acknowledged the importance of subjective norm
in influencing individual intention of pro-environmental behaviour. Behaviour change in community and
group could affect the way people think and do. As an example, [43] indicated that subjective norm has
been verified as a significant determinant that influences household intention towards energy saving
behaviour. The present study has identified three indirect determinants influencing ECB via Subjective
Norm. These include Social Norm and Personal Norm. Social Norm is the relevant expectations of a
community to which an individual will seek to comply [44]. Personal Norm can be explained by three
fundamentals, which are (i) when the individual is aware of the action necessary to solve the issues, (ii)
when the individual recognises the action is related to the issues and (iii) when the individual recognises
their own ability to change the situation and condition [44]. Moral Norm is individual responsibility to
conduct a certain action, which is influenced by the sense of moral obligation [45]. The significant
contribution of these indirect determinants has been proven in previous works. For instance, [46] has
recognised social norm as one of the important factors which can help to influence university students towards pro-environmental behaviour. According to [47], intention to use alternative fuel vehicles has been found significantly influenced by personal norm. Meanwhile, some studies also included moral norm as an indirect determinant, as moral norm has been found significant to improve the prediction of individual intention. A study by [48] reported that moral norm has significant power to engage with people’s intention toward carbon reduction behaviour in Taiwan.

3.1.3. Energy knowledge
In recent times, the importance of a knowledge base relating to saving energy has attracted attention from researchers and the media, especially when global warming issues arise. Previous study has acknowledged that energy saving intention can be improved by increasing people’s knowledge on energy use problems. Lack of energy knowledge on conservation practices may cause a negative consequence on behavioural changes as it will reduce individual concern on energy saving and limit the practice of energy saving behaviour. As an example, [14] stated that the effort of universities in providing energy-related knowledge to students has contributed to the energy saving behaviour in the laboratory. In certain situations, energy knowledge itself is not sufficient to trigger energy saving intention. Thus, public information related to energy problem is relevant to increase people’s knowledge on energy saving behaviour. Alternatively, public information can be delivered either written or face-to-face [51]. Many scholars believe information which is focused on the characteristic of the target group will have better strength compared to general information. A study by [6] found that public information has helped residents to improve energy saving behaviour.

3.1.4. Habit
When behaviours are repeatedly performed, it will become a habit for the individual. Habit could be defined as the automaticity of a person to perform certain behaviour in a specific situation. Previously, habit was presented as a stable connection between situational factor and pattern of behaviour whereby it has been developed by replication of the same behaviour within the same context [44]. Some scholars have acknowledged that habit plays a vital role in influencing people towards energy saving behaviour. For example, [52] found that habit and lifestyle factors have a strong correlation with the daily energy use among residents. Based on the content analysis conducted, the present study ascertained Past Experience as an indirect determinant influencing ESB via Habit. Past experience is about previous involvement of the individual in a certain situation or behaviour. Past experience can influence individual intention in two ways, through habit formation or semi-automatic responses in complex behaviour [53]. Previous study has acknowledged that past experience could be a good predictor of individual intention towards energy saving behaviour. According to [54], past experience was found positively correlated with household intention to perform recycling behaviour.

3.1.5. Motivation
Motivation can be defined as a reason for individuals to perform a certain behaviour where motivation will act as a significant stimulus for the individual to perform certain behaviour in specific situation [55]. Furthermore, motivation can be determined by two components, intensity and direction, which will drive individual motivation in choosing what behaviour to perform and why [38]. In addition, [51] has explained further on type of motivation: extrinsic motivation and intrinsic motivation. Extrinsic motivation refers to the individual who believes extrinsic reward is the main reason to perform a certain behaviour, while intrinsic motivation is defined as a voluntary behaviour performed by an individual due to specific reasons, such as concern about environmental issues. For example, [56] indicated that indirect incentives could be a
good motivation for the employee to perform energy saving behaviour and [30] also reported environmental motivation as the strongest single predictor of curtailment behaviour within an energy saving context.

3.1.6. Perceived behavioural control
Perceived Behavioural Control is another determinant construct in the TPB model and could be defined as the difficulty level of individuals to maintain rationality when performing a certain behaviour [11]. In detail, the concept of PBC can be explained within two contexts, which are the belief and the ability of a person to control certain behaviour and the difficulty of a person to perform a certain behaviour. In recent years, numerous studies have acknowledged the positive correlation of PBC with energy saving behaviour across different contexts. For instance, [32] has identified positive correlation between PBC and household intention to reduce energy consumption. Another study by [57] found that the PBC positively affected the energy conservation intention among students on campus. In the present context, self-efficacy is identified as an internal determinant in PBC which is strongly linked with conservation intention. According to [49], self-efficacy should be assessed when measuring PBC, as self-efficacy is related to the capability aspect. For example, [50] found self-efficacy has a strong correlation with recycling behaviour among households in China.

3.2. Discussion
Based on the extensive literature search, it is revealed that energy saving behaviour is associated with numerous psychological determinants. As an example, this study found a wealth of articles investigated the relationship of psychological determinants in regards to energy conservation behaviour across various contexts, including commercial and residential buildings. The psychological factors commonly related to energy conservation behaviour include: Attitude, Subjective Norm, Perceived Behavioural Control, Energy Knowledge, Habit, Motivation, Belief, Values and Awareness. However, some of the psychological determinants may not be strongly significant to formulate energy saving behaviour, as each factor has a different effect on energy saving behaviour according to the context. For instance, [58] found that injunctive norm has the strongest direct effect to energy conservation intention compared to PBC and it automatically reflected that social influence plays an important role in formulating energy conservation intention of individuals in China.

In this study, there are six (6) psychological factors that have been outlined which have been commonly investigated in previous studies and significantly associated with energy saving behaviour, these include: Attitude, Subjective Norm, Perceived Behavioural Control, Energy Knowledge, Habit and Motivation. Each psychological determinant may not have the same consistency in predicting energy saving behaviour as each determinant may interact with other determinants as well. However, this study has adopted common conceptualisation without further considering the complex interaction of each determinant. Based on the content analysis, 72% of the articles have identified Attitude as the strongest determinant that has a direct effect in formulating energy saving behaviour compared to other determinants. Furthermore, 44% of previous studies revealed that PBC has a significant direct effect in formulating energy saving behaviour. This is in line with prior study by [27], which indicated that Attitude, PBC and Environmental Concern have the strongest direct effect in predicting energy conservation intention among Italian households. Meanwhile, only 7% of previous studies reported the significant effect of Motivation in predicting energy saving behaviour. For example, [38] indicated that students with high motivation are more likely to practice pro-environmental behaviour in university. In addition, energy knowledge also plays a significant role in motivating energy saving behaviour, with a total of 27% of previous studies acknowledging energy knowledge as one of the significant predictors in formulating energy saving behaviour.

In summary, it is clear that energy saving behaviour is influenced by several psychological determinants. However, the psychological determinants cannot be generalised in overall segmentation as it depends on
the complex interplay between the determinants, as has been remarked in previous studies. Moreover, each determinant may not contribute consistently in formulating energy saving behaviour due to several external factors, such as demographic.

4. Conclusions
The present study reveals that energy saving behavior in a buildings context is associated with a number of psychological determinants. Based on the comprehensive literature review, each of the psychological determinants seems to play a vital role in influencing an individual to perform energy saving behavior. There are six broad categories of psychological determinants highlighted in this study: Attitude, Subjective Norm, Perceived Behavioral Control (PBC), Energy Knowledge, Habit and Motivation. The study also indicated the indirect determinants that have insignificant effect on energy saving intention, including Environmental Concern, Environmental Beliefs, Social Norm, Personal Norm, Moral Norm, Public Information and Past Experience. Generally, the key findings of the literature search have been summarized and generalized to emerge the context of energy saving behavior. Moreover, the importance of each psychological determinant has been further explained to provide more insight on the viability of the determinants in an energy saving behavior context. The framework proposed includes all relevant psychological determinants influencing ESB that may serve as a basis reference for the management team to determine the determinants that might influence ESB among the building users. However, the proposed framework in the present study is only based on the literature search from year 2005-2017 and on the two databases; the framework proposed is theoretical and yet to be tested. Thus, future researchers could further investigate the significance of the psychological determinants by testing in the local context.

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