

A New Frontier of Sustainable Lifestyle: A Shift from Comfortable to Acceptable

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ABSTRACT

At least 40% of the energy generated in most countries is used in buildings. A significant proportion of this energy consumption is for building operation including HVAC (Heating, Ventilating, Air-conditioning) to provide a healthy and comfortable indoor environment. Fossil fuels which generate the major proportion of energy are becoming increasingly scarce whereas energy generated from renewable sources is still not entirely popular, is still expensive and can only contribute a small amount of the total energy produced. The effort of many experts to create an energy-efficient mechanical or electrical system is commendable. However, the occupants can help to conserve energy by adopting energy-efficient behavior in their everyday life and accept a less comfortable but still acceptable indoor environment. This is even more important in light of the increasingly higher standard stipulated by the current building regulations. This paper explores the concept of this comfortable and acceptable environment and develops a research framework which presents factors that should be considered to facilitate the change to behavior that accept a less comfortable environment. The research framework would guide the future research to propose a leading lifestyle concept, a back-bone for sustainable environment.

KEYWORDS: acceptable; comfortable; sustainable environment; lifestyle

1. INTRODUCTION

A large amount of energy is consumed in building sectors (residential and commercial) to fulfill the occupants' requirements. The USA Energy Consumption Data 2011[1], and the European Commission Report 2005 [2] indicate that almost 40% of energy consumption was used in building sectors primarily for heating, cooling and lighting. This consumption is larger than those for industry and transport; and residential buildings consume more energy rather than commercial ones. This consumption increases at an average of 1.5% per annum with the highest rate for HVAC[3].

The European Union in 2007 [4] set a target of 20% energy reduction by 2020 based on certain projection levels. To achieve this target, the UK has revised certain aspects of Building Regulation[5]. Along with it, Green building rating tools in the USA and other developed countries have given high priority to achieving energy efficiency whose contribution typically varies between 20 to 25 percent [6-10]. Even Singapore's Green-mark rating tool has particularly emphasized the energy efficiency with more than 60 percent assigned to these criteria[11]. This is perhaps due to limited energy resources of this city state.

One component that takes up a large proportion of energy used in buildings in four-seasonal countries are the provision of space or room heating[1-2]. For example, in the Netherlands, there was a significant increase in energy consumption for heating between 1950 and 1980, followed by a decline until 2007 due to improved insulation and more efficient equipment, and then it started to gradually increase again. More than 50 percent of energy in Dutch households is used for heating[12]. The US Residential Energy Consumption Survey for 2009 [13] shows that energy consumption in US homes for heating and cooling is 48 percent, down from 58 percent in 1993. This decreasing energy consumption is mainly due to more efficient equipment, and better insulation. However, 48 percent is still a significant portion of energy consumption. Furthermore, the operational need of appliances and electronics would seem to raise household's energy consumption in the future. Given the scarcity of resources and the growing population, human reliance on energy to support their life and activities should be balanced with continuous efforts to reduce energy consumption [14-15]

The aim of heating or cooling requirement is to provide comfort to the occupants. There are two different approaches to achieving thermal comfort environment. The first is to create an indoor environment that offers 'optimal' thermal comfort. Experts have defined the term comfortable environment through laboratory study as stated in ISO and ASHRAE or other standards. The second is to consider comfort as a social phenomenon that can be achieved by individuals rather than offered to them[12]. Individuals can make themselves comfortable by

adjusting the environment, their bodies (eg. conduct an exercise), and the property of their bodies (eg. wear suitable clothes).

Studies conducted in Pakistan 1993 and 1994[16] suggest that the Pakistani workers had different comfort temperature in winter and summer. They use different clothes to cope with a different climate throughout the year. In Japan, local people prefer to use traditional low tables called 'kotatsu'. They use the table to warm their body. They choose to heat their body than the entire room[12]. These two examples demonstrate that individuals can adapt themselves to cope with temperatures beyond the comfortable range. This lifestyle adaptation may reduce the domestic energy demand and could be a model for future lifestyle to achieve more efficient use of energy and sustainability. Further, van Marken Lichtenbelt et.al [17] argue that regular exposure to 'mild cold' will bring health benefits to individuals as the body is forced to increase energy expenditure and utilize the excess calorie which otherwise will be retained as fat in the human body. There is a need to explore strategies so that appropriate intervention could be deployed to facilitate lifestyle change and hence reduce energy consumption [18].

To meet the challenge of energy demand reduction and to achieve sustainability, we should maximize our ability to adapt to a minimum level of comfort and be willing to accept a less comfortable environment. This should be encouraged by promoting strategies and benefit gains. In this paper, we argue that humans can adapt to an acceptable environment which is beyond their comfort zone. Here, 'acceptable environment' is the term to describe an indoor environmental condition that humans could still accept by adjusting themselves and their environment to meet their minimum requirements for health and well-being. This condition is probably not entirely comfortable by current expectations but it is still acceptable for human beings to live in.

The paper proposes the concept of an 'acceptable' environment and defines it in relation to a comfortable environment. It elaborates the idea of sustainable life style, comfortable environment, acceptable environment and their relationship. The aim is enhanced understanding of the scope of personal adaptation to acceptable environment in order to facilitate sustainability. The paper then proposes a research framework that includes factors which should be considered in the process of adaptation/transformation to this 'acceptable' environment.

2. MATERIALS AND METHODS

Comfort and Comfortable Condition

The term 'comfort' has been defined and discussed by various disciplines including: engineering and social science. Each has different perspective on 'comfort'. For instance, engineers see comfort as a technical issue whereas social scientists see it as a cultural phenomenon[18]. In terms of indoor environment, human comforts depend on three conditions, namely physical, intermediary and physiological ones[19]. It means that comfort is not just a matter of physical conditions, such as optimum heat, but is also influenced by intermediaries such as clothing, activity, adaptation, acclimatization, room occupancy and psycho-social factors, in addition to physiological conditions such as health, physical fitness, gender, age, ethnicity and food intake. Thus, comfort could be considered as a resultant of all these three conditions.

Hegger[19] further described that physical conditions consist of thermal conditions (including: interior air temperature, surface temperature, humidity, air movements), visual conditions (including: lighting contrast, glare, colors, view to outside), acoustic conditions (including: frequencies, noise level, reverberation times), olfactory conditions (including: unpleasant smell, carbon dioxide), and other conditions (including: air pressure, static charge of interior air). Among these conditions, two conditions that are commonly discussed are thermal and visual conditions, or in terms of comforts there are thermal and visual comforts.

ASHRAE 55-2010 and ISO 7330 define thermal comfort as a condition of mind which expresses satisfaction with the thermal environment. The comfort sensations are affected by air temperature, radiant temperature, relative humidity, air velocity, activity and clothing. In similar vein, Bougdah[20] stated that: "comfort is a state of mind which is informed by the environmental condition, the level of control that occupants have over them as well as some psychological factors and physiological factors". In relation to thermal comfort, humans as part of the environment also emit and absorb heat. Human heat emission depends on the level of activity, body size and age of the person. Whereas the heat absorbed depends on the type of clothes they wear and their gender. Similarly, the human thermal comfort will depend on the same factors as mentioned above.

In relation with indoor environment, research on thermal comfort is divided into two categories[20-23]. The first category is research on the balance between the heat that is produced and absorbed by the human body. This kind of research aims to identify criteria of environmental conditions that conform to human comfort known as the rational or human heat-balance[24-25]. The ideal condition of comfort is the condition when the human body is in this balanced situation, usually called 'Neutral Temperature' or PMV (Predicted Mean Vote) is 0 (zero). The second category is research into actions to adapt and change their environment. This kind of research is often based on the human natural tendency to adapt based on the changing environment, known as the adaptive thermal comfort [26-29].

An example of the first category is thermal comfort research conducted by Karyono in Jakarta, Indonesia and in Bandung, Indonesia [30-31]. It showed that participants from Jakarta had slightly higher neutral temperatures and comfort ranges than those from Bandung. Participants from Jakarta were workers under 40 years old and participants from Bandung were students between 19-24 years old. Jakarta is situated on the north coast of Java, at 6° south-latitude, with a mean monthly temperature of 28.5°C; while Bandung is located in 7° south-latitude, 700m above sea level, where the mean monthly temperature is 23°C. The difference of the subject's neutral temperature was about 2.1°C and the difference in term of comfort range was about 1.9°C to 1.5°C of air temperature, about 1.7°C of operative temperature and about 1.4°C of its comfort range. Participants from Bandung seemed to feel more comfortable in lower temperature than those from Jakarta. This suggests that participants from different living environments can have a different comfort range.

Compared to the first category, the second category seems to reflect the actual condition. Humans are able to adapt their condition or to change the environment to provide a comfortable environment. For instance, they can take off their jacket to cool down, or open the window to allow air movement. This is exemplified by research conducted by Humphreys in Northwest Pakistan in 1993-1994. [32]. The participants were Pakistani office workers, and they were asked how they feel toward their environment. Humphreys used the Bedford classification comfort scale ranging from 'much too cool' to 'much too hot'. The result for the neutral or 'OK (just right)' temperature is 30°C in summer and 15.5°C in winter. This indicates that the comfortable temperature varies widely due to an opportunity for participants to adapt their clothes or even to change the environment for example by opening windows.

In 2001, deDear and Brager[33-34] investigated an adaptive comfort standard that later was incorporated into ASHRAE Standard 55. It was based on an analysis of 21,000 data sets compiled from field studies in various naturally ventilated buildings. They found that occupants prefer a wider range of conditions that more closely reflect outdoor climate patterns.

Thermal comfort is manifested in a range of temperature. When occupants do not have an opportunity to adapt by changing their clothes or allowing air movement, the condition that is still considered acceptable may range as narrow as $\pm 2^\circ\text{C}$ from the neutral temperature [21]. The range of acceptable environment can widen if the occupants can control the environment or to adapt themselves.

There are three adjustments or adaptation modes, namely physiological, behavioral and psychological adaptations[35]. Physiological adaptations are all changes in physiological responses or changes of human body when interacting with thermal environment factors including: air and radiant temperature, relative humidity, and air velocity. Physiological adaptation can be divided into genetic adaptation and the acclimatization. Common examples of physiological adaptation are sweating and shivering, useful for maintaining the stable temperature of the human body

Behavioral adaptations can be classified into personal, technological and cultural responses. Several examples of personal adjustments are: changing clothes, activity, eating hot food or moving to other position. Examples of technological adjustments are: opening windows, turning fans on/off, operating HVAC controls; and the cultural adjustments include for example: dress codes, scheduling activities, and siestas.

Psychological adaptations are related to the perception and reaction to thermal conditions based on subjective experience/habituation and expectation. This kind of adaptations might play the most significant role in explaining the differences between observed and predicted thermal responses[36]. Experience and expectation are influenced by a person's currently a long-term experiences with both the indoor and outdoor climate. Subsequently, these experiences and expectations will directly affect personal thermal sensation and cognitive assessments of thermal acceptability

Furthermore, according to Nicol[21], the comfortable temperature is a result of interaction between humans with building or another environment they are occupying. The thermal attitude of individuals depends on three contextual variables, namely: climate (individuals tend to respond differently to a different climate), buildings (individuals tend to respond differently to different buildings), time(individuals tend to respond to their environment differently from time to time). This suggests that people have an innate ability to adapt to a changing environment. Therefore, strategies to reduce energy demand should focus on capitalizing on the individual's innate ability to adapt to a less comfortable environment which is still considered acceptable to well-being.

Humans need environmental conditions that allow them to live and support their activities. They determine their preferred environment and often have the ability and opportunity to control the indoor environment and themselves. Despite this advantage, the require effort for providing comfort for a growing population with increasing expectations has caused degradation to the environment and does not seem to be sustainable given the current technology and resource consumption. Humans realize the impact of a high energy demand to meet a high level of comfort which may not be appropriate anymore. Therefore, individuals should explore their potential ability to adapt to the indoor environment that is less comfortable but could still be accepted for their well-being. The following section explains what we mean by 'acceptable environment'.

3. RESULTS AND DISCUSSION

Acceptable environment

The human requirement of a comfortable environment might need to be amended related to the large amount of energy needed to support the condition. A new definition of environmental-conditions that could help reduce energy consumption and still be acceptable to human, needs to be sought. The previous studies related to human interaction practice with the environment needs to be compiled to find an area of the human potential ability to adapt in various environments.

Kuijjer[12], indicates three major shifts of thermal comfort in Dutch homes. The first is the shift from solid fuel to liquid fuel of heating equipment, the second is from a heated room to whole building of heated rooms, and the third is from insulation by clothes to insulation by building envelope. The second shift directly increases energy requirement if it is not followed by improvement of equipment efficiency. The third shift related to changing the allocation budget from the operational portion (energy to turn on the heating) to the construction portion (energy to build a building). Although the third shift still needs energy for heating, it is reduced to a minimum level. The occupants could reduce the energy demand by lowering the heating standard requirements. The minimum standard will vary from one household to another or one office to another, and the effort to lower the minimum standard heating could be made gradually to avoid occupants' shock and to accommodate gradual occupant's adaptation.

People in the hot climates could also use the strategy to reduce energy by raising the cooling standard requirements. The limit could be started from the government or institutional standard which is mostly higher than the occupant's expectation and gradually increased depending on the household or individual characteristics. For the example, The Indonesian government set the building's thermal comfort standard is 25°C (with relative humidity 60%±10%) although most of the building occupants' expecting the lower indoor temperature. If the building occupants' have become accustomed to the specified temperature then in the future they could gradually raise the standard by themselves according to their will and abilities. This kind of effort should not be a matter of whether occupants can pay the energy bill (ability to pay) but of how much occupants can save and conserve energy for the sustainable future.

In contrast to the Dutch, the Japanese tend to heat only one room or part of a room with a traditional low table (kotatsu), or an electric carpet (yuutampo), that could be considered as personal heating. The personal heating is an instant type of heating, focusing only on the person not the room that will directly affect the use of energy in households. It is an effective device since it directly accommodates the human expectation to avoid the sensation of feeling cold. A modern kotatsu uses electrical power and could be adjusted to meet the personal heating requirements. Although the energy consumed by kotatsu is already lower than heating the entire building or room, setting up the lower heating temperature will reduce energy even more. Apart from heating strategy, the use of kotatsu suggests a cultural idea about comfort and a form of routine social interaction where it often provides a vocal point for family life [18, 37].

Several researchers have developed a bioclimatic chart to illustrate the relationship between comfort and various factors impacting the building design [37-39]. Olgyay's[38] bioclimatic chart specified the human comfort zone in relation to ambient temperature and humidity, wind speed, mean radiant temperature (MRT), solar radiation and evaporative cooling. In this chart, the comfort zone is described as a constant area and was designed for sedentary activity with an indoor clothing level. Givoni's[39]chart or popular as bioclimatic chart could be used to predict indoor building conditions according to current outdoor conditions, based on the relationship between temperature amplitude and vapor pressure of the outdoor air. The charts provide various temperature amplitude and vapor pressure of the ambient air that could be used to identifies the suitable passive strategies cooling technique. Identification of average temperature and humidity condition is crucial point to determine the suitable strategy. Here, the comfort zone is defined as the range of climatic conditions within which the majority of persons would not feel thermal discomfort, either of heat or of cold [40]. Hegger[19]demonstrates that human comfort is a combination between interior air with relative humidity and air velocity. One important point of these charts is that beyond the comfortable area, humans also have an area that they can still accept, even though it is less comfortable.

Acceptable is not uncomfortable, it is only less comfortable. People could still work in a less comfortable environment with or without changing his behavior. Since comfort is a state of mind, working in a less comfortable environment means accepting a new level of comfort which is less energy consuming. Arguably, this level of comfort could be set gradually lower depending on how much energy efficiency we would like to achieve.

Based on Hegger's[19] chart, we propose an acceptable model, shown in Figure 1, which illustrates its position between comfortable and uncomfortable. People should be challenged, encouraged and rewarded to move from a comfortable to an acceptable environment. The acceptable zone provides a larger range than the comfort zone and it could be broadened to accommodate the human ability to adapt to a more challenging environment. This model covers a wide-range of human adaptation to thermal environment such as Humphreys's

research into Pakistani workers that spread from 15.5°C in winter until 30°C in summer or even ranging from 6°C to 31°C based to research by Goldsmith [41] and Nicol et.al[42].

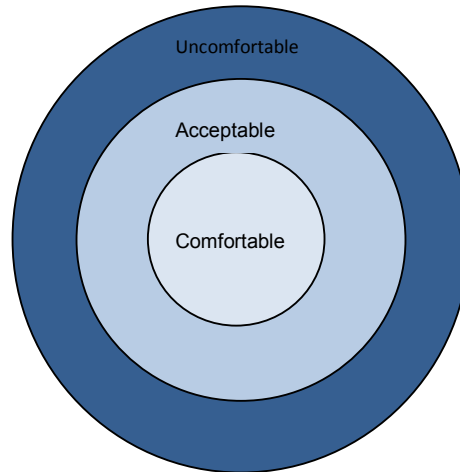


Figure 1. Acceptable models

The next section will describe various possible factors influencing individual potential ability to adopt an acceptable environment. The factors will then be used as guideline for proposing a strategy to encourage individual to move from comfortable to acceptable environment

Factors to change behavior

The first step to move from a comfortable to an acceptable environment is to explore factors that might play a role to encourage humans. Humans tend to interact actively with the environment to optimize their own condition. They do modify their environment and also their attributes (eg. clothes) to achieve heat balance. Researchers pay attention to observe the relation between humans and their environment, including how humans interact; why they interact; when they interact, and why humans want to alleviate discomfort [43]. Apart from the technical aspects human comfort is also a matter of social and collective negotiation, and is better constructed by institutions and embodied in socio-technical systems[18]. What happens among Pakistani workers, is a simple example of how each social community has their own definition about what they thought to be comfortable and since it's a matter of collective negotiation between members of the community it is better to construct (build) the idea of comfort by institution and implemented with their social structure.

Thøgersen and Grønhoj[44]list three contextual conditions that affect the effort to obtain efficiency in electrical usage, which are: physical–structural conditions (e.g., home size, technologies, standards); socio-demographic characteristics (household size and composition); as well as cultural and economic aspects (social norms and economic incentives). Stern and Dietz [45]also highlight the importance of contextual factor such as material costs and rewards and the availability of technology in supporting the human effort to use energy efficiently.

Instead of contextual factors, behavioral change needs encouragements from humans themselves to force them to accomplish the goals (called self-efficacy). The stronger human's self-efficacy, the stronger human's efforts to reach their goals [46]. Self-efficacy is associated with a measure of the belief in one's own ability to complete tasks and reach goals. The level of self-efficacy is related to the level of belief of each people to control their lives; the higher the level of self-efficacy, the more they believe that they can control their lives. Bandura identifies four factors affecting self-efficacy namely experience of mastery (experience to complete quite the same task), modeling (if they can do it then so can I), social persuasion and psychological factors. However, Hawkins[47]argued that self-efficacy is not a cause of behavior except a predictor of behavior. Self-efficacy could be used to predict the fulfillment of behavior that would happen, but the cause of the behavior might be something else.

Furthermore, behavioral change depends on attitudinal factors such as values, beliefs and norms [45]. There are two norms involved, namely personal and social ones. Personal norms are related to individuals' expectations about positive and negative outcomes[49-50]and social norms are related to social expectation [48 and 50]. Social expectations serve as guidance for society how to perceive and 'play' in our social worlds. People have a tendency to adopt social norms and adapt their behavior to meet the norm's expectation. People's behavior in using energy could be gradually modified if the society can promote energy efficient behavior as a norm and support the action.

Personal habits and routines which have been ingrained with human daily life are not easily changed. Changing behavior involves also personal capabilities such as financial resources and specific knowledge and skills [45]. Absence of those personal capabilities could prevent people from changing their behavior. Nordlund and Garvill [51] mentioned that there are many other factors that could be an obstacle for people to change their behavior to a pro-environmental direction, including immediate benefit and uncertain future effect of green act, cost and availability to go green, dependency on the use of energy, psychological barriers, the willingness to act, absence of environmental values, attitudes, or norms. Amongst factors that contribute to behavioral change to reduce over- consumption, Brown and Cameron [52] suggest to concentrate on the individual's decision to find the reason behind it and therefore be able to propose a strategy to meet the goals

Sustainable Lifestyle

Mont [53] defines sustainable lifestyle as patterns of action and consumption, used by people to affiliate and differentiate themselves from others, which: meets basic needs, provides a better quality of life, minimizes the use of natural resources and emissions of waste and pollutants over the lifecycle, and does not jeopardize the needs of future generations. This lifestyle concept based on awareness that environmental degradation happening today is an impact of our previous lifestyle. Our previous lifestyle consumes a lot of energy, emits a lot of waste and pollutants, exploring resources more than human required therefore the environment was suffering and might not be sufficient for future generation to meet their needs. The sustainable lifestyle consists of a set of behaviors in the consumer production life cycle process that need to be implemented in daily activity to pursue a sustainable development.

The Center of Expertise on Influencing Behavior, Department for Environment, Food and Rural Affairs UK, developed the Sustainable Lifestyle Framework which described understanding, approach, principles and action to achieve sustainable behavior. Three major factors identified by DEFRA are environmental changes, situational factors and behavioral factors. Environmental changes are environmental conditions that continuously change and tend to be worst, therefore there is a need for concern and anticipation (climate change, increasing pollution, degradation of natural resources). Situational factors consist of social learning, information, access to capital, institutional frameworks, social networks, infrastructure, culture and geography, whereas behavioral factors consist of beliefs, norms, experience, attitudes, habits, self-efficacy, values, awareness, altruism, perceptions, leadership, knowledge and identity. Defra[54] believed that the approach to influence human behavior should consist of multi-disciplinary approach, provide a range of potential solutions, be focused on individuals, rational, and prefer to use a bottom up process rather than top-down. DEFRA proposed 9 headline behaviors, 30 key behaviors and more than 50 sub behaviors that could be used as guidance to live with a sustainable lifestyle.

In line with this sustainable lifestyle, the effort to encourage people to move from a comfortable to an acceptable environment will reduce energy consumption, minimize emission and pollution, but still cover the human need of environmental conditions and support an effort to provide a better quality of life and a sustainable environment. Furthermore, factors and strategy to move from a comfortable to an acceptable environment will be discussed on the next section.

RESULT

1. Push and Pull Factors

From the description above, we are suggesting two major factors that could be used to encourage people to move from a comfortable to an acceptable environment, namely push and pull factors. The push factor is the factor that is inherent to individuals that could be awakened to encourage them to change their behavior, whereas pull factor is the factor that comes from a human's surroundings that could be used to pull human to change their behavior. Table 1 describes the details of push and pull factors with the references. These factors could be used to prepare an appropriate strategy to meet the goals.

Table 1. Affecting Factors

Factors	Reference
1	Push Factors
1.1	Knowledge & Perception DEFRA, 2011[54]; Osbaldiston& Sheldon 2003[55]; Webb, et.al, 2013[56]; Ekins, 2003[57]; Deci and Ryan, 2000[58]; Moller, Deci and Ryan, 2006[59]
1.2	Self-efficacy & leadership DEFRA, 2011[54]; Deci and Ryan, 2000[58]; Moller, Deci and Ryan, 2006[59]; Bandura 1977[46]
1.3	Beliefs, Norms, Values& Altruism DEFRA, 2011[54]; Stern and Dietz, 1994[45]
1.4	Habits& Attitudes DEFRA, 2011[54]; Osbaldiston& Sheldon 2003[55], Stern and Dietz, 1994[45]
1.5	Experience & Awareness DEFRA, 2011[54]; Bandura 1977[46]
2	Pull Factors
2.1	Environmental conditions& changes DEFRA, 2011[54]; Stern & Gardner 1981[15]
2.2	Institutional instruments & Infrastructures Thøgersen and Grønhoj, 2010[44]
2.3	Industrial availability Thøgersen and Grønhoj, 2010 [44];Rohracher, 2001[60]
2.4	Community support Stern & Dietz, 1994[45]; Dietz, et.al, 1989[61];

2. Strategy to move from the comfortable to the acceptable environment

Strategies are needed to encourage people to move from their comfort zone to an acceptable zone[62]. Using pull and push factors explained above, we could seek appropriate actors that could be involved in order to optimize achieving goals, as shown in Table 2.

Table 2. Factors and Actors

Factors		Actors
1	Push Factors	
1.1	Knowledge & Perception	Individuals with support from the government / institutions, industries, and the community
1.2	Self-efficacy & leadership	
1.3	Beliefs, Norms, Values& Altruism	
1.4	Habits& Attitudes	
1.5	Experience & Awareness	
2	Pull Factors	
2.1	Environmental conditions& changes	Government and formal institution
2.2	Institutional instruments & Infrastructures	
2.3	Industrial availability	Industry
2.4	Community support	Community / NGO

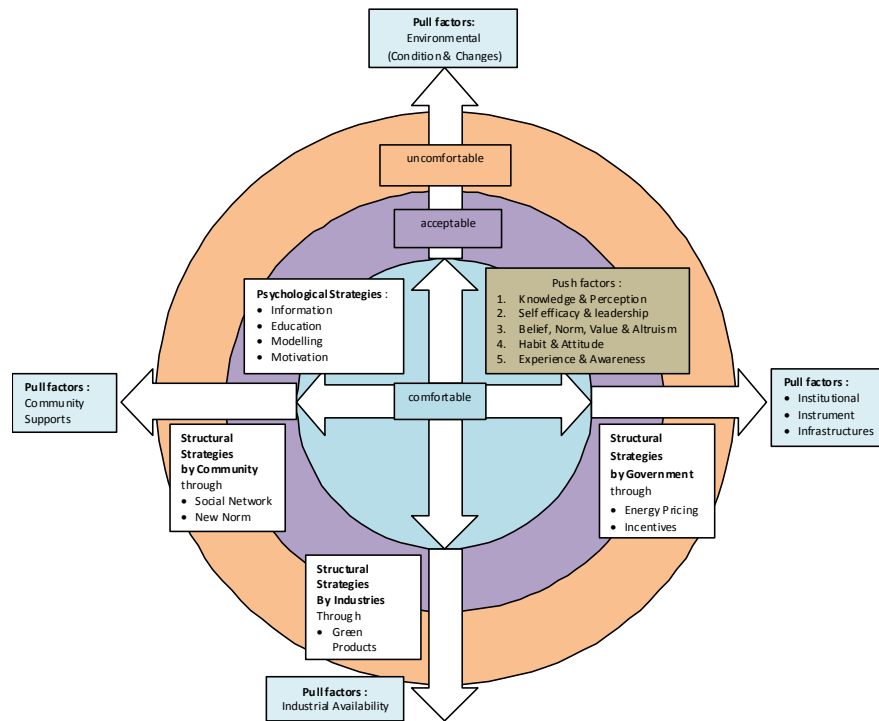


Figure 2. Acceptable Strategies

Furthermore, based on the factors stated before, two kinds of strategies are proposed that are psychological and structural strategy, as shown in Figure 2. Psychological strategies are used as the push factor, which concentrate on the human ability to control one’s behavior, whereas structural strategies are used as pull factors, which concentrate on the surrounding capacity to attract humans to change their behavior. Psychological strategies could be prepared by the human itself by searching what they need or by the community through providing what the human needs. The psychological strategy includes:

1. **Provide information** as a complete as possible to anticipate human’s curiosity about changing their behavior using all media that could be accessed by humans (Webb, et.al [56]; Ekins[57]; Osbaldiston& Sheldon [55], Deci and Ryan [58]; Moller, Deci and Ryan [59])
2. **Provide an Educational** mechanism to attract human to change their behavior (Ekins[57]; Osbaldiston & Sheldon [55])
3. **Accommodate Models** that derived from their community to be seen as an example to be followed (Bandura [46])

4. **Provide Motivation** methods to continuously support behavior change (Stern & Dietz [45]; Dietz, et.al [61])

The main actors are each individual, however the government and industries could involve promoting the idea by providing information and education, and the community could give support with accommodating models and provide motivation sessions to all individuals in the community.

On the other hand structural strategies are used as pull factors to attract individuals to move from a comfortable to an acceptable environment. This strategy could be prepared by the government, industry and community to actively invite individuals to live in more sustainable ways. The structural strategy includes:

1. **Government effort** to attract human moves to acceptable zones by providing such as: regulation (Oseland and Humphreys [63]; Shove [18];), incentives (Ekins[57]) and energy pricing schemes (Perrels, Ostertag& Henderson [64]; Martinsson, Lundqvist & Sundström[65]) that challenge all part of community to engage.
2. **Industries effort** to move from their comfort environment such as by creating innovative products that are environmentally friendly (Rohracher[60]; Stern & Dietz, 1994[45]) and saving even much more energy for humans to sustain or develop energy alternatives that could be used effectively, efficiently, and environmentally friendly
3. **Community efforts** to gradually and continuously support humans to change their recent behavior to pro-environmental behavior such as by strengthening social networks and introducing new norms (Stern & Dietz, 1994[45]; Dietz, et.al, 1989[61])

Beside these two strategies, there is one factor which is the environmental condition that does not need any strategy to be highlighted. The degradation of their environment condition itself should be an adequate reason for individuals to live sustainable, moving from a comfortable to an acceptable environment. The environmental condition could be used for the government, industries and the community as an example to promote an acceptable environment.

Furthermore, certain tools could be used to enforce these efforts, such as tools developed by DEFRA through 6E which are engage, enable, exemplify, encourage, explore, and evaluate. These tools could be used to assist the government, industries and the community to prepare a certain list of action or list of behavior to be changed and to be implemented in community.

4. CONCLUSION

One factor that could help humans to have a sustainable future is human lifestyle. We need to admit that environmental degradation happening today is part of our previous lifestyle and we could change and improve the environment quality by changing our lifestyle. Part of the human lifestyle that needs to be changed is human behavior in an indoor environment expecting comfortable condition that needs a relatively large amount of energy. Since individuals have the potential ability to adapt in various conditions, we suggest individuals to move from the comfortable to the acceptable environment as a step to support a sustainable future and that step is part of a sustainable lifestyle.

We need further research that defines the range of acceptable conditions in various climates, examining impact of an acceptable environment on human health and well-being, exploring the social or theoretical development of acceptable environmental policy, calculating the amount of energy that could be conserved by adopting the acceptable environment and other studies. The studies could be a studies of current condition of acceptable and comfortable environment or studies of future impact of adopting the acceptable environment or studies of the past condition and comparing with current condition. The research frame work is illustrated in figure 3.

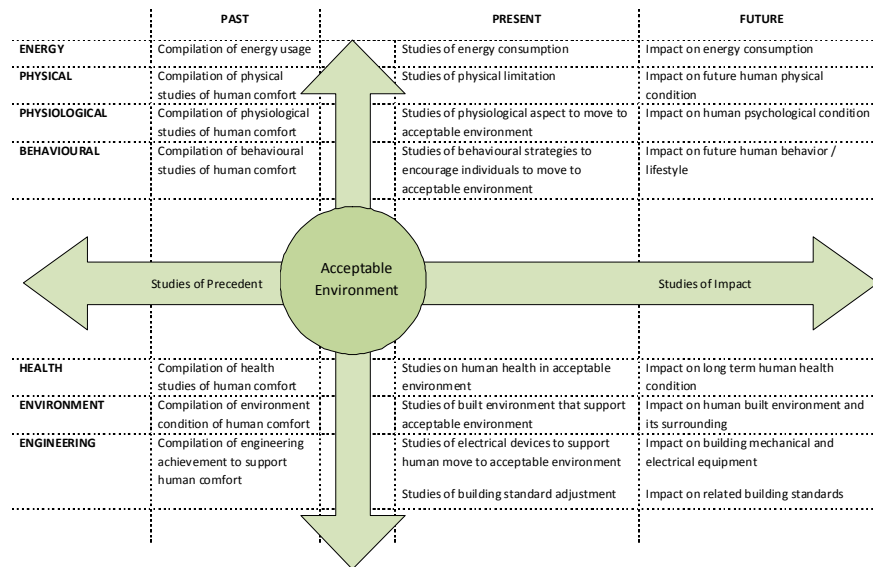


Figure 3. Research Framework

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