Energy Conservation Model for Malaysian Higher Learning Institution

Social Science and Humanities

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ABSTRACT

Energy awareness is the first step to achieve energy sustainability. Without energy awareness, effort to promote energy conservation can be difficult and lead to energy wastage. Public and private universities in Malaysia are confronting with issues of energy wastage due to the lack of awareness among the students and no specific model is available to guide facilities and energy managers to improve the situation. This research was intended to develop a Conceptual Model of Energy Awareness Development Process (CMEADP) as a guide for facilities and energy managers to raise energy awareness and improve energy-use behaviour among students in the universities. In this context, the objectives of this research were to identify elements of energy awareness development process, to develop the CMEADP, to verify the CMEADP, to validate the CMEADP and to establish the effectiveness of the CMEADP in raising energy awareness and improving energy-use behaviour. The scope of this research covers energy experts, departments responsible for energy management in universities and students of Malaysian universities. By adapting the Soft System Methodology (SSM) as a foundation, this research was conducted in six different stages, namely: literature review, elements identification, conceptual model development, verification, validation and experimental study. Eventually, the research produced a CMEADP that consisted of two segments: receiver dominated segment that represents the energy awareness achievement process and transferor dominated segment that represents the energy awareness development process. Each segment comprised a flow of core processes. Then, the core processes of transferor dominated segment were further divided into common practices and activities. The developed model was verified, validated and confirmed by conducting expert interview, feasibility study and control experimental test. Although the CMEADP is designed for Malaysian universities, it could be used in other public and private institution with modification and refinement.

1. INTRODUCTION

In the well known report, *Our Common Future*, the World Commission Environment and Development (1987) defines "sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Extended from that, Goldemberg *et al*. (2000) states "the production and use of energy should not endanger the quality of life of current and future generations and should not exceed the carrying capacity of ecosystem." One of the methods to achieve energy sustainability is through raising energy awareness. "Awareness is the seed for tomorrow's changes (Wong, 1997)". It is the first step in achieving energy efficiency and energy conservation. The latest noteworthy report, *Global Environment Outlook 4: Environment for Development* published by United Nations Environment Programme (2007) states that "it is important to raise awareness in the energy sector." The discussion of this chapter focuses on the related energy issues and reveals the rationales of developing a Conceptual Model of Energy Awareness Development Process (CMEADP).

Energy is significant to the mankind. It is the foundation of civilization; without it, modern life would cease to exist. *Dictionary of Energy* defines 'energy' as "the capacity or ability to do work (Hall and Hinman, 1983)." Energy exists in various forms, including mechanical, thermal, chemical, electrical, radiant and atomic. The modern energy refers to electricity and liquid fuels.

Energy is a finite resource and is bound to deplete eventually. Nevertheless, energy is wasted due to lack of appreciation among societies. The cause can be related back to the past when energy source is inexpensive and convenient. During that time, most people believed resources are plentiful. Soon, society developed a habit of using large amounts of cheap and plentiful petroleum for granted which lasted until the energy crisis in 1973 and 1978.

Two energy crises occurred in the past. The first crisis in 1973 was during the Arab-Israel War; when Arab oil-production countries cut back oil production and embargoed oil shipment to United States and Netherlands. The second energy crisis followed in the wake of the Iranian Revolution in 1978 when Iranian oil production and exports dropped precipitously. Such energy crisis brings immediate global economic impacts. In the United States, New York Stock Exchanges share lost $97 billion in value in six weeks. Schools and offices in the West were closed down to save on heating oil while factories cut production and laid off workers. For non-communist industrial world, there was a sudden inflation and economic recession. Although the unexpected oil crisis in the 70's reminded people about the constancy supply of energy resources. The effect, however was not sustained and for those countries gifted with substantial energy resources, the crisis seemed insignificant. After two decades of the crisis, the world seemed to forget about the event and once again consumed great amount of energy.

The total energy consumption in the developing world is still growing. With rapid development in China and India, the energy consumption also increases in at a fast rate. "In the *International Energy Outlook 2007*, Energy Information Administration (2007) projects that the total world consumption of marketed energy is increase by 57 percent from 2004 to 2030." The possibility of an increase of energy consumption rate will reduce the non renewable energy resources. Figure 1 illustrates the World Marketed Energy Usage by Fuel Type from 1990 to 2030. Based on the Figure, projected oil consumption in the year 2030 still represents 34% of the world energy consumption while the renewable energy only represents 5.7%.

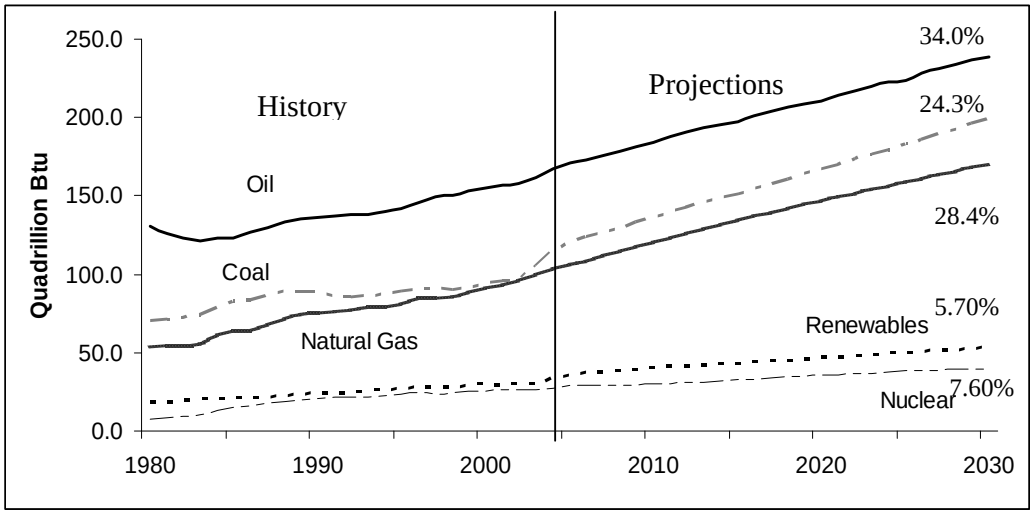

Figure 1 World Marketed Energy Use by Fuel Type, 1990-2030
Source: Energy Information Administration (2007)

Although there is an increase of renewable energy sources, the fact is that the petroleum and natural gas are still dominate the global energy market. Since energy is finite resources, the energy resources will deplete sooner or later. Recently, various energy issues

had raise as global concerns. Indeed, the world is racing to find energy solution as worry about sky high energy price, environment disturbance and sustainable of the energy supply.

Campbell and Laherrère (1998) estimate that "oil decline will begin before 2010." However, international oil price had already reached new historic peak US$80 (RM280) a barrel level in April, 2006 (Star, September 14, 2007, p. N12). "The main reason for these increases was the existence of a tight market caused by the small margin between production (83.0 million barrels per day (bpd)) and demand (82.5 million bpd); high demand for oil by China, India and the United States; uncertainty of supply in some OPEC (Organization of Petroleum Exporting Countries) countries; adverse weather condition such as Hurricane Emily in Mexico, affecting oil production and speculation on oil prices (Economic Planning Unit Prime Minister's Department, 2005)." A continuous trend of such high energy price will have negative effects on global economy and society; this includes recession, inflation and higher unemployment. The sky high oil price also affected Malaysia when the price of petrol and diesel sought a new hike on February 28, 2006. The decision to increase the price of fuel was to overcome the impacts of rising international crude oil prices and to curb the increase in subsidies paid by the government. At present, the new rate for unleaded petrol is RM1.92 per litre, while leaded petrol is sold for RM1.88 per litre. The price of diesel is RM1.58 per litre and Liquefied Petroleum Gas (LPG) costs RM1.75 per kilo. This is the highest-ever-single hike in the price of fuel – 30 sen per litre. "The last increased was on July 31, 2005, when the government increased the price of petrol by 10 sen (New Straits Times, February 28, 2006, p. 1)." "On June 1, 2006, the electricity tariff in the peninsula rose by an average of 12% (Star, May 25, 2006, p. B1) as the cost of generating electricity has increased." Malaysians, already grappling with the impact of expensive fuel prices need to bear with higher electricity rates.

Improper and unfriendly use of energy will raise environmental issues. One of the critical issues is greenhouse effect or well-known as global warming. "Presently, the amount of greenhouse gases such as carbon dioxide in the atmosphere is fast increasing and most of it comes from burning fuels for energy (Adams, 2006)." Human activities have overloaded the atmosphere with carbon dioxide (CO_2) and this has significant climatic consequences. "The authoritative Intergovernmental Panel on Climate Change predicts temperatures will rise 4 degrees Celsius or more by the end of the century (Underhill, 2007)." This has significantly affected the ecology and ecosystems. Although global warming is now a reality, the public is still not aware of how their daily task will affect the climate changes. In reality, inefficient use of electricity will affect the global climate. This is because massive amount of greenhouse gas will be released to the atmosphere during the power generation process. Another energy-environmental issue is the pollution resulting from improper use of energy harvesting technology. In certain cases, technology itself that is used to harvest energy resources will produce environmental disturbance and social repercussion.

Energy sustainability is another critical issue. The world nowadays feed a daily oil habit of nearly 80 million barrels. "In 20 years, the energy demand is expected to rise worldwide about 50 per cent, with growth in developing nations hitting 90 per cent (Schafer, 2006)." The rise of China and India also boosts up the energy demand. "By 2025 China could be using ten million barrels a day, most of which will come from outside its own borders (Appenzeller, 2004)." Sustainable supplement of energy in the coming future will remains as a great challenge. Estimation shows that as Malaysia moves towards 2020, the total energy requirement is expected to increase to about 75,000 ktoe yearly. The capacity required to provide the electrical energy is expected to be close to 40,000 MW. This will require massive budget to build the additional generation infrastructure and would become a great burden to the nation. On the other hands, Malaysia is still heavily dependent on crude oil as the primary energy supply and fossil fuels are still the primary fuels for generating

electricity. Figure 2 shows 47 percent of the total energy supply in Malaysia is from cruel oil and 41 percent from natural gas; the other sources of energy supply are still too little.

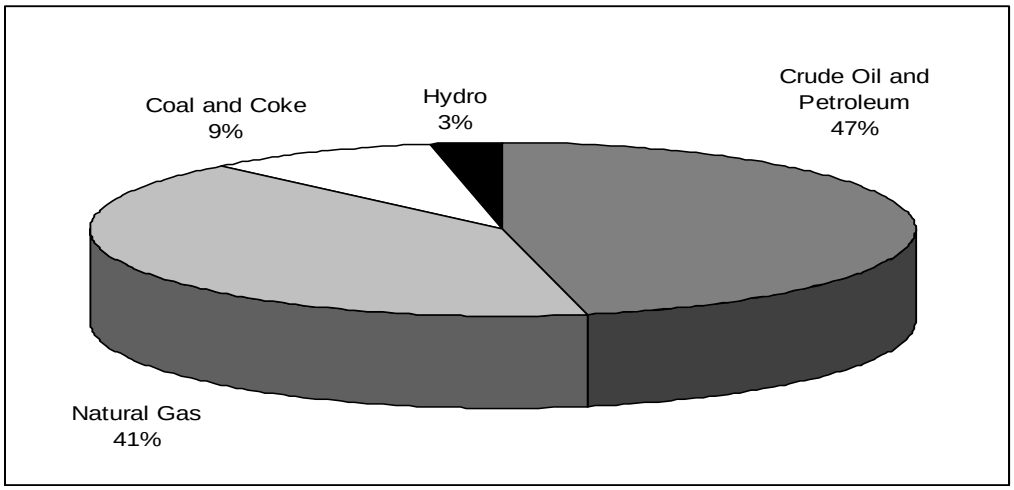

Figure 2 Primary Commercial Energy Supply by Source for the Year 2005
Sources: Government of Malaysia (2006a)

Even though Malaysia is blessed with oil and gas deposits, these could quickly become a net importer of oil, if the society is continuously not aware and lacks of concern for it. Furthermore, the country is overly dependent on oil as primary energy resources. With a heavy industrialisation programme, Malaysia is relying on the use of its energy resources. "Malaysia therefore gives high priority in ensuring the security and sustainability of energy supply (Norhayati Kamaruddin and Yuzlina Mohd. Yusop, 2000)." "With current production at 650,000 barrels per day, Malaysia is expected to become a net importer of oil by the year 2010 (New Straits Times, April 21, 2006, p. 4; Roy, 2001)." Sooner or later, the country has to deal with oil shortage problems.

World Energy Council (1993) declaimed that "Malaysia is identified as the rapidly industrialising countries. Among the more obvious examples are Brazil, Thailand, and Mexico. These countries are gifted with substantial natural resources, however, the rate of their depletion is very high, and often the manners of their exploitation have aroused widespread concerns. The needs for these countries to manage their industrialisation process better more mature economies, to protect their natural resource base while combating poverty and environmental degradation are particularly pressing."

Having realized that energy plays an important role for sustainable development, Malaysia's government had suggested and proposed new orientations. However, in the early stage, solution taken by the government is more on supply sides concern. Roy (2001) say "the primary focus of energy planning in the country under the National Energy Policy (NEP) was on fulfilling the policy's supply objective, aimed at ensuring adequate, cheap and secure supply energy based on the development of indigenous energy resources." These also can be traced from the Seventh Malaysia Plan, session 12.02 (Government of Malaysia, 1996), "…the focus will be to expand and upgrade the transmission and distribution infrastructure…" In this case, the country is emulating the supply based policy like those of the resources-scarce economies such as Hong Kong, Korea, Singapore and Taiwan. At any rate, such supply based policy only acts as short-term solution as the public will not appreciate the continuous supplement and subsidies, worst still, they will continuously consume and waste. "The continued emphasis on supply based energy development trend poses several challenges, which Malaysia will have to deal with in the medium to long-term (Roy, 2001)."

For the Eight Malaysia Plan period, the Government of Malaysia strengthened the use of renewable energy. As noted in the Eight Malaysia Plan, session 11.02 (Government of Malaysia, 2001), "…encourage greater utilization of gas and renewable energy as well as provide adequate electricity generating capacity…" Overall, the strategy is more on technology fixed and overlooks the human aspects. "These include encouraging the use of palm oil as bio fuel, the use of renewable energy, the use of alternative sources of energy such as solar energy and biomass, and increasing the use of natural gas vehicle in the transportation system (New Straits Times, October 19, 2004, p.1.)." All of these require high budgets to install and maintain. Also, part of them will cause technology pollution problems. An example of technology pollution donor is the hydro electric dams. Roy (2001) mentioned "a major contributor to the problems associated with technological pollution in Malaysia is the construction of hydroelectric dam." Most of the time, we do not need technology fixed as a solution. "Independent studies conducted by several non-government groups in the countries pointed out that the supply gap, which the Bakun Dam Project is expected to fill, can easily be done at a much lower cost as aggressively pursuing energy efficiency (Muniandy, 1996)." In fact, using the technology fixed only serve as temporary solution. Kempton and Schipper (1994) say "as we develop physical technologies to improve energy efficiencies, we only migrate the effects of energy use by human, not curing the energy problem we are experiencing." Most of the time, using the technology approach may seem impressive and attractive. However, it is not the unique answer to achieve a sustainable future. Certainly, the best way to meet the rising demand for energy is not to supply more or solely depend on the technology fixed. The cheapest, fastest and cleanest energy by far is through energy conservation.

In the coming future, the economic, social and technology impacts of the energy problem will continue to remain as the focal point of debate and controversy. As the energy problems become a global issue, one important step, perhaps the most immediate and potentially of greatest significance, is through energy conservation. According to Yukata Mizuta (2003), "energy conservation may not only bring reductions in carbon dioxide (CO2) emission, but also may lead to savings in expenditure on energy, thus it should therefore be one of the first problems to be tackled." "Energy conservation, according to Schumacher (1985), is not only one of the most necessary but also one of the least expensive energy options, indigenous, clean and a supply source in its own right, while reducing energy inputs." "Due to the limited reserves in Malaysia, there is a need to conserve for as long as possible, said RAM Consultancy Sdn Bhd chief economist Dr Yeah Kim Leng (New Straits Times, April 21, 2006, p.4.)." In fact, the government encourages consumers to embrace energy saving activities. As expressed by Energy, Water and Communications Minister Datuk Seri Dr Lim Keng Yaik as he expressed that "…consumers should conserve energy instead of using electricity as if there is no tomorrow (Star, May 25, 2006, p. B1.)..." On the other hand, "energy efficiency as according to Sapar and Siew (2005), can lead to lower running costs; amounting to relatively large savings over the life of the building; reduced emissions and less use of natural resources. Improving energy efficiency can also lead to better buildings with greater comfort; a better working environment, more satisfied occupants and improved productivity as spin-off benefits."

"Energy conservation as defined in the *Dictionary of Energy*, is any deliberate action taken to reduce energy consumption such as avoiding use, finding alternative uses which require less energy, reducing dependence on the more costly less available sources, developing and utilizing more efficient energy using devices and processes (Hall and Hinman, 1983)." Benefits of practicing energy conservation come in many way; these include environmental benefits, economical benefits and social benefits. From the perspective of

environmental benefits, better energy efficiency will decelerate the overall emissions of greenhouse gas, prevent climate change and assure a better environment. From the economy aspect, energy conservation reduces energy bill, lessen the burden of company paying unnecessary energy cost and delays the country's movement to energy imported status. Social benefits include sustainable society development, resolvable energy conflict between countries and decreased nuclear proliferation and nuclear power plant. Having realised the significance of energy conservation and energy efficiency, it is important to know the related methods to achieve it.

"According to Wong (1997), there are two energy conservation methods - technology fixed and operational changes." Technological fixed are instrument based such as using motion sensor control lighting and air seal. On the other hand, the operational changes are behavioural approach which requires the changes of human behaviour by using motivation, awareness and skill development. These two methods are dissimilar and need different paths to be achieved. "Mohon *et al.* (1983) argued that energy saving activities can be divided into two types: technology and management." See Figure 3.

Technology fixed is an instrument based approach by using tools to conserve energy. Typically, the technology fixed refers to applying technology instruments and large-scale investment. These include introducing a new process, changing to automation system, or installing large energy-saving devices such as heat recovery system, new building design, inverter, pre heater, motion sensor, building envelope system and others. In the technology fixed, the payback is a significant issue. The 'return of investment' must be decided first before applying any technology implementation. It is effective in conserving energy and the results that can be observed within a short period. However, the initial cost for technology fixed is high and not suitable for the organization that has only limited budget. Also, the method appears only as a temporary solution. Since technology fixed requires no behaviour changes of the users, it means the user could still waste energy in the same way. Therefore, technology fixed is only suitable as a short term energy conservation method. For benefits in the long term, human aspects of energy conservation should be taken into consideration.

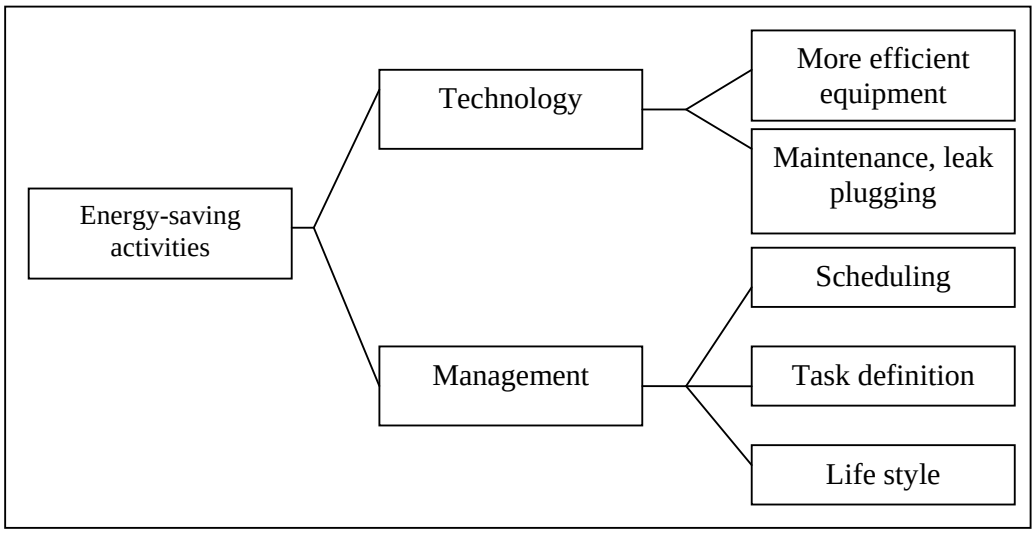

Figure 3 Types of energy-saving activities
Source: Mohon *et al.*(1983)

"Regardless of the method selected for achieving energy savings, either complete system replacement or modification of an existing system, it is important to consider the human aspect of energy conservation (Shinskey, 1982)." Compared with the technology

approach, sometimes, the behavioural approach can be effective and make a significant difference. According to Wedge (2003), "the outcome of behavioural approach is very effective and helpful in energy conservation." "Experiments have shown that 5 to 10% of the domestic energy use can be saved by correct domestic behaviour (Loozen and Moosdijk, 2001)." "In fact, behavioural approach is vital in any energy conservation programme and is regarded as one of the key success factors in energy management (Dahle and Neumayer, 2001; Loozen and Moosdijk, 2001)."

Facilities managers should realize that the behavioural approach is useful to manage energy. Nowadays, the responsibility of facilities managers is not only limited to managing buildings, but it also includes management of energy and people. Energy management is gaining in importance, although it is neither a new term nor a new idea. "After the initial, obvious conservation steps taken by many business – switching off lights, removing lamps from fixtures, reducing night time illumination of facade, signs and advertising – the concept of energy management offers a practical approach to an on going problem of the effective and efficient use of energy resources (Harrold, 1993)." In energy management, behavioural approach is an alternative method to conserve energy. Energy conservation affects employees and alternatively, the employees affect the energy conservation. Gordon (1980) says "it may add to their workloads, require their cooperation, and affect their general comfort or even their pay packets." "Sheila Sheridan, chairman of the International Facility Management Association (IFMA) during an interview with Druckman (2004) had given her opinion that facilities management professional have growing shared responsibilities with human resources." Besides focusing on technology fixed, it is important to take account of human behaviour factors in energy conservation. As stated by Energy Efficiency Office (1993) that "being successful in saving energy is thus a question of motivating people to behave differently."

Owens (1987) in the paper "*The Urban Future: Does Energy Really Matter?"* noted that "we must remember it is people who use energy indeed." Therefore, "it is important to consider the human aspect of energy conservation (Shinskey, 1982)." To encourage and change people's behaviour to conserve energy is thus a question of behavioural approach. By monitoring people's behaviour, there is a great chance to improve energy efficiency. "Hansen (2002) mention that people is the main factor in energy efficiency, that 80 percent of the savings in an effective energy management program could be attributed to them." Furthermore, survey of the successful school energy-conservation programs in Tuscon carried out by Gaballa (1996) revealed that "one of the successful criteria to generate saving is to focus primarily on behavioural changes." "However, facilities managers and plant operators tend to be sceptical of behavioural approaches, and yet have little understanding of them and their potential (Geller *et al*., 1982)." For that reason, the facilities manager has a tendency not to pay attention to the benefits of operational changes.

"In behavioural approach, there are tremendous opportunities to save energy by engaging with issues such as attitudes, knowledge, awareness and skills (Vesma, 2002)." However, the initial step for behavioural changes is raising awareness. "Wong (1997) asserts that awareness is the seed for tomorrow's changes." Without awareness, there will be no further action to conserve energy. "Dahle and Neumayer (2001) conclude that behavioural change, and thereby a change in culture, cannot be expected to take place unless people aware to do so." This indicate people will not take any steps to conserve energy if they do not aware the importance of energy saving. For instance, top management would not support any energy conservation programme because they did not realize enormous use of energy is a waste; the staff would not carryout any energy conservation efforts because they did not take it as a responsibility. In the past practice, 'awareness' has been utilized as the method to

conserve energy. "For instance, the Imperial College of Science, Technology and Medicine in London, has defined objectives to focus on raising staff and student awareness of energy conservation issues as one of the strategy to help protect the environment through more efficient energy use and to save money on fuel bills (Pancucci, 1998)."

Literature search revealed that 'lack of awareness' is the main reason of energy inefficiency. Yik and Lee (2002) once stated that "one of the key barriers to improving energy efficiency of buildings is lack of knowledge and motivation of the operation and maintenance (O&M) staff." Yik *et al.* (2002) also pointed out that "the key barriers to energy efficiency improvement in existing buildings are the knowledge." According to Pearce and Miller (2006) that "an entire class of enviro-economic opportunities are created by sub-optimal behaviour of building occupants (e.g. contamination of recycling containers, leaving lights and computers powered on in unoccupied rooms). This, in part, can be ascribing to general ignorance. " Figure 4 indicates the outcomes from a research carried out by Dahle and Neumayer (2001), which identified factors that are considered to be of greatest importance in preventing a greening process from occurring at six institutions of higher education in London, United Kingdom. The outcome of this research indicates that the 'awareness' is the second barrier to the greening process in the higher education institutions.

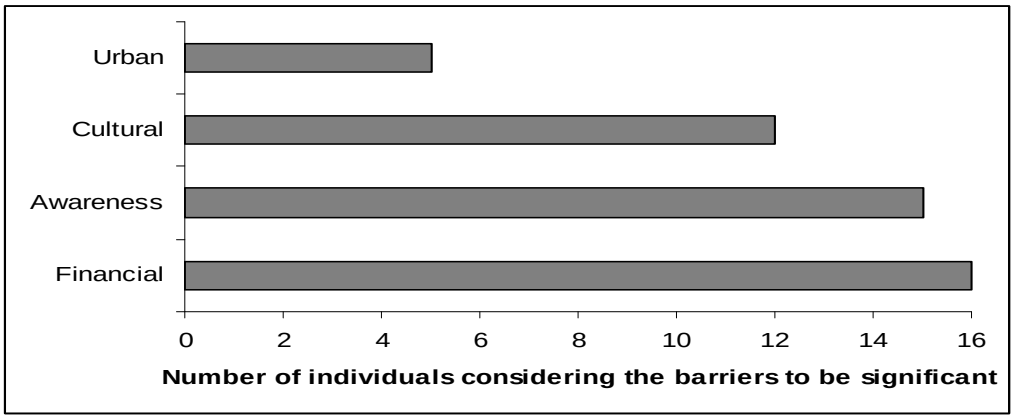

Figure 4 Main barriers to greening and with energy and solid waste management
Sources: Dahle and Neumayer (2001)

Williams (1993) states that "one of the most successful means of motivating employees is through awareness." Furthermore, Camp (2005) states that "staff 'awareness' plays a crucial role in reducing utility bill and making those who use the energy responsible for paying the bill can have a big impact." According to him, raising awareness is a large part of the solution. In Malaysia, Mohamed El Halimi *et al.*(2000) state that "the first step in the promotion of energy efficiency and renewable energy is information and education concerning energy environmental issue and this could be done through 'awareness' campaigns." Creating energy awareness is correlated with the energy strategy of Ninth Malaysia Plan. According to the speech given by the Prime Minister on 31 March 2006, (Government of Malaysia, 2006b) that "…The public has to realise the value and scarcity of such resources, an energy conservation culture must be inculcated…Such resources need to be prudently and carefully utilised…" The speech revealed that there is a need to create awareness among society so they will realise the value and scarcity of energy resources and eventually, develop energy conservation behaviour.

Overall, awareness is the first step beyond other energy conservation strategies. In Malaysia, the place that is in urgent need of energy awareness, perhaps, is the local university. Simpson (1994) has mentioned that "campus energy awareness is an essential ingredient, no

campus energy conservation program will last long if the campus community becomes complacent and takes campus energy use for granted." As the highest learning institution in this country they must be at the forefront to achieve energy efficiency and energy sustainability. There are several reasons to explain why raising energy awareness and improving energy-use behaviour in local university are essential. First of all, universities have large number of building users compared with other industries; therefore, human factors is one of the notable aspect. By raising student energy awareness, it will help them be more conscientious about wasting energy in their lifetime and perform better in saving energy at home and at work. Indeed, energy awareness developed in this stage can provide long term benefits as the students will carry the energy awareness to others such as family, friends and even in the workplace right after their graduation. Also, an excited and involved student will motivate and serve as a role model for other students and family members. Besides that, universities have a large number of facilities ranging from classroom, hall, office, restaurant, sport, library, lab, shop, hostel and other similar facilities. Most of the energy systems embedded in these facilities such as lighting and air conditioning system are still manually operated; thus to recommend ways for students to use it effectively is imperative. Also, since a university is an education centre, education training can be easily implemented. Behavioural improvement is much more possible for the students compared to those already working. In addition, creating energy awareness can yield monetary saving. "The typical energy bill in the education sector is approximately 5 percent of the total expenditure (Keeffe and Grimshaw, 1994)." "There is a possibility of saving 5 to 10% of the energy expenditure through improved energy-use behaviour (Loozen and Moosdijk, 2001)." This can be a substantial amount for the university as it is not a single sum, but annual expenditure. Also, energy saving and being green will enhance the public image of the university.

In the early of the research, a preliminary study had been done to highlights the rationales of modelling a Conceptual Model of Energy Awareness Development Process (CMEADP) to raise energy awareness and improve energy-use behaviour in Malaysia's universities. For this purpose, the researcher conducted an initial study which involved a questionnaire survey and an informal interview. The questionnaire survey covers students from three local universities; namely, Universiti Teknologi Malaysia (UTM), International Islamic University Malaysia (IIUM) and Universiti Sains Malaysia (USM). The informal interview involves energy managers from UTM and IIUM. Interpretation of the preliminary survey indicates that the universities students had low level of energy awareness and were engaged in inappropriate energy-use habit. These were confirmed by the energy managers. Both energy managers from UTM and IIUM had expressed their concern that the university need a guideline to raise energy awareness and improve energy-use behaviour as at this moment, there was no procedure or strategy to be referred.

Raising energy awareness is significant in the local universities, nevertheless, without the guideline of how to create energy awareness and improve user's energy-use behaviour, no changes can be expected. Simply teaching or giving the information regarding energy conservation is not enough. "This had been agreed by Pike *et al.* (2003) that many educators and environmentalists emphasize that a university must act more responsibly before its faculty can teach an ethic of responsibility." Nonetheless, only limited researches on energy awareness development process had been conducted and no conservation model is available. Comprehensive steps to achieve energy awareness are still unknown in the academic field. Stebbins (1986) notes "that in all other areas, changing people's attitudes is more difficult than employing new technology." It is because the solution may work under one set of circumstances and not under others. In this case, there is a need to develop a conceptual model which will serve as the guidelines to raise energy awareness and improve energy-use behaviour among the students.

Several research questions were taken into consideration in developing the Conceptual Model of Energy Awareness Development Process (CMEADP). The first research question is relates to what are the elements of energy awareness development process while the second question is regarding how to conceptually model the energy awareness development process since there is no current available model. After the conceptual model had been developed, two more questions arose: the issue of verification and validation of the CMEADP. Finally, in order to determine effectiveness of the CMEADP led to another question: how to study the effectiveness of the CMEADP.

In recognition of the above research questions, this research focuses on the following objectives:

1. To identify elements of the energy awareness development process.
2. To develop a Conceptual Model of Energy Awareness Development Process (CMEADP).
3. To verify the Conceptual Model of Energy Awareness Development Process (CMEADP).
4. To validate the Conceptual Model of Energy Awareness Development Process (CMEADP).
5. To establish the effectiveness of the Conceptual Model of Energy Awareness Development Process (CMEADP) in raising energy awareness and improving energy-use behaviour.

2. RESEARCH METHODOLOGY

To accomplish the research objectives, the research divides into six stages as follows:

(I) Literature review
(II) Identification of the elements of energy awareness development process
(III) Developing the Conceptual Model of Energy Awareness Development Process (CMEADP)
(IV) Verification of the Conceptual Model of Energy Awareness Development Process (CMEADP)
(V) Validation of the Conceptual Model of Energy Awareness Development Process (CMEADP)
(VI) Experimental Study of the Conceptual Model of Energy Awareness Development Process (CMEADP)

Figure 5 illustrates the overview of the research methodology. Then, the six stages are briefly explained.

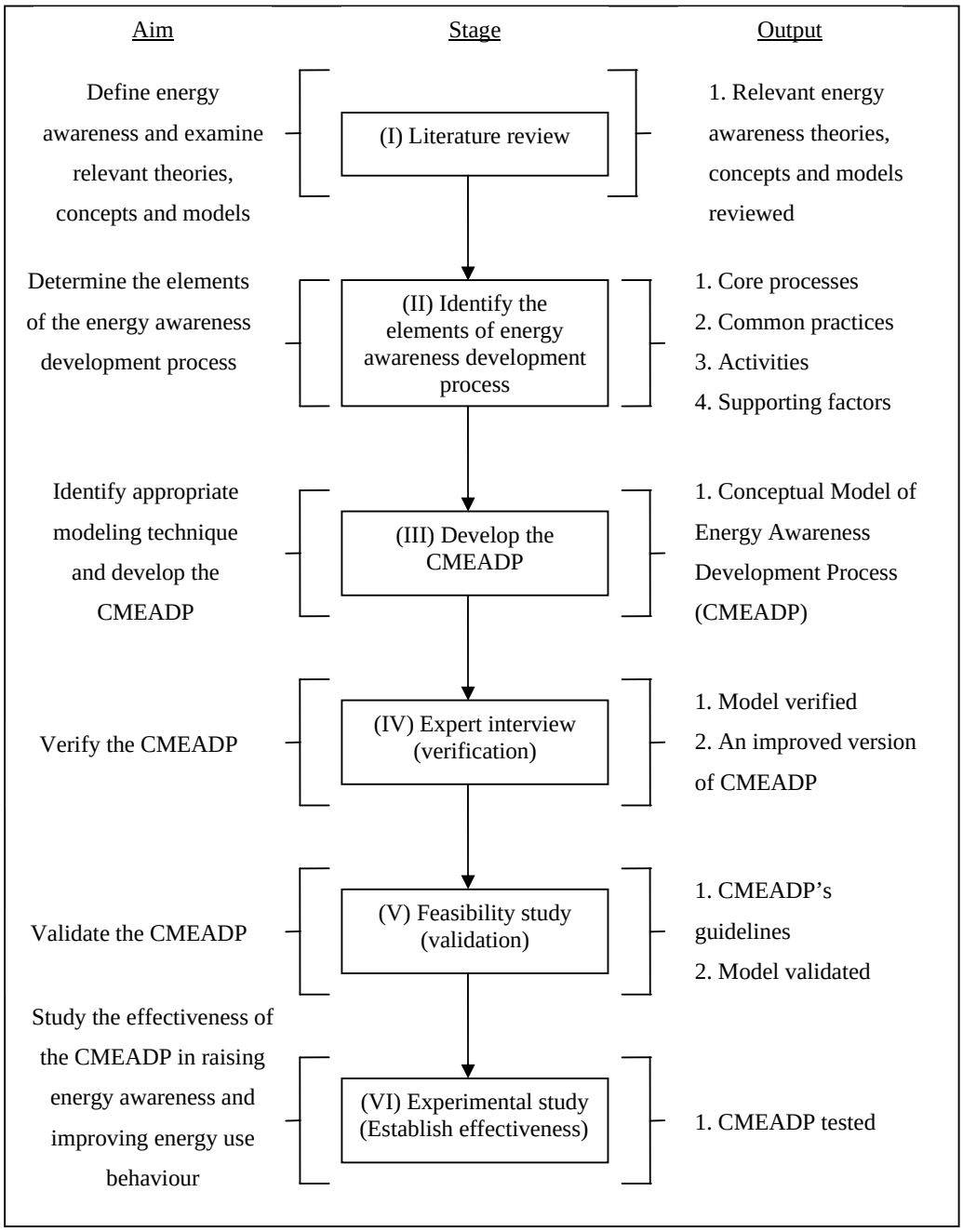

Figure 5 Summary of research methodology

Literature Review

A comprehensive literature review is done to examine the overall definition of energy awareness and discuss the energy awareness achieving process through two dimensions, viz. biological base and psychological base. Relevant theories, concepts and models of energy awareness development process, such as Learning Theory, Perception Process, Information-Processing Theory, Three-Term Contingency Theory (A-B-C) model and the Yale model of Persuasive Communication were reviewed.

Identification of the Elements of Energy Awareness Development Process

In Stage II, the researcher identified elements of the CMEADP through primary sources, which include existing researches, journals, reports, books, articles and thesis. The comprehensive literature search examine and confirm elements of energy awareness development process and included core processes, common practices, activities and supporting factors.

Developing the Conceptual Model of Energy Awareness Development Process (CMEADP)

Having identified the elements, the conceptual model is developed based on the most appropriate modelling technique. In this context, the Process Flow Chart (PFC) is employed. It is achieved based on the model selection framework proposed by Luo and Tung (1999). Then, the research incorporates the steps suggested by Galloway (1994) to construct the CMEADP. The key outcome at this stage was the CMEADP.

Verification of the Conceptual Model of Energy Awareness Development Process (CMEADP)

Having developed the CMEADP, the conceptual model was verified through interview with experts. Earlier in the investigation, a comprehensive questionnaire is developed and administered amongst ten energy experts from Malaysia Energy Centre (PTM), Centre for Education and Renewable Energy and Energy Efficiency (CETREE), Energy Commission and the National Energy Convention 2006. Based on their comments and opinions, the CMEADP was revised. The key outcome at this investigation stage was an improved version of the CMEADP.

Validation of the Conceptual Model of Energy Awareness Development Process (CMEADP)

The CMEADP is validated by conducting a feasibility study. Along with this purpose, a feasibility survey form and CMEADP implementation guideline are developed and submitted to the responsible energy management department of the universities that participate in the study. Consequently, respondents' assessment are collectively analysed to validate the feasibility of the conceptual model.

Experimental Study of the Conceptual Model of Energy Awareness Development Process (CMEADP)

Finally, an experiment is carried out to establish the effectiveness of CMEADP in raising energy awareness and improving energy-use behaviour. The experiment involves a control group and three experimental groups. Each group receive different level of treatments from the CMEADP. In the early stage of the experiment, various energy wastage scenarios in a room were set up and all the groups are invited to attend. The participants are requested to complete three energy awareness assessments (pre-treatment, post-treatment and follow-up). Unknown to them, their behaviour are observed throughout the assessment. Eventually,

results are compared to indicate the effectiveness of the CMEADP in raising energy awareness and improving energy-use behaviour.

3. LITERATURE REVIEW

The *Microsoft Encarta Dictionary* (2005) defines 'Awareness' "as (1) *knowing something*: having knowledge of something because you have observed it or somebody has told you about it; (2) *noticing or realizing something*: mindful that something exists because you notice it or realize that it is happening; (3) *knowledgeable*: well-informed about what is going on in the world or about the latest developments in a particular sphere of activities." The *Dictionary of Psychology* defines 'Awareness' as "(1) consciousness; alertness; (2) Cognizance of something; a state of knowledge or understanding of environmental or internal events (Chaplin, 1975)." According to *A Student's Dictionary of Psychology*, 'Awareness' is "a subjective state of being alert of conscious; cognisant of information received from the immediate environment (Hayes and Stratton, 2003)."

In the context of this research, the term, 'Awareness' is defined as having knowledge or realizing something. The route, procedure or method to attain, achieve or gain realization about something is called awareness achieving process. Then, 'Raising Awareness' can be understood as creating or improving the knowledge, making the target realize, understanding and alerting about the problems which generate positive attitudes and beliefs towards the issue.

One must understand that the ultimate purpose of raising awareness is to improve energy-use pattern. In this case, behavioural improvement is needed. The linkage between awareness and behaviours is complex and interrelated, in fact, there is a gap between having awareness and improving energy-use behaviour.

Although energy awareness development may appear typical or ordinary to many people, it did not have direct related empirical studies. In fact, most of them are not well documented and embedded in other disciplines. Realized that energy awareness development is a multidisciplinary task, researcher must considers and weights all the possible elements from various disciplines. The coming sections explained the biological aspects and psychology aspects of energy awareness development process that include the five most relevant theories and models: Learning Theory, Perception Process, Information-Processing Theory, Three-Term Contingency Theory and the Yale model of Persuasive Communication. Such fundamental is important and must be well discussed as the energy awareness development process is complicated and difficult for any layman to understand.

At present, only limited research has been conducted and no energy conservation behaviour theoretical model is available. Most of the available theories and models attempted to reveal the process of how human interpret information and behave rather than what should be done to change their behaviour. One example is the learning theory which focused on how people learn rather than how to trigger and create the learning needs, see Weiss (1968); Wexley and Latham (1991) and Barker (1997). The perception theory on the other hand, explained on how people receive and select information through the senses instead of how to prepare interesting materials to grab receiver's attention, see Devito (2000) and Adler and Rodman (1991). Although the Information Processing Theory and Three Term Condition Theory are able to provide more detail processes on how people interpret information and use them to decide how to perform, there are no related activities or tasks associated with the

proposed processes, see Bourne and Bruce (1976); Schmidt (1991); Maag (2004) and Kahn, (1999). The Persuasive Communication Model is much relevant to this research, see McGuire (1968); Eagly and Chaiken (1993) and Banyard (1999). However, current model only shows the key process and do not further explain the detail activities associated with each of them.

In overview, most of the theories and models merely explained the process regarding 'how respondent change their attitude and eventually change their behaviour". None of them examine the processes or procedures of "how to change respondent's attitude and behaviour". In other words, the models and theories reviewed only focussed on respondent's 'reaction' instead of paying attention to the administrator's 'action'.

Since there are variations in the 'function' of the existing models and theories compared to the current research objectives. It is therefore not appropriate to adopt such theories and models directly. On the other hand, they served as the fundamental factors to develop the CMEADP. Eventually, the proposed conceptual model developed at the end of this research is a dual process model that incorporates the role of 'administrator' and information-processing sequence of 'receiver' instead of a single process model as proposed by the others. One must understand that the energy awareness development process is multidisciplinary and indeed, complex. The task of raising energy awareness and eventually improving someone's behaviour, comprises a variety of highly interconnected subtasks. It embraces various disciplinary, including sensory, perception and cognitive psychology, effective training, behavioural management, effective persuasive communication, facilities management, energy management, environmental and behaviour and information processing theory. The diversity of the variables involved provides the researcher with a difficult task when attempting to conceptualize the model. Indeed, this appears to be the major challenge in the thesis. Hence, it is difficult and unwise to draw a sharp line separating one field of inquiry from another.

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4. FINDINGS

Realizing that absence of the energy awareness development model, a Conceptual Model of Energy Awareness Development Process (CMEADP) that incorporates the role of 'transferor' and information-processing sequence of 'receiver' have been developed. See Figure 6:

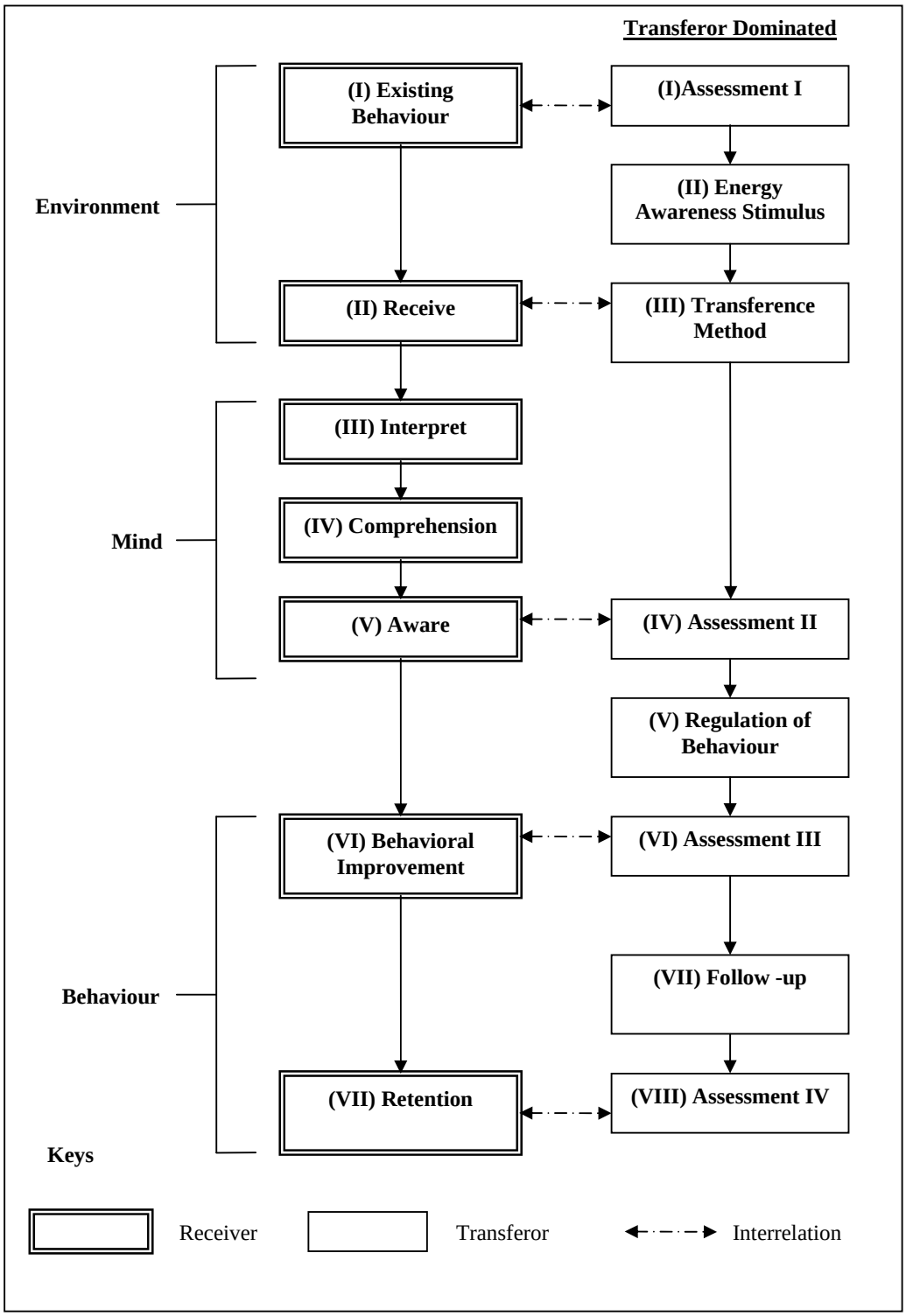

Figure 6: Conceptual Model of Energy Awareness Development Process

In this model, one implication of viewing the relationship between the respondent (person who receive and develop awareness) and the administrator (person who raise awareness and implement the changes) is seen as receiver and transferor. Basically, the entire model is divided into two segments – 'Receiver Dominated' and 'Transferor Dominated' and each of the segments consists of a sequence of core processes.

Transferor is defined as conveyor, somebody to transfer and develop awareness to another person (receiver). 'Transferor Dominated Segment' refers to the awareness development process conducted by the transferor. In the transferor dominated segment, the transferor is able to control, develop and monitor the energy awareness development process. The following section discusses the justification and functions of each core process associated with the transferor dominated segments.

A. Assessment I

Assessment is needed to evaluate the effectiveness of energy awareness development process in different stages. The assessment is significant as we cannot change something that is not able to be measured. Only through assessment, transferor could review, improve and correct performance for better awareness achievement. Assessment can be conducted by using various techniques. "It may occur one-on-one questioning of learners, one-on-one demonstrations of ability during or after instruction, or questionnaires to assess changes in learner attitudes (Rothwell and Kazanas, 1998)" Whichever method to be used depends on the assessment's purposes and strategies. Since the assessment's results will be used for future references, therefore, administrator must properly keep track and maintain the records.

On the whole, there are four assessments throughout the model. The first assessment begins before any energy awareness development process is carried out. It is a pre-survey or pre test to serve as the baseline for later comparison and evaluation. In assessment I, transferor has to collect information about respondent's pre energy awareness and energy-use pattern (Existing Behaviour). The rationales of doing so is to find out user's existing energy-use attitude and practice, to use the assessment results to design the program, to initiate and prepare users for the coming change and to gather users' favourite energy information and transference methods.

In the later stage, collected information will serve as the basis for the transferor to compare responses about energy use behaviour before and after the treatment. By doing so, the transferor can evaluate the effectiveness of the treatment in changing people's habits. Examples of the criteria to be assessed in the first assessment include: Background information; General energy knowledge; Willingness to participate in energy conservation programmes; User's energy concern; Types of energy knowledge that they intend to know; Existing energy-use practices, general awareness of energy-use; Energy conservation concept; Current energy issues; User's best and favourite communication channels and other such factors.

B. Energy Awareness Stimulus

Based on the classic stimulus-response (S-R), the first step to raise awareness is to present the appropriate stimulus. Stimulus is incentives- something that encourages an activity or a process to begin, increase or develop. There are various kinds of stimulus, for example: A very simple motivation sticker saying that "the best way to predict the future is to help create it"; The cover story of newspaper about the sky high crude oil price; Seeing others practicing energy conservation to reduce energy bills by; Fear and concern about the global warming issue.

Every energy awareness stimulus brings out certain information and knowledge. Indeed, it is the information and knowledge that help receivers to achieve awareness and shape energy conservation behaviour. Basically, providing effective energy information is able to raise energy awareness although it is still not good enough. Nickerson (2003) who argued that simply providing consumers with information about ways in which they can reduce their use of energy, or attempting to persuade them to conserve, has resulted in reductions in some, although not all.

Energy awareness can be developed by transferring message that consists of relevant knowledge and information. "A message is the stimulus produced by the sources (Seiler and Beall, 2003)." Studies had mentioned the significance of providing the relevant knowledge. "Barr (2007) states that knowledge for action is a significant prerequisite for behaving in appropriate manner and would be a significant barrier to action if knowledge level were low." "People cannot be concerned about environmental issues if they do not know about them, and they cannot be faulted or behaving in environmentally detrimental ways if they are unaware of the implication of specific form of behaviour (Nickerson, 2003)."

Generally, it is not wise to say that receiver would be highly energy aware if they know what to do. "In a warning research, Leonard *et al*. (1999) explained that many workers are injured when they fail to lock out properly the power to the machinery that they are repairing." Most of the injured workers had been trained on lock out procedures and 'knew' what to do, but nevertheless, they 'forgot' or are still not aware of the relevant hazards at the proper moment. Therefore, it is not enough to simply provide receiver with energy knowledge or information as other process needs to be taken into consideration as well.

C. Transference Method

The proposed energy awareness stimulus in the previous stage is not useful if they are not being transferred to receiver. Considering the 'Medium' proposed by the Yale Group (Banyard, 1999) in the key features of persuasive message, the researcher includes the 'Transference Method' as a core process in energy awareness development process. Basically, it is a technique or communication channel to effectively transfer the energy awareness stimulus to receivers. Devito (1996) defines communication channel as "the medium through which a message passes." It serves as the bridge for the information and message to cross over to the receiver. To develop energy awareness, both transferor and receiver need to be available. The responsibility of the transferor is to effectively transfer the energy awareness stimulus. On the other hand, the responsibility of the receiver is to receive the stimulus. The transference method is the intermediate between transferor and receiver. There are many types of transference method, such as lecture, printed material, multimedia, displaying material, role play and demonstration. In fact, each of them has its strengths and weaknesses. Consideration of the limitation and advantages of the approach is essential when selecting the appropriate transference method.

D. Asessment II

"It was noted that some members of a target group adopt awareness more quickly than other members, even when all members of the target group are exposed to the advocated change more or less at the same time (Zaltman and Duncan, 1977)" After receivers obtained information from the transferor, they will interpret, comprehend and achieve awareness. However, as noted earlier, each individual is different and such difference may be vary among groups too. For that reason, the level of achievement may differ among each receiver.

Assessment II begins right after the transferors convey information to the receivers. The purpose of assessment II is to measure the receivers' level of awareness and success of the transference process. The rationale for carrying out the Assessment II in this stage is if the transferors wait until the process ends before evaluating it, transferors may find out that certain aspects of the programme are not effective or incorrect. By that time, it may be too late to correct it. Therefore, Measurement is needed in this case to measure or test whether the respondents had achieved awareness.

In Assessment II, examples of criteria to assess include the level of energy awareness; Willingness to participate in future energy conservation programmes; User's concerns; Understanding on previous delivered energy information, knowledge and message; Energy conservation concept and other criteria.

E. Regulation of Behaviour

Although receiver had gained awareness in the previous stage, it is not enough because awareness do not guarantee improvement in behaviour. "It is easier to change a participant's knowledge about energy and conservation than it is to change their attitudes (Smith, 1978)." For instance, many smokers continue to smoke even when they are aware (having knowledge and realize) that smoking is harmful to their health. Similarly, those who are aware about the importance of energy saving and knew energy saving techniques might not practice them.

The core process namely 'Regulation of Behaviour' dominated by transferor is derived based on the motivation stage in the Information-Processing Model proposed by Wogalter and Laughery (1996) and 'Consequences' stages in the A-B-C Model proposed by the Kahn (1993). Behavioural regulators are needed to strengthen the association between a response and preceding stimuli for the purpose of increasing the level of awareness and enforcing behavioural improvement. In this context, reinforcement and punishment are needed. Reinforcement is a consequence that causes behaviour to occur with greater frequency, more often referred to as incentive, motivation and rewards. On the other hand, punishment is a consequence that causes behaviour to occur less frequently, which refers to disincentives. Turning off unused light, riding bicycle to work, buying energy efficient product and hibernating computer are all operant behaviours having relevance to the pro energy conservation behaviour. Indeed, they are behaviours that we approved of and should be increased. "The phenomenon of increasing responses by manipulating response consequence is known as the 'Reinforcement' (Cone and Hayes, 1980)." On the other hand, leaving unnecessary unused light, having poorly maintenance, using inefficient electrical equipment and overcooling are all energy wasting behaviour that we do not approve of and should be decreased. In this case, 'Punishment' can play a significant role in reducing the unwanted behaviour or effect. Reinforcement and punishment are umbrella terms in behavioural psychology. It can be understood more simply if we look at the elements that fulfil the function of the terms 'Reinforcement' and 'Punishment'. In this case, 'Incentives' is to fulfil the function of reinforcement which increases the likelihood of anticipated behaviour; on the other hand, 'disincentives' is the function of punishment to decrease the occurrence of unwanted behaviour. "Zirpoli and Melloy (1997) provide a very useful explanation on how to use reinforcement and punishment effectively." When most rules state that what *cannot do*, then the focus of transferor attention will likely be on the punishment of inappropriate behaviours. Vice versa, when the rule states what *can do*, then the transferor should focus on the motivation or rewards of appropriate behaviour.

F. Assessment III

Assessment III intends to measure the level of behavioural improvement of the respondents, either from squander to conserve or from depreciate to appreciate. Energy awareness development process is not complete until it is apparent that the targeted group practice energy awareness. "According to Mcmakin and Lundgren (1999), at the end of the campaign, the transferor should understand two fundamental things: First, is to what extent the people took actions that reduced energy use (including action taken) and second, the effectiveness of various activities and communication in prompting those changes." Therefore, it is necessary to conduct another assessment regarding user's behaviour. Overall, the results will be able to indicate the effectiveness of the model. Examples of criteria to assess include: User's energy-use behavioural improvement – to what extent the users took actions to reduce energy use; Are users doing anything differently now as a result of the energy awareness increment; The effectiveness of model (such as energy awareness, transference methods and regulation of behaviour) in prompting those changes; The financial impact of the CMEADP- the amount of energy saved.

G. Follow-up

As is generally accepted, "Raising energy awareness is a continuous effort (Hein and Jacobsen, 2001; James, 1977)". The energy awareness development process model, regardless of how effective, is not of much help if receivers revert to their former behaviour when the programme ends. Reverting to the model, by this time, receiver should have appropriate awareness and is willing to make behavioural changes to conserve energy. However, maintaining continuous awareness and energy conservation behaviour is thus another challenge. Munson (1984) argued that "as time goes on, the probability of 'self implementation' will decline." "Dick-Larkam (1977) states that people have, however, very short memories for these things and easily drop back into old ways." In fact, it is very easy for the receiver to forget about energy awareness and practice energy-conservation. Wong (1997) mentions that forgetfulness is a great enemy of energy efficient behaviour". "It is clear that many changes in behaviour resulting from reinforced practice do indeed persist over very long periods, but in some cases, changes in behaviour that would otherwise qualify as learning do not persist more than minutes (Walker, 1996)." Therefore, the energy awareness development process does not end even after the receiver had improved their behaviour. The transferor should continuously monitor and maintain receiver behaviour, evaluate the programme itself and keep on motivating them to put their learning to daily life. "Hein and Jacobsen (2001) state that changing of habits demand prolonged and continuous activities in order to have impact and in order to maintain the new habits after the campaign is over." "In fact, challenges aspect of energy-efficiency programs aimed at changing behaviour is sustaining new behaviours over time (Mcmakin *et al*., 1999)." "Wade (1995) mentions the importance of tracking ongoing follow-through in his high-impact training model." In general, the purpose of 'Follow-up' is to refine and reinforce the previous phases for the purpose of sustaining receiver's willingness to continue their energy efficient lifestyles. There are two sub sections under this category: (1) Reminder and (2) Feedback. The bottom line of reminder is to cause receiver to remember, put in mind and recap them about the significance of practising energy conservation. Reminders can range from a simple notice, letter, and booklet to complete lecturing. On the other hand, feedback is the return of receiver's opinion on quality of the programmes and relevance of their new learning. At the same time, feedback functions as self evaluation. It is an activity that calls upon the participants themselves to make a post evaluation after they complete the programme.

H. Assessment IV

The final assessment intends to measure the level of continuous compliance of the receivers. The challenging aspect of energy-efficiency programs aimed at changing behaviour is sustaining new behaviours over time. People were enthused at the beginning of the programme, however, as the time went on, enthusiasm waned and behaviour reverted. As people are likely to forget and drop back to their existing behaviour, there is a need to measure the level of continuous compliance after the treatment. Transferor must understand that temporary behavioural improvement is not enough, he or she needs to ensure that the receivers will continuously embrace and practise energy conservation efforts. Through the assessment, transferor will gain a better understanding regarding effectiveness of the treatment and also, the extent to which the expected results were achieved. The criteria to be assessed include: The level of continuous comply; receiver's energy awareness over time; Receiver's energy-use behaviour over time; Sustainability of the CMEADP and willingness of the users to continue their energy-efficient lifestyles after the treatment.

5. CONCLUSION

The research establishes the Conceptual Model of Energy Awareness Development Process (CMEADP) for Malaysian Higher Learning Institution. Admittedly, the CMEADP is not universal and can be adjusted by user's needs for people behaviour is unique and different from each other. To ensure sustainability of the CMEADP, continuous improvement is needed. Researchers may consider updating the components of the model periodically so it would be sensitive and always match the market needs. The model is designed to raise energy awareness and improve energy-use behaviour in the universities. Therefore, it is possible to apply the model in organizations with similar characteristics, such as school, colleges and other education centres with modification and refinement. The future research may look at how the CMEADP could be modified and applied in other industries, such as construction and manufacturing.

6. RESEARCH OUTPUT

6.1 Citation Details of Articles

1. Low Sheau Ting, Abdul Hakim Mohammed, Choong Weng Wai and Buang Alias (2010). Facilities Management: Paths of Malaysia to Achieve Energy Sustainability. *International Journal of Facility Management*. 1(2).

2. Ng Sock Yean, Elia Syarafina Binti Abdul Shakur and Choong Weng Wai (2010). Energy Conservation Opportunities in Malaysian Universities. *Malaysian Journal of Real Estate*. 5(1): 26-35.

3. Choong Weng Wai, Abdul Hakim Mohammed and Low Sheau Ting. (2009). The Needs for Raising Energy Awareness and Improving Energy Use Behaviour in Malaysian Public Universities. *Malaysian Journal of Real Estate*. 4(1): 1-9.

6.2 Citation Details of Conference Papers

1. Ng Sock Yean and Choong Weng Wai (2010). *The Needs to Measure Energy Awareness in Malaysian Universities*. International University Social Responsibility Conference and Exhibition. K. Lumpur. 5th-6th October 2010.

2. Low Sheau Ting, Abdul Hakim Mohammed, Choong Weng Wai and Buang Alias. (2010). *The Energy Knowledge and Conservation Behaviour Among Community in University.* International University Social Responsibility Conference and Exhibition. K. Lumpur. 5th-6th October 2010.

3. Choong Weng Wai. (2009). *The Conceptual Model of Energy Awareness Development Process*: *The Transferor Segment*. 3rd International Conference on Energy and Environment. 7th -8th December 2009.

4. Elia Syarafina Binti Abdul Shakur and Choong Weng Wai (2010). *Model dan Konsep Universiti Lestari*. Management in Construction Researchers Association Conference (MICRA). K. Lumpur. 5th -6th October 2010.

6.3 Citation Details of Other Publications - books / standards etc. *(Please specify)*
None

6.4 Details of IPR *(Please specify)*
None

7. HUMAN CAPITAL DEVELOPMENT

7.1 Details of Human Capital Development *(Name and qualification sought)*

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8. AWARDS / ACHIEVEMENT

None

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Appendixes:

A1. Low Sheau Ting, Abdul Hakim Mohammed, Choong Weng Wai and Buang Alias (2010). Facilities Management: Paths of Malaysia to Achieve Energy Sustainability. *International Journal of Facility Management*. 1(2).

A2. Ng Sock Yean, Elia Syarafina Binti Abdul Shakur and Choong Weng Wai (2010). Energy Conservation Opportunities in Malaysian Universities. *Malaysian Journal of Real Estate.* 5(1): 26-35.

A3. Choong Weng Wai, Abdul Hakim Mohammed and Low Sheau Ting. (2009). The Needs for Raising Energy Awareness and Improving Energy Use Behaviour in Malaysian Public Universities. *Malaysian Journal of Real Estate.* 4(1): 1-9.

A4. Ng Sock Yean and Choong Weng Wai (2010). *The Needs to Measure Energy Awareness in Malaysian Universities*. International University Social Responsibility Conference and Exhibition. K. Lumpur. 5th-6th October 2010.

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Facilities Management: Paths of Malaysia to Achieve Energy Sustainability

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ABSTRACT

The world is haunted by sky high energy price and uncertain energy supply. With the ever increasing domestic energy demand but limited reserves, Malaysia that has long claim herself as a petroleum producer would become a net importer in less than 20 years. As buildings are among the major contributors to nation's total energy usage, the professional of facilities management should take proactive role to manage building's energy usage effectively and efficiently. The discussion in this paper focuses on four new dimensions of facilities management in managing energy: exploring alternative energy resources, embracing energy policies, implementing energy management and improving energy awareness and energy-use behavior. This paper endeavors to be a catalyst to alert the nation as well as the world on how the professional of facilities management can contribute a sustainable energy future.

Key words: Energy Sustainability, Energy Management, Facilities Management

1.0 Introduction

Energy problems has long became global concerns, nowadays, the world is racing to find energy solution as worry about energy shortage, sky high energy price, unsecure of energy supply, un-eco friendly use of energy and the issue of enormous wastage. To solve such energy issues, residents of the earth should think global and act local, or at least, act according to their expertise. Following discussion examines the current energy issues globally and locally.

1.1 Sky High Energy Price

The prices of oil and natural gas have gone through the roof and are expected to stay there. "Campbell and Laherrère (1998), once estimate that oil decline will begin before 2010." However, in July 2008, international oil price already reaches new historic peak US$147.29 (RM470.87) a barrel level. The main cause of such increases was the existence of a tight market due to the small margin between production (83.0 million barrels per day (bpd)) and demand (82.5 million bpd), high demand for oil by China, India and the United States, uncertainly of supply in some OPEC (Organization of Petroleum Exporting Countries) countries, adverse weather condition such as Hurricane Emily in Mexico which affecting oil production and speculation on oil prices (Economic Planning Unit Prime Minister's Department, 2005). In late 2008 and early 2009, the oil price has responded strongly perceptions that the worst of the global recession is over with after reaching a low of USD$36 a barrel on 27th February 2009.

However, the oil prices started to rebound in March and climbed to USD$70 a barrel by mid of 2009 (IMF, 2009)

A continuous trend of high and unstable energy price have significant negative effects on global and local economy and society, this include recession, inflation and higher unemployment rate. Malaysian also being affected as the price of petrol and diesel sought a new hike in year 2008. The decision to increase the price of fuel was to overcome the impact of rising international crude oil prices and to curb the increase in subsidies paid by the government. In year 2009, the total amount of subsidies provided by government is RM3.4 billion for petrol and RM1.9 billion for diesel. In response to the hike of energy price in international level, Malaysia has reviewed and increased energy price in recent years. In year 2010, the price of petrol is RM1.80 for RON95 and RM2.05 for RON97. The price of diesel is RM1.70 per litre and Liquefied Petroleum Gas (LPG) cost RM1.75 per kilo.

For June 1, 2006, the electricity tariff in the peninsula was rise by an average of 12% for the cost of generating electricity has increases tremendously. Recently, the government alarmed all Malaysian to be prepared for the raising in the electricity tariff again in 2010. Malaysian, already grappling with the impact of fuel prices increase is need to bear with higher electricity rates.

1.2 Unsecure Energy Supply

Continuous available of energy supply still remain as a big doubt for the world, as well as Malaysia. Energy demand is expected to rise worldwide with growth in developing nations hitting 90 percent. The rise of China and India boost up the energy demand where most of supply will come from outside its own borders. This poses a real and growing threat to the world's energy future. Sustainable supplement of energy in the coming future remain as a great challenges.

Malaysia is still heavy dependence on oil as the primary energy supply. 50% of the total energy supply in Malaysia is from oil while the other sources of energy supply are still too little. Although Malaysia is well blessed with oil and gas deposits, there is a possibility that Malaysia could quickly become a net importer of oil. With heavy industrialisation programme, Malaysia is relying on the use of its energy resources. Malaysia therefore gives high priority in ensuring the security and sustainability of energy supply (Norhayati Kamaruddin and Yuzlina Mohd. Yusop, 2000). With current production at 650,000 barrels per day, Malaysia is expected to become a net importer of oil if we still do not conserve (Roy, 2001). In the past, Malaysia was over dependent on oil almost 80% was used in power generation. Presently around 60% of power generation is fuelled by natural gas. Soon or sooner, our country has to deal with oil shortage problems.

1.3 Environment Degradation and Disturbance

Environmental degradation - improper and unfriendly use or harvest energy bring disturbance to the environment, one of the critical issues is green house effect or better known as global warming. Presently, the amount of green house gases such as carbon dioxide in the atmosphere is increasing fast and most of it comes from burning fuels for energy supply. These have significantly affect ecology, ecosystems and public health associated with global climate change.

Undoubtedly, the heat is continuous to rise. Human activities have overloading the atmosphere with carbon dioxide (CO_2) and this result as significant climatic consequences. International Energy Agency (2008) projected that the current energy-related emissions trend will pushing up average global temperature by 6°C in long run. The Outlook also forecast the global energy related CO^2 emissions will peak in 2025. Several studies carried out revealed that fossil energy combustion and production is the

largest, single and main contributor to the greenhouse gases emissions and higher global temperature which negatively damage the vital ecosystem (WEO, 2007; Malla, 2009; Yang, 2009; Moriarty and D. Honnery, 2009 and Halicioglu, 2000). Although global warming is now a reality and most discussed by the public, anyway, the public is still not aware about how their daily activities could affect the climate changes.

Another energy-environmental issue is the pollution resulted from improper use of energy harvesting technology. In some cases, technology itself that used to harvest energy resources can generate environmental disturbance and social repercussion. For example, construction of mega hydroelectric projects such as Bakun Dam in the eastern Malaysian State of Sarawak has brings environmental and social impact. The Bakun dam requires the relocation of indigenous people. Also, a total of ecological destruction on 69,640 hectares of forest ecosystem and unique geographical feature has been reported (Keong, 2005).

2. Energy Sustainability

The word 'sustainability' embraces the meaning of to keep in existence and maintain. The classic definition of sustainability is given by the World Commission on Environment and Development in their report, *Our Common Future*, that sustainable development is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs. (WCED, 1987)" Basically, sustainability can be understood as the continuously available, present and the future.

'Energy Sustainability' refers to the continuous availability of energy, in sufficient quantities, and at reasonable prices. Most of the time, energy sustainability also refer to energy security, which has many aspects. These two terms has been used interchangeably. It means limited vulnerability to transient or longer disruptions of imported supplies. It also means the availability of local and imported resources to meet, over time and at reasonable prices, the growing demand for energy (Khatib et al., 2001).

No doubt that our world has achieved a great success in making our life easier and comfortable, from the aspect of technology, transportation, communication and entertainment. However, behind this fantasy is inefficiency and wastage of energy that has brings disturbance to the environment, economy and social. The choice of what our society make today will affect the future of tomorrow's generation, the issues of energy sustainability must be seriously considered before it is too late.

Critical energy issues: sky high energy price, unsecure energy supply and the environmental degradation indicates that the world energy sustainability has been threatened. Energy is the principle of sustainability as it is the main contributor and driver to achieve total sustainability. The various energy issues arise provided considerable evidences that human are on an unsustainable path. Malaysia, as a developing country is not been excluded from the wave of energy sustainability challenges. Hence, to achieve sustainability, Malaysia must ensure the sustainability of energy in terms of its supply, availability and usage pattern. For that reason, it is important to identify the various paths towards energy sustainability and appropriate efforts must be actively placed. Only then, we are able to sustain energy future.

As a professional from the discipline of facilities management, facilities manager should take proactive role to help nation to achieve energy sustainability rather than passively manage the building. It is important that the facilities manager act and serve as the role model to other professional. Moreover, contribute to this field brings a lot of advantage to facilities professional, especially in monetary saving and cost cutting. The following discussion listed and discussed various paths to achieve energy

sustainability. Contemporaneously, the role of the professional of facilities management in each of strategy will be stressed.

3. Role of Facilities Management

Refers to the definition of facilities management given by International Facility Management Association (IFMA), facilities management is "a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, process and technology." It is a key function in managing the working environment, facilities resources and support services to support the core business in long run (Sarich Chotipanich, 2004). The core business means the central or main activities of an organization while the support services are those services which must be in place to support the functionality of the core business. For instance, core business of a university is education and its support services include accommodation, property maintenance, energy management, etc.

The facilities management professionals play a vital role in providing quality and high performance facilities (Zuriati Ashaari, 2005). Facilities manager is responsible to ensure all the facilities are performing effectively and efficiently. The major challenges for facilities management professional are to maximize the utilization and production of the organization's facilities at the minimal cost. Among the critical area that needs to be managed is energy usage in the organization.

To achieve overall energy efficiency, facilities manager professionals must poses good knowledge and skills in the management of energy as well as to find alternatives or paths to achieve energy efficiency. For instance, a facilities manager may propose to install solar photovoltaic if the building is located at strategic location which expose to high radiant energy from the sun. The installation not only brings monetary payback through increase of overall efficiency but also in non monetary benefits through the increase of corporate image.

4. Paths towards Energy Sustainability

Energy sustainability can be ensured and enhance through various methods. Anyhow, approaches to ensuring energy sustainability in the 21st century should be differing from the past that concentrated on supply side solution. Following discussion proposes and justify four major ways in achieving energy sustainability from the perspective of a facilities manager.

4.1 Exploring Alternative Energy Resources

Energy is the key component of the Malaysian economy as the development of the energy resources contributes greatly towards the industrialization of the nation economy and the socio-economic improvement of the people, as well as the country's exports earnings. Malaysia is well endowed with an abundance of conventional fossil energy resources, especially oil and gas, as well as renewable energy resources such as hydro, biomass and solar.

Among many types of energy, electricity, the most useful end product requested by the users so far is at the top of the energy ladder. It is the key for a satisfactory of life, which being used to power

cooking, lighting, transportation, communication, refrigeration and motor appliances. It is the basic requirement for a modern building. However, since it is secondary types of energy transformed from the primary energy resources such as natural gas. Therefore, wastage happens along the transformation and distribution process.

Presently, Malaysia is over dependence on the natural gas and oil as the main resources, whereas other energy resources are not given appropriate attention. As reported in the National Energy Balance 2007, the main energy input in power stations is natural gas which constitute of 57%. In order to achieve energy sustainability, allowing more flexible fuel choices is a must. Besides natural gas and petroleum, Malaysia should develop other renewable energy resources. As a country locates at the equator zone, there are abundant of sunlight that we can utilized to generate electricity. Malaysian should enjoy relatively high solar radiation intensities.

By using photovoltaic, it can replace some of the building materials such as roof or wall while generate electricity. A good facilities manager should be well alert about the existing alternative energy supply and adapt it the best possible into the existing plant. For example, the SURIA 1000 program launched by Malaysian government to encourage public to install photovoltaic panel has provide incentives for building users to install solar energy. Facilities manager should equipped with good energy knowledge and skills and well aware about up to date government policies on green technology. Also, they should well analyze the available alternatives and implement the best fit to achieve sustainability.

4.2 Embarking on Energy Policies

Having realized that energy plays an important role for sustainable development, Malaysia's government has proposed and applied several energy policies which intend to extend the life span of non-renewable energy resources such as natural gas and crude oil, reduce the dependence on non-renewable energy resources and to assure sustainable energy supply in the future.

In the 1970s, most of the solution taken by the government is concentrated on supply sides concern. These include National Petroleum Policy (1975), National Energy Policy Objectives (1979), National Depletion Policy (1980) and Four-Fuel Strategy (1981). The primary focus of energy planning in the country under the National Energy Policy (NEP) is to fulfil the policy's supply objective, aimed at ensuring adequate, cheap and secure supply energy based on the development of indigenous energy resources (Roy, 2001). In fact, Malaysia is emulating those of the resources-scarce economies such as Hong Kong, Korea, Singapore and Taiwan.

The supply based policy only act as short term solution as the public not appreciate the continuous supplement and subsidies, to make the matter worst, they develop negative habits on wasting energy. The continued emphasis on supply-based energy development trend poses several challenges, which Malaysia will have to deal with in the medium to long term (Roy, 2001). The best way to meet the rising demand for energy is not to supply more, but is to save, monitor the use of energy and achieve energy efficiency.

Having such awareness, government introduce the Fifth-Fuel Strategy (1999). Besides the four fuels: oil, gas, coal and hydropower, the fifth fuel which is the renewable energy was added in June 1999. The purpose of introducing fifth fuel energy are to secure long term energy supply, address the environment concerns by reducing the emission of green house gases and acts as a pollution control. There are other regulation that has been carried out by the government to protect energy resources and promote energy saving, including Petroleum Development Act (1974), Electricity Supply Act (1990),

Electricity Supply Successor Company Act (1990), Gas Supply Act (1993) and Energy Commission Act (2001).

The latest energy related efforts carried out by government was the Ninth Malaysia Plan. The Plan states that more focus should be given to energy efficiency initiatives in industrial and commercial sectors which include label of effectiveness of electrical appliances, encourage using of high efficiency motors and establishment of efficient electrical energy management regulation.

No doubt a clear and written policy is important to gear towards a sustainable energy future. However, whether the organization is thoroughly implements and put the written policy into action remains as a challenge. The distinction between action and policies is not trivial (Gordon, 2007). The facilities manager has to take the lead to support those policies by actions and creatively adapt the ideas of the proposed policies in their daily task. For examples, encourages the industrial to use high efficiency motors, install solar heater and use eco-friendly equipments. By speaking out efficiently, facilities manager can share with their clients about government's fiscal incentives to achieve energy efficient efficiency, among offered incentives include pioneer status, investment tax allowance, initially accelerated capital allowances, import duty and sales taxes exemption.

Besides ensuring the written policy is well implemented, the professional of facilities manager should reflect their opinions to improve existing energy policies either in national or international level. It is encourages that facilities manager to register and involve in various professional body, for example: Malaysian Association of Facilities Managers, International Facility Management Association (IFMA), British Institute of Facilities Management (BIFM), etc. By gathering their professionalism, it is possible to bring facilities managers' suggestion to the government through proposal, forum or national conference such as National Asset & Facility Management (NAFAM) Convention. In previous case, Malaysia Government Asset Management Policy was formulated results from the first convention of NAFAM which was held in August 2007. The policy serves as a guideline in managing and maintains government-owned facilities.

4.3 Embracing Energy Management

Energy management can stand alone or treated as the sub function of facilities management which can be categorized as maintenance and operations. It is a technical and management function the remit of which is to monitor, record, analyse, critically examine, alter and control energy flows through system so that energy is utilized with maximum efficiency. It embraces the disciplines of engineering, science, mathematics, economics, accountancy design and operational research, computation and information technology (O'Callaghan, 1993). It is the judicious and effective use of energy to maximize profits (minimize cost) and to enhance competitive positions (Thuman and Mehta, 1997).

Energy manager is the professional who practice the energy management, according to Murphy and Mckay (1982), the energy manager is, the first and foremost, a manager and as such he must control his area of responsibility efficiently." He must be capable of directing all personnel involved in consuming the supply of energy for which he is responsible for.

The energy management play an important role in organization since the energy consumption is one of the major expenditure. "Katipamula at el (1999) once states that energy accounts for a significant portion of the operating cost in many facilities." Successful energy management will assure energy effectiveness in the organization and avoid unnecessary energy cost. The duties of energy manager are diverse, including energy conservation, energy consumption monitoring, motivation and training, energy information system establishment, energy efficiency assured, energy budget tracking, faults identifying,

cost saving opportunities identifying and more. In practical, energy management can be either in or out sourcing which depends on the needs and policy of the organization.

"The two most significant benefits are to improve company performance and environment qualities (Energy Efficiency Office, 1993)." Seeing that industry, commerce and public sector spend over £13 billion each year on energy. "This could be reduced by a fifth through improved energy efficiency (Energy Efficiency Office, 1993)." Besides saving money, better energy efficiency can reduce the CO_2 emission and extend the life span of non renewable energy resources such as petroleum and coal. "Carlyle Consulting Group (2004) once asserts that energy conserving is one of the top ten ways to reduce the facilities budget without sacrificing quality."

As energy price have increased in Malaysia, commitment to energy efficiency is to reap a big reward. Modern facilities manager must enhance their energy management knowledge and skills and cooperate with the top committees and other professional in practicing energy management. Two methods in conserving energy should be given attention, namely technical approach and behavioural approach. The technological approach refers to the application of technology instruments which normally involve large or small scale investment. On the other hand, the behavioural approach requires the improvement of awareness and energy-use behaviour.

In many times, simple or non-cost energy management can be achieve through switch off unnecessary lighting when leaving the room, shut down computer when not in use or put the computer into sleep mode when leaving it for temporary, using an energy efficiency light bulbs such as compact fluorescent light bulb (CFL) and even set the cooling thermostat according to the comfortable level. All of these can reduce energy usage and cut carbon emission.

4.4 Raising Energy Awareness and Improving Energy-use Behaviour

People behaviour is significant to be taken consideration in realizing energy sustainability. Through improving energy awareness and behaviour, there is a great opportunity to improve energy efficiency. As mentioned by Hansen (2002) that people is the main factors in achieving energy efficiency, that 80 percent of the savings in an effective energy management program could be attributed to the energy efficient practices of the operations and maintenance (O&M) staff. Survey of the successful school energy-conservation programs in Tuscon as carried out by Gaballa (1996) also revealed that one of the successful criteria to generate saving is to focus primarily on behavioural changes.

In this regard, there is a need to improve energy-use behaviour. This is very relevant to facilities professionals as the management on energy and people should be part of facilities manager's duties (Author, 2006). The major challenge is that techniques that can be utilized to develop energy awareness and change people behaviour to conserve energy are still a doubt. In overview, there are tremendous opportunities to save energy by engaging with issues such as attitudes, knowledge, awareness and skills (Vesma, 2002). However, the initial steps for behavioural changes are awareness. Awareness is the seed for tomorrow changes (Wong. 1997). This suggests that there will be no further action to conserve energy if awareness is not exits. Users will not take any steps to conserve energy if they do not aware the importance of energy saving. As mentioned by Dahle and Neumayer (2001), behavioural change cannot be expected to take place unless people aware to do so. In this case, top management would not support any energy conservation programme because they did not realize enormous use of energy is a waste. Also, the staff would not carry out any energy conservation efforts because they did not take it as a responsibility.

In this regard, facilities manager should realize that building user's awareness and behavioural is the critical factors in realizing energy sustainability. More attentions should be given in this area instead of installing expensive energy saving appliances. In fact, advancement in technology is not the only solution for energy sustainability issue. This was agreed by Kempton and Schipper (1994) that as we develop physical technologies to improve energy efficiencies, we only migrates the effects of energy use by human, not curing the energy problem we are experiencing. The proper process to raise energy awareness and improve people energy conservation behaviour needed to be clearly understood by the facilities manager. To doing so, facilities managers may refer to the awareness and behavioural model such as the Theory of Reasoned Action, Stages of Changes, Theory of Planned Behaviour and Conceptual Model of Energy Awareness Development Process. All of these explain and indicates a proper process to improve energy-use behaviour.

5. Conclusion

Nowadays, the sky high oil price, unsecure energy supply and environment degradation has risen as a global concern. Energy sustainability is still remaining as a great challenge to Malaysia and the world. Undoubtedly, such issues will continue to become the barrier to prevent Malaysia towards energy sustainability. Facilities manager who responsible for manage energy usage in a building must act accordingly to the nation's ambition. Facilities managers should aware that their roles are not limited in managing building, they need to play active roles in helping our nation in achieving energy sustainability. Among many methods has been suggested in this paper to achieve energy sustainability, such as diversify energy resources, propose good energy policy, practice energy management and raise energy awareness and improve energy-use behaviour. Facilities manager may select method that suits their organization strength the most and plan the right path to achieve sustainability. In fact, it is the business and social responsibility for the professional of facilities management to facilitate the nation in achieving energy sustainability.

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ENERGY CONSERVATION OPPORTUNITIES IN MALAYSIAN UNIVERSITIES

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Abstract

The Ministry of Education Malaysia has urged all education centres to conserve energy. Energy wastage tends to occur in Malaysian universities mainly due to inefficient use of energy and lack of awareness among building users. In this context, energy conservation should be implemented to optimize energy use. This paper discusses the concept of a sustainable university with a view to propose some steps to conserve energy and achieve sustainability. Review of literature reveals that energy conservation methods can be classified into two categories: structural and non-structural. Within the context of these two categories, five high-impact energy conservation methods are suggested, including renewable energy, improvement of energy efficiency, energy usage management and monitoring, promotion and integration of energy concept, improvement on energy-saving awareness and energy-use behaviour. Based on the recommendations in this paper, Malaysian universities can adopt energy conservation methods that can be in harmony with their policies and strategies.

Keywords: Energy conservation, structural and non-structural energy conservation methods, sustainable university.

1.0 INTRODUCTION

Sustainability is an idealized societal state where people can live long, comfortable, productive, without compromising their needs. Such understanding is a concept originated from the Brundtland Report (1987), that sustainable development is "a process that aims at meeting the needs of the present generation without harming the ability of future generations to meet their needs". It enables human beings to do the same now as well as in the distant future. The concept of 'sustainability' has been widely promoted, integrated and considered in many sectors, including private, government, as well as education (Prugh *et al.*, 2000).

Malaysia is confronted with tremendous challenges in ensuring sustainable development (Aini Mat Said *et al.*, 2003). But, Malaysians have shown positive attitudes towards environmental and project sustainability through the initiatives undertaken by the government and others. Malaysian Universities will not be exceptions. However, creating sustainable universities in Malaysia is still at a pioneering and infancy stage (Nazirah Zainul Abidin, 2009). In fact, campus sustainability initiatives are being constrained by a numbers of barriers, including low priority of environmental issues on the campus, and lack of coordination between and

among advocates and key constituencies (Sohif Mat *et al.* , 2009)

Many universities have taken initiatives to create sustainable environment through various projects and research activities. Nevertheless, misunderstanding the concept of sustainability and not good planning has made such projects a failure. Hence, there is need for the concept of sustainability to be well understood by university's stakeholders before any sustainability projects are undertaken.

This article discusses sustainable university concept and its models, which are introduced by eternal expert to university. The discussion, however, is focused on interest and methods specific to 'energy conservation'. The purpose of discussion is to identify 'energy conservation' methods suitable for being used in a university. Two methods are singled out, namely 'structural energy conservation method' and 'non-structural energy conservation method', which will be discussed below.

2.0 THE CONCEPT OF SUSTAINABLE UNIVERSITY

University is a place of knowledge, where ideas are generated, transferred, and creative solutions are offered. It is a place of targeting local and global communities. It is this notion that compels us to identify university campus as a place for that needs to achieve sustainable energy conservation.

A sustainable university is defined by the Velazquez *et al.* (2005), as:

"A higher educational institution, in its entirety or part, that addresses, involved and introduce, on a regional or a global level, minimize of negative environment, economy, social, and health effects generated in their resource utilization in order to complete to its functions teaching, research, outreach and partnership, and inside supervision ways to help society make the transfer for sustainable lifestyle"

The definition could be better understood if we relate it to sustainable university's activities. The Association of University Leaders for a Sustainable Future (ULSF) (1999) has clarified sustainable activities in a university, as those which are "ecologically sound, socially just, economically viable and humane", and able to "continue to be so for future generations". Basically, universities can achieve and contribute to sustainable development in many ways, including management, planning, community service, design**,** new construction, renovation, retrofit, and others.

In a achieving a sustainable campus, thus far, several suggestions are made. Among others, *The Sustainable University Classification Model* (Weenen, 2000) and *Frameworks for Sustainability University Model* (Clarke *et al.*, 2009) are noteworthy. The *Sustainable University Model*, developed by Velazquez *et al.* (2005) through point of reference for making comparisons the best practices with 80 different universities around the world, is explored in this article (*see* Figure 1). This model consists of four stages that are integrated into a plan-do-check-act (PDCA) framework. The first stage of the PDCA is identification of problems of unsustainability and generation of ideas to solve the problems (PLAN). Then, stakeholders have to evaluate a small-scale proposal for cost saving (DO). Next, they conduct review to determine whether the proposal achieves the desired result (CHECK). The final stage is the implementation of the proposed plan to resolve the problem as well as to enhance the quality and efficiency (ACT). However, the model does not stop at this stage, it requires running the process recurrently and routinely, from the beginning to the end of the above four stages, to find and resolve new challenges for continuous improvement in campus sustainability. This model has four strategies for sustainability initiatives at universities, namely education, research, outreach and partnership, and sustainability on campus.

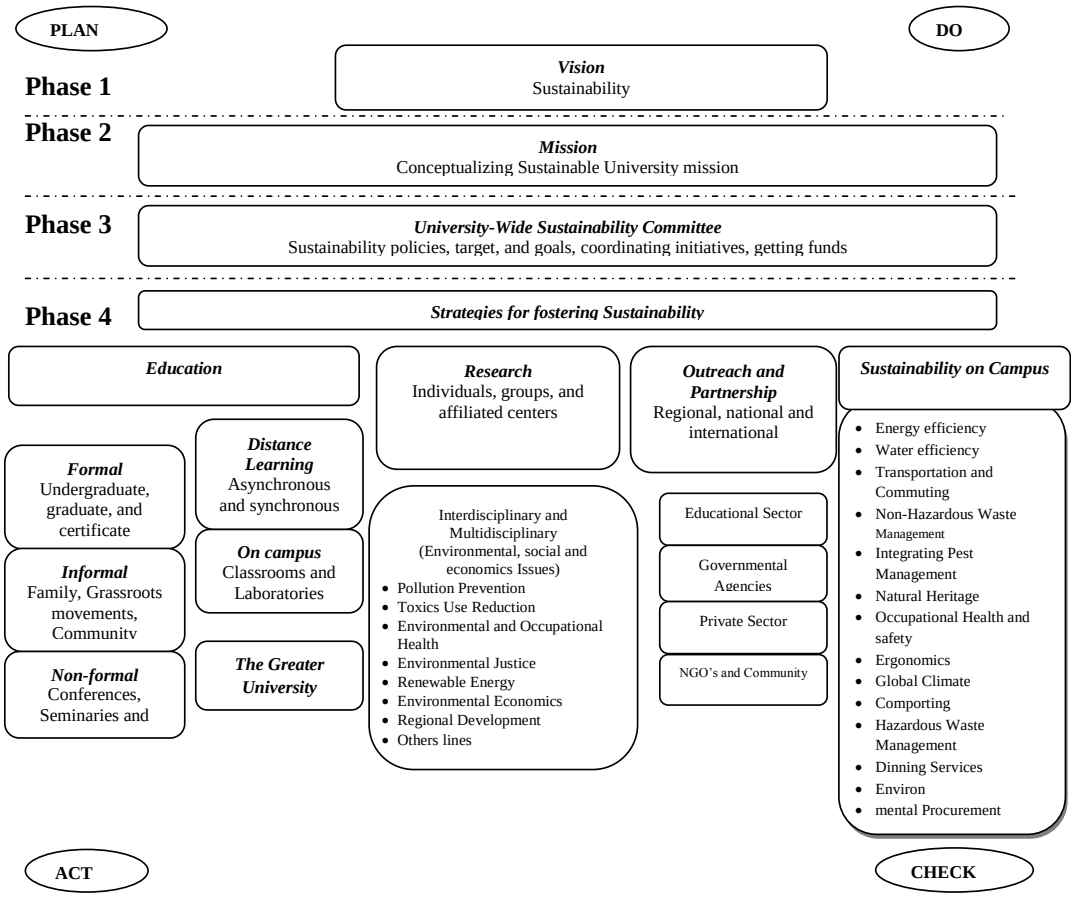

Figure 1: The proposed sustainable university model.
Source: Velazquez *et al.* (2006)

University stakeholders need to understand the three elements of sustainable development i.e., environment, social and economic. These three elements are integrated with each other (*see* Figure 2). Blackburn (2007) has suggested that metrics for Sustainable University should include these three aspects, namely environment performance, social performance and economic performance. Commitment towards these three basic elements is essential if the university has set its aspiration in achieving sustainable status. Table 1, Table 2 and Table 3 have listed out some outstanding commitments from various foreign universities towards these three elements. They could serve as example for Malaysian universities that intend to make their campuses sustainable.

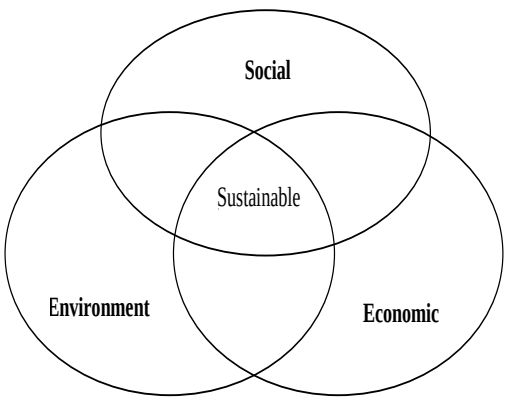

Figure 2: Sustainability across the Curriculum
Source: World Commission on Environment and Development (1987)

Table 1: Commitments of select universities towards sustainability

Name of University	Commitments
Environmental Sustainability	
University of Bordeaux	• Management of natural resources, including energy and water use are based on a "laissez-faire" policy • Water conservation program in the university is supported by Regional Water Utility Agency
Francis Marion University	• Installation of efficient lighting system in gymnasium and conduct paper recycling program.
The University of Edinburgh Estates & Buildings Department	• Establishment of environmental friendly policies code of practices guidance notes and specifications. Among policies that they introduce are Sustainability Policy 2000, Environmental Policy 1993, Waste Reduction Policy 2005, Integrated Travel Policy 2000 and Utilities Policy 2003.
Dalhousie University	• Adoption of an environmental policy in 1990, which includes contents on operation, education and research. Many initiatives are focused on the areas of solid waste, hazardous waste, toxins, air quality, energy conservation, and environmental education
Social Sustainability	
Technical University of Catalonia	• Technical University of Catalonia (UPC) Environment Plan is according to 41 action projects within the framework of the five natural areas of the University such as undergraduate education, postgraduate education, research, university life and awareness raising.
University of Hertfordshire	• Development of a Sustainable Development Policy • Promoting awareness among students regarding the environmental impacts on their studies and cooperation interdisciplinary research on sustainable development themes. • Best practices for the university as well as the local community to participate in sustainable development.
Aalborg University	• All first-year students in Engineering and Science attend a course in Technology, Human Beings and Society, dealing with some of the notions of sustainability. • The majority of teachings in sustainable development and related environmental issues is undertaken by the Division of Technology, Environment and Society in the Department of Development and Planning.
Clemson, Medical University of South Carolina and University of South Carolina	• Students' organization introduce of seminars and presentations, as well as volunteer projects to clean up campus or nearby waterways, plant trees and involved in other environmental activities during Earth Day.
Economical Sustainability	
St Petersburg State University	• A project, in the Russian Science Academy, was conducted aiming to provide energy saving solutions for academic institutions. In an early evaluation of the project, it achieved 15 percent reduction in energy budget. Other academic institutions such as Lebedeve Physical Institute and Baikov Metallurggy Institute also benefited from this project.

***Source**:* Compilation from University of Hertfordshire (1995); Barnes and Jerman (2001); Capdevila *et.al* (2001); Bonnet *et al.* (2002); Verbitskaya *et al.* (2002); Pike *et al.* (2003); The University of Edinburgh (2004); Clarke (2006);Christensen *et al.* (2009).

The rationale of the sustainable campus is to become more efficient in resources use, particularly in energy usage. Among many listed activities, energy conservation can be one of the effective tools in assisting Malaysian universities to achieve sustainable status. In fact, the integration and promotion of energy conservation concept in the university can reduce energy usage and minimize carbon footprint. Sohif Mat *et al.* (2009) explains that the energy efficiency can increase the lighting performance, keep comfortable temperature, reduce the high cost of electric power, minimise dependence on electricity, and improved ventilation and indoor air quality. Choong *et al.* (2009) has justified energy conservation in Malaysian universities on ground that they have large number of building users and enormous facilities such as classrooms, offices, libraries, etc. Also, universities are education centres, therefore, training on energy saving can be easily implemented among student and staffs.

3.0 SIGNIFICANCE OF CONSERVING ENERGY

Energy is the capacity of a physical system to perform work (Hall and Hinman, 1983). Cutler and Christopher (2006) defines energy conservation as:

'A collective term for activities that reduce end-use demand for energy by reducing the service demanded, e.g., a reducing the number of miles driven, or a reduction in the demand for natural gas for space heating by lowering the thermostat'

Energy has become one of the essential inputs for social and economic development and a basic need in our modern life and contributes to nation's growth and development (Energy Policy of Malaysia, 2005).

Goldemberg et.al, (2000) has stated that the production and use of energy should not endanger the quality of life of creatures and be able to help in the ecosystems. Since the oil crisis in the 1970s, energy conservation and security of energy supply has become a global concern (Gardner & Stem, 2002).

Since 2007, The Malaysia Ministry of Education has urged all education centres to save energy (The Star, September 13, 2007). Administrators in Malaysian universities also are concerned about the expensive monthly electricity bill. Both energy managers from Universtiti Teknologi Malaysia (UTM) and International Islamic University Malaysia (IIUM) have agreed that local university nowadays are facing serious energy wastage problems. Energy cost them more than ten million ringgit annually and this burdens the universities (Choong et.al., 2009). This leads to a new thinking and search for new methods of conserving energy that need to be studied and used in order to save costs.

4.0 ENERGY CONSERVATION METHODS

Behavioural approach and technology approach are two common ways in energy management (Mohon et.al., 1983). These two approaches are also known as structural and non-structural conservation methods. Al-Mofleh *et al*., (2009) explains the two methods in electrical energy conservation in Malaysia by the integration of three measures: use of efficient electrical equipment; application of passive energy technology in buildings, such as insulation, evaporative cooling, ventilation and solar heating; and supporting tools such as public awareness, energy codes, regulations, energy information and databases. The use of efficient electrical equipment and application of passive technology in buildings are categorized as structural energy management whereas public awareness, energy codes, regulation and other supporting elements are termed as non-structural energy conservation measures.

The energy conservation opportunities in Malaysian Universities need to be investigated in the context of both the structural and non-structural energy conservation methods.

5.0 STRUCTURAL ENERGY CONSERVATION METHOD

Structural energy conservation method refers to technology fixation. Technology fixation is a process whereby instrument, tools or technology are used to conserve energy. These include the introduction of new process, change to automation systems, or installation of large energy-saving devices, such as heat recovery systems, new building designs, inverter, pre-heater, motion sensor, building envelope systems, and others. Basically, the structural energy conservation method can be further divided into three types namely renewable energy generating technology; energy efficiency improvement technology; and technology for managing and monitoring energy usage.

5.1 Renewable Energy

The largest non-renewable energy resources found in Malaysia are fossil fuels and natural gas, which is being actively exploited. There are also potential renewable energy sources in Malaysia, most of which is biomass and solar. Biomass requires the available of palm oil and bio waste to serve as the input for generating electricity whereas the solar using Photovoltaic (PV) technology to harness the power of sunshine to supply electricity (Snyder and Bonta., 2008). Among the two, the solar energy is more convenient to be utilized in Malaysian universities since it makes use of renewable energy directly from sun. It is possible and beneficial to implement the solar panel system to power electrical appliances in Malaysian university as they receive abundant of sunshine throughout the year. It is said that most of electrical appliances that run with utility-supplied power theoretically can be powered by solar power (Snyder and Bonta., 2008). This can significantly reduce university electricity cost. Also, the benefits of installing solar penal come in many ways: it is reliable and virtually maintenance free; it does not produce greenhouse gases, and above all, it is renewable as long as the sun keeps shining.

5.2 Improvement of Energy Efficiency

'Energy efficiency is a reduction in the quantity of energy used per unit service provided' (Cutler and Christopher, 2006). The two major systems providing common building services are: (1) Heating, Ventilation and Air conditioning (HVAC) system, and (2) lighting system. Appropriate measures and improvement can help in efficient energy consumption.

HVAC is the most common system throughout Malaysian universities. With HVAC system, electricity is used to generate cooling air for lowering room-temperature. The efficiency of HVAC system can be improved through two structural approaches: (a) better HVAC control system and plant, and (b) better insulation.

HVAC control system is a computerized climate control system for indoor environment. Basically, the system uses central controllers to monitor remote terminal unit. The latest system allows remote access from a web browser indeed. Since many existing HVAC systems are manually operated, adapting remotely operated HVAC control system, by local universities, can assure better energy efficiency. Besides, Malaysian Universities should take initiative to upgrade their HVAC plants. This can be achieved through installation of smaller and more efficient heating and cooling equipments to match the building's operating load (Lancashire, 2004). The size of an appropriate HVAC plant can be determined after detail energy audit.

Building insulation is the method of preventing heat or cold air from escaping and entering the building. In order to increase the effectiveness of any hot or cold system, one can adopt the use of insulation into a particular system (Javier & Micheal, 2006). Heat and cool air is transferred from one material to another by conduction, convention and/or radiation. Insulators are used to minimize the transfer of such energy. Insulation is an important common element to improve energy efficiency in Malaysian buildings that uses a large proportion of total monthly energy consumption. A building such as a lecture hall should be well insulated as it

can save on the monthly electrical bills by reducing the cooling air generated by the air conditioning system from flowing to outside. Besides, insulation does not require complicated maintenance, upkeep, or adjustment.

Besides cooling, another common building service in Malaysian Universities is lighting. A well-designed lighting system should attain the desired lighting performance such as light levels and colour quality by using energy-efficient means. Nowadays, technological advances, such as electronic ballasts and compact fluorescent lamps, have increased the energy efficiency of lighting components. By introducing relevant technology, such as lighting control system that integrates with the HVAC system, the energy efficiency of the overall system could be increased. Another energy saving method, in this context, is the upgrade of the interior and exterior lighting, by using high-efficiency bulbs and ballasts, including replace of incandescent light bulb to fluorescent light. As fluorescent bulb produces less heat, i.e. 50 and 100 lumens per watt, it is four to six times efficient than incandescent bulbs.

5.3 Energy Usage Management and Monitoring

One of the simplest and most effective methods of conserving energy is to operate equipment whenever it is needed. Energy savings can be achieved without affecting occupant comfort by turning the equipment off (Thumann, 1985). Best still, the equipment can be switched off automatically when there is no one using it. Energy consumption can be monitored and managed properly through tools such as motion sensor, Building Energy Management System (BEMS) and Computer Aided Facilities Management (CAFM).

Motion sensor can be used for many purposes in university, including security and energy savings. A sensor automatically turns lights on when movement is detected and off when movement stops. Universiti Teknologi Malaysia has taken initiatives to install motion sensors in some of its toilets. The lighting will turn on automatically when they sensed movement in the toilets. This would definitely reduce unnecessary energy cost.

Building Energy Management System (BEMS) is a microcomputer systems used for controlling and monitoring building services plant (Levermore, 2000). Also, it can be implemented for monitoring other building's electronic appliances. BEMS system can also be used for better energy monitoring and saving. Several institutions have invested in building energy management systems (BEMS) to control and monitor the building's temperatures. The results reveal that it can reduce energy-use, up to 20 percent (Creighton, 1999).

On the other hand, Computer Aided Facilities Management (CAFM) is a combination of Computer-Aided Design (CAD) or relational database software with specific functions to manage facilities. The CAFM can assist facility manager to plan, monitor and review the facilities management process. Although CAFM differ from BEMS, both of them, however, could be integrated for better energy performance. The tasks can be performed by the CAFM querying the BEMS, or by a form of integration (Elmualim, 2009). Different types of CAFM system are currently available in the market, including *Archibus* and *Maximo*. Universities may select any of them, based on their suitability and cost.

6.0 NON-STRUCTURAL ENERGY CONSERVATION METHOD

A sustainable future cannot be secured by relying only on the structural energy conservation methods. The non-structural energy conservation method must be taken into consideration as well. Non-structural energy conservation includes integrating energy conservation concept in the management and co-curriculum of universities, and improving energy awareness and energy use-behaviour among users.

6.1 Promotion and Integration of Energy Conservation Concept

In order to foster "energy concern" among students, university's management should integrate environmental subjects into the co-curriculum by offering the relevant subjects or activities to include energy issues, energy conservation techniques, as well as benefits gained from energy conservation. Many conferences, seminars, and workshops on energy should also be conducted from time to time.

The Ninth Malaysian Plan has stressed that energy sector will continue to focus on sustainable development to support economic growth, enhance competitiveness as well as contribute towards achieving a balanced development. In line with the national interest, energy conservation can be achieved through proper university's energy policy. The university's energy policy should embrace all three fundamental concepts of sustainability: environmental, economical, and social. In addition, it should also create an understanding among campus community about the importance of energy conservation. A good energy policy will cover the interest of the energy conservation stakeholders as well as those of users. In the context of stakeholders, it may allow energy managers to participate in business and facility planning, selection and purchase of energy efficiency equipment, and conducting training. For users, the university may set regulation such as to forbid students from using rice cooker, televisions, refrigerator and other high current electronic appliances in hostel. Penalties can be imposed to enforce such a policy.

6.2 Improvement of Energy Awareness and Energy Use-Behaviour

'Behaviour' is defined as "the totality of intra and extra organism actions and interactions of an organism with its physical and social environment (Wolman, 1973)." In terms of behavioural approach, attitudes, knowledge, awareness, and skills can tremendously help in energy conservation (Vesma, 2002)." The behavioural approach can enhance energy conservation by encouraging and persuading building users to conserve energy.

A Conceptual Model of Energy Awareness Development Process (CMEADP) was proposed by Choong (2009) to raise energy awareness and improve energy-use behaviour among students and staffs in university. The model was divided into eight phases that consisted of Assessment I: measurement of original behaviour, energy awareness stimulus, transference method; and assessment II: measurement of energy awareness, regulation of behaviour; assessment III: measurement of behavioural improvement, follow-up; and assessment IV: measurement of retention.

Malaysian universities may get the benefits from such model in creating energy awareness and improving energy-user behaviour. Energy awareness is an important criterion to achieve energy sustainability. Without energy awareness, effort in energy conservation can be difficult, which may lead to energy wastage. Attention must be paid by universities to creating awareness as an initial step in any energy conservation program.

7.0 CONCLUSION

In response to the call by the Ministry of Education Malaysia to save energy, it is important for Malaysian universities to completely understand the concept of sustainability and to commit themselves to energy conservation efforts. There are two methods in conserving energy namely structural and non-structural. The structural method includes using renewable energy, improvement of energy efficiency, as well as managing and monitoring energy usage. The non-structural method includes promotion and integration of energy conservation concept, raising energy awareness, and improving energy-use behaviour. Both methods, it is believed, can help Malaysian Universities contribute to energy conservation more effectively. However,

structural energy conservation method i.e., installing solar panels and CAFM system may seem too costly to university. Therefore, it is suggested that universities should begin with low budget energy conservation methods. This can be achieved through the non-structural energy conservation method, which can be used after an appropriate feasibility study is conducted.

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Choong Weng Wai, Abdul Hakim Mohammed and Low Sheau Ting. (2009). The Needs for Raising Energy Awareness and Improving Energy Use Behaviour in Malaysian Public Universities. *Malaysian Journal of Real Estate*. 4(1): 1-9.

The Needs for Raising Energy Awareness and Improving Energy Use Behaviour in Malaysian Public Universities

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Abstract

This paper highlights the rationales for raising students' energy awareness and improving energy-use behaviour in Malaysian public universities. We conducted a study which involved a questionnaire survey covering one hundred and fifty students from three local public universities. Besides, an interview was also conducted among energy managers from two of the universities. The survey indicated that the respondents have a low level of energy awareness and they were engaged in inappropriate energy-use habit. These were corroborated based on the comments made by energy managers that Malaysian public universities need a guideline for raising energy awareness and improving energy-use behaviour. At the moment, there was no energy-use procedure or strategy to refer to. This paper proposes the need for developing a conceptual model of energy awareness development process (CMEADP) for Malaysian universities.

Keywords: Facilities management, energy management, awareness development, energy-use behaviour, sustainable development, education

1.0 INTRODUCTION

At the beginning of 21st. century, the issues of sky-high energy prices, depreciation of energy resources, environmental disturbance and energy conflicts have reminded people about the needs for a sustainable energy-use. World Commission on Environment and Development (1987) defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Goldemberg *et al*. (2000) have extended and related the definition to energy with two important arguments. Firstly, the importance of adequate energy services for satisfying basic human needs, improving social welfare, and achieving economic development. Secondly, the production and use of energy that should not endanger the quality of life of current and future generations and that does not exceed the carrying capacity of ecosystems. One way to achieve a sustainable energy development is to save energy, to reduce wastage, and to extend the time for the world to resolve energy issues. These are part of energy management.

Energy management is gaining recognition, although it is neither a new term nor a new idea. According to Capehart *et al.* (2006), energy management is the judicious and effective use of energy to maximize profits or minimize costs and enhance competitive positions. Conservation steps taken by businesses – switching off lights, removing lamps from fixtures, reducing night time illumination of facade, signs and advertising offers a practical approach to an ongoing problem in respect of the effective and efficient use of energy resources (Harrold, 1993).

2.0 BEHAVIOURAL APPROACH VS TECHNOLOGY APPROACH

Basically, there are two common approaches to energy management, namely the behavioural approach and the technological approach (Mohon *et al*., 1983; Wong, 1997). The technological approach refers to the application of technology instruments which normally involve large-scale investment. These include introducing a new process, automation system, or installing large energy-saving devices such as heat recovery system, new building design, inverter, pre-heater, motion sensor, and building envelope system. In the technological approach, the payback period is a significant issue. The 'return on investment' must be decided first before implementing any technology. The technological approach is effective in conserving energy and the results can be observed within a short period of time. However, the initial cost of technological approach is high and not suitable for an organization that has a limited budget. Since technological approach requires no behavioural changes among users, it means that a user could still waste energy in the same way. As we develop physical technologies to improve energy efficiencies, we only migrate the effects of energy use by human, not curing the energy problem we are experiencing (Kempton and Schipper, 1994). Using technological approach may seem impressive and attractive. However, it is not the unique answer to achieve energy sustainability. Regardless of the method selected for achieving energy savings, either completes system replacement or modification of an existing system, it is important to consider the human aspect of energy conservation (Shinskey, 1982). Owens (1987) noted that it is people who use energy indeed. It is, therefore, important to consider the human aspect of energy conservation. To encourage and change people's behaviour to conserve energy is, thus, a question of behavioural approach.

The literature in the energy use reveals the vitality of behavioural approach in any energy conservation programme whereby energy use is regarded as a key success factor in energy management (Dahle and Neumayer, 2001; Loozen and Moosdijk, 2001). Compared to the technological approach, the behavioural approach can be effective and can make a significant difference in energy conservation (Wedge, 2003). Experiments have shown that 5-10% of the domestic energy use can be saved by appropriate use behaviour (Loozen and Moosdijk, 2001). This means, by monitoring people's behaviour, there is a great chance to improve energy efficiency. Hansen (2002) mentioned that people is the main factor in energy efficiency. Furthermore, a survey on successful school energy-conservation programs in Tuscon revealed that one of the successful criteria to generate saving is to focus primarily on behavioural changes (Gaballa, 1996). However, facilities managers and plant operators tend to be sceptical about behavioural approaches, and have little understanding about them and their potential (Geller *et al.*, 1982). For that reason, they have a tendency not to pay attention to the benefits of behavioural approach.

3.0 AWARENESS: THE SEED FOR TOMMOROW'S CHANGE

There are tremendous opportunities in the behavioural approach to energy conservation by engaging users with issues such as attitudes, knowledge, awareness and skills (Vesma, 2002). However, the initial step towards behavioural changes is to raise awareness as it is the seed for tomorrow's changes (Wong, 1997). Without awareness, there will be no realistic action to conserve energy. One noteworthy report had stated that it is important to raise awareness in the energy sector (United Nations Environment Programme, 2007).

Awareness is defined as having knowledge or realizing something (The Microsoft Encarta Dictionary, 2005). Lack of knowledge or awareness is always the key barriers for energy inefficiency (Yik and Lee, 2002; Yik *et al.*, 2002). Dahle and Neumayer (2001) disclosed several influential factors that become a barrier to greening process such as financial, cultural and urbanization. Awareness was the second barrier to the greening process.

Dahle and Neumayer (2001) conclude that behavioural change, and thereby cultural change, cannot be expected to take place unless people are aware to do so. This indicates that people will not take any steps to conserve energy if they are not aware of the importance of energy saving.

In the past, awareness has been promoted as a method to conserve energy in higher learning institutions. For instance, the Imperial College of Science, Technology and Medicine, in London, has defined objectives to focus on raising staff and student awareness about energy conservation issues as a strategy to help protect the environment through more efficient energy use and to save money on fuel bills (Pancucci, 1998).

4.0 THE SIGNIFICANCE OF IMPROVING ENERGY AWARENESS ON CAMPUS

Simpson (1994) has mentioned that energy awareness is an essential ingredient of energy conservation program on campus. It will not succeed if campus community is complacent and taking campus energy use for granted. There are several reasons why raising energy awareness and improving energy-use behaviour in local university are important. Firstly, universities have large number of building users compared to industries and, therefore, human factor is critical to energy saving. Raising energy awareness among students will help them to be more conscientious about energy saving at home, at work and in their life. Secondly, universities have a large number of facilities ranging from classrooms, halls, offices, restaurants, sports centres, libraries, labs, shops, clinics, hostels and other similar facilities. Most of the energy systems embedded in these facilities such as lighting and air-conditioning system are still manually operated and, thus, to recommend ways for students to use it effectively is imperative. Thirdly, since a university is an educational institution, education training on energy saving can be easily implemented. Behavioural improvement is more possible to be implemented among students than among working people. Fourthly, creating energy awareness can yield monetary savings. The typical energy bill in the education sector is approximately 5% of the total expenditure (Keeffe and Grimshaw, 1994). There is a possibility of saving 5- 10% of the energy expenditure through improved energy-use behaviour (Loozen and Moosdijk, 2001). This can be a substantial amount

for a university as it is not a single sum, but an annual expenditure. Fifthly, energy saving and being green will enhance the public image of the university.

This research attempts to find out the level of energy awareness and energy-use behaviour among students in three Malaysian universities, namely Universiti Teknologi Malaysia (UTM), International Islamic University Malaysia (IIUM) and Universiti Sains Malaysia. A sample of 50 respondents from each university were randomly chosen in the survey.

5.0 RESEARCH METHODOLOGY

To ascertain current energy awareness and energy-use behaviour among students in Malaysian public universities, a questionnaire survey was carried. Besides, interviews with campus energy managers were also conducted as a supplementary source of information for the study.

5.1 Questionnaire Survey

The questionnaire comprised cognition and behavioural sections. The cognition section was designed to measure student's existing energy awareness on some energy knowledge and issues while the behavioural section was designed to measure respondent's energy-use pattern.

The cognition section comprised eight multiple-choice questions on energy awareness evaluation. For each question, respondents were asked to select only one correct out of five answers. One point was given for each correct answer. Besides, there were two questions (9 and 10) concerning student's willingness to participate in energy conservation programme. For these two questions, respondent were required to express their answer as 'yes' or 'no'.

The behavioural section consisted of 10 "evasive" questions to which respondents revealed their peer's energy-conservation behaviour (e.g. "how often do you see people leaving lights on in empty rooms in your university?"). The rationale for such questions was to avoid presumably threatening or blaming questions on respondents (e.g. "how often do you leave lights on in empty rooms in your university?"), that will possibly invite untruthful answers. In this section, respondents were instructed to mark each answer based on the scale as shown in Table 1.

Table 1: Behavioural scales used in the questionnaire survey

1= Never	0 case
2= Rarely	At least once in every six months
3= Occasionally	At least once in every three months
4= Often	At least once in every month
4= Always	At least once in every week

The data collected from the questionnaire survey were summarised into frequency analysis and grouped into categories to indicate the distribution of the results. To reveal the awareness of students towards current energy issues, the gain scores analysis was applied for the cognition section. In this case, the total scores and mean gain scores of groups were compared with each other.

5.2 Interviews

Two key informants who are energy managers from Universiti Teknologi Malaysia (UTM) and International Islamic University Malaysia (IIUM) have been interviewed to supplement the questionnaire survey. Both of them have more than 8 years experience in energy management. An open-ended questionnaire was designed to ascertain their views on students' energy awareness and behaviour in the university.

The questionnaire covered many aspects, such as trends of energy usage in the university, university's annual energy cost, efficiency of the energy usage, student's energy-use pattern, efforts taken by the university to overcome energy problems and major barriers to achieve energy efficiency in the university.

6.0 RESULTS FROM THE QUESTIONNAIRE SURVEY

The results are presented into cognition and behavioural sections.

6.1 Cognition Section

In the cognition section, the scores for correct answer were low except for question one (Table 2). For question three, only 38 out of 150 (25%) respondents were able to answer the question pertaining to electricity rate. For question six, only one out of 150 (0.7%) respondents was able to answer it correctly. Overall, the respondents have low scores of between 0.7% to 58% for all answers indicating low energy awareness among them.

Table 2: Summary of total gained scores and mean scores for the respondents from three universities (Questions 1 and 8)

Number	Question	Correct Answer	Scores for correct answer (over 150 respondents)	Percentage
1	Nowadays, the sky-high oil price problem at which level?	(D) International Level	87	58%
2	Until today, what is the recent oil price per barrel?	(D) >US 45	40	26.7%
3	How much is the current electricity tariff?	(C) RM0.2-0.3/KWh	38	25.3%
4	What is the current retail consumer price of petrol in Malaysia?	(D) RM1.9-2.0/litre	62	41.3%

Number	Question	Correct Answer	Scores for correct answer (over 150 respondents)	Percentage
5	Which sector is the biggest energy user in Malaysia?	(D) Transportation	10	6.7%
6	What is the main source of energy supply in Malaysia?	(D) Crude oil/Petroleum	1	0.7%
7	What is the major resource for electricity generation in Malaysia?	(B) Natural Gas	21	14%
8	How much do you think the university had spent on electricity annually?	(D) >8million	14	9.3%

In responding to Question 9, majority of the respondents (122 out of 150) stated that there is a need for the university to conserve energy (Table 9). As for Question 10, the proportion of respondents who have expressed their willingness to participate in energy conservation programme was (105 out of 150) = 70%. The findings have disclosed that although students feel the needs to conserve energy at the university, however, they may do not want to contribute in the energy saving activities. It seems that there is a gap in between attitude and behaviour. The following section intends to reveal the energy-use behaviour pattern among them.

Table 9: Summary of answers for the respondents from three universities (Questions 9 and 10)

Number	Question	Yes	No
9	Do you see any needs for local university to conserve energy?	81%	19%
10	If given the chances, would you be interested to participate in any energy conservation program in University?	70%	30%

6.2 Behavioural Section

The results showed that the university students did not have appropriate energy-use behaviour. Based on the answers to questions 11 to 13, the respondents appeared to be unapprehensive about energy problems. The majority of them said that they occasionally and rarely conserved energy or discussed energy issues with their peers. Also, as many as 104 out of 150 (69.3%) respondents stated that they had never attended any energy awareness campaign.

The survey also revealed that 61% of the respondents have confronted people who left lights in inside unoccupied rooms. About 28% of the respondents confessed that they occasionally saw other people leaving lights on without use.

The energy conservation issues regarding air conditioning system were asked in three different questions. The first question is about whether respondents confronted other people leaving air conditioning system on for empty rooms, 29% and 26% of the respondent said they often and always confronted such scenario. Question two asked whether the air conditioning system was operated to the overcooling temperature. In this case, many of them select occasionally (30%) and often (29%). In Question three, most of the respondents said they occasionally (31%) see people operate air conditioning system in the setting where door and window remained open.

With regard to the computer issue, 36% of the respondents stated that they always saw people leaving computer on even there is no one using it.

It was also found that 42% of the respondents had always confronted other people using heavy electricity consumptions equipment such as kettle, television and iron in the hostel. All of these revealed that there is a need to improve energy awareness and energy-use behaviour of students in local universities. The following section intends to confirm the needs through university energy manager's perspectives.

7.0 RESULTS FROM THE INTERVIEW

Both energy managers agreed that the local university nowadays face serious energy wastage problems where the annual energy cost is about ten million ringgit and this imposes a heavy burden on the university.

According to the energy manager from UTM, student's "take energy for granted" behaviour is the main factors that contribute to the unnecessary energy cost. He gave examples that students did not switch off lightings when not using them, air conditioning system is often operated to the overcooling temperature and students tended to use heavy electricity equipments in their hostel's room, including television and electric kettle. The wire system in hostel is not design to sustain heavy electricity load and easily be heated when overload. In this case, it could cause electricity failure and energy inefficiency as electricity loss in the form of heat.

The energy manager from IIUM gave the same opinion. He expressed that energy wastage in IIUM is partially due to student's low energy awareness and non-appreciating behaviour with regards to energy use. Both of managers believe that improving student's energy-use awareness and behaviour would reduce unnecessary energy cost and increase energy efficiency.

According to them, the rational is because most of the electric appliances in university such as lightings, computers, air conditioning system, washing machines, televisions are manually operated; therefore, it efficiency can be improved through change in awareness and change in behaviour. Although both of them realized students' inefficiency energy-use pattern is the reason for the situation, no related action had been taken by their department to overcome this issue. This is because they do not have any guidelines for them to refer to on how to raise energy awareness and improve energy-use behaviour.

The interview also revealed that both mangers believe that technology and human behaviours can significantly influence energy consumption. Since there is limited budget for maintenance or application of high technology equipments, energy awareness is critically important as one of the methods for conserving energy in Malaysian universities. Technology is not the only criterion should be given consideration in energy-saving strategies, but also the human factor. There is where university can lead in the development of creative human resource and technology in line with the aspiration of the nation.

8.0 CONCLUSION

The survey results indicated that Malaysian university students do not have appropriate energy awareness and were engaged in inappropriate energy-use habit. These were corroborated by energy manager in the same institution who perceived that student's inappropriate energy-use behaviour as one of the reasons that had contributed to expensive energy cost. Therefore, it is important to develop a guideline in helping facilities managers or energy managers to conserve energy through awareness development and behavioural improvement approach. This research recommends that a conceptual model of energy awareness development process be developed in a future study. The model will serve as the guidelines for raising energy awareness and improving energy-use behaviour among university students (Choong, 2008).

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The Needs to Measure Energy Awareness in Malaysian Universities

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Abstract: **The Malaysia Ministry of Education has urged all education centres to conserve energy. Energy wastage tends to happens in Malaysian university mainly due to inefficiency use of energy and lack of awareness among the building users. In this context, energy conservation should be imposed to optimize the usage of energy. Awareness is the seed for tomorrow changes. Raising appropriate energy awareness among building uses can improve building's energy performance. As we only can manage what we measure, it is difficult for the facility and energy manager to monitor building users' energy conservation behaviour without proper energy awareness measurement matrix or parameters. The discussion in this paper intends to investigate the needs to measure energy awareness in Malaysian Universities.**

Keywords: **Energy Conservation; Energy Awareness; Measurement**

I. INTRODUCTION

Energy is the capacity of a physical system to perform work. "Energy is 'Fundamental physical concept, defined classically as the capacity to do work" [1]. It has become one of the essential inputs for social and economic development and a basic need in our modern life as well as contributes to nation's growth and development.

What is energy management specifically? "Energy management is the judicious and effective use of energy to maximize profits or minimize costs and enhance competitive positions" [2]. By the way, this is agreed by Thumann and Metha which defined energy management as the effective use energy to maximize profits and to enhance competitive positions [3].

Energy management is the strategy of adjusting and optimizing energy-using systems and procedures so as to reduce energy management from different researcher reveals that the basic aim of energy management that is to reduce energy consumption and total costs therefore maximize profits [4].

The production and use of energy should not endanger the quality of life of the creatures and able to help in the ecosystems [5]. Since the oil crisis in the 1970s, energy conservation and secure of energy supply has become a global concern [6]. Energy use will be lesser if societal demand for energy can be reduced or if growth in demand can be slowed. This makes energy conservation an important part of the debate over climate change and the replacement of non-renewable resources with renewable energy sources.

*E*nergy Conservation is defined as '*A collective term for activities that reduce end-use demand for energy by reducing the service demanded, e.g., a reducing the number of miles driven, or a reduction in the demand for natural gas for space heating by lowering the thermostat*' [7].

Energy conservation among consumers is often advocated as a cheaper or more environmentally sensitive alternative to increased energy production. Consequences of the energy conservation, energy consumption and energy demand per capita will be reduced and thus offsets some of the growth in energy supply needed to keep up with population growth. This reduces the rise in energy costs, and the need for new power plants and energy imports. The reduction of energy demand provides more flexibility in choosing the most preferred methods of energy production.

II. NEEDS OF ENERGY CONSERVATION IN MALAYSIAN UNIVERSITIES

Since 2007, The Malaysia Ministry of Education has urged all education centers to save energy [8] the expensive monthly electricity bill has become the major concern among many parties in universities. Both energy managers from Universtiti Teknologi Malaysia (UTM) and International Islamic University Malaysia (IIUM) have agreed that local university nowadays are facing serious energy wastage problems on top of about ten million ringgit of annual energy cost and this circumstance burden the universities [9]. This leads to an expensive monthly electricity bills. In large university campuses, electricity and water uses are similar to those of medium-sized cities, as demonstrated by the Ecocampus European Collaboration [10].

In addition, a research has justified the reasons that Malaysian universities should implement energy conservation, it is because universities have large number

of building users and enormous facilities such as classrooms, offices, libraries, etc [11]. Also, university is an education centre, therefore, training on energy saving can be easily implemented among students. Besides reducing energy cost, it also enhances the public image of the university.

III. BENEFITS OF ENERGY CONSERVATION

In the well-known report of "Our Common Future", by the World Commission has defined sustainable development as development that meets the needs of the present without compromising the ability of future generation to meet their own needs [12]. The world is now taking a prominent concentration on the sustainable issues. Nevertheless, global sustainable issues encompass energy sustainability issues, which has been a prominent issue for the past few decades. Buildings are responsible for approximately 40% of the total world annual energy consumption. To further maintain the sustainability of energy, it is suggest that desirable to reduce energy consumption and decrease the rate of depletion of world energy reserves and pollution of the environment [13].

By taking a look on Malaysia itself, Malaysia has shown its commitment on sustainable issues by signing 26 principles of the Stockholm Declaration and action Plan since 1971 [14]. By embracing the sustainable concept, the government has given great attention to the call of Agenda 21 which emphasizes on the development of tool for sustainable development. Sustainable Energy Use specifically, has been considered as potential indicators for inclusion as sustainable development indicators for Malaysia developed for the EPU's consideration [15]. This greatly substantiates that energy governance is very vital as one of the aspects of sustainable development.

To ensure energy is sustainable at its best, effective governance is required. Being recognised as one of the disciplines of built environment management, energy management is an activity to optimize the use of energy by avoiding waste of energy, as nowadays, energy plays an important role in our daily routine.

Many countries are figuring on how to focus on new and sustainable sources of energy. Among the most effective ways to achieve a sustainable energy development is through energy conservation as it can extend the time in order for the world to resolve the energy issues.

"Energy conservation is a collective term for activities that reduce end-use demand for energy by reducing the service demanded, e.g., a reducing the number of miles driven, or a reduction in the demand for natural gas for space heating by lowering the thermostat" [16].

Energy conservation is any deliberate action taken to reduce energy consumption such as avoiding use, finding alternative uses which require less energy, reducing dependence on the more costly less available sources, developing and utilizing more efficient energy using devices and processes [17].

Energy use will be lesser if societal demand for energy can be reduced or if growth in demand can be slowed. Energy usage is expected to continue to increase rapidly in the 21st century, as mainly because of the expansion of the economies of developing nation [18]. This makes energy conservation an important part of the debate over climate change and the replacement of non-renewable resources with renewable energy sources. Energy conservation among consumers is often advocated as a cheaper or more environmentally sensitive alternative to increased energy production. Consequences of the energy conservation, energy consumption and energy demand per capita will be reduced and thus offsets some of the growth in energy supply needed to keep up with population growth. This reduces the rise in energy costs, and the need for new power plants and energy imports. The reduction of energy demand provides more flexibility in choosing the most preferred methods of energy production.

IV TECHNOLOGY APPROACH VERSUS BEHAVIOURAL APPROACH

Technology approach and behavioural approach are two common ways in energy management [19]. These two approaches are also known as structural and non-structural energy conservation methods. There are two methods in electrical energy conservation in Malaysia by the integration of three tools: (1) Use of efficient electrical equipment; (2) Application of passive energy technology in buildings, such as insulation, evaporative cooling, ventilation and solar heating; (3) Supportive tools such as public awareness, energy codes, regulations, energy information and databases. The use of efficient electrical equipment and application of passive technology in buildings are categorized as structural energy management whereas supportive tools such as public awareness, energy codes, regulation, etc are termed as non-structural energy conservation method [20].

Technology fixed is an instrument based by using tools or technology to conserve energy. These include the introduction of new process, change to automation systems, or installation of large energy-saving devices such as heat recovery systems, new building designs, inverter, pre-heater, motion sensor, building envelope systems and others. Basically, the structural energy conservation method can be divided into three types, (1) the use of technology in generating energy and (2) the use of technology in improving energy efficiency and (3) the use of technology in managing and monitoring energy usage. However, the technological approach refers to the application of technology instruments which normally involve large-scale investment and the initial cost of technological approach is high and not suitable for an organization which has a limited budget. Furthermore, even the technological approach can conserve the effectively but does not means that it have any behavioural changes among the users. In this case, it means that users still continuous waste energy.

A sustainable future cannot be secured by relying only on the structural energy conservation methods, the non-structural energy conservation method must be taken into consideration as well. Non-structural energy conservation method include: (1) integrating energy conservation concept in the management and co-curriculum and (2)

improving energy awareness and energy use-behaviour among users.

V. THE NEEDS TO MEASURE ENERGY AWARENESS IN MALAYSIAN UNIVERSITY

In foster an energy concern student, the management of the Universities should integrate environmental subjects in university co-curriculum by offering a subject or activity relevant to energy conservation, including energy conservation benefits and its techniques. Besides that, improving energy awareness and energy use-behaviour in universities also one of the non-structural energy conservation methods. "Behaviour" is defined as "the totality of intra and extra organism actions and interactions of an organism with its physical and social environment [21]." In term of behavioural approach, attitudes, knowledge, awareness, and skills can tremendously help in energy conservation [22].

Awareness is the seed for tomorrow changes [23]. The key barriers to energy efficiency improvement in existing building are the knowledge [24]. In fact, the lack of knowledge is the reason of energy inefficiency. Therefore, awareness plays an important role in changes behaviour among consumers [25].

Awareness is the essential foundation for an installation's energy program. It helps to change attitudes, thus encouraging users to seek out ways to save energy and also changes behaviours, making sure that energy users take energy-saving actions and continue to use and maintain energy saving equipment after it has been installed. That is, energy awareness helps to increase the persistence of energy-savings projects so that they continue to reap savings year by year. Besides that, under Energy 2005, the initial savings from awareness provide the seed money for higher-cost energy saving investment According to Energy Technology Bulletin, the way to measure an awareness program's effectiveness is to develop a set of subjective assessment criteria to gauge changes in users' energy habits.

Energy management activity will not percolate to industries unless senior business executives are convinced of the potential of energy management in real terms. Sensitization of senior executives and government administrations through training programmes and awareness programmes can only improve the commitment for energy conservation and management. Energy management is needed more in the developing countries since they need more energy to increase gross domestic product compared to the developed world. Energy wastage and inefficient energy use are major environment problems that need more attention than energy generation [26].

Savings in energy consumption worth millions of dollars may be realized through public conservation campaigns that raise consumers' awareness of the financial and environmental impact of wasteful practices [27].

Energy management awareness among consumers are very important. Building can be designed with super green technology features but if lack of end user awareness, the building would not operate efficiently and waste energy. Most of operators do not have sense of energy of energy management due to lack of awareness and commitment [28].

A Conceptual Model of Energy Awareness Development Process (CMEADP) has been proposed to raise energy awareness and improve energy use-behaviour among students and staffs in university, the model was divided into eight phases that consisted of Assessment I (measurement of original behaviour), energy awareness stimulus, transference method, assessment II (measurement of energy awareness), regulation of behaviour, assessment III (measurement of behavioural improvement), Follow-up and assessment IV (Retention). The initial step in Conceptual Model of Energy Awareness Development Process (CMEADP) proposed in the research was to assess receivers' existing energy awareness and energy use-behaviour. However, the awareness measurement attributes for the model is absent and not being proposed [29].

Awareness is the first step beyond other energy conservation strategies. One of the most successful means of motivating employees is through awareness [30]. However, energy awareness among the students and staffs are abstract. We do not know how high the level of energy awareness among the staffs and students in Malaysian Universities. Without knowing the level of energy awareness, we cannot provide the better energy conservation program.

Therefore, we need to measure awareness so that we can manage it and we can keep track on management goal. In addition, it dictates a proactive measure of conserving energy. "If you keep the score, you are going to practice it", hence, this substantiates the saying of "we can only manage what we measure" [31].

VI. CONCLUSION

In response to the urge from Malaysian Ministry of Education to save energy, it is important to instil energy awareness among building users. In this case, a list of energy awareness measurement attributes should be established in order to quantify the level of awareness. In future research, it is important to measure the energy awareness among the users so that stakeholders can introduce the energy awareness raising program according to their level of energy awareness. Researcher is currently working on a project to conduct nationwide survey on the level of energy awareness in Malaysian University.

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The Energy Knowledge and Conservation Behaviour Among Community in University

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Abstract— Overriding energy issues such as energy security, high energy price and environmental degradation which threatening the exhausted planet are attracting global concern. The utmost energy-related issue is climate change which proved mainly caused by fossil fuel combustion. The world energy sustainability is challenged by many of these energy related issues. One of the immediate and effective solutions to prolong energy sustainability is to reduce the ever increase energy demand through energy conservation activities. Generally, there are two approaches in conserving energy which are structural (technological) and non-structural (human behaviour). Although technological innovation may somehow improve the energy efficiency, it remains a doubt whether it could solve all the energy problems in long term. Thus the most effective and cleanest solution to global energy issues must look beyond the technological innovations and consider the energy conservation behaviour. Before embarking on any research to improve and instil user's energy conservation behaviour, it is important to measure the level of knowledge and conservation behaviour within the organization. For that reason, this paper was crafted to reveal the level of energy knowledge and conservation behaviour among the community in University. For this study, Universiti Teknologi Malaysia (UTM) has been selected as the case study as she avidly to become a sustainable university. This study is part of the university's efforts in achieving sustainability status, as has been highlighted in the UTM's Carbon Footprint Project. The findings of this survey suggest that the university community has poor energy knowledge and lack of energy conservation behaviour practically.

***Keywords*—Energy Conservation Behaviour; Energy Sustainability; Social Responsibility**

I. INTRODUCTION

Today, among the current emerging global energy issues are: roller coaster energy prices, depletion of energy resources, unpredictable energy supplies, host of major environmental problems and other energy-related problems. All of these are attracting public's utmost concern and hungry for solution. In fact, they have become the focus in many global discussions such as Kyoto Conference, Johannesburg Earth Summit, Bali Global Warming Conference as well as in the latest United Nations Climate Change Conference 2009 in Copenhagen (COP 15).

Generally, all these energy-related issues can be classified as energy sustainability issues. As defined in Bruntland report, Our Common Future (1987), "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs [1]." When approaching sustainable development, energy consumption represents a major challenge [2]. The current pattern of overconsumption of natural resources is threatening the sustainability status [3]. As according to [2], the world might be impossible to reach the journey of sustainable development if the patterns of energy consumption remain no change. Hence, energy acts as the main contributors and drivers for the world to achieve sustainable status.

Consider which various energy-related issues are threatening the energy sustainability, energy conservation, is one of the immediate solutions [4, 5, 6, 7]. According to [8], the world must consume less energy to build a sustainable society. According to [9], "the cheapest, fastest and cleanest energy by far is through energy conservation". In reality, perhaps it is naïve to claim that energy conservation is a single solution which able to completely solve all the energy issues; however, it can immediately ease the strain on our environment and prolong the time frame for the scientist to discover new energy resources [7]. For now, energy conservation is fair enough to be claimed as one of the prominent solutions for these overriding energy issues.

In general, energy conservation means "using less of energy service and therefore saving the energy that would be needed to provide it" [10]. Energy conservation focus on human behavioural approach always provides promising results. As according to [11], human behaviour is an essential ingredient in energy conservation activities whereby an energy cost saving can be obtained by anything up to approximately 10 percent if building users can be persuaded to more energy conserving. An experiment study carried out by [12] reveals the similar result which 5 – 10 percent of energy savings can be obtained by improving energy use behaviour. Other study conducted by [13] reveals the same result (10 percent of electricity reduction can be easily achieved through the process of improving of user's energy-use behaviour).

The significance of embracing energy-use behaviour has been mentioned and reported by many researchers. A survey carried out by [14] revealed that one of the successful criterion to generate saving is to focus primarily on behavioural changes. The study by [15] suggested that the participants' energy use behaviour has been improved after their participation in the energy related project. Another study performed by [16] in the Universiti Putra Malaysia reveal that the students' behaviour is the major contributor to large amount of energy wastage in the higher learning institution.

Realizing the potential of behavioural approach, this article conducts a preliminary study to measure the level of energy knowledge and energy conservation behaviour among the community in the Universiti Teknologi Malaysia. The results of this study serve the purpose to provide a general view on campus community's energy knowledge and energy conservation behaviour; this will contribute to provide an insight in appropriate planning of any energy related program.

II. CURRENT STUDY

In order to assess and examines the level of knowledge and energy conservation behaviour, a preliminary survey was conducted. A questionnaire survey was conducted in Universiti Teknologi Malaysia. To the extent that there has been limited research in measuring the level of knowledge and energy conservation behaviour among the community in UTM, this survey is important to explore to which extend the community's common knowledge about energy issues, energy production, energy resources, and energy saving tips particularly in lightings, air conditioning, and computer; this survey is too to measure how far the energy conservation behaviour is practice among the community.

III. METHOD

A. Participants

All the participants are from the community of UTM. Total of 350 sets of questionnaire were distributed in the UTM and only 166 sets of questionnaire were returned; the response rate is approximately 47.4%. Based on the questionnaires received, the majority of participants were students in which the participants were 20 staffs and 146 students. All the participants answered the questionnaire on voluntarily basis.

B. Procedures and Measures

A set of questionnaire was prepared which takes approximately ten minutes to answer. The questionnaire is adopted and modified from [9]. The questionnaire comprised four sections, namely Section A, Section B, Section C and Section D.

Section A consisted of general background information related questions, including gender and department. Also, respondent is required to identify himself either as student or staff.

Section B consists of cognition questions which intends to investigate respondent's energy knowledge. Questions in section B were briefly grouped into two parts: the first is the general knowledge about energy issues including current energy price, energy resources, electricity consumption rate and other energy related questions; the following part is the questions about energy saving tips for the three main energy consumption sources, lighting, air-conditioning, and computer.

Then, the section C is regarding the respondent's energy conservation behaviour. Respondents are enquired to self evaluate energy-conservation behaviour that they embraced. Section C consists of questions about energy behaviour in three main areas: lighting, air conditioning, and computer. All the questions in section C were assessed using five-point scales (e.g., 1, never=0 case in a month; 2, rarely= at least once in every month; 3, occasionally= at least once in every two weeks; 4, often= at least once in every week; and 5, always= at least once in every 3 days). Given instances here, respondents were asked about "I turn off the computer when I go out for lunch", "I switch off the monitor whenever I do not use it".

It is worry that the bias will occur in answering self-evaluating questions as in section C. The rationale is that people tends to be dishonest when evaluate themselves but act much more fair when they being asked to judge others. If this is happen, it will possibly invite untruthful answers. Therefore, questions in section D ask about the respondent's opinion and observation about peers' energy conservation behaviour. The questions in section D are similar to the questions in section C; only that section D is question about the respondent's opinion about their peers. Given instances here, respondents were asked about "I notice people turn off the lights and fans when they leave their room for a short period", "I notice people set the computer to sleep mode after 10 minutes of inactivity automatically".

To analyze data collected from the preliminary survey, frequency analysis was used. The gain scores from the analysis were used to interpret community's energy knowledge and energy conservation behaviour.

IV. RESULTS AND DISCUSSION

The result and discussion were divided into two parts: energy knowledge and energy conservation behaviour.

A. Energy Knowledge Among Community in UTM

Data gathered in section B are submitted for frequency analysis. The rationale is to measure the level of how many percentage of the respondents hold energy related knowledge and how many are not. Assumption was made that the respondent has particular energy related knowledge if he or she answered the question correctly and score 1 will be given; conversely, respondent is assumed do not have the particular knowledge if he or she answered the question incorrectly or do not know the answer, in this case, score 0 will be allocated.

Table I shows the result of analysis for section B. For the first eight questions regarding the knowledge about energy, majority of the respondents answered incorrectly; only 6% to 38% of them able to provide the correct answer. Q-K6 which regarding petrol price in Malaysia is an exception, it is 54.2%.

For the two questions about energy saving knowledge on lightings, respondents score average which about half of the respondents able to provide the correct answer while the other half unable to.

There are total of three questions were ask in regarding to the energy saving knowledge on computer and three about air conditioning respectively. As reported in the table, respondents score low for all the three questions about energy knowledge on computer; ranging from 11.4% (19 out of 166) to 49.4% (82 out of 166). Similarly, scores for the questions which answered correctly about energy knowledge on air conditioning are as low as others. Most of the respondents unable to answer the questions correctly; the percentage of which the questions being answered correctly is at less than 50%. Among the total of 16 questions stipulated in Section B, only question about the petrol price in Malaysia scores more than 50% which is slightly more than it, 54.2%. Respondents are do not know or aware and updated about the current energy knowledge; which out of the 16 question except the Q6, the scores is ranging from as low as 6% to 50%.

Overall, such results reveal that the community do not poses good energy knowledge, either in general energy knowledge or energy saving knowledge on lightings, computer, and air conditioning. The following section reveals the community's pattern of energy use behaviour.

Table I.
Frequency Analysis of Energy Knowledge among Community in UTM

	Without Knowledge	With Knowledge	Answered Correctly
Knowledge about energy			
Q-K 1 : Oil Price	134	32	19.3 %
Q-K 2 : Carbon Emission Reduction	156	10	6 %
Q-K 3 : Carbon Emission Source	106	60	36.1 %
Q-K 4 : Energy Supply in Malaysia	103	63	38 %
Q-K 5 : Energy Source in Malaysia	147	19	11.4 %
Q-K 6 : Petrol Price in Malaysia	76	90	54.2 %
Q-K 7 : Coal Burning to Generate Electricity	136	30	18.1 %
Q-K 8 : UTM's Energy Cost	155	11	6.6 %
Energy Saving Knowledge: Lightings			
Q-L 1	50	50	50 %
Q-L 2	85	81	48.8%
Energy Saving Knowledge: Computer			
Q-C 1	84	82	49.4 %
Q-C 2	123	43	25.9 %
Q-C 3	147	19	11.4 %
Energy Saving Knowledge: Air Conditioning			
Q-A 1	90	76	45.8 %
Q-A 2	139	27	16.3 %
Q-A 3	147	19	11.4 %

B. Energy Conservation Behaviour Among Community in UTM

As explain in earlier section, questions in Section C are about respondent's energy use behaviour and Section D about respondent's point of view about their peers. In present context, we found that the respondents tend to rank higher score for themselves in comparing to their peers. Such scenario is not rational for respondent have very low energy knowledge towards the relevant behaviour. Another justification is that respondents declare themselves poses more positive energy conservation behaviour than their peers. Making assumption that if the respondent poses positive energy use behaviour, their peers should ranked them as so. However, it did not happen. It is not surprise to find out that people are much more genuine when evaluate others compared to evaluate themselves. Hence, we question about the reliability of data in Section C as it may contain biases, therefore, we have decided to exclude them from the results.

To analyze data in Section D, frequency analysis was conducted. There were total of nine questions distributed in this section. Overall, the results revealed that the community did not have appropriate energy use behaviour. The results of analysis indicate that out of the 166 respondents, majority of their peers did not practice even once in a month for all types of energy use behaviour as stipulated in the questions. Based on the 105 out of 166 respondents' declaration, there is 0 case happened in a month which their friends advice them not to waste electricity. For the energy use behaviour in relation to the air conditioning, only 1.8% of people always (at least once in every 3 days) raise the temperature of air conditioning when the room is overcooling; 55.4% of them are never (0 case in a month) adjust the temperature to 24-26 C to maintain its comfort level; and also approximately 41.6% of them will left the air conditioning turned on when they leave the lecture hall while only 2.4% will make sure it is turned off. Besides, the results also indicate poor lighting use behaviour; the respondents reveal that they notice 62% of their peers never turn off the lights and fans when they leave the room for a short period of time. Similar goes to the energy use behaviour for computer; approximately 59% of them do not turn off the computer when they go out for lunch; only 1.8% of them always set the computer to sleep mode after 10 minutes of inactivity automatically while 94 out of 166 of their peers are never; and majority of their peers (51.8%) did not switch off the monitor whenever they do not use it. Generally, the overall results suggest that majority of the community did not practice good energy conservation behaviour.

V. LIMITATION AND RECOMMENDATION

The present study posses some limitations that must be acknowledged and overcome in future study. Firstly, the size of sample for this study was relatively small (166 samples) to represent the community. Besides that, the samples are mixture of two distinct groups of respondent:

student and staff. The energy use behaviour for both categories may vary as the campus is learning and living environment for student but it is only a working environment for a staff. Hence we are recommending that future studies in relevant topic of interest should enlarge the size of sample and conduct the study according to specific group to enhance the predictability and reflectivity of the results. Also, the design of the questions should avoid asking self-evaluation question for greater generality of the results.

VI. CONCLUSIONS

In conclusion, the results of the preliminary study suggested that the community has low energy knowledge about the energy issues and energy saving methods for the lighting, air conditioning, and computer. Also, the results indicate that the energy conservation behaviour among the community is not encouraging. Poor energy conservation behaviour always contributes to large portion of energy wastage which resulted in poor energy efficiency performance and expensive electricity bill. Hence further efforts are needed to improve the level of energy knowledge and energy conservation behaviour among the community for better complementary of the university social responsibility as well as to serve a greater energy sustainable future for tomorrow's generations.

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The Conceptual Model of Energy Awareness Development Process: The Transferor Segment

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Energy awareness is the first step to achieve energy sustainability. Without energy awareness, effort in energy conservation can be difficult and leading to energy wastage. This paper intends to introduce the Conceptual Model of Energy Awareness Development Process (CMEADP) as a guide for facilities and energy managers to raise energy awareness and improve energy-use behaviour among the building's users in Malaysian university. The CMEADP consisted of two segments: receiver dominated segment that represents the energy awareness achievement process and transferor dominated segment that represents the energy awareness development process. Each of the segments consist a sequence of core processes. This paper focus on the transferor dominated segment which play an essential role in creating energy awareness and lead to energy saving.

I. INTRODUCTION

At the beginning of 21st. century, the issues of sky-high energy prices, depreciation of energy resources, environmental disturbance and energy conflicts have reminded people about the needs for a sustainable energy-use. World Commission on Environment and Development (1987) defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs [1]. Goldemberg *et al*. (2000) have extended and related the definition to energy with two important arguments [2]. Firstly, the importance of adequate energy services for satisfying basic human needs, improving social welfare, and achieving economic development. Secondly, the production and use of energy that should not endanger the quality of life of current and future generations and that does not exceed the carrying capacity of ecosystems. One way to achieve a sustainable energy development is to save energy, to reduce wastage, and to extend the time for the world to resolve energy issues. These are part of energy management.

Energy management is gaining recognition, although it is neither a new term nor a new idea. According to Capehart *et al.* (2005), energy management is the judicious and effective use of energy to maximize profits or minimize costs and enhance competitive positions [3]. Conservation steps taken by businesses – switching off lights, removing lamps from fixtures, reducing night time illumination of facade, signs and advertising offers a practical approach to an ongoing problem in respect of the effective and efficient use of energy resources (Harrold, 1993) [4].

II. BEHAVIOURAL APPROACH VS TECHNOLOGY APPROACH

Basically, there are two common approaches to energy management, namely the behavioural approach and the technological approach (Wong, 1997) [5]. The technological approach refers to the application of technology instruments which normally involve large-scale investment. These include introducing a new process, automation system, or installing large energy-saving devices such as heat recovery system, new building design, inverter, pre-heater, motion sensor, and building envelope system. In the technological approach, the payback period is a significant issue. The 'return on investment' must be decided first before implementing any technology. The technological approach is effective in conserving energy and the results can be observed within a short period of time. However, the initial cost of technological approach is high and not suitable for an organization that has a limited budget. Since technological approach requires no behavioural changes among users, it means that a user could still waste energy in the same way. As we develop physical technologies to improve energy efficiencies, we only migrate the effects of energy use by human, not curing the energy problem we are experiencing (Kempton and Schipper, 1994) [6]. Using technological approach may seem impressive and attractive. However, it is not the unique answer to achieve energy sustainability. Regardless of the method selected for achieving energy savings, either completes system replacement or modification of an existing system, it is important to consider the human aspect of energy conservation (Shinskey, 1982) [7]. Owens (1987) noted that it is people who use energy indeed [8]. It is, therefore, important to consider the human aspect of energy conservation. To encourage and change people's behaviour to conserve energy is, thus, a question of behavioural approach.

The literature in the energy use reveals the vitality of behavioural approach in any energy conservation programme whereby energy use is regarded as a key success factor in energy management (Dahle and Neumayer, 2001) [9]. Compared to the technological approach, the behavioural approach can be effective and can make a significant difference in energy conservation (Wedge, 2003) [10]. Experiments have shown that 5-10% of the domestic energy use can be saved by appropriate use behaviour (Loozen and Moosdijk, 2001) [11]. This means, by monitoring people's behaviour, there is a great chance to improve energy efficiency. Hansen (2002) mentioned that people is the main factor in energy efficiency [12]. Furthermore, a survey on successful school energy-conservation programs in Tuscon revealed that one of the successful criteria to generate saving is to focus primarily on behavioural changes (Gaballa, 1996) [13]. However, facilities managers and plant operators tend to be sceptical about behavioural approaches, and have little understanding about them and their potential (Geller *et al*., 1982) [14]. For that reason, they have a tendency not to pay attention to the benefits of behavioural approach.

III. AWARENESS: THE SEED FOR TOMMORROW'S CHANGE

There are tremendous opportunities in the behavioural approach to energy conservation by engaging users with issues such as attitudes, knowledge, awareness and skills (Vesma, 2002) [15]. However, the initial step towards behavioural changes is to raise awareness as it is the seed for tomorrow's changes (Wong, 1997) [16]. Without awareness, there will be no realistic action to conserve energy. One noteworthy report had stated that it is important to raise awareness in the energy sector (United Nations Environment Programme, 2007) [17].

Awareness is defined as having knowledge or realizing something (The Microsoft Encarta Dictionary, 2005) [18]. Lack of knowledge or awareness is always the key barriers for energy inefficiency (Yik and Lee, 2002; Yik *et al.*, 2002) [19] [20]. Dahle and Neumayer (2001) disclosed several influential factors that become a barrier to greening process such as financial, cultural and urbanization [21]. Awareness was the second barrier to the greening process. The behavioural change, and thereby cultural change, cannot be expected to take place unless people are aware to do so. This indicates that people will not take any steps to conserve energy if they are not aware of the importance of energy saving.

In the past, awareness has been promoted as a method to conserve energy in higher learning institutions. For instance, the Imperial College of Science, Technology and Medicine, in London, has defined objectives to focus on raising staff and student awareness about energy conservation issues as a strategy to help protect the environment through more efficient energy use and to save money on fuel bills (Pancucci, 1998) [22].

IV. ABSENT OF MODEL REGARDING ENERGY AWARENESS DEVELOPMENT PROCESS

Review of literatures indicates that there are no theories and models designed specifically in raising energy awareness and improving energy-use behaviour. In fact, most of the available theories and models attempted to reveal the process of how respondents interpret information and change behaviour rather than what should be done to change their behaviour. One example is the learning theory which focused on how people learn rather than how to trigger and create the learning needs, see Weiss (1968) [23], Lawrence and Festinger (1962) [24], Wexley and Latham (1991) [25], Barker (1997) [26] and Buckler (1996) [27]. The perception theory on the other hand, explained on how people receive and select information through the senses instead of how to prepare interesting materials to grab receiver's attention, see Devito (2000) [28] and Adler and Rodman (1991) [29]. Although the Information Processing Theory and Three Term Condition Theory are able to provide more detail processes on how people interpret information and use them to decide how to perform, there are no related activities or tasks associated with the proposed processes, see Bourne and Bruce (1976) [30], Schmidt (1991) [31], Wogalter and Laughery (1996) [32], Maag (2004) [33] and Kahn, (1999) [34]. Perhaps, the Persuasive Communication Model is much closer to the awareness development process., refer to McGuire (1968) [35], Eagly and Chaiken (1993) [36] and Banyard (1999) [37]. However, the model only shows the key process and do not further explain the detail activities associated with each of them. Moreover, the major focus is still given to the respondents.

In overview, the existing theories and models are merely explained the process regarding 'how respondent change their attitude and behaviour", which is the internal process. None of them examine the processes or procedures of "how to change respondent's attitude and behaviour" which is the external process. In other words, the models and theories reviewed only focussed on respondent's 'reaction' instead of paying attention to the administrator's 'action'.

V. OVERVIEW OF THE CONSTRUCTION PROCESS OF THE CONCEPTUAL MODEL OF ENERGY AWARENESS DEVELOPMENT PROCESS (CMEADP)

Realizing absence of such model, the Conceptual Model of Energy Awareness Development Process (CMEADP) was developed to fulfil the academic and industry demands. The construction of conceptual model of energy awareness process consists of five significant stages. These include Stage I: Identified the elements of energy awareness process, Stage II: Development of the CMEADP, Stage III: Verification of the CMEADP, Stage IV: Validation of the CMEADP and Stage V: Establish the effectiveness of the CMEADP. The following discussions summarize these five stages.

The initial step to develop the conceptual model began by setting up the theoretical framework and identifying the

elements of energy awareness development process. In this case, a set of elements were identified. These included core processes, common practices, activities and supporting factors.

Then, in stage II, the researcher conducted an investigation on various modelling methods. In which the Process Flow Chart (PFC) was considered as the most suitable model for the purpose of this study. The rationale for selecting the PFC as the modelling techniques was it satisfied the listed perspectives and characters of the energy awareness development process. Moreover, it is user friendly, easy to understand and can be modified to fit other needs.

The third stage attempted to verify the conceptual model through interviews with the experts. The purpose of verification' is to ensure the model was developed through the right process (correctness of the model). In this research, 10 energy experts from Malaysia Energy Centre (PTM), Centre for Education and Training in Renewable Energy and Energy Efficiency (CETREE), Energy Commission and National Energy Convention were invited. A careful and comprehensive interpretation of the interviews confirmed that the CMEADP had achieved verification. The key outcome of this objective was an improved version of the Conceptual Model of Energy Awareness Development Process Model (CMEADP).

The fourth stage intends to validate the CMEADP, the purpose of validation is to ensure the research builds the right model that matches the industrial needs (applicable of the model). In this case, the CMEADP was tested for its feasibility. A list of questions on model's feasibility was designed and distributed among the departments responsible for energy management in public and private universities in Malaysia. The study had confirmed that most of the universities which participated were interested to implement the CMEADP in which they agreed that it will work probably in raising energy awareness and improving energy-use behaviour.

In the final stage, an experiment was conducted to study the effectiveness of the CMEADP in raising energy awareness and improving energy-use behaviour. Effectiveness of the model was determined by looking at whether there is a significant improvement between the control group and experiment group right after the treatment of CMEADP. Groups that received different treatments yielded different results of energy awareness and energy-use behaviour. The findings indicated that there was a significant improvement on energy awareness and energy-use behaviour among the experimental groups compared to the control group. For details description of the research methodology, refer to Choong (2008) [38]. See Figure 1 for the output of this research.

VI. THE CONCEPTUAL MODEL OF ENERGY AWARENESS DEVELOPMENT PROCESS (CMEADP)

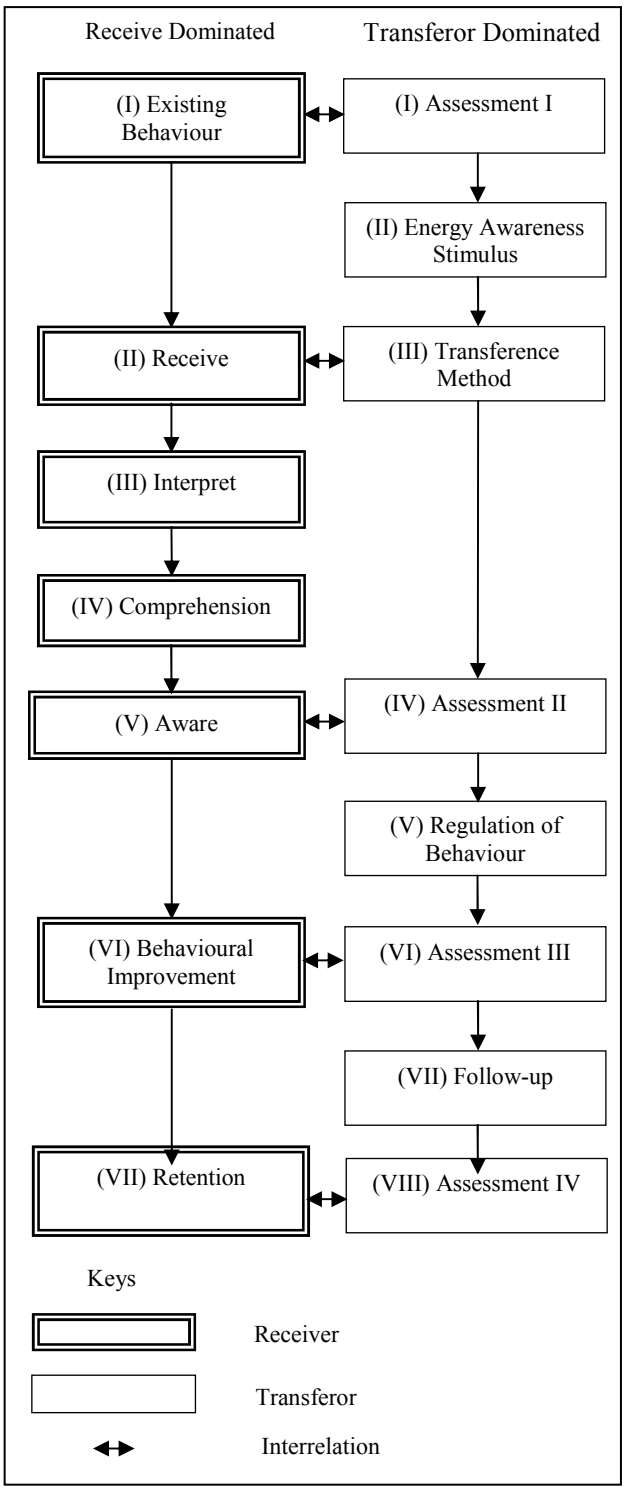

Figure 1: Conceptual Model of Energy Awareness Development Process

The Figure 1 depicts the Conceptual Model of Energy Awareness Development Process (CMEADP) that incorporates the role of 'transferor' and information-processing sequence of 'receiver'.

"Communication is transactional (Devito, 2003) [39]." In this model, one implication of viewing the relationship between the respondent (person who receive and develop awareness) and the administrator (person who raise awareness and implement the changes) is seen as receiver and transferor. Basically, the entire model is divided into two segments – 'Receiver Dominated' and 'Transferor Dominated' and each of the segments consists of a sequence of core processes.

'Receiver Dominated Segments' refers to the awareness achievement process by receiver. Such process cannot be monitored directly by others and is self-achieved (internally) by receiver. Receiver refers to respondent or participant, either as individual or group, who is the target in energy awareness development process. Anyhow, this paper merely focusing on the awareness development process which is the "transferor dominated segment".

VIII. TRANSFEROR DOMINATED SEGMENT

Transferor is defined as conveyor, somebody to transfer and develop awareness to another person (receiver). 'Transferor Dominated Segment' refers to the awareness development process conducted by the transferor. In the transferor dominated segment, the transferor is able to control, develop and monitor the energy awareness development process. The following section discusses the justification and functions of each core process associated with the transferor dominated segments.

A. Assessment I

Assessment is needed to evaluate the effectiveness of energy awareness development process in different stages. The assessment is significant as we cannot change something that is not able to be measured. Only through assessment, transferor could review, improve and correct performance for better awareness achievement. Assessment can be conducted by using various techniques. "It may occur one-on-one questioning of learners, one-on-one demonstrations of ability during or after instruction, or questionnaires to assess changes in learner attitudes (Rothwell and Kazanas, 1998) [40]." Whichever method to be used depends on the assessment's purposes and strategies. Since the assessment's results will be used for future references, therefore, administrator must properly keep track and maintain the records.

On the whole, there are four assessments throughout the model. The first assessment begins before any energy awareness development process is carried out. It is a pre-survey or pre test to serve as the baseline for later comparison and evaluation. In assessment I, transferor has to collect information about respondent's pre energy awareness and energy-use pattern (Existing Behaviour). The rationales of doing so is to find out user's existing energy-use attitude and practice, to use the assessment results to design the program, to initiate and prepare users for the coming change and to gather users' favourite energy information and transference methods.

In the later stage, collected information will serve as the basis for the transferor to compare responses about energy use behaviour before and after the treatment. By doing so, the transferor can evaluate the effectiveness of the treatment in changing people's habits. Examples of the criteria to be assessed in the first assessment include: Background information; General energy knowledge; Willingness to participate in energy conservation programmes; User's energy concern; Types of energy knowledge that they intend to know; Existing energy-use practices, general awareness of energy-use; Energy conservation concept; Current energy issues; User's best and favourite communication channels and other such factors.

B. Energy Awareness Stimulus

Based on the classic stimulus-response (S-R), the first step to raise awareness is to present the appropriate stimulus. Stimulus is incentives- something that encourages an activity or a process to begin, increase or develop. There are various kinds of stimulus, for example: A very simple motivation sticker saying that "the best way to predict the future is to help create it"; The cover story of newspaper about the sky high crude oil price; Seeing others practicing energy conservation to reduce energy bills by; Fear and concern about the global warming issue.

Every energy awareness stimulus brings out certain information and knowledge. Indeed, it is the information and knowledge that help receivers to achieve awareness and shape energy conservation behaviour. Basically, providing effective energy information is able to raise energy awareness although it is still not good enough. Nickerson (2003) [41] has argued that simply providing consumers with information about ways in which they can reduce their use of energy, or attempting to persuade them to conserve, has resulted in reductions in some, although not all.

Energy awareness can be developed by transferring message that consists of relevant knowledge and information. "A message is the stimulus produced by the sources (Seiler and Beall, 2003) [42]." Studies had mentioned the significance of providing the relevant knowledge. "Barr (2007) [43] states that knowledge for action is a significant prerequisite for behaving in appropriate manner and would be a significant barrier to action if knowledge level were low." "People cannot be concerned about environmental issues if they do not know about them, and they cannot be faulted or behaving in environmentally detrimental ways if they are unaware of the

implication of specific form of behaviour (Nickerson, 2003) [44]."

Generally, it is not wise to say that receiver would be highly energy aware if they know what to do. "In a warning research, Leonard *et al*. (1999) [45] explained that many workers are injured when they fail to lock out properly the power to the machinery that they are repairing." Most of the injured workers had been trained on lock out procedures and 'knew' what to do, but nevertheless, they 'forgot' or are still not aware of the relevant hazards at the proper moment. Therefore, it is not enough to simply provide receiver with energy knowledge or information as other process needs to be taken into consideration as well.

C. Transference Method

The proposed energy awareness stimulus in the previous stage is not useful if they are not being transferred to receiver. Considering the 'Medium' proposed by the Yale Group (Banyard, 1999) [46] in the key features of persuasive message, the researcher includes the 'Transference Method' as a core process in energy awareness development process. Basically, it is a technique or communication channel to effectively transfer the energy awareness stimulus to receivers. Devito (1996) [47] defines communication channel as "the medium through which a message passes." It serves as the bridge for the information and message to cross over to the receiver. To develop energy awareness, both transferor and receiver need to be available. The responsibility of the transferor is to effectively transfer the energy awareness stimulus. On the other hand, the responsibility of the receiver is to receive the stimulus. The transference method is the intermediate between transferor and receiver. There are many types of transference method, such as lecture, printed material, multimedia, displaying material, role play and demonstration. In fact, each of them has its strengths and weaknesses. Consideration of the limitation and advantages of the approach is essential when selecting the appropriate transference method.

D. Asessment II

"It was noted that some members of a target group adopt awareness more quickly than other members, even when all members of the target group are exposed to the advocated change more or less at the same time (Zaltman and Duncan, 1977). [48]" After receivers obtained information from the transferor, they will interpret, comprehend and achieve awareness. However, as noted earlier, each individual is different and such difference may be vary among groups too. For that reason, the level of achievement may differ among each receiver. Assessment II begins right after the transferors convey information to the receivers. The purpose of assessment II is to measure the receivers' level of awareness and success of the transference process. The rationale for carrying out the Assessment II in this stage is if the transferors wait until the process ends before evaluating it, transferors may find out that certain aspects of the programme are not effective or incorrect. By that time, it may be too late to correct it. Therefore, Measurement is needed in this case to measure or test whether the respondents had achieved awareness.

In Assessment II, examples of criteria to assess include the level of energy awareness; Willingness to participate in future energy conservation programmes; User's concerns; Understanding on previous delivered energy information, knowledge and message; Energy conservation concept and other criteria.

E. Regulation of Behaviour

Although receiver had gained awareness in the previous stage, it is not enough because awareness do not guarantee improvement in behaviour. "It is easier to change a participant's knowledge about energy and conservation than it is to change their attitudes (Smith, 1978) [49]." For instance, many smokers continue to smoke even when they are aware (having knowledge and realize) that smoking is harmful to their health. Similarly, those who are aware about the importance of energy saving and knew energy saving techniques might not practice them.

The core process namely 'Regulation of Behaviour' dominated by transferor is derived based on the motivation stage in the Information-Processing Model proposed by Wogalter and Laughery (1996) [50] and 'Consequences' stages in the A-B-C Model proposed by the Kahn (1993) [51]. Behavioural regulators are needed to strengthen the association between a response and preceding stimuli for the purpose of increasing the level of awareness and enforcing behavioural improvement. In this context, reinforcement and punishment are needed. Reinforcement is a consequence that causes behaviour to occur with greater frequency, more often referred to as incentive, motivation and rewards. On the other hand, punishment is a consequence that causes behaviour to occur less frequently, which refers to disincentives. Turning off unused light, riding bicycle to work, buying energy efficient product and hibernating computer are all operant behaviours having relevance to the pro energy conservation behaviour. Indeed, they are behaviours that we approved of and should be increased. "The phenomenon of increasing responses by manipulating response consequence is known as the 'Reinforcement' (Cone and Hayes, 1980) [52]." On the other hand, leaving unnecessary unused light, having poorly maintenance, using inefficient electrical equipment and overcooling are all energy wasting behaviour that we do not approve of and should be decreased. In this case, 'Punishment' can play a significant role in reducing the unwanted behaviour or effect. Reinforcement and punishment are umbrella terms in behavioural psychology. It can be understood more simply if we look at the elements that fulfil the function of the terms 'Reinforcement' and 'Punishment'. In this case, 'Incentives' is

to fulfil the function of reinforcement which increases the likelihood of anticipated behaviour; on the other hand, 'disincentives' is the function of punishment to decrease the occurrence of unwanted behaviour. "Zirpoli and Melloy (1997) [53] provide a very useful explanation on how to use reinforcement and punishment effectively." When most rules state that what *cannot do*, then the focus of transferor attention will likely be on the punishment of inappropriate behaviours. Vice versa, when the rule states what *can do*, then the transferor should focus on the motivation or rewards of appropriate behaviour.

F. Assessment III

Assessment III intends to measure the level of behavioural improvement of the respondents, either from squander to conserve or from depreciate to appreciate. Energy awareness development process is not complete until it is apparent that the targeted group practice energy awareness. "According to Mcmakin and Lundgren (1999), at the end of the campaign, the transferor should understand two fundamental things: First, is to what extent the people took actions that reduced energy use (including action taken) and second, the effectiveness of various activities and communication in prompting those changes. [54]" Therefore, it is necessary to conduct another assessment regarding user's behaviour. Overall, the results will be able to indicate the effectiveness of the model. Examples of criteria to assess include: User's energy-use behavioural improvement – to what extent the users took actions to reduce energy use; Are users doing anything differently now as a result of the energy awareness increment; The effectiveness of model (such as energy awareness, transference methods and regulation of behaviour) in prompting those changes; The financial impact of the CMEADP- the amount of energy saved.

G. Follow-up

As is generally accepted, "Raising energy awareness is a continuous effort (Hein and Jacobsen, 2001; James, 1977) [55] [56]". The energy awareness development process model, regardless of how effective, is not of much help if receivers revert to their former behaviour when the programme ends. Reverting to the model, by this time, receiver should have appropriate awareness and is willing to make behavioural changes to conserve energy. However, maintaining continuous awareness and energy conservation behaviour is thus another challenge. Munson (1984) [57] argued that "as time goes on, the probability of 'self implementation' will decline." "Dick-Larkam (1977) [58] states that people have, however, very short memories for these things and easily drop back into old ways." In fact, it is very easy for the receiver to forget about energy awareness and practice energy-conservation. Wong (1997) [59] mentions that forgetfulness is a great enemy of energy efficient behaviour". "It is clear that many changes in behaviour resulting from reinforced practice do indeed persist over very long periods, but in some cases, changes in behaviour that would otherwise qualify as learning do not persist more than minutes (Walker, 1996) [60]." Therefore, the energy awareness development process does not end even after the receiver had improved their behaviour. The transferor should continuously monitor and maintain receiver behaviour, evaluate the programme itself and keep on motivating them to put their learning to daily life. "Hein and Jacobsen (2001) state that changing of habits demand prolonged and continuous activities in order to have impact and in order to maintain the new habits after the campaign is over. [61]" "In fact, challenges aspect of energy-efficiency programs aimed at changing behaviour is sustaining new behaviours over time (Mcmakin *et al.*, 1999). [62]" "Wade (1995) mentions the importance of tracking ongoing follow-through in his high-impact training model. [63]" In general, the purpose of 'Follow-up' is to refine and reinforce the previous phases for the purpose of sustaining receiver's willingness to continue their energy efficient lifestyles. There are two sub sections under this category: (1) Reminder and (2) Feedback. The bottom line of reminder is to cause receiver to remember, put in mind and recap them about the significance of practising energy conservation. Reminders can range from a simple notice, letter, and booklet to complete lecturing. On the other hand, feedback is the return of receiver's opinion on quality of the programmes and relevance of their new learning. At the same time, feedback functions as self evaluation. It is an activity that calls upon the participants themselves to make a post evaluation after they complete the programme.

H. Assessment IV

The final assessment intends to measure the level of continuous compliance of the receivers. The challenging aspect of energy-efficiency programs aimed at changing behaviour is sustaining new behaviours over time. People were enthused at the beginning of the programme, however, as the time went on, enthusiasm waned and behaviour reverted. As people are likely to forget and drop back to their existing behaviour, there is a need to measure the level of continuous compliance after the treatment. Transferor must understand that temporary behavioural improvement is not enough, he or she needs to ensure that the receivers will continuously embrace and practise energy conservation efforts. Through the assessment, transferor will gain a better understanding regarding effectiveness of the treatment and also, the extent to which the expected results were achieved. The criteria to be assessed include: The level of continuous comply; receiver's energy awareness over time; Receiver's energy-use behaviour over time; Sustainability of the CMEADP and willingness of the users to continue their energy-efficient lifestyles after the treatment.

IX. CONCLUSION

The paper presents the transferor segment of the Conceptual Model of Energy Awareness Development Process (CMEADP). It is part of the Doctoral research and has been verified and validated through expert and practitioners review

(Choong, 2008) [64]. Nevertheless, since people behaviour is unique and different from each other, the CMEADP therefore is not universal and may be adjusted by user's needs. To ensure sustainability of the CMEADP, continuous improvement is needed. Researchers may consider updating the components of the model periodically so it would be sensitive and would match the market needs. The model is designed to raise energy awareness and improve energy-use behaviour in the universities. Therefore, it is possible to apply the model in organizations with similar characteristics, such as school, colleges and other education centres with modification and refinement. The future research may look at how the CMEADP could be modified and applied in other industries, such as construction and manufacturing.

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Model dan Konsep Universiti Lestari

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Abstrak

Pembangunan kampus lestari merupakan cabaran yang besar kepada pihak universiti tempatan. Memandangkan terdapat banyak perbezaan definisi dan tafsiran konsep yang wujud, maka terdapat juga banyak perbezaan di antara strategi-strategi yang boleh diambil oleh universiti tempatan untuk menjadi kampus lestari. Berbanding dengan universiti tempatan yang masih berada pada peringkat inisiatif, kebanyakkan universiti luar negara telah mengambil pelbagai langkah untuk menjadi universiti lestari. Langkah-langkah lestari dilaksanakan adalah berdasarkan model serta konsep universiti lestari yang dibangunkan dan diperkenalkan oleh pakar lestari. Antaranya termasuk 'Model Pengelasan Universiti Lestari', 'Cadangan Model Universiti Lestari', 'Dimensi daripada penyelidikan dan projek pembangunan Universiti Lestari' dan 'Rangka untuk Model Universiti Lestari'. Penulisan tersebut bertujuan untuk mengulas pelbagai model lestari universiti dan mengkaji ciri-ciri universiti lestari melalui perbincangan literatur yang menyeluruh.

Kata kunci: *Universiti Lestari, Model Lestari, Pembangunan Lestari*

Abstract

Sustainable campus development is a great challenge to Malaysian universities. There are many different definition and interpretation towards the sustainable concepts. As for this reason, paths and strategies that could be adapted by local university to become sustainable university are very different. Many foreign universities had taken numerous steps to become sustainable university. On the other hand, Malaysian university is still at initiative level. Sustainable steps taken by them is based on models and concepts of sustainable university which introduced by sustainable experts, including 'The Sustainable University Classification Model', 'The Proposed Sustainable University Model', 'Dimensions of the Research and Development Project Sustainable University" and 'Framework for Sustainable University Model'. This paper intends to review various sustainable university model and characteristics of sustainable university through comprehensive literature discussion.

Keyword: *Sustainable University, Sustainable Model, Sustainable Development*

I. PENGENALAN

Konsep pembangunan lestari wujud daripada kesedaran di kalangan masyarakat terhadap kepentingan pemuliharaan dan pemeliharaan sumber alam sekitar. Menurut Omar (2005), kebanyakkan aktiviti pembangunan hanya bertumpu kepada kemajuan ekonomi sehingga mengabaikan kepentingan alam sekitar dan menyebabkan berlaku impak negatif terhadap ekosistem dunia. Isu pembangunan lestari telah lama dibincangkan dalam pelbagai sidang, termasuk Sidang Kemuncak Bumi yang diadakan di Rio de Janerio pada tahun 1992 dan pada tahun 2002 di Johannesburg. Daripada persidangan tersebut, Agenda 21 iaitu pelan tindakan yang mengandungi prinsip-prinsip positif secara menyeluruh bagi membantu pihak kerajaan dan institusi-institusi lain dalam melaksanakan dasar-dasar pembangunan lestari di negara-negara masing-masing telah dibangunkan.

II. PERANAN UNIVERSITI DALAM PEMBANGUNAN KE ARAH LESTARI

Penyelidikan dan institusi pengajian tinggi dalam negara yang sedang membangun perlu meningkatkan kemampuan mereka untuk bertindakbalas dalam menentukan cabaran mengikut perubahan semasa. Contohnya keadaan demografi, polisi ekonomi dan perdagangan, iklim, pembangunan pertanian dan pembandaran. Ini menunjukkan semua universiti perlu membangun ke arah lestari bagi membanteras masalah yang dihadapi di dunia ini.

Berdasarkan kepada Hansen *et. al.* (2004), universiti-universiti tempatan mempunyai potensi yang baik sebagai 'pusat pembangunan' iaitu memudahkan pembangunan lestari secara sosial, ekonomi dan ekologi. Menurut Fincham *et. al.* (2004), universiti adalah pusat pembekal graduan-graduan yang cekap, motivasi, inovasi dan penghasilan ilmu. Selain itu, ia merupakan tempat berhubung dan berkerjasama dengan rakan kongsi serta organisasi daripada sektor swasta, sektor awam dan masyarakat. Tambahan pula, universiti juga turut menyumbang kepada pertumbuhan ekonomi, peningkatan aktiviti kebajikan, demokrasi dan perlindungan alam sekitar. Sekiranya universiti ingin menjadikan 'pusat pembangunan' yang berkesan, universiti tersebut hendaklah peka kepada keadaan semasa agar dapat memperolehi pentadbiran yang baik, penyelidikan yang berkualiti tinggi, dan memperolehi kaedah pembelajaran dan teknologi maklumat yang baru.

Universiti adalah satu organisasi yang bertujuan untuk memenuhi perlaksanaan program dengan pelbagai operasi fakulti-fakulti di kampus. Namun begitu, fokus utama universiti adalah pendidikan (Weenen, 2000). Ini menunjukkan bahawa pendidikan di semua peringkat merupakan aspek yang penting dalam mempromosikan lestari.

Berdasarkan kepada Osterwalder (2009), terdapat tiga aspek yang terlibat dalam memperkenalkan universiti lestari iaitu pembinaan dan peneguhan dalam asas pemahaman kepada masalah lestari, penyemakan semua aspek dalam hidup kita di bawah kriteria lestari dan akhir sekali aktif mencari kaedah dan teknik baru untuk meneruskan pembangunan lestari.

Ini bermakna pendidikan lestari adalah topik yang menarik di mana ia boleh membawa kepada banyak perbezaan aktiviti. Menurut Osterwalder (2009), institusi pengajian tinggi juga adalah tempat tanggungjawab untuk melahirkan para graduan bagi guru terlatih di peringkat

sekolah menengah dan sekolah rendah. Mereka bertanggungjawab untuk membangunkan kaedah baru dan pendekatan baru untuk menjelaskan mengenai lestari kepada semua, daripada peringkat pra-sekolah hingga ke dewasa.

Menurut Pike *et. al* (2003), peranan kolej dan universiti adalah memberi pendidikan kepada masyarakat, termasuk melahirkan pemimpin pada masa akan datang, mereka seharusnya juga berhadapan dengan pergerakan lestari. Contohnya melaksanakan sesuatu program untuk meningkatkan kesedaran orang awam terhadap isu alam sekitar dan peningkatan pengetahuan dan teknologi, dan seterusnya membangunkan lestari pada masa depan.

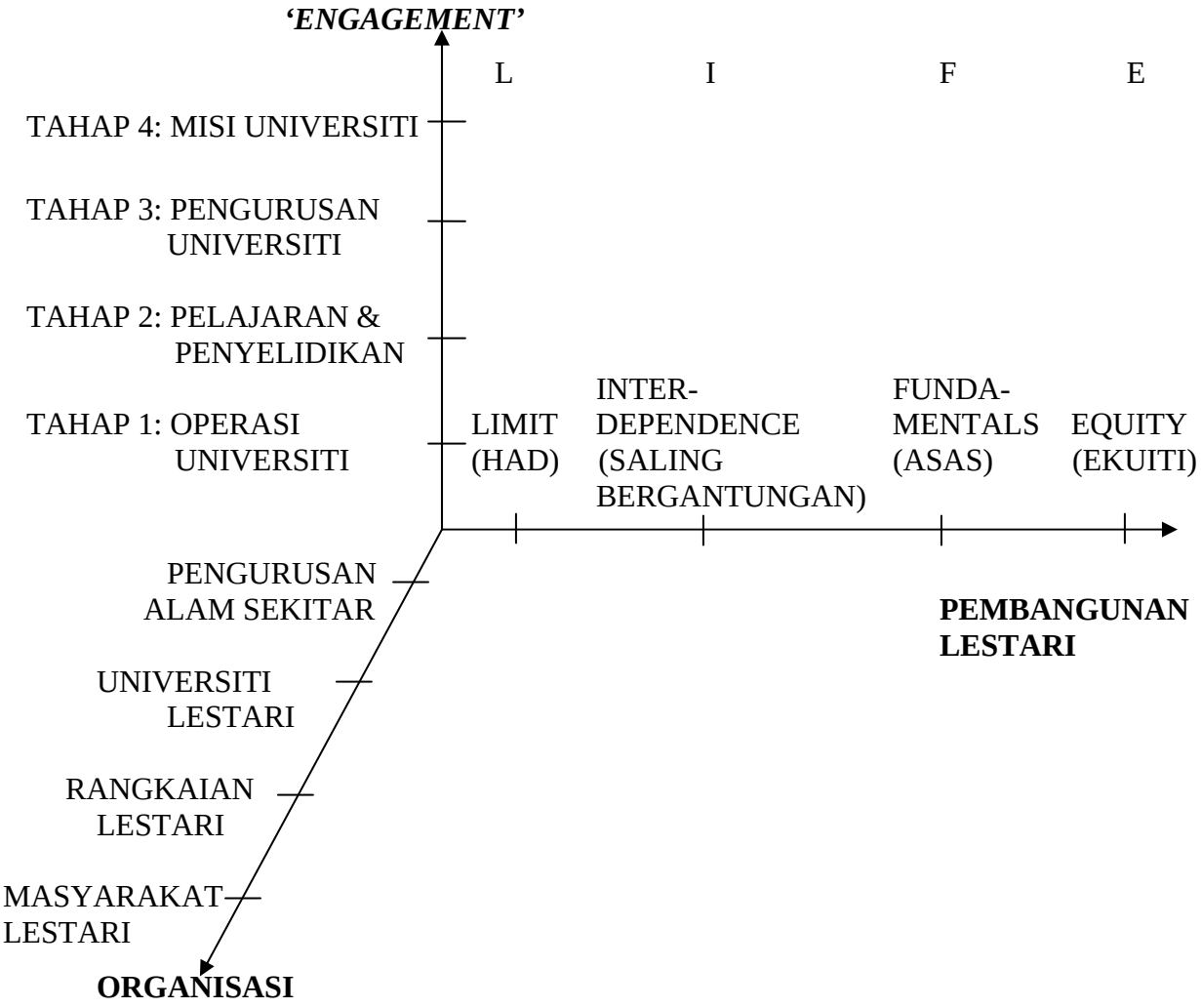
Universiti memainkan peranan utama dalam pengurusan lestari melalui institusi mereka dan perolehan polisi untuk memastikan kesedaran global, *'ethically sound'* dan proses keseimbangan alam sekitar dapat diperkenalkan agar alam sekitar dapat membantu ke arah pembangunan lestari. Namun begitu, dalam mencapai lestari bukan sahaja melalui kemahiran dan pengetahuan yang dipelajari dan dipraktikkan oleh graduan, malah ia juga melalui gabungan strategi dan operasi dengan kerjasama masyarakat. (Zainal Abidin Sanusi, 2008).

III. KONSEP DAN MODEL UNIVERSITI LESTARI

Universiti lestari telah didefinasikan oleh Velazquez *et. al* (2005), sebagai: "Institusi pengajian tinggi, keseluruhan atau sebahagian, penglibatan dan memperkenalkan, kepada tahap global atau serantau, meminimumkan negatif terhadap alam sekitar, ekonomi, sosial dan kesihatan yang memberi kesan dalam sumber penggunaan mereka supaya dapat melengkapi fungsi mengajar, penyelidikan dan cara dalam penyeliaan bagi membantu masyarakat melakukan penukaran cara hidup lestari." Definisi ini lebih mudah difahami sekiranya kita merujuk kepada aktiviti lestari. Persatuan *'University Leaders for a Sustainable Future'* (ULSF) (1999), menjelaskan aktiviti lestari di universiti adalah ekologi, sosial, ekonomi persendirian dan berperikemanusiaan, dan mempunyai kebolehan menyambung untuk generasi akan datang.

Dengan itu, universiti boleh mencapai pembangunan lestari dengan pelbagai cara, termasuk pengurusan, perancangan, perkhidmatan masyarakat, reka bentuk, pembinaan baru, penambahbaikan, retrofit dan lain-lain. Lestari juga adalah penting untuk mengalakkan universiti mengadakan program isu alam sekitar bagi menjadikan pelajar yang berpendidikan supaya memahami tentang isu alam sekitar. Berdasarkan kepada Probet (1995), kes universiti seharusnya melahirkan kepimpinan yang intelek dan menunjukkan bagaimana masyarakat lestari boleh dicapai.

Dalam melaksanakan pembangunan lestari di universiti, Weenen (2000), telah memperkenalkan model pengelasan universiti lestari. Rujuk kepada **Rajah 1** di mana ia digunakan oleh universiti sebagai garis panduan bagi menilai dimensi, status dan tahap mereka berdasarkan komitmen yang diberi. Pengelasan universiti telah diambil kira melalui tiga isu di mana ia dikelaskan berdasarkan kunci soalan iaitu ‘mengapa’, ‘apa’ dan ‘bagaimana’. Isu ‘mengapa’ adalah berkaitan dengan tahap penglibatan. Ia menjelaskan mengenai perkara yang harus dilakukan dengan penggunaan sumber yang terhad, dan ia amat penting tentang pengakuan melalui tahap tertinggi kesedaran. Isu alam sekitar adalah penting dan organisasi harus berwaspada terhadapnya. Daripada model ini, terdapat empat perkara yang berkaitan dengan pembangunan lestari iaitu LIFE, singkatan nama *‘Limit* (Had), *Interdependence* (Saling Bergantungan), *Fundamental* (Asas) *and Equity* (Ekuiti)*”*. Set isu tersebut adalah berdasarkan kepada konsep pembangunan lestari yang menunjukkan bahawa pentingnya universiti mengambil tindakan.



Rajah 1: Model Pengelasan Universiti Lestari

Sumber: Weenen (2000), muka surat 30

'Limit' (Had) adalah berdasarkan kepada kualiti hidup di mana ia bermaksud untuk kerja dan kualiti kerja baik. Ini bermakna pengakuan dan nilai sumber manusia dan pelbagai budaya harus dihargainya. Ini kerana ramai manusia tidak mempunyai kesedaran mengenai kualiti hidup. Kemudian, *'Interdependence'* (Saling Bergantungan) adalah berdasarkan kepada usaha lestari iaitu pengeluaran mereka adalah datang daripada sumber asli di mana ia sudah dibangunkan sama ada di atas tapak atau berhampiran dengan tapak. *'Fundamental'* (Had) adalah konsep, paradigm dan sistem yang harus diubah untuk melaksanakan pembangunan lestari melalui

pendidikan, penyelidikan, pengurusan dan komunikasi. Sebagai contoh, pendidikan lestari adalah peringkat awal ke arah menjadi universiti lestari. Akhir sekali, *'Equity'* (Ekuiti) di mana industri menyokong usaha dalam pembangunan negara dan latihan pembangunan lestari untuk memastikan bahawa ia terlibat melalui produk atau perkhidmatan. Ini kerana ia dapat dibangunkan dan akan digunakan oleh mereka. Selain itu, pertambahan bilangan orang akan memberi kesan kepada kualiti hidup. Jadi, daripada penggunaan sumber harus mempunyai potensi kerana ia sangat penting untuk diselamatkan supaya ia dapat digunakan masa akan datang.

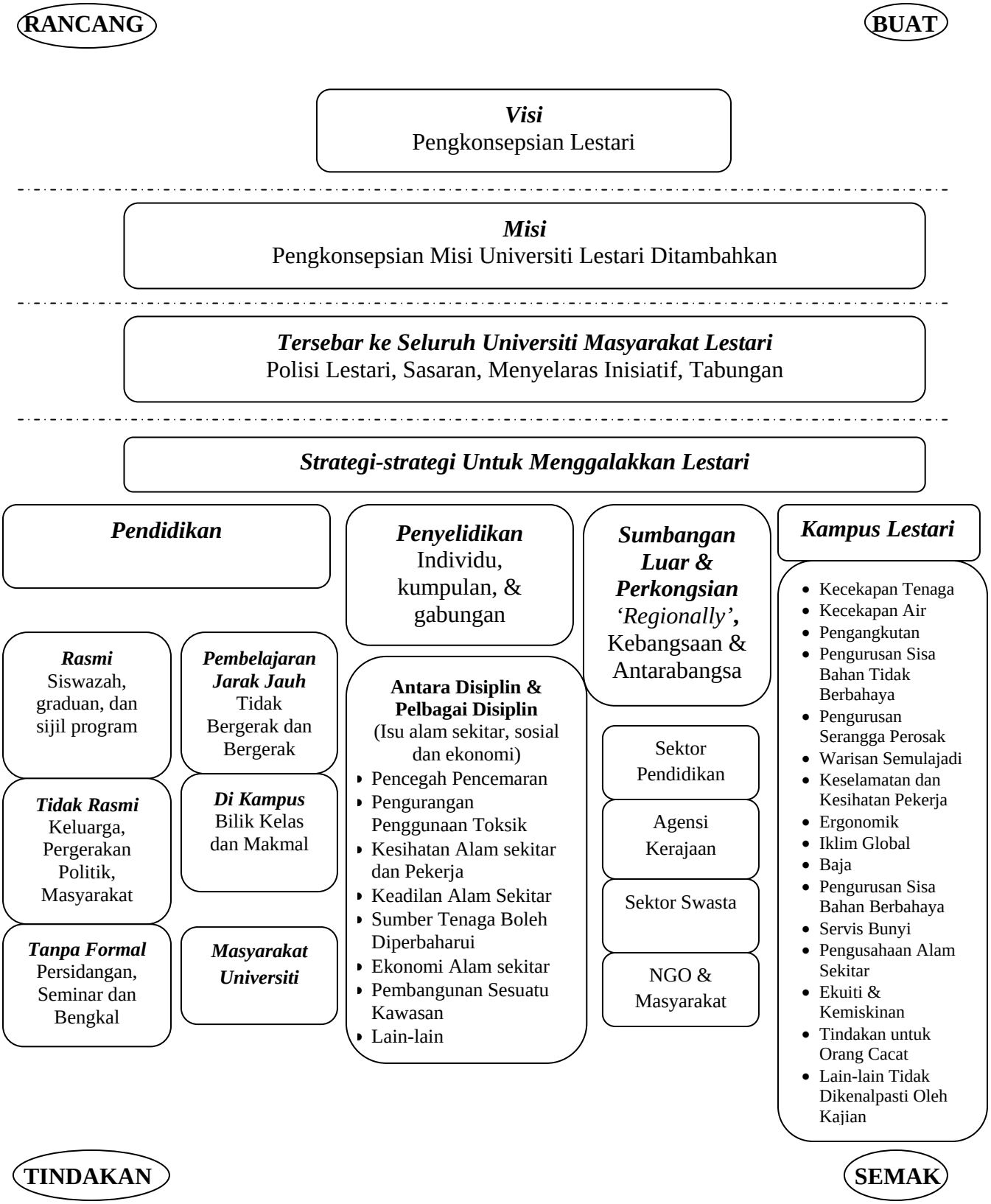
'What' (Apa) adalah sesuatu mereka harus lakukan melalui tahap tertinggi. Terdapat empat tahap yang berdasarkan kepada urutan-urutan untuk mencapai universiti *'engagement'* (janji atau jaminan formal, terutama sekali dalam bentuk tulisan). Pada tahap pertama, operasi universiti di mana melibatkan organisasi dalam banyak aktiviti seperti penggunaan bahan dan tenaga, fasiliti dan ruang. Tahap kedua, adalah gabungan dengan tahap pertama kerana ada kaitan dengan penyelidikan dan pendidikan. Melalui sokongan daripada kerja dalam, untuk memulakan pembangunan universiti adalah melibatkan bangunan, fasiliti, kampus, infrastruktur dan pengangkutan. Tahap ketiga pula adalah penglibatan daripada pakar luar, masyarakat dan organisasi bukan kerajaan (NGO) memberi sokongan untuk masyarakat universiti seperti memperlengkapi latihan untuk pengurus universiti sama ada tempatan dan antarabangsa dengan misi yang jelas. Akhir sekali, tahap empat adalah tahap tertinggi universiti *'engagement'*. Sebelum ke tahap tersebut, ia perlu fokus kepada organisasi terlebih dahulu kerana penglibatan dan tindakan melalui sokongan dalam adalah amat perlu.

'How' (Bagaimana) adalah cara mereka mengatur lestari. Dalam pengurusan alam sekitar, operasi universiti adalah peringkat pertama untuk *'engagement'* iaitu memimpin sesuatu untuk dibawa kepada penawaran melalui tindakan. Golongan yang terlibat biasanya mempunyai pengetahuan mengenai alam sekitar dan bertanggungjawab dalam pengurusan universiti yang berdasarkan kepada polisi. Ciri-ciri universiti adalah lebih baik dibincangkan, diformulasikan dan dilaksanakan dalam pengurusan alam sekitar. Rangkaian lestari adalah rangkaian mereka tersendiri untuk berhubung. Contohnya, semua *'stakeholders'* universiti perlu terlibat; seperti pelajar, pensyarah, staf dan lain-lain kerana mereka menggunakan rangkaian tersebut untuk

berhubung dengan penyelidik, pendidik dan pengurus. Ia mengandungi universiti yang sama profil dan rakan menyumbang kepada pembangunan lestari antarabangsa. Rangkaian lestari adalah lebih baik diatur dan dikekalkan dalam masyarakat lestari. Ini kerana ia dapat membantu masyarakat untuk mencari kelebihan keseimbangan di antara kehendak manusia, kualiti dan sumber asli yang diperoleh.

Namun begitu, model Universiti Lestari yang paling popular telah dibangunkan oleh Velazquez *et. al* (2005) melalui *'benchmarking'* (titik rujukan dalam membuat perbandingan) yang terbaik dengan 80 universiti yang berbeza di seluruh dunia, lihat **Rajah 2**. Pada asasnya, Cadangan Model Universiti Lestari mempunyai empat fasa yang menyepadukan dalam rancang-buat-semak-tindakan (*Plan-Do-Check-Act* (PDCA). Peringkat pertama PDCA adalah mengenalpasti masalah bukan lestari dan mengembangkan idea untuk menyelesaikan masalah tersebut (Rancang). Kemudian, *'stakeholders'* (pemegang saham) harus menilai cadangan kertas kerja dalam skala yang kecil untuk penjimatan kos (Buat). Selepas itu, mereka bercadang untuk memimpin bagi mengkaji semula cadangan perancangan untuk menyelesaikan masalah selagi ia mampu untuk memperbaiki kualiti dan kecekapan (Tindakan). Tetapi, ia tidak berhenti kepada langkah yang terakhir kerana ia sentiasa mengikut tempoh kitaran lagi untuk menyelesaikan cabaran baru dan masalah dalam memperbaiki lestari di institusi.

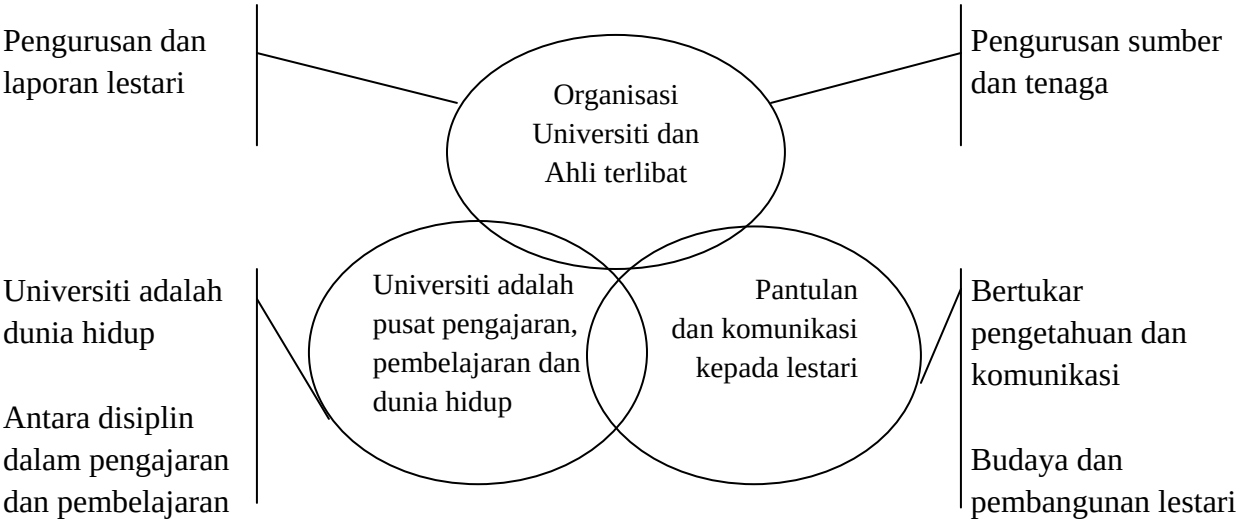
Semua inisiatif universiti lestari adalah disusun kepada empat strategi termasuk pendidikan, penyelidikan, sumbangan luar dan perkongsian, dan lestari dilaksanakan samaada di dalam atau di luar kampus.



Rajah 2: Cadangan Model Universiti Lestari
Sumber: Velazquez *et. al* (2005), muka surat 814

Selain memperkenalkan model, timbul pula pendekatan “Lu”neburg” yang diperkenalkan oleh Adomssent *et. al.,* (2007), iaitu penyelidikan dan pembangunan inisiatif “Universiti Lestari-Pembangunan Lestari dalam Konteks Bidang Kuasa Universiti”. Ia adalah bertujuan untuk menyepadukan idea lestari kepada *‘a range of areas’* di universiti-universiti. Dimensi yang diperkenalkan daripada **Rajah 3** adalah bertujuan untuk menjawab beberapa persoalan seperti bagaimana universiti boleh berhadapan dengan cabaran yang bergabung bersama pembangunan lestari dan kepada apakah *‘extent’* (kawasan/ julat) boleh disasarkan bagi perubahan struktur dalam memberi sumbangan terhadap perubahan universiti untuk lestari? Persoalan ini terjawab apabila ia menjadi tugasan kepada sesuatu tempat untuk pembelajaran dan alam sekitar hidup. Manakala persoalan pengurusan lestari dan penggunaan sumber dalam sasaran kepada perubahan prestasi lestari merupakan antara kunci tugasan di universiti. Sistematik *‘engagement’* dengan proses komunikasi universiti- adalah mustahak untuk penyebaran idea mengenai lestari dan di mana ia ditujukan kepada *‘critical reflection’* (pantulan kritikal) secara konsep keseluruhan. Komunikasi dan penglibatan adalah kunci prinsip untuk melaksanakan idea lestari dalam konteks universiti. Antaranya adalah tugas bagi membangkitkan isu mengenai proses pembangunan ke arah universiti lestari, membincangkan dan membangunkan langkah-langkah praktikal yang biasa ke realisasinya.

Oleh itu, projek Lu¨neburg ‘Universiti Lestari’ telah berkembang dalam pendekatan kes kajian termasuk aspek transformasi, dengan mendapat pandangan melalui proses transformasi daripada dua tahap berbeza iaitu tahap pertama, kes pembangunan seharusnya dijangka kepada asas sistem analisis di mana ia membawa sesuatu kejadian yang mungkin berlaku kepada bangunan. Tahap kedua, isu yang boleh dipindah seharusnya dipertimbangkan di dalam analisis. Ini bermaksud dengan analisis yang terperinci, ia seharusnya boleh memindahkan pengetahuan yang diperolehi daripada kes kajian kepada kes lain dalam perbezaan konteks.



Rajah 3: Dimensi daripada penyelidikan dan projek pembangunan 'Universiti Lestari'
Sumber: Adomssent *et. al.*, (2007), muka surat 392

Model telah disusun atur kepada polisi-perancangan-perlaksanaan-penyemakan-pengulasan yang dikategorikan daripada Clarke *et. al.* (2009), merujuk kepada jadual 2.

Jadual 2: Rangka untuk Model Universiti Lestari

	Universiti Lestari
Polisi	• Visi • Misi • Masyarakat Lestari (cipta polisi, sasaran and objektif)
Perancangan	• Strategi pendidikan, penyelidikan, sumbangan luar & perkongsian dan kampus mengenai lestari
Perlaksanaan	• Melaksanakan strategi • Rangkaian & Organisasi
Penyemakan	• Audit Lestari
Pengulasan	• Penambahbaikan berterusan

Sumber: Clarke *et. al* (2009)

IV KOMITMEN-KOMITMEN UNVIERSITI LUAR NEGARA DAN TEMPATAN KE ARAH KAMPUS LESTARI

Jadual di bawah adalah contoh komitmen yang dirumuskan daripada pelbagai universiti di luar negara dalam usaha untuk mencapai lestari. Terdapat beberapa ciri-ciri lestari yang dilaksanakan oleh universiti dari segi alam sekitar, ekonomi dan sosial.

Jadual 6: Komitmen Universiti Ke Arah Alam Sekitar Lestari

Nama Universiti	Komitmen
University of Bordeaux	• Pengurusan sumber asli, termasuk kegunaan tenaga dan air yang berdasarkan kepada polisi *"laissez-faire"* (bahasa Perancis iaitu dasar bebas dari kawalan kerajaan) • Program pemuliharan air di universiti tersebut adalah disokong oleh Agensi Daerah Utiliti Air
Francis Marion University	• Memasang sistem lampu efisien dalam gimnasium dan menjalankan program kitar semula kertas
The University of Edinburgh Estates & Buildings Department	• Mewujudkan kod polisi mesra alam mengenai catatan bimbingan dan penentuan. Antara polisi yang mereka memperkenalkan adalah Polisi Lestari 2000, Polisi Alam Sekitar 1993, Polisi Pengurangan Bahan Buangan 2005, Polisi Perjalanan Bersepadu 2000 dan Polisi Utiliti 2003.
Dalhousie University	• Memelihara polisi alam sekitar pada tahun 1990, termasuk kandungan kepada operasi, pendidikan dan penyelidikan. Banyak inisiatif telah dilakukan ke atas sisa pepejal, sisa bahan berbahaya, toksik, kualiti air, pemuliharaan tenaga dan pendidikan alam sekitar.

Sumber: Bonnet *et. al* (2002), Pike *et. al* (2003), The University of Edinburgh Estates & Buildings Department (2004), Clarke (2006)

Jadual 7: Komitmen Universiti Ke Arah Sosial Lestari

Nama Universiti	Komitmen
Technical University of Catalonia (UPC)	• Perancangan Alam Sekitar *The Technical University of Catalonia (UPC)* adalah mencukupi dengan melaksanakan 41 projek termasuk rangka kerja daripada lima cara seperti pendidikan siswazah, pendidikan lepasan ijazah, penyelidikan, gaya hidup universiti dan peningkatan kesedaran.
University of Hertfordshire	• Membangunkan Polisi Pembangunan Lestari • Menggalakkan pelajar sedar mengenai kesan alam sekitar dalam pembelajaran mereka dan kerjasama serta berdisiplin dalam penyelidikan dalam tema pembangunan lestari. • Mencadangkan latihan untuk universiti dan masyarakat tempatan agar mereka boleh mengambil bahagian dalam pembangunan lestari.
Aalborg University	• Semua pelajar tahun satu dalam Kejuruteraan dan Sains dijemput untuk menghadiri kursus dalam Teknologi, Kewujudan Manusia dan Masyarakat. • Menfokuskan pembangunan lestari dalam pendidikan dan isu yang berkaitan dengan alam sekitar adalah diambil alih oleh Pembahagian Teknologi, Alam Sekitar dan Masyarakat dalam Jabatan Perancangan dan Pembangunan.
Clemson, Medical University of South Carolina and University of South Carolina	• Staf dan pelajar telah mengadakan serta menyertai program seminar-seminar dan pembentangan; melakukan aktiviti-aktiviti secara sukarela seperti gotong-royong membersihkan kampus, penanaman pokok dan sebagainya. Contohnya kempen Hari Bumi Sedunia

Sumber: Capdevila *et.al* (2001), University of Hertfordshire (1995), Christensen *et. al,* (2009), Barnes and Jerman (2001)

Jadual 8: Komitmen Universiti Ke Arah Ekonomi Lestari

Nama Universiti	Komitmen
Royal Melbourne Institute of Technology (RMIT) University	• Pada tahun 2001, $500,000 telah dilaburkan daripada bajet perkhidmatan harta tanah untuk diserahkan kepada pelaburan dalam inisiatif pemuliharaan tenaga. Bajet tersebut membolehkan perkhidmatan harta tanah bagi membangun senarai tindakan untuk mengurangkan penggunaan tenaga dan simpanan jangka panjang melalui pengurangan bil tenaga RMIT's • Kumpulan Pengurusan Tenaga (EMT) telah mewujudkan perkhidmatan harta tanah bagi menguruskan perbelanjaan bajet baru sebanyak $500,000 dalam projek penjimatan tenaga. • Walaupun projek gagal dilaksanakan memandangkan keseluruhan pengeluaran gas rumah hijau telah meningkat sebanyak 33% dan bil tenaga telah naik sebanyak $2.5 juta semenjak pada tahun 2000 (RMIT University, 2004). Walau dengan kenaikan ini, satu sijil tetap diterima daripada Pejabat Rumah Hijau Australia hanya mengucapkan tahniah kepada RMIT bagi penglibatan dalam program cabaran rumah hijau.
St Petersburg State University	• Pemuliharaan tenaga dalam institusi daripada akademi sains Rusia adalah salah satu contoh projek yang berorientasikan mesra alam. Projek ini bertujuan menyediakan perancangan bagi aktiviti penjimatan tenaga untuk institusi akademik. Penilaian pada peringkat permulaan menunjukkan perbelanjaan tenaga dalam institusi akademi menghampiri 15 per sen daripada bajet untuk saintifik institusi yang telah menggunakan peralatan dan tumbuhan sebagai percubaan untuk diuji. Penggunaan teknik dan peralatan dalam penjimatan tenaga adalah keputusan projek yang telah sedia ada di mana sudah dimulakan di beberapa institusi, termasuk '*Lebedev Physical Institute, Baikov Metallurggy Institute, National*

	Botanical Gardens' dan lain-lain.

Sumber: RMIT University (2004), Verbitskaya et. al (2002)

Universiti tempatan juga tidak terkecuali dalam memberi komitmen ke arah universiti lestari. Rujuk **Jadual 9** adalah beberapa contoh IPTA yang telah melaksanakan lestari di universiti masing-masing. Ini menunjukkan bahawa telah wujud kesedaran di kalangan pihak universiti iaitu begitu penting apabila menjayakan universiti lestari bagi memelihara alam sekitar.

Jadual 9: Komitmen Institut Pengajian Tinggi Awam (IPTA) Ke Arah Lestari

Nama Universiti	Komitmen
Universiti Sains Malaysia (USM)	• Mengadakan program "Kampus Sihat" iaitu pengetahuan mengenai cara hidup yang sihat dan program ini telah mendapat sokongan daripada Jabatan Teknologi Industri, Sains Biologi, Sains Kimia, Kejuruteraan dan Komunikasi. • Memperkenalkan Taman Keamanan, penggunaan kertas/pokok (contoh menghasilkan kertas daripada pokok pisang), menggunakan minyak masak untuk motosikal dan meningkatkan kesedaran terhadap pembangunan lestari. • Mengadakan program 'Kafeteria Sejahtera-Membangunkan Kampus Lestari' iaitu kafetaria menggunakan bekas makanan mesra alam yang diperbuat daripada bahan buangan kelapa sawit bagi membungkus makanan. • Diiktiraf sebagai Pusat Kecemerlanagan Serantau Pendidikan untuk Pembangunan Lestari oleh Pertubuhan Bangsa-bangsa Bersatu di Universiti Nagoya, Jepun pada 29 pada Jun 2005. Ini kerana kejayaan kempen-kempen kelestarian seperti The White Coffin yang berjaya menyahkan penggunaan polisterin dan mengurangkan penggunaan plastik.

Universiti Kebangsaan Malaysia (UKM)	• Projek Pengurangan Karbon @ Universiti Kebangsaan Malaysia (CRed@UKM) mempunyai sasaran untuk mengurangkan 60% pengeluaran karbon pada tahun 2015 melalui pelbagai strategi terutama yang berkaitan dengan program kecekapan tenaga dan perubahan polisi dalam universiti. • Pada tahun 1994, Institut Pembangunan dan Alam Sekitar dikenali sebagai LESTARI telah diperkenalkan. Objektifnya adalah memperkenalkan dan mengawal komponen lestari termasuk alam sekitar dan pendidikan • Meletakkan sasaran untuk mencapai kampus lestari pada tahun 2020 • Menubuhkan Institut Penyelidikan Tenaga Solar (SERI) pada 1 Julai 2005 dengan tujuan mencapai lestari bagi penggunaan tenaga. Antara kajian penyelidikan adalah sistem haba solar, kesan sosial-ekonomi pada sistem tenaga solar, senibina *'zero energy'* dan bahan lestari dalam bangunan, dan sebagainya. Inovatif bagi penyelidikan tenaga solar di SERI telah memenangi beberapa medal dan anugerah khas pada tahap tempatan dan antarabangsa.
Universiti Teknologi Malaysia (UTM)	• Menubuhkan Persekutuan Penyelidikan Lestari (SUTRA) dengan tujuan menjadi fungsi sebagai komuniti lestari, mempunyai tanggungjawab dalam penggunaan sumber dan pengurusan bahan buangan. Ini adalah untuk melahirkan kepakaran dalam pelbagai bidang bagi menyelesaikan isu lestari di dalam negara dan luar negara. • Antara tindakan yang diambil iaitu:- i. pengurangan bahan pencemar (mengitar semula kertas, mengurangkan penggunaan air botol plastik dalam mesyuarat universiti dan menghentikan penggunaan bekas makanan polystyrene kepada kertas kitar semula berlilin

	(waxed recycled paper) ii. penjimatan tenaga/ utiliti (pengurangan kadar penggunaan elektrik sebanyak 10 % setahun sehingga mencapai tahap optimum dan pengurangan kadar penggunaan air sebanyak 10 % setahun sehingga mencapai tahap optimum iii. penjimatan dalam penggunaan sumber (pengurangan penggunaan kertas sebanyak 10 % setahun sehingga mencapai tahap optimum

Sumber: Osterwalder (2009), (Utusan, 2010); (Kadaruddin *et. al*, 2008); (UKM International Bulletin, 2007); Sutra (2010)

V KESIMPULAN

Secara keseluruhan, kebanyakkan universiti di luar negara telah mengambil usaha untuk menuju ke arah universiti lestari. Pelbagai strategi telah diambil oleh mereka dan ini dapat membantu dalam memelihara alam sekitar dan mempertingkatkan kualiti hidup manusia. Berdasarkan kajian literatur oleh pakar-pakar lestari maka dapat disimpulkan bahawa universiti lestari adalah amat penting untuk dimurnikan. Dengan menggunakan konsep-konsep, model-model dan contoh-contoh yang dibincangkan dalam penulisan ini, pihak universiti tempatan seharusnya mengambil langkah aktif untuk menjadi universiti lestari. Penulisan tersebut adalah sebahagian daripada Projek Sarjana untuk membangunkan Metrik Penialaian universiti lestari. Pembangunan metrik penilaian universiti lestari adalah diperlukan kerana sasaran lestari tidak akan tercapai sekiranya tiada pengukuran yang dilakukan. Dengan adanya metrik penilaian ini, universiti tempatan boleh mengetahui sejauh mana tahap lestari telah yang dilaksanakan di IPTA dan memperbaiki tahap lestari yang belum tercapai.

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