

## Promoting Energy Conservation Behaviour: A Plausible Solution to Energy Sustainability Threats

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**Abstract**— This paper aims to discuss promoting energy conservation behaviour as complementary of global efforts towards a sustainable energy future. Today, the world is afflicted by various energy sustainable threats, including depletion of energy resources, expensive energy price and climate change. Pressures are mounting among global community to act immediately to revert the energy exhausted planet. Systematic review of literature suggests energy conservation via behavioural approach can results significant reductions in energy demand. This paper explicitly expressed the significance of energy conservation from human dimension in achieving a sustainable energy future.

**Keywords:** Energy Conservation Behaviour, Energy Sustainability, World Energy Threats

### I. INTRODUCTION

Our Common Future defines sustainable development as to meet the needs of the present without compromising the ability of future generations to meet their own needs [1]. One of the major challenges derived from preserving the global sustainability is on how to reduce the ever-rising energy demand. Review of literature suggested that changing or improving user behaviour could be the solution to reduce energy demand. The following section elaborates the threats to energy sustainability and how the energy conservation can aid in achieving a sustainable energy future.

### II. THREATS TO ENERGY SUSTAINABILITY

Figure 1 depicts the present scenario where ranges of threats are diving to attack the centre – energy sustainability.

Energy threats can be grouped into four main categories: energy-economy, energy-security, energy-environment, and energy-social. The energy-economic, the first category of global energy issues is closely linked to the steeply increasing of energy trading price. Expensive energy price will cause higher production cost therefore affects significantly on global and local socio-economy. Malaysia, even as one of the oil exporter country has not been excluded being affected from the world steadily increase oil prices. In 2008, Malaysian government has revised the petrol price when the international oil price reaches a new historic peak US\$147.29 (RM470.87) a barrel level. Second diving threat is the energy-security. It is about the uncertain of future energy supply, of a scenario where more energy resources

are being extracted than being discovered. Reference [2] has predicted that the reserves of fossil fuels would depleted in range of 40 to 200 years, which oil reserves would only last a further 40 years, natural gas a further 70 years and coal a further 200 years. Thirdly, it is the energy- environment, including climate change and the environmental degradation. The cause is due to the fossil fuels combustion. It is projected that the current energy-related emissions trend will pushing up average global temperature by 6°C in long run whereas global energy related CO<sub>2</sub> emissions will peak in 2025 [3]. Then, another energy diving energy threat is the social-energy issues, including steadily increases in world population and stress of food price. As projected in the International Energy Outlook 2009, within 2005 to 2030, the projected world populations' growth rate is at approximately 3.9 % - 6% for every five years [4]. People must be fed, clothed and housed [5]. Increasing of world population is ultimately stimulated higher food and energy demand. The confrontation of multi energy issues in relevant to economic, security, environmental and social has put the world energy sustainability at risk. To become a sustainable society, the world must consume less energy [6]. For that reason, appropriate efforts are necessary be placed to ensure threats are resolved immediately before it cause adverse impacts to the ecosystem. Only then, we are able to sustain the uncertain energy future. In consider various threats of energy sustainability, an immediate solution to reduce the steadily increasing energy demand is essential. Management to conserve energy is one of the immediate solutions for these overriding energy threats [7, 8, 9]. Although it is not an ultimate solution, "perhaps it can ease the strain on our environment and give us time to develop new energy resources" [9]. As according to [10], "energy conservation is the need of the hour."

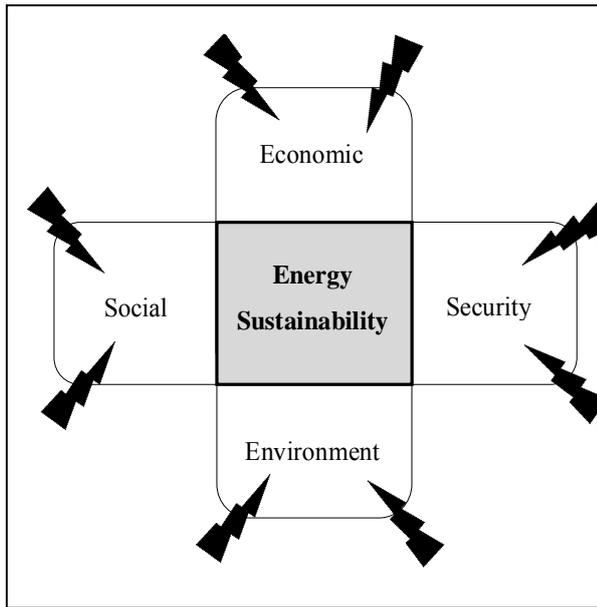


Figure 1. Threats to Energy Sustainability

### III. ENERGY CONSERVATION

The Dictionary of Energy defines energy conservation as “a collective term for activities that reduce end-use demand for energy by reducing the service demanded” [11]. In general, energy conservation means consume less energy to achieve an overall energy reduction. Recently, energy conservation is attracting global concern and has emerged as great challenge due to the recognition of burning fossil fuels is one of the main contributors to global warming [12, 13]. There are wide ranges of studies on the importance and effectiveness of energy conservation in reducing energy consumption, see reference [14, 15, 16, 17]. Energy conservation is one of the most necessary, indigenous and clean energy options [18]. The rationale is that it always required no cost or low cost to gear towards energy consumption reduction. There are wide ranges of benefits derived from energy conservation efforts. The utmost benefit is financial benefits through energy cost savings [19, 20, 21, 22]. Other than financial benefits, it is also drawn nonmonetary benefits: promotes environmental preservation [13, 17, 19, 20, 21, 22, 23, 24], creates positive company image [17], as well as fulfils social responsibility [23, 25].

Commonly, there are two approaches to promote energy conservation, namely structural energy conservation and non-structural energy conservation approaches. Structural energy conservation refers to the application of technology instruments, tools, or alternative energy resources, most of them require capital investment. Conversely, non-structural energy conservation is emphasizes on improving or changing of the user’s energy use behaviour to achieve energy reductions. The fact that energy efficiency technologies may contributes to the reduction in energy consumption is undeniable. However, it can become not efficient in certain circumstances for it ignores the human dimension. One of

the paradoxical aspects of the structural energy conservation is it creates rebound effects: People tend to use the appliances more often when the appliances is labelled as energy efficient. As according to [26], the improvement made by efficiency appliances is always offset by the growth in frequency of utilizing the appliances. Subsequently, it will draw higher energy consumption. As technology approach requires no behaviour changes of the users, consequently, user could still waste energy in the same way [27]. In fact, installing expensive energy efficiency appliances or installation of insulation is not the ultimate solution to overcoming the energy sustainability issues. This was agreed by [28], “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.” Hence the best way in energy conservation is concentrated on behaviour aspects by improving or changing the user’s energy conservation behaviour. The following section details the essential of the energy conservation behaviour in complement to a sustainable energy future.

Energy Conservation Behaviour: Complement to A Sustainable Energy Future

The core concept of the non-structural energy conservation approach is about human behavioural change. As defined in the Dictionary of Energy, behavioral change is “a change in the activities of a person or organization that affects the level of energy conservation, either positively (turning off lights when not in use) or negatively (e.g using an electric dryer to replace a clothesline)” [11]. Some examples of energy conservation behaviour but not limited to, switching off the unnecessary lightings, thermostat control, turn off the monitor screen whenever not in use, turn the computer into hibernate mode or sleep mode when leaving the computer for a short period, use stairs instead of lift as possible as could, as well as maximum use of the natural lighting. All of these energy conservation actions can reduce energy usage dramatically.

Human behaviour is an essential ingredient in energy conservation efforts. In support of that, the best way to cope with the rising energy demand is not to supply more but is to save. “Energy conservation is an inescapable responsibility for humanity” [13]. Reference [29] once asserts that the excess consumption of energy always arises from wasteful of the user’s behaviour. Reference [30] also quotes that over half of the energy used by user is wasted. “People is the main factor in achieving energy efficiency” [31]. The significance of this approach has been reported by many researchers. Reference [32] indicates that approximately 10 percent of savings in energy cost can be achieved if the users are more energy conserving. Reference [33] also reveals that about 5-10 percent of energy savings can be achieved by improving energy user’s behaviour. A similar result has been evidenced in a study conducted by [34] of which 10 percent of electricity reduction achieved easily by improving user’s behaviour. Therefore, cumulative amount of energy cost saving can be reached through energy conservation behavioural changes [35, 36].

Energy conservation through behavioural change provides immediate energy cost savings. For an example,

energy users may enjoy immediate reduction in energy consumption when adjusting the temperature according to the comfort level or set the computer into hibernate mode when they leave the room for a short period. In such case, the payback period is immediate. Unlike the structural energy conservation which involves capital investment, although savings of energy generated right after the appliances in operation, the net savings can only be enjoyed after the return on investment Reference [27] indicates that technology approach is only appropriate as a short term energy conservation method. Therefore, for long term benefits, non-structural energy conservation approach by taking human aspects into consideration is more appropriate in comparing to structural energy conservation approach.

Energy conservation behaviour is especially important for large organization that incurs multi-level energy expenditures [37]. Taking university as an example. It is one of the types of organization that comprise multi level occupants (student and staff) that consume energy day and night of which substantial amount of energy is consumed annually. A study conducted by [38] in Universiti Putra Malaysia reveal that student's behaviour contributes to large amount of energy wastage. Hence significant energy savings can be obtained by improving energy user's energy conservation behaviour. Despite the gained from reduction in energy bill, there are a lot of extraordinary benefits to be earned still. Among is the savings in terms of monetary can be channelled to other beneficial usage. Other sentimental value gained is improving of the organization's overall image. By promoting the energy conservation, the organization will contribute towards reducing the carbon emission and therefore creates a healthy environmental friendly image. In consider the possible contribution of the energy conservation behaviour towards a sustainable energy future, the essential to promote energy conservation behaviour among the nations should be regarded as the highest priority.

There are works has been done to examine the effectiveness of promoting energy conservation behaviour to achieve energy reductions by using various methods. Of particular relevant example is an experiment study conducted by [27] which suggested that there was a significant improvement on energy awareness and energy use behaviour among the experimental group who received energy information, regulation of behaviour, and motivation compared to the control group that did not received any treatments. Another study conducted by [39] has demonstrated the effects of education, incentive, and feedback on the electricity and water use among the college student's dormitories. Overall, the study shows the education, incentive, and comparative feedback contributes to the overall 32 percent of reduction in energy use. Besides in educational organization, promising result could be achieved in other sectors too. For example, a study held among 127 households has demonstrated monetary rebate as an effective tool to achieve energy reduction of which the households that received high monetary rebate conserved approximately 12% of energy use throughout study period [40]. Other example is The Positive Energy/oPower field experiments

carried out on approximately 75,000 household from two utilities (Sacramento Municipal Utility District and Puget Sound Energy) has showed the effectiveness of comparative feedback in promoting energy conservation behaviour among household, of which randomly selected households who received comparative feedback periodically has made significant reductions in their energy use [41].

Behavioural approach can serve as the path for the world to achieve energy sustainability. Human behaviour must be taken into serious consideration in realizing a more sustainable future. The International Energy Agency has recommended using behavioural approach as one of the strategies to save energy [42]. Also, the IPCC report 2007 pointed out changes in lifestyle and behavioural pattern can make a significant difference and result in energy use reduction along with climate change mitigation [43]. Over the years, there are evidence indicates the poor progress made in different countries in energy conservation and the reluctance to change in user behaviour has been cited as the reason behind the happening [10]. Realizing that, the importance of influencing behavioural change has been emphasized during the United Nations Framework Convention on Climate Change held in Copenhagen and reported that it is insufficient debate on reducing energy consumption through behavioural change [44]. Also, the importance of non-structural energy conservation has been stressed in the World Energy Outlook 2008 which stated that the nation has to change the way people use energy [3]. People need to practice and shift towards a more energy savings behaviour.

In consider various threats of emerging energy sustainability and the potential of behavioural approach as the plausible solution, poor energy use behaviour need to be improved for a better environment and realizing a sustainable energy future [6]. This article is not made to claim that promoting energy conservation behaviour serve as a universal solution to solve all these overriding energy sustainable threats, it could however, be one of the alternative and complementary along the path towards a sustainable energy future. No doubt that the discovery of new or alternative energy resources can be the solution. It should be noted, however, the renewable energy resources discovered will become non-renewable if over consumed by the users [45]. Thus, energy conservation behaviour should be perform by every energy user to achieve overall energy demand reduction, enhance the energy security, ease the strains on environment, eventually, contributes to a sustainable energy future.

#### IV. CONCLUSION

Energy conservation behaviour is urgently needed as part of the solution to achieve world energy sustainability. No doubt that discovery of a new energy resources is critical; yet, whether the limited energy resources are sufficient to feed the current consumption until new energy source being discovered remains a question mark. Hence the world shall shift the focus towards energy usage pattern – improving energy conservation behaviour. As such, we will able to secure a sustainable energy future for coming generation.

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