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ENERGY KNOWLEDGE IN INFLUENCING HOUSEHOLD'S ENERGY CONSERVATION BEHAVIOUR

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Abstract:

Malaysia needs to ensure stable energy consumption to improve environmental quality and energy security. The increasing trend of the country's population growth and economic development are parallel with the country's overall energy demand. The building sector, commercial and residential sector has contributed to more than 12% of the country's final energy consumption in the year 2018. The energy demand from the household sector is on an increasing trend. The residential sector is responsible for the increasing trend of energy consumption with the improvement of lifestyle and living standards. Variation in residents' behaviour can cause significant differences in energy consumption due to dwellings, household size, income, and building energy consumption. Past studies have shown the identification of the relevant psychological factors that formulating energy conservation behaviour contributed to household energy consumption reduction. By focusing on the psychological dimension, this study explores the role of energy knowledge in influencing energy conservation behaviour among households in Malaysia. Energy knowledge is about the household's understanding in the context of energy-saving and consumption. Despite massive information and awareness of climate change about the contribution of climate change from household energy consumption, many households still do not practice energy conservation actively. By conducting a systematic literature review, this study found that energy knowledge plays an essential role in influencing household energy conservation behaviour. The findings of this study could help the institutions and relevant authorities to gain a better understanding of the role

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of energy knowledge as one of the psychological factors in household energy conservation behaviour.

Keywords:

Energy Knowledge, Household, Energy Conservation Behaviour

Introduction

Energy consumption appears to contribute to the most carbon dioxide (CO_2) emissions and ultimately lead to global climate change (Zhang and Zhang, 2018a, 2018b). Energy is one of the most important inputs for urbanization, development, and modernization. Rapid urbanization and population growth make many fast-developing countries to be dependent more on energy-intensive. Growth of energy consumption level that parallels with a range of negative environmental impacts, and human health becoming a serious challenge that impedes the sustainable development of the natural and human systems (Song *et al*., 2019) . Among the different sectors, the residential and commercial sector is one of the major energy consumption contributors that consumed about 12.0% of Malaysia's total energy in the year 2018 (Energy Commission, 2018). The household is one of the primary and fastest-growing sources of CO_2 emissions (Kusumadewi and Limmeechokchai, 2017). The residential sector creates CO_2 emissions that can be categorised into direct and indirect emissions. Indirect or embedded emissions from indirect energy consumption in different phases of the lifecycle of products and services such as production, transportation, and marketing (Jakučionytė-Skodienė *et al*.,2020). For example of the manufacture of a TV made in China, and along with supply chains arising domestically and abroad account for the majority of the carbon footprints of the Western households (Druckman and Jackson, 2016). Meanwhile, direct emissions from the energy consumption at home, the activities in the daily life of residents, such as gas for space and water heating, and electricity for lighting and electrical home appliances and gadgets and fuels (petrol and diesel) for personal transportation (Druckman and Jackson, 2016;Jakučionytė-Skodienė *et al*., 2020)

As the population increases, electricity consumption increases in Malaysia significantly. Energy consumption in the residential sector has contributed to the country's total electricity demand. The residential sector consumed 20.5% of total electricity consumption (Energy Commission, 2018). Most houses were equipped with a wide range of electrical appliances. The households might not aware of the strategies to consume energy efficiently in their daily lives. In recent years, energy conservation behaviour among households has received numerous attention from the community (Boomsma *et al*., 2019;Song *et al*., 2019;Thøgersen, 2018;Trotta, 2018). As suggested in previous studies, significant energy reduction can be achieved by promoting energy conservation behaviour among the household. The psychological factors that drive household energy conservation behaviour are becoming more complex across the contexts (Boomsma *et al*., 2019; Thøgersen, 2018). Awareness to reduce energy consumption at home has been well promoted to households through campaigns and programs, however, energy consumption for residential buildings remains on an increasing trend. Various psychological factors have been identified in the previous research that contributing to individual behaviour, including attitude, social norm, past experience, perceived behaviour control and other psychological factors. For instance, biospheric and altruistic values, environmental concern, and green lifestyle orientation have influenced green

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technology purchasing intention in both US and Canadian consumers (Berman *et al*.,2021). A study, Zhang *et al.* (2019), suggested the personal norm is found to be the major factor influencing the intentions of Chinese residents towards waste sorting.

In the context of household energy conservation, one of the psychological factors influencing household energy conservation behaviour is energy knowledge. Imbulana and Managi (2021) have found that energy knowledge of energy sustainability in 37 countries based on gender with the concepts of holistic associations and cause-effect logic. In the study, most countries reported males having more energy knowledge about energy sustainability with cause-effect logic than females with holistic associations that were beneficial to decision-making processes about energy sustainability and energy conservation practices. In another study, Broek (2019) reviewed on literature of household energy knowledge regarding energy literacy that focus on the understanding of domestic electricity and gas consumption, by providing a framework for categorisation of the different conceptual and methodological approaches. Existing literature presented that four types of household energy knowledge distinguished such as device energy knowledge, action energy knowledge, financial energy knowledge, and multifaceted energy knowledge concerning energy consumption often stimulate energy conservation behaviour.

By understanding how and why to conserve energy, the individuals will tend to be more active towards the energy conservation behaviour. Therefore, this study aims to highlight the significant role of energy knowledge in contributing to energy conservation behaviour.

Energy Knowledge In Influencing Household Energy Conservation Behaviour

Energy knowledge may drive energy conservation behaviour among households to reduce energy consumption. Energy knowledge has been acknowledged as a psychological factor that has a significant impact on household energy consumption behaviour. A large number of past studies analyzing the energy knowledge impact on energy conservation behaviour have stated that energy represented a catalytic factor in driving energy conservation behaviour impede substantial energy consumption behaviours among households (Anastasya *et al*., 2021;Kowalska-pyzalska and Byrka, 2019; Stojanovski *et al*.,2020;Trotta, 2020;Ucal, 2017).

Energy knowledge is defined as the understanding that drives the sustainable consumption of energy by households. According to Kowalska-pyzalska and Byrka (2019), energy knowledge increases the commitment to conserve energy associated with awareness of energy consumption among the households in Poland. In a study conducted by Gołębiowska (2020), the households have demonstrated that their energy literacy contributes to influencing household energy consumption behaviours. Knowledge of renewable energy has been found to affect the willingness of ordinary households to pay in applying renewable energy as an energy source for household electricity needs related to human behaviour or actions in Kepulauan Seribu Regency (Anastasya *et al*., 2021). A study conducted by Ucal (2017) in analyzing energy consumption behaviours among women in Turkish has indicated that knowledge of energy-efficient electrical home appliances and climate change with energy conservation have significantly influenced their energy conservation behaviour and purchase decision of electrical appliances. Consistently, another study by Trotta (2020) on Finnish households for electricity consumption has shown that information provision about energy consumption and conservation increased knowledge about electricity bills, prices, and costs. The above studies represent the significant role of energy knowledge in influencing household

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energy consumption behaviours towards energy efficiency and the energy conservation behaviours that should be achieved when households consider their energy consumption. A study in Mexico has indicated that improving energy knowledge about energy conservation by helping consumers understand how their electricity-consuming actions and the price schedule they face impact their electricity bill can empower them to make more informed decisions about how much electricity to consume (Stojanovski *et al*., 2020).

Individuals with good energy knowledge are willing and able to conserve energy, hence perform energy conservation behaviour actively and regularly. This study addresses the link between energy knowledge and energy conservation behaviour. This study presents the essential role of energy knowledge in energy consumption behaviours among households to conserve their energy.

Methodology

A literature search has been conducted on two databases of a scientific journal: Scopus and Web of Science. The search is limited to articles published from the year 2015 to the year 2021. Only the work written in English is selected. The keywords used for basis search through the two databases including "energy knowledge", "energy conservation behaviour.", and "household". Also, the basic search extended to identification of all articles that inclusive or synonym of keywords in the same sentence did not limit to title, abstract, and subject field. The search has resulted in a total of fifty-four (54) articles after ensuring that synonyms of "factors", 'determinants" and "barriers" are presented in the same field. Lastly, a total of twenty-four studies that considered the significant relationship of the role of energy knowledge influences household energy consumption behaviour were included in the review of present study.

Discussion

Table 1 shows the 24 related studies on energy knowledge in influencing household energy conservation behaviour. These studies have identified a significant positive relationship between energy knowledge and energy conservation behaviour. The majority of these studies suggested that energy knowledge has changed household energy consumption to conserve energy in fulfilling their daily activities. These studies indicating the relationship between energy knowledge and energy consumption behaviours that drive conserve energy demonstrate households 'understanding of how and why energy consumption to be detrimental and benefited by them.

Table 1: Related Works of Energy Knowledge Influencing Household Energy Consumption Behaviour

No.	Source	Country
1	Khani *et al*., 2021	France
2	Anastasya *et al*., 2021	Indonesia
3	Jijie *et al*., 2021	Romania
4	Brülisauer *et al*., 2020	Singapore
5	Eriksson and Kjeang, 2020	Sweden
6	Stojanovski *et al*., 2020	Mexico
7	Trotta, 2020	Finland
8	Li *et al*., 2020	China
9	Diawuo *et al.*, 2020	Ghana

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10	Nie *et al*., 2019	China
11	Fijnheer *et al*., 2019	Netherlands
12	Jareemit and Limmeechokchai, 2019	Thailand
13	Kowalska-pyzalska and Byrka, 2019	Poland
14	Amoah *et al*., 2018	Ghana
15	Tabatabaei and Klein, 2018	United States of America
16	Stikvoort *et al*., 2018	Sweden
17	Ucal, 2017	Turkey
18	Blasch *et al*., 2017	Switzerland
19	Enshassi and Elzebdeh, 2017	Palestine
20	Hobman *et al*., 2017	Australia
21	Seebauer and Wolf, 2017	Austria
22	Tanaka *et al*., 2017	Japan
23	Pothitou *et al*., Hanna, 2016	Peterborough
24	Pothitou *et al*., 2015	United Kingdom

Several studies have linked energy knowledge to influence household energy consumption behaviours significantly and positively (Blasch *et al*., 2017; Li *et al*., 2020; Nie *et al*., 2019; Pothitou *et al*., 2015).

Blasch *et al.* (2017) have studied the influence of energy and investment literacy on the level of transient and persistent efficiency in consumption of electricity of households in Switzerland. By analyzing data from the households survey, they found that energy and investment literacy significantly positively exhibiting energy conservation behaviour as households associated with lower electricity consumption, such as energy literacy asserts knowledge relating to the average price of 1 kWh of electricity in Switzerland, the usage cost of different household appliances (running a PC for one hour, running a washing machine cycle with full load), and the electricity consumption of various household appliances. For example, respondents were given two energy services and were asked which of the two consumed more electricity or consumed about the same for boiling one (1) litre of water on the stove rather than boiling one (1) litre of water using an electric kettle.

Nie *et al*. (2019) have conducted a study of careful use, energy conservation behaviour based on the theory of planned behaviour among the residents in Changchun, China; the results indicated that energy knowledge and information enhanced careful-use behaviours regarding energy conservation behaviours. Likewise, a study of Hefei residents in China, Li *et al*. (2020) have found that the resident's knowledge of the increasing block tariffs policy for household gas is significantly associated with their acceptance, which has a significant positive impact on residents' gas-conserving intention. A study by Pothitou *et al*. (2016) have identified that energy knowledge leads to energy conserving activities in households particularly in adopting and purchasing energy-efficient appliances. Similarly, a study found that household knowledge of greenhouse gas emissions, the number of laptops owned and the number of electric showers owned by households associated with households income had a significant positive influence on energy-conservation behaviour (Pothitou *et al*., 2015).

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Conclusion

Household energy conservation behaviour contributes to efforts in overcoming sustainability challenges including the increasing trend of energy consumption, climate change and tension to the natural resources. There are essential focuses on the role of energy knowledge to educate and guide households in their energy consumption behaviour to help in achieving energy reduction effectively. Although this study is based on the small number of reviews of the 24 pieces of past works, the findings suggest that emphasis on energy knowledge in influencing household energy conservation behaviour will be able to result in a potential energy reduction as a whole. Unfortunately, this study only includes the review of a single psychological factor that contributes to energy conservation behaviour, further investigation should be conducted to explore other psychological factors that significantly influencing the household energy conservation behaviour, thus contributing to the route of the nation to achieve a sustainable future.

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