Energy Efficiency Policies and Initiatives in Malaysia

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ABSTRACT

The dependence of office and commercial buildings on the use of energy in daily operations can lead to excessive use of energy especially for heating and cooling, lighting systems, and power appliances or equipment. As a result, there has been a high demand for potential energy efficiency in office and commercial buildings over the last few years. Given this, there is a question of whether the existing policies and initiatives introduced by the authorities are sufficient to ensure that aspects of energy efficiency can be properly implemented in an existing office and commercial building. Improvements to existing policies and initiatives may be the best path for policymakers and stakeholders but often ignored in some building sectors as it could play a significant role similar to technological and technical approaches. Therefore this paper reviews and identify the impacts of energy efficiency policies on the building sector in Malaysia. The paper highlights the research needed to fully incorporate energy conservation policies and strategies into the processes of building construction and operation to minimize the usage of energy in buildings while

improving comfort and productivity for occupants. There are 11 policies or initiatives related to energy efficiency towards buildings that have been analysed. The findings show that the relevant ministries and agencies involved in policy formulation have placed a strong emphasis on the implementation of energy efficiency programs, especially on the use of electricity in commercial buildings. The key goals of energy conservation policies and programs are to conserve electricity and reduce the rise in electricity demand while continuously monitoring the effectiveness of its implementation. This study finds that in general, there is a need for existing policies to be strengthened and enforced with greater effectiveness and more proactive initiatives.

Keywords: Energy Policies, Energy Management, Energy Efficiency, Energy Audit, Building Performance

Introduction

For an office building to achieve energy efficiency that meets national standards, the process of improving the performance of a building must be guided by the best practices in the energy management program. A good energy management aspect should consider the various factors contributing to energy efficiency issues within the office building [1]. With a well-planned energy management program, the most apparent advantage of energy conservation is that it decreases running costs, representing relatively significant savings over the life of the building [2]. Reduced emissions and less use of energy resources, though, have now become more of significant long-term advantage. Improving energy efficiency initiatives can also contribute to better, more comfortable buildings, a better working atmosphere, more pleasant occupants, and better productivity. This is in line with Bano and Sehgal (2020) [3], who stated that failing to follow the effective energy-saving method causes office buildings to experience issues such as high electricity costs every year.

Besides, an initial energy audit, top management support, energy usage monitoring, energy policy, an energy-saving project program, and staff encouragement, as well as training, are some of the other critical elements [4]. Among the initiatives of the government and government policy are that subsidies, grants, discounts, and other related initiatives can be effective in overcoming the financial barriers of using renewable energies and energy-efficient appliances. Five primary building energy usage management measures: building energy codes, improvements to existing buildings (retrofits), appliance energy standards and labelling, energy-efficient and green energy appliance subsidies, and increasing block tariffs [5]. For example, in developing energy efficiency codes and regulations, several countries have enforced minimum standards for window performance and design.

Energy awareness programs are also very crucial in energy management activities because it involves attitudes and habits of building occupants. Building occupants, such as management staff and employees, should be fully involved in all energy efficiency programs and activities led by energy managers or consultants. The influence of building occupants such as user behavior and attitudes [6]-[9]), individual consumption patterns and social science aspects in the implementation of energy management activities must be taken into account in addition to other technical aspects [7]. This will not only raise awareness and provide exposure to them but will also make the energy efficiency program more sustainable and the practices will be implemented for a longer period. Even though there is a huge challenge in multidisciplinary research involving occupant behavior in buildings, particularly concerning data collection, but according to Hong et al. (2016) [7], there is a great opportunity in pursuing the existing energy efficiency program. This

statement is supported by solutions in both energy-efficient behavior and technical aspects that will inclusively contribute to achieving energy efficiency buildings [7].

Based on the previous study, Choong et al. (2012) [10] indicated that concerning the need for energy efficiency, two things need to be taken into account: environmental and economic factors. The sustainability of energy has gained serious attention as it serves as a core principle in the management of energy. Excessive use of energy contributes to greenhouse gas emissions and a lack of energy supply, as the energy used mostly comes in the form of finite, non-renewable traditional resources. Energy management is seen as an improvement in benefit and costs reduction activities from another viewpoint, especially in economics, since it is intended to save costs at some levels of an organization.

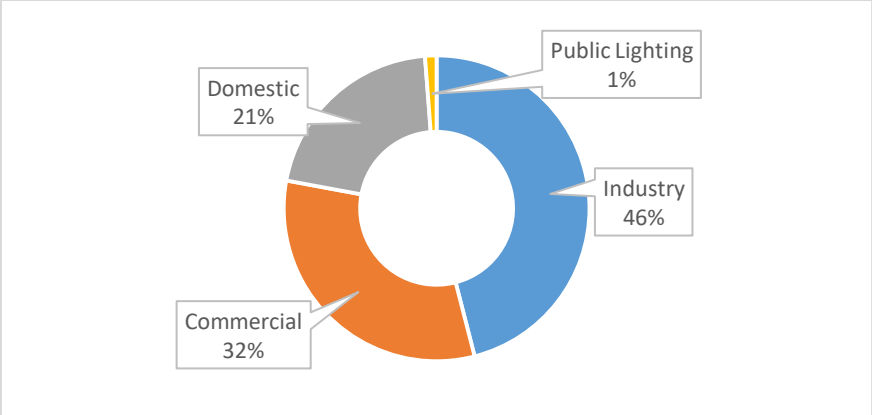

Figure 1. Electricity sales by sector in 2017, adapted from Energy Commission (Malaysia) (2019)

Factors

The main factor to save energy in the office building is generally inspired by the global need to save energy. Although there are so many factors that lead to efficient energy management in the office building [11], this research only focuses on the factors that are related to energy consumption in the building. The average electricity selling prices in Malaysia have also increased compared to 10 years ago based on the type of tariff that has been set.

The classification of electricity tariffs in this country is based on the business operation of customers in each building or structure and its level of supply voltage. Consumer classifications related to the energy use of a building are limited to domestic, commercial and industrial consumers. Domestic consumer means a consumer occupying a private residence that is not used as a commercial property, such as a hotel, an office or other sort of industry, trade, professional activity or service. This word, in short, describes Malaysia's household consumption of electricity. For commercial customers, office buildings, hotels, service apartments, retail complexes, stores, restaurants, airports, educational institutions, hospitals and warehouses are the tariffs set for this category. The industrial consumer, on the other hand, means a consumer engaged in the manufacture of goods and products. Table 1, Table 2 and Table 3 show the average electricity selling prices of Tenaga Nasional Berhad (TNB), Sarawak Energy Berhad (SEB), and Sabah Electricity Sdn. Bhd. in units of sen / kWh from 2011 to 2018.

Table 1

Average electricity selling prices of TNB (Unit: sen/ kWh)

Year	Domestic	Commercial	Industry
2011	27.97	39.10	29.77
2012	28.93	40.98	30.89
2013	29.15	40.76	31.00
2014	32.28	47.10	35.88
2015	32.67	47.68	36.56
2016	33.21	46.76	37.13
2017	32.87	47.16	36.97
2018	33.09	47.28	37.30

Table 2

Average electricity selling prices of SEB (Unit: sen/kWh)

Year	Domestic	Commercial	Industry
2011	31.20	31.20	24.70
2012	31.20	32.00	24.90
2013	31.30	32.00	25.10
2014	31.30	32.00	25.10
2015	28.25	31.72	24.48
2016	28.30	30.53	24.15
2017	28.21	30.54	23.86
2018	28.27	30.50	23.69

Table 3

Average electricity selling prices of SESB (Unit: sen/kWh)

Year	Domestic	Commercial	Industry
2011	23.83	29.27	22.43
2012	25.10	31.41	24.68
2013	25.30	33.59	28.81
2014	29.32	39.25	32.90
2015	29.14	37.63	30.80
2016	28.86	38.21	31.36
2017	28.39	38.26	31.09
2018	29.11	39.19	31.36

Energy consumption in commercial buildings such as office buildings is more to the Heating, Ventilation, and Air Conditioning (HVAC) system. While the lighting system and office equipment is the second-highest energy consumption in an office building. The office building is a structure that responds, during its operation, to the behavior of building occupants and the use of HVAC, lights and electrical equipment. Therefore, energy-saving measures and plans are carried out to achieve the objective of using the minimum possible energy in the building with the comfort levels being maintained. To make efficient use of energy and, as a consequence, to save it, the actions are focused on energy conservation, energy recovery, and energy substitution.

Approaches

According to Gupta et al. (2017) [12], some approaches have been used in energy-saving measures as well as to achieve the objective of efficient energy management in the office building, such as *Understanding Energy Uses, Energy Management Opportunities Identification* as well as *Opportunities Assessment and Implementation*.

Firstly, energy usage trends need to be recognized and past facility service logs and energy bills checked. With complete data, it is possible to benchmark energy efficiency across similar facilities or buildings, allowing the researcher to concentrate further on patterns in usage. Then, an energy audit can help identify energy-saving opportunities with a preliminary understanding of energy use. In general, an energy audit involves several site visits to the building, a system-based analysis of energy best practices and energy infrastructure and results in personalized energy management solutions [13]; [14]. All prospects for energy management should be analyzed according to their technological and economic feasibility. Large-saving, low-cost opportunities should often be implemented first, such as improved energy housekeeping practices. Opportunities that involve a greater capital investment or have a longer payback (such as those requiring the construction of new equipment or the retrofitting of existing equipment) may be gradually implemented to gain expertise before full-scale implementation by operating pilot projects.

Review of Energy Efficiency

In this study, the word energy refers to the electric current used in a building, whether it involves the use of office equipment and related equipment by building occupants, or even the use of a system and the machinery for the operation of the building. Running lifts, office equipment, as well as HVAC and electrical lighting, are components of mechanical and electrical (M&E) building systems that consume more energy in a building. Therefore, the use of very high energy in a building involves many causes or factors that contribute to this problem. In addition to equipment, appliances, machines used in construction, features, and design of a building that does not fit also contribute to higher energy consumption. On the other hand, implementing energy efficiency measures at the design stage could dramatically reduce energy consumption by effectively managing and curbing energy consumption growth [15],[16] Energy efficiency has been described as the energy services offered to produce desired energy services, such as heating, lighting and movement, per unit of energy input. Additionally, energy efficiency keeps maintenance costs to a minimum [17]. This is because optimal energy consumption through energy efficiency levels allows a daily saving. Efforts to improve energy efficiency can also be carried out in existing buildings, especially office buildings that consume very high electricity consumption and inefficient [29].

Considering energy efficiency in the building's lifecycle would ensuring lower energy consumption throughout its operation. According to Alaileh et al. (2013) [18], energy efficiency has become an important approach to manage increasing growth in electricity demand and might contribute to energy conservation for a long term solution.

Analysis of Building Energy Efficiency Policies and Initiatives

The energy sector contributed to Malaysia's economic growth over the past decade. However, previously there was no clear and precise initiative to reduce electricity usage in commercial buildings in Malaysia until the introduction of the Efficient Management of Electrical Energy Regulations 2008 under the Electricity Supply Act 1990. These regulations required that any installation used, owned, or operated by a private installation

licensee with a cumulative net electrical power generation equal to or greater than 3,000,000 kWh for six months in a row should be required to carry out energy audit activities.

Since then, the growing demand for energy from related sectors has prompted energy efficiency policies to be implemented (Kamaruzzaman & Zulkifli, 2014) [19]. The policy and initiatives are in line with the government's desire to ensure sustainable development in the country and promoting efficient utilization of energy as stated in National Green Technology Policy (NGTP) as one of the pillars to improve quality of life (Yiing, Yaacob, & Hussein, 2013)[20]. This refers to green technology which involves the development and application of equipment and systems used to conserve the natural environment and resources, minimizes and reduces the negative impact of human activities. However, according to Yiing et al. (2013)[20], it is believed that the application of Green Technology Policy (GTP) only is enforced to the development projects of new buildings as well as the latest system on the market at present.

Overall, the key emphasis of these policies and initiatives is to set standards, requirements, and criteria in driving toward achieving energy efficiency implementation in Malaysia especially for conventional buildings that do not focus on energy-saving aspects. Previous studies [21], [22] and [31] have shown that many of existing construction types are still being built with traditional designs, the usage of old equipment, inefficient lighting as well as air-conditioning system. Thus, they contribute to inefficient energy consumption in the commercial and residential buildings and this excessive energy consumption lasts for many years without any awareness from the building management or the owner himself.

Therefore in 2017, the Ministry of Energy, Green Technology and Water (KeTTHA) has launched an RM200 million energy performance contracting (EPC) fund provided by Malaysia Debt Ventures Bhd. (MDV) as authorities work to reduce electricity usage and slash the government’s subsidy for the power sector. The EPC development aims to improve the efficiency of energy use in commercial buildings and government sectors by fostering the design of energy conservation for new buildings and by improving the efficiency of energy use in the operation of existing buildings in Malaysia. MDV is a company wholly owned by the Ministry of Finance Inc. (MoF Inc.) as a technology financier and the fund will be provided to eligible energy service companies (ESCOs) to achieve energy savings as much as RM399 million, by the fifth year of the financing program.

The progress of energy efficiency in terms of policies and initiatives outlined by the Malaysian government and agencies that relate to energy efficiency in the building and construction industry are summarized in Table 4.

Table 4

Selected energy efficiency policies and initiatives introduced in Malaysia for the building sector

Year	Ministry/ Agency	Policy/ Initiative	Key Emphasis
1989	Ministry of Energy, Communications, and Multimedia Malaysia (MECM)	Malaysian Guidelines for Energy Efficiency in Buildings	- Set minimum requirements in the key segments: minimization of losses in electricity and distribution equipment; designing of an energy-efficient lighting system; design of an efficient air-conditioning system; building envelope design criteria; and design of a successful energy management system.
1984	Department of Electricity and Gas Supply (DEGS)	Malaysia Uniform Building By-Laws (UBBL)	-MS1525:2007 In 2007, the Code of Conduct was integrated into UBBL. It offers the minimum baseline level for energy-efficient design rating tools for the Green Building Index (GBI). Increasing the use of thermal insulation for roofs in air-conditioned buildings to save energy
2008	Energy Commission	Electricity Supply Act 1990: Efficient Management of Electrical Energy Regulations 2008	-These Regulations shall apply to: (a) Any installation that receives electrical energy from a licensee or supply authority with a cumulative consumption of electrical energy equal or higher than 3,000,000 kWh as calculated at or more than one metering point for a period not exceeding six straight months; or (b) Any installation used or operated by a licensee of a private installation with a cumulative net generation of electrical energy equal to or higher than 3,000,000 kWh for any duration not surpassing six straight months. c) to assign a registered energy manager
2009	Ministry of Energy, Green Technology and Water, Malaysia	National Green Technology Policy (2009)	-To accelerate the national economy and promote sustainable development by seeking to promote efficient energy use. - Minimizing energy consumption growth thus improving economic development.

2009	Conservation and Environmental Management Division (CEMD) Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM)	The National Policy on Climate Change	-Energy Efficiency: Through the use of less energy, mostly by more efficient technology or processes, to provide the same quality of energy service. - Promoting and increasing EE in the industrial sectors by energy audits in the industrial and building sectors; and adoption by new industries of EE practices.
2010	Economic Planning Unit (EPU)	National Energy Efficiency Policy - Tenth Malaysia Plan (2011-2015)	-Implementation of Energy Efficiency Plan: To ensure the continuous implementation of energy efficiency measures in the country, an effective action plan has been established as an important element. -The Action Plan involves 10 specific initiatives aimed at reducing energy consumption in the manufacturing, commercial, and domestic (appliance) sectors.
2011	Malaysian Institute of Architects (PAM) Association of Consulting Engineers Malaysia (ACEM)	Green Building Index (GBI)	-There are several main criteria in the GBI namely such as Energy Efficiency and Indoor Environment Quality. Green Building Index Malaysia (GBIM) located energy efficiency as the priority, followed by other criteria.
2014	Ministry of Energy, Green Technology and Water (KeTTHA)	Minimum Energy Performance Standard (MEPS)	- To evaluate the minimum energy efficiency level that must be met by electrical appliances before they can be listed for sale and used for commercial purposes. -The efficiency level is shown by using the star rating label.
2015	Ministry of Energy, Green Technology and Water (KeTTHA)	The National Energy Efficiency Action Plan (2016-2025)	- A plan to incorporate energy efficiency initiatives in the industrial, commercial, and residential sectors in a well-coordinated and cost-effective manner, resulting in reduced energy consumption and economic savings for customers and the country. -Only confined to electricity usage

2017	Ministry of Energy, Green Technology and Water (KeTTHA)	Energy Performance Contracting (EPC)	-Government buildings are authorized to involve companies in the field of energy services (ESCO) to boost energy efficiency. -Investment costs for enhancing energy efficiency will be provided by ESCO, while government buildings will be entitled to cover the cost of ESCO's investment from the savings made by improvement activities. -The initiative would help to develop an ESCO industry in Malaysia and to reduce the budgetary burden of the government on energy bills.
2020	Ministry of Science, Technology, and Innovation (MOSTI)	MOSTI Initiatives 2020	-In the energy sector, one of the four areas of focus is to achieve 8% savings in energy efficiency by 2025 through stimulus and awareness programs to the private sector, government agencies, and the public.

The Importance of Increasing the Consideration of Energy Efficiency Measures in the Office Building

At present, there are several issues associated with energy efficiency in the building. Despite support from previous studies [23]-[26]) that noted the importance of emphasizing energy efficiency in the building sector, the issues that arise do not yet have been addressed to the best solution in term of human factors, effective management as well as policy and initiative. This argument is further supported by Salvia et al. (2020) [27], in which it notes that if behavioural improvements occur, energy savings and emission reduction goals can be accomplished at a lower cost, demonstrating that "soft measures" are an important lever for the implementation of "hard" technological measures.

Therefore, according to Abd Rahman, Kamaruzzaman, and Akashah (2019) [28] the government policies, initiatives, and programs for energy efficiency and energy conservation have seen some improvement for the last 10 years. Thus, the energy efficiency issue has drawn the attention of many parties in the construction sector, building owners, energy managers as well as Economic Planning Unit (EPU), Malaysian Institute of Architects (PAM), and Association of Consulting Engineers Malaysia (ACEM). The government has implemented many policies and initiatives on the importance of energy efficiency in office buildings, but the penetration is still limited, and the economic value has not been completely exploited.

Many policies and energy conservation-related programs are gaining popularity and many researchers have conducted initial studies. Additionally, the latest research in the field of energy management will certainly further outline emerging developments and concerns directly related to the introduction of energy-saving initiatives that can produce operational returns and cost savings in terms of maintenance. This matter has revealed the importance of considering energy efficiency in the existing office building and possibly being supported by governmental policies that aim to prioritize sustainable development.

Since energy efficiency policies exist and initiatives implemented in Malaysia are promoting energy conservation through energy-efficient technologies, as seen in Table 4, energy efficiency offers opportunities to enhance energy performance and building

operation. Energy efficiency design when implemented effectively can achieve a lower cost during post-construction compared to conventional building designs, with lower energy consumption that can be achieved at a reasonable cost. The elements of energy efficiency if taken in the early stages of a building not only determine the design of buildings, interior, and exterior, as well as the selection of building materials that are environmentally friendly but also result in being cost-effective in terms of internal modifications or additions to the building exterior

Conclusion

This paper has highlighted an array of major policy developments since 1984, although significant improvements are still needed. The study also takes into account some latest policies and initiatives that have been issued by the relevant authorities in promoting energy efficiency for the past seven years since 2014. This fact shows the commitment of the government and its agencies to ensure that efforts towards energy efficiency have been started. The appropriate practice of energy efficiency in the office building is to ensure cost-effective energy consumption because most of the current and existing office buildings are still below the requirement of energy-efficient building. However much has yet to be done and researchers would need a better understanding of the scenario. The effect of implementing such policies and initiatives should also be explored in-depth, in particular concerning returns after the allocation of huge financial allocations to encourage more efficient energy management in Malaysia.

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