

Review

Miscellaneous electric loads in Malaysian buildings - Energy management opportunities and regulatory requirements



Qi Jie Kwong^{a,*}, Joo Eng Lim^b, Mohamad Sufian Hasim^a

^a Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA (UiTM), 40450, Shah Alam, Selangor Darul Ehsan, Malaysia

^b Faculty of Engineering, Tunku Abdul Rahman University College, Setapak, 53300, Kuala Lumpur, Malaysia

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ABSTRACT

Energy efficiency enhancement in the building sector is crucial due to the escalating energy cost and continuously depleting energy resources. The energy consumed by electrical appliances, which is categorized under miscellaneous electric loads (MELs), often takes a significant portion of the total energy consumption in buildings and it is increasing rapidly. With the growing number of MELs being used in the semi-periphery countries, driven by higher economic and population growth rates, efficient use of these small and energy-consuming devices is essential to make buildings more sustainable. This paper reviews the energy management opportunities (EMOs) of MELs in both commercial and residential buildings in Malaysia by taking the legislative and regulatory requirements of such appliances into consideration. Two case studies were carried out to identify the EMOs of the MELs in Malaysian buildings and a comparison was made with the findings of previous research studies. Several issues related to MELs are also highlighted, such as the distribution and marketing of uncertified electrical items, absence of mandatory energy efficiency testing and labelling requirements on certain appliances, extension of regulatory coverage to the presently non-regulated equipment and awareness of the locals about purchasing certified electrical products.

1. Introduction

The energy consumed by the building sector worldwide is expected to exceed 100 quadrillions BTU in the year 2035 [1]. In many of the developing nations, the fast development in the economic sector and growth in population has led to an increase in energy usage which hastens the depletion of locally available resources and causes more emission of greenhouse gases. It was reported that the semi-periphery countries in Asia account for two-thirds of the global energy growth which resulted in Southeast Asia being one of the regions with the highest energy use [2].

Malaysia, which is a part of the Southeast Asia region, is a fast-developing tropical country and the annual average growth rate is expected to be 6.2% under the Eleventh Malaysia Plan (11 MP) guided by the Malaysian National Development Strategy. Regulated by the Energy Commission, the electricity consumption of the residential and commercial sectors had reached 7559 ktoe in 2015 and constitutes 53.6% of the total electricity consumption and 14.6% of final energy demand in this country [3]. The electricity demand for these two sectors has increased for about 53.7% from 2000 to 2015 as a result of rapid development in economic activities (as shown in Fig. 1) [3] and fast

population growth [4,5]. A global energy review [6] projected Malaysia's energy demand to rise two-fold in 2035, similar to other developing countries in Southeast Asia.

The major factors that have been found to contribute to the increase in energy consumption in both commercial and residential buildings are the modernization of such building types, the installation of the ACMV system to improve the comfort of occupants and the widespread use of electric equipment [7], both regulated and non-regulated ones. Among the energy consuming systems in buildings, the energy consumed by the electrical appliances, which is often lumped under the category of Miscellaneous Electric Load (MELs) or simply plug load, has long been identified by energy researchers as one of the most significant energy users [8,9]. The MELs usually encompass both major domestic appliances (MDA) and small domestic appliances (SDA), which cover broad categories of equipment. It is identified that such “miscellaneous” load often takes up 15–20% of the total energy consumption in buildings [6,10] and a previous study highlighted that the MELs are the fastest growing end-user of electrical energy in the commercial sector [11]. This directly suggests that more attention should be given to the MELs for energy efficiency improvement.

The air conditioning system is often the highest energy user in

* Corresponding author.

E-mail addresses: kwong@salam.uitm.edu.my, kwong.qjie@mail.com (Q.J. Kwong).

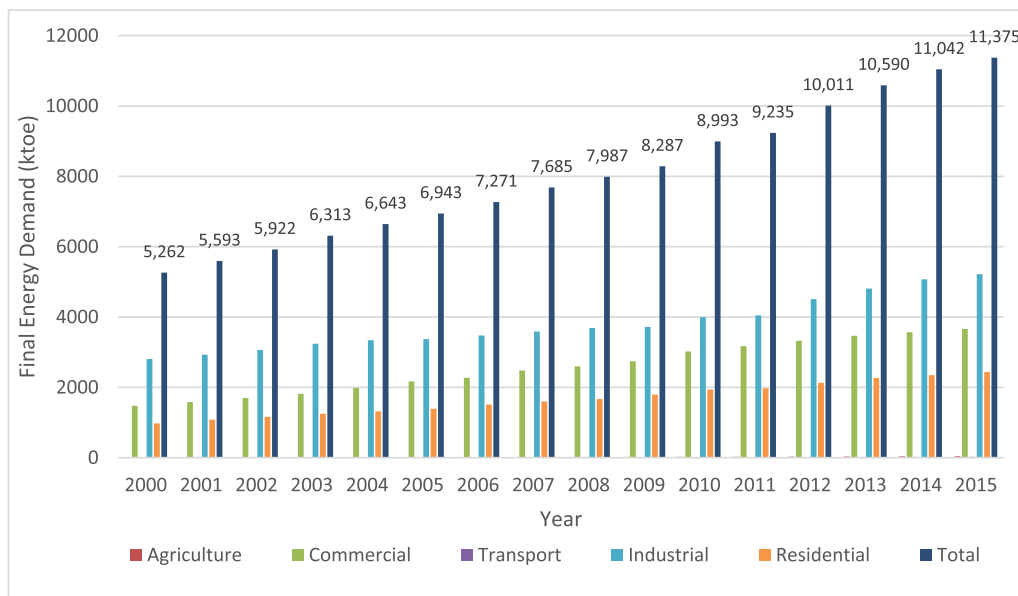


Fig. 1. Final electricity consumption by sectors in Malaysia from 2000 to 2015 [3].

buildings in the equatorial region building, followed by light fittings. Due to that reason, most of the energy efficiency studies on active building systems have been directed towards these two building services. The MELs are often neglected, possibly owing to the distinctive operating patterns and different power demands for each of the equipment which make the estimation of electricity consumed by the MELs more difficult. This paper gives a conceptual review of the available information pertaining to the EMOs of MELs by taking the energy and legislative requirements into consideration and provides a clear description of the current trend and future development of the use of these small yet energy consuming devices in Malaysia. Two case studies are then presented to show the potential energy savings of the MELs in Malaysian commercial and residential buildings and the results are compared to that of earlier studies in this technical field.

2. Legislative and regulatory requirements for electrical appliances in Malaysia

The Malaysian government, with the advice of the Ministry of Energy, Green Technology and Water and the Energy Commission of Malaysia, has gazetted the Electricity Supply Act 1990 [12] and the Electricity Regulations 1994 [13] to ensure electricity supply and its uses can be accomplished safely and efficiently. Section 4 of the Electricity Supply Act 1990 stipulates that among the functions of the Energy Commission is to set the minimum standard and specification for all electrical items in Malaysia. Furthermore, it is clearly prescribed under sub-regulation 97 (1) of the Electricity Regulations 1994 that no person shall manufacture, import, display, sell or advertise – a) any domestic equipment; b) any equipment which is usually sold directly to the general public; or c) any equipment which does not require special skills in its operation, unless the equipment is approved by the Commission.

In Malaysia, some of the electrical appliances are regulated, and approval from the Energy Commission is required prior to commercialisation. Product testing and audits are carried out during the certification process and safety labels are issued upon successful consignment test for imported goods and for new and renewal products which have been tested and registered under the product certification scheme. The list of controlled electrical appliances regulated by the Energy Commission is tabled in Table 1 [14].

Fig. 2 presents the total number of applications for the registration

of electrical appliances in Malaysia, from 2001 to 2016 [15–18]. It shows that the energy commission of Malaysia received more than 9000 new registrations in 2016, and most of the manufacturers/suppliers had decided to renew the registrations of their products every year after the initial approvals were obtained, as required under Regulation 106 of the Electricity Regulations 1994 [13]. In other words, this information shows that more electrical appliances are being introduced into the Malaysian market, which is one of the leading causes of changes in the building energy consumption patterns.

It is important to limit the purchase to only tested and efficient electric products so that the safety of the users as well as energy efficiency are ensured. However, the selling of uncertified products is not uncommon in Malaysia. As shown in Fig. 3, these untested electrical appliances without local authority issued certification labels/product serial numbers are still being sold in several retail outlets throughout the country. It was evident in an independent study conducted in Malaysia that the information provided on the labels affixed to some of the electrical appliances are often misleading, for instance, not showing the actual electricity consumption of the products and even the sellers and distributors were unsure of the products' accreditation status [34]. However, no statistical data about the estimated number of uncertified products being sold in Malaysia is currently available. Some enforcement activities, usually in the form of unsolicited electric product inspection and raids in department stores and electric shops have been periodically carried out around major cities in the country by officers of the Energy Commission with the support of other technical agencies to identify any non-compliance with the Electricity Regulations 1994. Although the number of enforcement activities had increased from 51 in 2013 to 106 in 2016, the registered investigation papers and compound notices pertaining to the distribution and sales of unregistered and untested products were relatively low. To this date, only 3 investigation papers have been opened for alleged offences related to electrical equipment [17,18].

To ensure that energy is being utilised efficiently in Malaysia, the government has introduced the Efficient Management of Electrical Energy Regulations (EMEER) 2008 [19] which is a new regulation under the Energy Supply Act 1990. This regulation is applicable to the consumers of electrical energy and generators, which stipulates several requirements for large installations that receive energy supply through meters and the requirements for registration of electrical energy managers. Nevertheless, the requirements for efficient use of home and

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