CHAPTER 2
ELECTRICITY AND INDOOR ENVIRONMENT IN MALAYSIAN HOUSES

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2.1 INTRODUCTION

A nation's economic growth is closely reflected in its electricity consumption patterns. Assuming energy consumption continues to rise, people need to shift their behaviour and how they use energy to reduce the energy consumption in the buildings. The residential and commercial sectors contribute around 20% of the total energy consumption (Energy Information Administration, 2019). Other than that, it has been stated that the building sector consumes up to 48% of Malaysia's electricity generation (Hassan et al., 2014). Thus, the electricity consumption characteristics in the residential sector should be focused. In addition, the use of air-conditioners rises as the incomes of the residents and populations increase, especially in the hotter regions. A survey was conducted to calculate the annual average electricity consumption for each appliance based on the number of appliances, time of usage, and the electric capacity for each appliance (Kubota et al., 2011). They discovered that air-conditioners have the highest electricity consumption (1,167 kWh), which is the primary factor influencing residential electricity usage. In order to maintain the stability

of energy demand on the grid, fluctuations in energy demand caused by the high power of air-conditioner (AC) use must be managed or minimised (Hassan et al., 2014). According to Hu et al. (2019), the rise of global energy demand due to space cooling would improve people's comfort and health while also having a significant effect on the country's total electricity consumption, thus giving tension to the power grids. Therefore, a precise estimation of the stochastic electricity consumed by the AC is required in the operation of residential distributed generation systems. This is especially challenging during peak demand, which could rise significantly in the upcoming years due to changes in technology.

In order to be able to limit, prevent, and otherwise control energy use, it would be crucial to fully understand the purpose for which the energy is utilised. However, most of the previous studies that carried out field measurements or surveys related to electricity usage in residential buildings focused more on developed countries in subtropical regions. The electricity consumption profiles in certain subtropical regions may be impacted by climate variations and variations in culture regarding the use of air conditioning. Moreover, there is a rising issue of the uncertainty associated with standard occupant behaviour profiles programmed into simulation tools (Kim et al., 2017). An initial study on electricity used a static model to estimate the demand for electricity in UK homes. The study disproved the popular assumption by showing that household income and electricity prices impact how much electricity is consumed (Houthakker, 1961). Therefore, this study aims to investigate how electricity consumption (total and AC) in Malaysian dwellings varies between their household income. This could benefit the electricity industry since precise estimation of electricity demand can be facilitated by real-time measurement data of electricity usage. Next, this research aims to identify the variations of daily peak demands in terms of total, AC, and other appliances' electricity consumption from all targeted dwellings and, lastly, to investigate the relationship between AC operation and indoor air temperature.

2.2 FIELD MEASUREMENT

Field measurements were carried out to gather detailed data on electricity consumption and indoor environmental conditions, focusing on the targeted dwellings and the setup of instruments to ensure accurate data collection.

2.2.1 Targeted Dwellings

Figure 2.1 illustrates the building and location of 19 houses from one of the apartments in Kuala Lumpur for the field measurement. This apartment has 12 blocks, which can accommodate 2791 units of dwelling. However, only seven of them, namely A, B, C, D, F, J, and K, were included in the field measurement. The AC ratings and lifespan vary among all the targeted dwellings. As long as one or more rooms included air conditioning, the targeted dwellings were selected voluntarily. The field measurement was carried out between March 2016 and August 2017 with the consent of each dwelling resident. Every week, the homes would be visited to collect the data. Every residence's electricity usage was effectively measured with an average of 241 days.

Figure 2.1 The location and building of the field measurement (Source: Aqilah et al., 2021)