COMPLETION REPORT

A Cross-Cultural Analysis of Household Energy Use Behavior in Malaysia and Japan

Dr. Sheikh Ahmad Zaki Bin Shaikh Salim
Senior Lecturer
Malaysia-Japan International Institute of Technology,
Universiti Teknologi Malaysia
Malaysia

According to annual energy consumption of household in 2009, Malaysia consumed the total of 24.5 GJ. Meanwhile, household in Japan consumed the total of 25.6 GJ in 2009. Despite with the population of merely 25, 715, 820 for 2009, Malaysia apparently consumed energy with almost the same amount as Japan with higher population of 127, 078, 700 in 2009. Japan population is more than twice the population in Malaysia. Therefore, according to the data, annual energy consumption of household in Japan is considered as low compare to Malaysia. It is adequate to suggest that household in Malaysia consume more energy than household in Japan.

In Malaysia, cooling device is the second highest contributor to the energy consumption with 17 %. This shows that apart from cooking gas, air-conditioner is also the most important necessity to households in Malaysia. Although air-conditioner is rated as the fourth largest contributor to household in Japan for 2009 with 7.4 %, the usage is still low compared to Malaysia. It proves that space cooling contributes larger factor in energy consumption of household in Malaysia compared to Japan.

The study revealed significant contrast in space cooling habits of occupants in both cities. The probability of occupants in Malaysia to use the air-conditioners frequently at night time during sleeping hour, between 11 pm and 6 am was the highest. While the pattern of air-conditioner use during sleeping hours was apparent in the Malaysian case, the same could not be concluded for the time of use in the Japanese case. There was significant air-conditioner use both in daytime and night time observed in Fukuoka. Residents in Malaysia concern more on the time of usage while residents in Japan concern more on the temperature. It is because the probability of residents in Japan to turn on the air-conditioner was the highest when the room temperature is between 28°C to 30°C. Considering these factors and habits, we concluded energy consumption on air-conditioner as the primary interest in this study.

There were two apparent factors affecting air-conditioner use among Malaysian residents, which are the high room temperature as well as the occupied/vacant state of the room. The average room temperature at night was 31°C without air-conditioner. The house is rarely occupied in the daytime on weekdays, with the exception of some occupants who work night-shifts ranging from 7.00 pm to 7.00 am. Therefore, the frequency of air-conditioner use in during day time was very low and the duration of air-conditioner use tend to be short.

Malaysian and Japanese space cooling habit is culturally significant. Malaysia is a country with tropical climate with little to no temperature variation throughout the year. The annual average temperature is 32°C in the day and 23°C at night. On contrary, Japan is a country with temperate climate. It experiences four seasons. Therefore, space cooling in Japan only lasts for three to four months while space cooling in Malaysia occurs the entire year. It is

common for households in both of the countries to own at least one air-conditioner. Nonetheless, both of the countries have the cultural belief that air-conditioner is not naturally good for body. Compared to Malaysia, most houses in Japan still hold onto the said belief as less percentage of its consumption. Malaysia recorded high energy consumption from air-conditioner compared to Japan. This is partially because Japanese are more conscious on the issues of environment as Japan is not a country with adequate natural resources. On contrary, Malaysian are not aware of the breakdown of their energy consumption.

At the beginning of our research, we proposed to use the analysis from this study to develop a numerical model for generating stochastic schedules of air conditioner usage applicable to tropical climatic conditions. Currently, we have developed a model using the probabilities of time at which an air-conditioner is turned on, duration it remained on, and interval between operations. The time of use and the duration of use are better parameters compared to the indoor air temperature, in the case of Malaysian climate, to generate stochastic air-conditioner use behavior schedule in Malaysia. However, our model needs revision after statistical analysis has shown that the generated schedule did not represent the measured data. More work is to be done to successfully generate correct behavior schedules.

It is our goal that after completing the analysis and generating the behavior schedule, the information could be used as inputs for building energy simulation program to improve accuracy of energy prediction. This energy prediction will be valuable to establish new energy policy towards better energy efficiency in Malaysian residential sector.

Publication of the Results of Research Project:

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