variables (electricity consumption caused by respective appliances) were created for each of the household electric appliances by multiplying its electric capacity by the number of the appliance and its usage time. Secondly, further determinants for respective electric appliances were analyzed in the two cities respectively (Table 4c).

As shown in Table 4a, the major appliances contributing the electricity consumption largely differ between the two cities. In the case of Jakarta, air-conditioner (β=0.71) is found to be the major determinant for the electricity consumption in this model, followed by television (0.21), stand fan (0.20), ceiling fan (0.16), and refrigerator (0.14), etc. As seen in Figures 5b, 6b and 7b, this result confirms that energy consumption for cooling appliances, in particular air-conditioners, is significant and large in the case of hot-humid climate of Jakarta. In contrast, in the case of Bandung, water pump (β=0.35) is found to be the most influential contributor for the electricity consumption in this model, followed by television (0.29), lighting bulb (0.26), and refrigerator (0.24), etc. Both of the regression models obtain high R^2-values of 0.93 and 0.87, respectively. The determinants for LPG consumption are similar in the two models for respective cities, although both of the R^2-values record low values of 0.08 and 0.13 respectively (Table 4b). In the two cities, both household size and building size may be able to explain weakly the LPG consumption.

As shown in Table 4c, in Jakarta, the energy consumption caused by air-conditioning, which is the main contributor to the electricity consumption, can be explained by the total floor area, the household income and the age of husband with a coefficient of determinant of 0.47. Other major appliances (i.e. television and stand fan) are weakly explained by the total floor area and the number of children, respectively. On the other hand, in Bandung, water pump is weakly explained by the household income. Other major appliances (i.e. television and lighting bulb) can be determined by the lot area and the household income, and total floor area, respectively.

It is seen that overall, the increase in household income and building size, such as total floor area and lot area, increase the electricity consumption caused by the major appliances. In both of the cities, it was found that the increase in household income increase their building size such as the total floor area (r = 0.38** in Jakarta and r = 0.72** in Bandung) and the lot area (r = 0.39** in Jakarta and r = 0.60** in Bandung). Hence, it is anticipated that the further increase in household income would increase the building size, thus the energy consumption caused by major household appliances. As a consequence, the increase in household income would increase the total household energy consumption significantly in the near future in Indonesian cities. It has been reported that the household income in Indonesia is predicted to rise dramatically in the near future in line with the rise of middle class as described before (JETRO, 2011). The household energy consumption in major Indonesian cities is predicted to increase very sharply if proper energy-saving strategies are not implemented.

It is important to avoid the tendency that building size increases straightforwardly with the increase in household income. From the viewpoint of energy, one of the possible solutions is to recommend more apartments rather than landed houses that generally increase total floor area. It should be noted that most of the incandescent bulbs were already replaced by compact fluorescent bulbs in Indonesian cities. This means that further energy-saving should be made for lighting by utilizing more natural lighting or using LED lamps. The increase in air-conditioning would be a major concern in terms of the energy-saving strategies in Indonesia (the relatively cool climate of Bandung is not typical of other major cities). Even in Jakarta, the ownership level of air-conditioner was only 32% on average at the moment in this survey. It is important to reduce the use of air-conditioning in the future despite the expected increase in household income. Passive cooling techniques should be adopted wherever possible. Insulation for building envelope should also be considered.

On the other hand, the current energy efficiency in electricity generation in Indonesia is not as good as other developed nations. The total loss due to electric efficiency and transmission losses results in the increase in primary energy consumption by approximately 2.7 times than the end-use electricity consumption. This exceeds the scope of this paper but this should also be considered in the future energy-saving strategies in Indonesia.

CONCLUSIONS

Key findings are summarized as follows:

1. The households in Jakarta and Bandung can be grouped into three clusters based on their 'wealth' and 'household size'. It was seen that the average household energy consumption and CO_2 emissions increase with the increase in the above two factors, in particular the 'wealth'. Overall, the average annual energy consumption in Jakarta was approximately 5,726 kWh, which was 1,402 kWh larger than that of Bandung. Accordingly, the average annual CO_2 emission in Jakarta was estimated at 7.8 ton CO_2-equivalent, while that of Bandung was 4.8 ton CO_2-equivalent.
2. The difference of household energy consumption and CO_2 emission between the two cities was mainly attributed to the use of air-conditioning. The ownership levels of air-conditioners significantly differed between the two cities: they are 16-79% in Jakarta and 0-17% in Bandung. It was predicted that the increase in use of air-conditioning in the future would dramatically increase the household energy consumption and therefore their CO_2 emissions.
3. It was anticipated that the further increase in household income would increase the building size, thus the energy consumption caused by major household appliances. As a consequence, the increase in household income would increase the total household energy consumption significantly in line with the rise of middle class in the near future in Indonesian cities if proper energy-saving strategies are not implemented.
4. It is important to avoid the tendency that building size increases straightforwardly with the increase in household income. We recommended the following potential energy-saving strategies for urban houses in Indonesia: (a) provision of more apartments rather than landed houses (from the viewpoint of energy), (b) natural lighting and use of LED lamps, (c) passive cooling techniques wherever possible, and (d) insulation for building envelope.

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