New modern energy consumers: a survey on energy consumption and energy efficiency of Cambodian households

Tharith Sriv[1,*], Kunthy Sok[2], Vibol San[1], Sopheap Ek[2], Monin Von[2]

[1]*Royal University of Phnom Penh, Federation of Russia Blvd., Khan Tuol Kork, Phnom Penh, Cambodia*
[2]*Royal University of Agriculture, Dongkor District, Phnom Penh, Cambodia*

Abstract:
A survey on socio-economic perspectives of Cambodian households related to energy efficiency and consumption was conducted in 2014. We focused on information about households, their current energy, and energy efficiency. A total of 503 electrified households living on an income between two and five dollars, defined as MECCON households, from six provinces and the capital city of Cambodia were selected for this study. A statistical analysis was done using MS-Excel. The study interestingly shows that among the chief wage earners, 13% have a university degree while 12% are government officials. Approximately 94% of the MECON households have access to electricity through the national and community grids. Aside from electricity, other sources such as LPG, charcoal, and biomass are commonly used. For lighting, it is seen that 29% of the studied households use incandescent, while 83.8% employ fluorescent lamp, 54.5% have compact incandescent lamp installed, and only 5.3% consider LED lamp. Finally, it is found that 35% of the MECON households intend to own a refrigerator, 13% are willing to have a washing machine, while about 52% wish to have irons, air conditioners, and so on equipped in their home. In terms of energy efficiency, limited knowledge on it is seen among the studied households. This requires a special attention from the government to widely promote energy efficiency awareness and to establish a strong policy that will contribute to economic development, energy efficiency and security, as well as environmental benefits of the country.

Keywords: *Energy efficiency, modern energy consumer, household, socio-economic survey*

**Corresponding author. E-mail address: tharith@rupp.edu.kh/ tharithsriv@hotmail.com*

1. Introduction

Despite economic growth within the last five years, Cambodia is described by WorldBank (2014) as a developing country with low income. Its population reached 15.14 million in 2013 while about 20.5% of them were reported to live under the national poverty line. In energy view point, efficiency improvement offers multiple benefits such as reducing household energy expenditure and improving productivity, thus contributing to economic growth, enhancing energy security and facilitating cheaper and faster energy services. In addition, it will reduce the consumption, leading to lower energy bills and resulting in less fossil fuel imports. In other words, it can free up funds for other needs of the households (Sarkar and Singh, 2010). This attracts many scientists to study on household energy consumption and associated socio-economic and cultural dimensions (Hewen, N. et al., 2014; Xiaoge, P. et al., 2013; &Vinod, J. et al., 2009).

In the Greater Mekong Subregion (GMS - Cambodia, Laos, Myanmar, Thailand and Vietnam), 'new Modern Energy CONsumers' (the MECON), that is, people who have access to grid electricity but who live on low incomes (USD 2-5 per day), will be responsible for a large share of expected increase in energy demand and thus GHG emissions. Many of the non-technical barriers to energy efficiency (EE) deployment will be more prevalent in these low-income, low-energy consuming households. This motivated us to conduct a socio-economic household survey in Cambodia where the result is to be used as a partial robust evidence-base upon which future policies to promote EE amongst the MECON can be developed. This research aims at collecting information about household characteristics of the survey population i.e. the new modern energy consumers; determining how new modern energy consumers currently use energy; understanding household energy aspirations and to analyze the commodities of rural and urban MECON households.

The rest of this paper is organized as follows. Section 2 describes briefly the material and method while Section 3 shows the analysis result and discusses about household characteristics, current

household energy use, and energy efficiency perspectives. The conclusion remark is shown in Section 4.

2. Material and method

The site for the present study covered the capital city and six provinces such as Takeo, Kandal, Prey Veng, Svay Rieng, Battambang, and Siem Reap (Fig. 1). It is carefully selected based on the following criteria: 1) being accessible through available road condition, 2) being close to the border since some households are known have access to electricity imported from neighboring countries, and 3) being the capital city due to the fact that electricity is apparently available almost everywhere in the city. Under this special consideration, approximately 64% of households are from urban areas while the rests are rural residents. They are then randomly selected for the study during the primary data collection process. Door-to-door survey of households was done between January and May 2014 based on a socio-economic questionnaire consisting of 100 questions that had been trialed with around 20 households in Phnom Penh and Kandal province before the actual primary data collection. It should be noted that the questionnaire included mainly closed questions and some open-ended questions; the final question was also open-ended to provide respondents with the opportunity to raise any energy-related issues that had not been raised. All survey data were inputted using the online survey tool known as Survey Monkey. The survey data were then downloaded from the Survey Monkey website, checked if anything is wrong, and analyzed using MS-Excel.

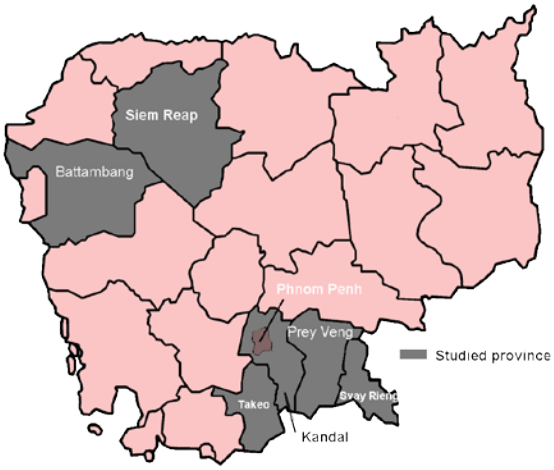


Fig. 1 Provinces and city selected for the study.

3. Results and discussion

3.1. Household characteristics

This section shows MECON household incomes, occupations of chief wage earners and their education level, household size and who makes a decision in using electricity and other energy sources. Table 1 shows that about 60% of the MECON households have the family members between 4 and 6, 24% have more than 7 persons and the other 16% live in a small family (<4 persons). Among the chief earners of the households, about 13% of them have earned a university degree while approximately 84% acquire only high school education or lower. Their occupations range from government officials (12%), retailer or street vendors (10%), farmers (20%), construction workers (5%), self-employed (11%), to unemployed or retired (24%). Surprisingly, government officials fall in the group of low-income households in this country. In addition, university-degree holders are also in this group especially those who work as high school teachers. This is totally different from about 60 years ago where teacher is the most popular job that people wish to become due to being a well-paid one. Regarding the decision to use electricity and other sources of energy, 75% of the households give the power to chief wage earners while approximately 20% of the households are where decision is jointly made.

3.2. Current household energy use

Electricity is commonly used for lighting, cooking, ventilation, cooling, and functioning electrical appliances in MECON households in Cambodia. Aside from electricity, other sources of energy are still practical, mostly in rural areas. This sub-section shows different supply systems that MECON households have access to, what other energy sources are commonly used, and what types of traditional cooking facilities are popular. Table 2 shows that 67% of them have access to the national grid, while 27% are connected to community grid where owners had sub-contracted with the government to supply electricity to some rural areas. About 5% of them have a stand-alone system and an approximate of 1% is marked to have unauthorized access. It should be noted that unauthorized-access user refers to those who do not submit the official documents to the electricity supplier nor authority; however they connect to their neighbor's facility.

Table 1 Background characteristics of MECON households

MECON household size	<4 persons 4-6 persons >=7 persons	16 % 60 % 24 %
Education level of households' chief wage earners	3 % 13 % 31 % 53 %	No answer! College/University Lower & higher secondary Primary/no formal education
Percentage of MECON households' chief wage earners according to their occupation	18 % 20 % 12 % 11 % 5 % 10 % 24 %	No answer! Farmers Government officials Self-employed Construction workers Retailer/street vendors Unemployed/retired
Percentage of MECON households according to their incomes	5 % 25 % 18 % 15 % 17 % 15 % 5 %	No answer! >300 USD 241-300 USD 181-240 USD 120-180 USD 61-120 USD <60 USD
Who in the MECON households makes decision on usage of electricity and other energy sources?	5 % 75 % 20 %	No answer! Chief wage earners Jointly

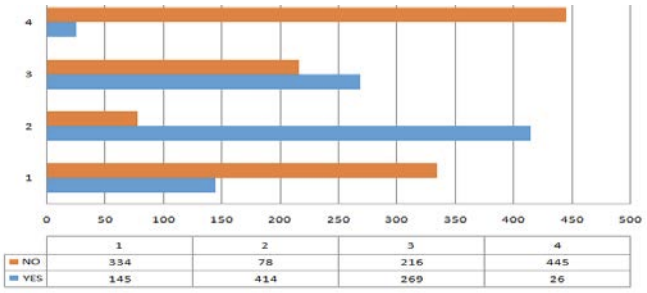
Aside from electricity, Table 2 shows that almost 70% of MECON households use LPG, 39% use charcoal, 65% traditionally employ biomass and about 7% use other energy sources for their daily life. Finally, traditional biomass stoves are popular among 39% of the MECON households, while almost 60% of them have rice cookers and approximately 12% employ other stuffs for cooking.

Table 2 Current energy use of MECON households

Source of electricity (access and perception of availability)	National grid Community grid Stand-alone Unauthorized access	67 % 27 % ~5 % ~1 %
Percentage of MECON households using different energy sources aside from electricity	LPG Charcoal Biomass (fuel wood, rice husk, others) Others	69 % 39 % 65 % 6.8%
Percentage of MECON households having access to different types of cooking facilities (biomass stoves/ rice cookers, others)	Traditional biomass stoves Rice cookers Others	39 % 59 % 12.3%

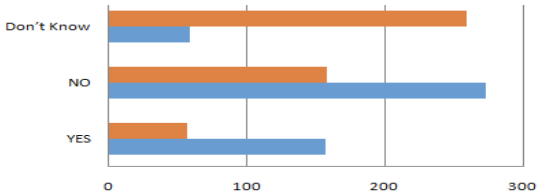
3.3. Energy efficiency perspectives

This section presents the popularity of lighting appliances, different types of TVs used, appliances that households intended to own, and their knowledge about energy efficiency. Figure 2 shows that 29.4% of MECON households use incandescent lamps, while 83.8% of them own fluorescent lamps, 54.5% employ compact incandescent lamp, and 5.3% are found to used LED lamps. While showing the energy efficient labels or asking about knowledge on energy efficiency, limited number of MECON household representatives knew it. Figure 3 shows that only 157 among 503 household representatives have seen or noticed about energy efficient labels and only 57 of them understand what the labels tell regarding energy efficiency. Moreover, MECON households are, in general, influenced by the costs of EE equipments and choose to own low-price appliances instead for their daily life. This is due to the fact that they face financial difficulty in the family. Table 3 indicates that 67% of MECON households are equipped with inefficient box TVs while only 27% use flat screen TVs. Refrigerator, washing machine, and other appliances such as air-conditioner, iron, electric pump are among what MECON households aim to have since, in the same table, 35%, 13%, and 53% are the percentages of the households wishing to own these appliances, respectively.



	1	2	3	4
NO	334	78	216	445
YES	145	414	269	26

Fig. 2 Popularity of **1**: incandescent lamp (29.4%), **2**: fluorescent lamp (83.8%), **3**: compact incandescent lamp (54.5%), **4**: LED lamp (5.3%) among MECON households.



	YES	NO	Don't Know
Understand them?	57	158	259
Seen them or some of them?	157	273	59

Fig. 3 Knowledge on energy-efficient labels among MECON households.

Table 3 Appliances that MECON households hav and intend to have in the future

Appliances being equipped with	Inefficient box-TVs Flat screen TVs	67 % 27 %
Appliances that MECON households wish to have one	Refrigerator Washing machine Others (irons, air conditioners, pumps, etc)	35 % 13 % 52 %

4. Conclusion

A study on MECON households in terms of household characteristics, current energy use and their knowledge on energy efficiency was conducted. The results show that it is common to have access to national and community grid. Moreover, aside from electricity, LPG, charcoal, and different biomass sources such as rice-husk and fuel-wood are supplementary. In addition, inefficient appliances for lighting such as fluorescent lamp and incandescent lamps are widely seen in MECON households and they even lack knowledge about energy efficiency. This requires a lot more attention from the government in order to promote energy efficiency awareness and to establish a strong policy that will lead to economic development, energy efficiency and security, as well as environmental benefits of this country.

5. Acknowledgement

This project is funded from a grant provided by the UK Research Councils' Energy Programme, through the MECON Project managed by Royal University of Agriculture, Cambodia. Aside from this financial support, the authors wish to thank a group of students who were involved in data

collection and data entry during the initial stage.

6. References

Hewen, N., Yuanqing, H., Umberto, D., Peidong, Z. and Hongyi, Q. 2014. Rural household energy consumption and its implications for eco-environments in NW China: A case study. Renewable Energy (65): 137-145.

Sarkar, A. and Singh, J. 2010. Financing energy efficiency in developing countries: lessons learned and remaining challenges. Energy Policy 38(10): 5560-5571.

Vinod, J., Chandra, A. and Bhattacharya, M. 2009. Household energy consumption pattern and socio-cultural dimensions associated with it: A case study of rural Haryana, India. Biomass and Bioenergy (33): 1509-1512.

Xiaoge, P., Chunwang, L. and Zhigang, J. 2013. Household energy consumption pattern in agricultural zone in eastern part of Qinghai-Tibet Plateau. Biomass and Bioenergy (58): 1-9.