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The determinants of household energy-saving behavior: Survey and comparison in five major Asian cities

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HIGHLIGHTS

- ▶ We conduct a survey of energy saving behavior in household in major Asian cities.
- ▶ We identify the factors that influence people's actions.
- ▶ Global warming consciousness and social interaction affect people behavior.
- ▶ This indicates community-based activities impact energy-saving behaviors in Asia.

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ABSTRACT

It is difficult to control household energy consumption through regulation. From a policy standpoint, it is particularly challenging to identify the factors that influence people's actions. Moreover, whatever these factors are, they are unlikely to uniformly span multiple cities in the Asian region. In this paper, we conduct a survey of energy-saving behavior to clarify the differences among such factors across five major Asian cities. The results from these surveys in Dalian, Chongqing, Fukuoka, Bangkok, and Ho Chi Minh indicate that global warming consciousness, environmental behavior, and social interaction significantly affect energy-saving behavior. Income and age also had weak positive effects on energy-saving behaviors. Social interaction was strongly linked to energy-saving behaviors, particularly in the rural areas of Dalian and Chongqing. This result indicates that community-based activities impact energy-saving behaviors.

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1. Introduction

In Asia, energy consumption is rapidly increasing. According to the International Energy Agency (IEA), energy consumption in Asia is expected to increase by 54% compared with the average predicted international increase of 20% in 2000–2008 (IEA, 2010). This increase in energy consumption is concurrent with Asian economic development. In the future, total energy consumption in Asia is forecasted to increase by 2.2 times, in parallel with a GDP increase of 3.9 times in 2008–2035 (EIA, 2011). In non-OECD Asian countries, levels of industrial and residential sector energy consumption are projected to increase by 1.9 and 2.2 times, respectively, compared with projected worldwide increases of 1.5 and 1.3 times, respectively (EIA, 2011). For this reason, energy saving and energy efficiency are important for sustainable, stable growth in Asia. In the civil sector, and particularly in the household sector, energy

saving has become important because the increase in civil-sector energy consumption is expected to exceed the increase in average energy consumption in Asia. While regulation has been effective in controlling industrial energy consumption, it is more difficult to control household energy consumption through regulatory means because households are run by individuals and, unlike institutions, are not forced to take particular actions. Therefore, a key challenge of current policy efforts is to promote household energy-saving actions and identify the key determinants that influence people's energy-saving behaviors.

Several surveys about household energy consumption in Asia have been conducted (Wang et al., 2011; Li et al., 2009; Ouyang and Hokao, 2009; Zhou et al., 2008; Xiaohua and Zhemnin, 2005). These surveys have shown the existence of several factors that affect household energy-saving behaviors. However, Asian countries are not of uniform character, and a wide variety of factors across Asia can influence energy-saving behavior in numerous ways. Policies promoting household energy saving must therefore consider the key factors that influence these behaviors in each designated area.

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Asian countries are characterized by sharply differing lifestyles across urban and rural areas (Cai and Jiang, 2008; Hubacek et al., 2007; Reddy and Balachandra, 2006). In the developing stages, there are significant gaps between the lifestyles of rural and urban areas. In rural areas, traditional lifestyles typically remain stable, whereas urban areas undergo periods of rapid population concentration. This difference between rural and urban is an important factor to consider in determining appropriate policies.

Another important factor in developing countries is the strength of communities that encourage people to respect collective action instead of individual action. Collective society has greater social interaction compared with individualistic society (Faiers et al., 2007; Lynn and Gelb, 1996). Although civic cooperation is frequently important in developing countries, economic development and modernization ultimately tend to diminish traditional communities (Owen and Videras, 2006).

In this paper, we clarify the key factors affecting energy-saving behavior by comparing data from five major cities in Asia and highlight effective energy-saving behavior policies.

2. Household energy research

2.1. Energy-saving behavior and critical factors

Much research has been conducted to clarify the key factors that influence energy-saving behaviors. Wang et al. (2011) surveyed electricity-saving behavior in Beijing, China, demonstrating that economic benefits, governmental policies and propaganda, and perceived inconvenience are all factors that influence behavior. Environmental knowledge, including knowledge related to climate change, was not a contributing factor. In contrast to Wang et al. (2011), many other studies have instead emphasized the role of information in promoting energy saving. For example, Ek and Soderholm (2010) demonstrated that cost, environmental information, and social exchange were important factors in electricity-saving behavior. According to their survey, information programs play an especially important role. Wang et al. (2011) emphasized that in China, policy and social propaganda by governments have an important role, while environmental awareness has a limited effect on energy-saving behavior. Wang et al. (2011) also raised the question of whether this phenomenon was unique to Beijing or was also present in other cities.

The effect of social interaction on energy-saving behavior is also emphasized in some studies (e.g., Ek and Soderholm, 2010). Researchers have examined different expressions of a wide range of social interactions, such as civic cooperation (Owen and Videras, 2006), meaning a willingness to contribute to society.

Some studies also indicate that demographic variables influence energy-saving behavior. It has been suggested that the seniority effect on energy saving behavior is positive (Wang et al., 2011; Samuelson and Biek, 1991), though other studies indicate a negative effect (Sardianou, 2007; Linden et al., 2006). As for the income effect, some research has shown a positive

effect of income on the adoption of energy-saving actions (Sardianou, 2007).

Why do these studies report different results? Because each of the surveys focused on one city and one area, the results do not necessarily extend to other areas. Hence, it is important to identify the influences to determine different trends. We assume that the influences include knowledge, environmental behavior, community development and government policies. We suppose that if the conditions are similar, the trend will prove the same even in different cities. Wilhite et al. (1996) compared Norwegian and Japanese households and confirmed that both countries have similar trends, such as energy-intensive households. Behaviors are defined over the long history of culture, with similar cultures creating similar actions. Owen and Videras (2006) noted that the influence of civic cooperation on individual attitudes toward environmental protection varies with the level of development and the environment quality of the country.

For this paper, we conducted surveys in Dalian and Chongqing, China; Fukuoka, Japan; Bangkok, Thailand; and Ho Chi Minh, Vietnam to examine differences between these cities. Although all five cities have large populations and rapidly growing energy consumption, they also differ in numerous ways. To consider the distinctiveness of each city, we focused on factors including climate, development stage, and government policy.

With reference to residential energy use, climate and energy access conditions are very important due to their effect on energy demands for heating and cooling (Wang and Feng, 2005; Neumayer, 2002); we thus chose Dalian from the northern part of Asia and Chongqing and two Southeast Asian cities from the southern part. Second, development stage is also a factor (Hubacek et al., 2007; thus we selected cities at different development stages. Fukuoka is the most developed city. Third, social structure is expected to influence energy-saving behavior, so we chose cities from different countries. Information for the five cities is shown in Table 1.

All five cities have taken action to promote energy saving in households. Among them, the Bangkok Metropolitan Administration (BMA) leads the effort with the implementation of the “Action Plan on Global Warming Mitigation (2007–2012),” whose results include a 15% reduction of Green House Gas (GHG) emissions. Ho Chi Minh is currently drafting an action plan called “Mitigate and Adapt to Climate Changes.” Dalian and Chongqing have also conducted related measures, including the publication of leaflets to promote energy saving in major energy use sectors.

By comparing different types of cities, we aim to clarify the factors that affect energy-saving behaviors. In general, factors that affect energy-saving behaviors also influence household energy consumption.

2.2. Rural and urban areas

Some research has shown that energy use patterns differ between rural and urban areas in Asia. For example, Reddy and

Table 1
Information about five cities.

	Dalian ^a	Chongqing ^a	Fukuoka ^b	Bangkok ^c	Ho Chi Minh ^d
Annual mean temperature (°C)	10	18.5	16.6	28.8	27.9
GRP per capita (US\$)	11,478	4076	35,341	9616	2615

Note:

^a Data for 2010 (National Bureau of Statistics (2011)).

^b Temperature (average 1971–2000), DRP (2008) (National Statistics Bureau (2011)).

^c Data for 2009 (National Statistical Office (2011)).

^d Data for 2009 (Ho Chi Minh City Statistical Office (2009)).

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