# Impacts of low-carbon technologies for the Chinese residential sector at provincial-level

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## 1. Introduction

Until recently rural areas accounted for a majority of population in China. In 2011 urban population surpassed rural population for the first time due to urbanization process, still there are over 650 million people and over 210 million households [1] live in rural areas. Instead of commercial energy, most of the rural households rely on straw and firewood for their daily energy use. It is necessary to increase rural access to less polluting commercial energy and alleviate environmental problems caused by the highly unsustainable energy structure.

## 2. Estimation of service demands

In this research, the service demands of rural residential sector are estimated by a macro-model [2] through 2030. The macro-model simulates the demands for final energy services on the parameter inputs of futures trends in a variety of factors. The urbanization process is also taken into account by estimating future rural population and floor area. The model estimates the changes in service demands by different applications every 5 years.

The preliminary estimation from the model appears to be much higher than statistical data [1] in base year (2010). One possible reason is that in the model energy usage patterns such like frequency of shower times and operation hours of household electronics are set on standard level of developed countries. While in rural China these usage terms may not be fully applied due to the limited financial resource. Thus we introduce corrective coefficients – satisfaction factors to calibrate the model estimation. The calibrated service demand is calculated by using Equation (1).

$$SD_i = U_i \times A_i \times SF_i \quad (1)$$

Here, $SD_i$ is service demand of each province. $U_i$ represents service demand of each application per household or per floor area, $A_i$ represents amount of household or floor area, $SF_i$ represents satisfaction factors.

Satisfaction factors are coefficients which evaluate adequacies of service demands and are closely related to per capita income. Satisfaction factor of each application is resulted by optimization analysis in order to keep model estimation consistent with historical data in the base year.

For hot water application, SF is calculated by Equation (2).

$$SF_i = \frac{18653 \times PCIC_i}{17034 \times (PCIC_i + 1619)} \quad (2)$$

where $PCIC_i$ is rural per capita income (2011 US$) of each province.

For other applications SF is calculated by Equation (3).

$$SF_i = \frac{25775 \times PCIC_i}{17034 \times (PCIC_i + 8741)} \quad (3)$$

Figure 1 shows satisfaction factors of hot water use and per capita incomes of 31 provinces.

## 3. Low-carbon technologies

To select effective low-carbon technologies for rural residential sector, we use the AIM/Enduse model [3], a bottom-up optimization model with a detailed mitigation technology database, to estimate mitigation potential of low-carbon policies. In the base year (2010) the estimated service demands are disaggregated to energy usage of existing technologies, while in the target year (2030) service demands are satisfied with energy efficient technologies. The model selects technology combination for each province under the least total-system cost.

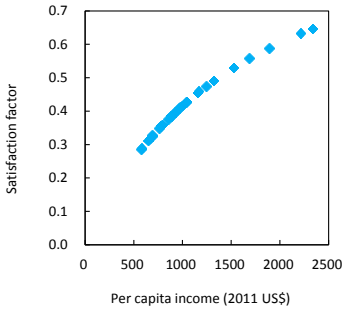


Figure 1. Satisfaction factors of hot water use

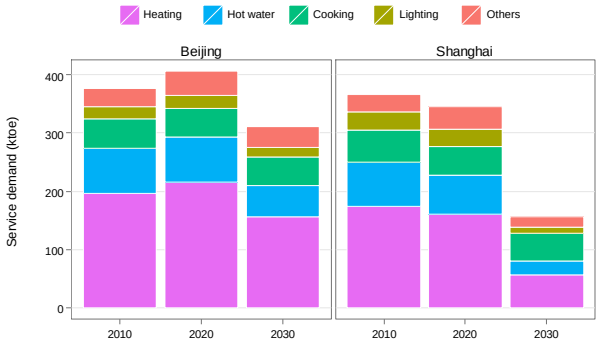


Figure 2. Estimation of rural residential service demands

## 4. Results and discussions

Figure 2 indicates breaks downs of service demands from 2 regions as an example. In most of the provinces rural residential service demands will decrease in the future due to urbanization process. Still implementation of low-carbon technologies will improve rural energy structure and bring $CO_2$ emission reductions as well as financial benefits.

## Acknowledgments

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## References

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