

Investigation and Analysis for the Current Condition of Rural Residential Energy Consumption in Jilin, China

Jindan Cui*, Xindong Wei, Haixia Wu, Xiaoxuan Wang

School of Municipal and Environmental Engineering, Jilin Institute of Architecture and Civil Engineering, Changchun, China

*corresponding author: germdone@yahoo.com.cn

(Received 30 November 2009; accepted 7 December 2009)

This paper investigates and analyses 100 households of rural residential energy consumption practically by selecting Jilin Province, which is located in Northeast China, as a model. The research chooses 5 different regions to make the investigation to the energy consumption for per household, per building area and per person. Based on the research, there are small differences in the same region, while there is wide variation of average between the different regions. Every region uses more than 90 percent of clean energy including culm, firewood and brushwood, and it also uses electricity and liquefied gas that only account for less than 10 percent. This paper draws the conclusion that per household energy consumption of winter is much bigger than that of summer in every region as well.

Key words: Investigation, Analysis, Rural residence, Energy consumption, Jilin, China

1. INTRODUCTION

There is lots of energy consumption of per household in rural residence compared with the city in China. While the economy is growing fast which directly improved people's living standard, the urban residential energy consumption increases dramatically, which also has been affected the increasing tendency of rural residential energy consumption in the past few years. At present, there are many studies on the urban residential energy consumption^[1-7], but only a few of them are related to the rural residential energy consumption and the facts of the focal point are unclear. Therefore, this paper investigates and analyzes the rural residential energy consumption, and also introduces the research findings about Jilin Province which is located in Northeast China, as a model.

2. RESEARCH OBJECT

There are 9 regions altogether in Jilin province in China. The research chooses 5 different regions namely Changchun, Siping, Songyuan, Baishan and Yanbian, and selects 20 households in each region as research objects (Figure 1). The investigation period is from January to December in 2005, and the total research objects are 100 pieces and 94 pieces of them are effective.

3. RESUTLS AND DISCUSSION

3.1 Energy Consumption of per Household



Fig. 1. Location of research object

The energy consumption of per household is shown in Figure 2 to Figure 6. There are few differences of the energy consumption of per household within every research area, but when it comes to averages of different areas, there are prodigious differences between them (17.5~118.4GJ/household-year). From these figures, every region uses more than 90 percent of clean energy including culm, firewood and brushwood, and it also uses electricity and liquefied gas that only account for less than 10 percent. The research reckons that the energy consumption of per household (the average of all research objects) is 57.3 GJ / household-year. According to "China Energy Statistics Yearbook" in 1999, the reckoned result of the rural residential energy consumption of Jilin province is 61.8GJ / household-year, which is little larger than the reckoned value of the research.

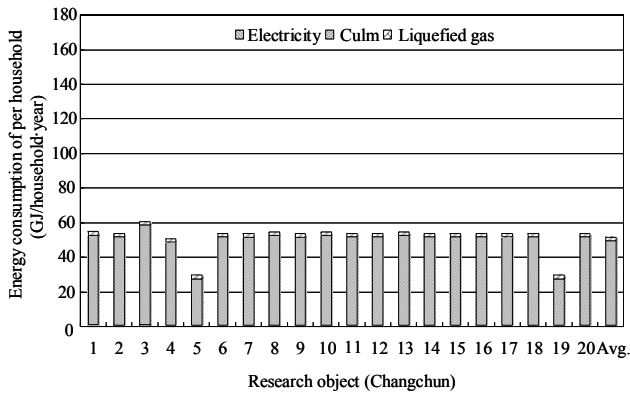


Fig. 2. Changchun energy consumption of per household

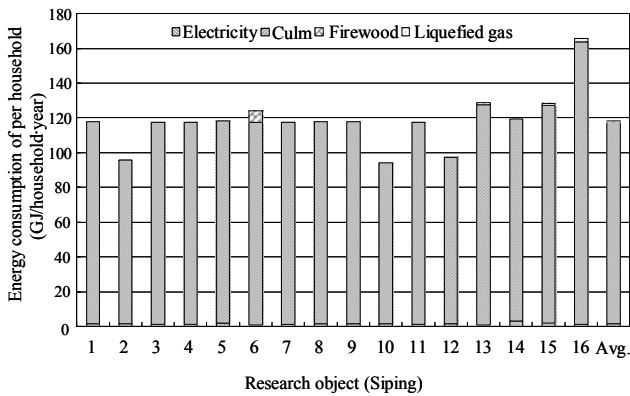


Fig. 3. Siping energy consumption of per household

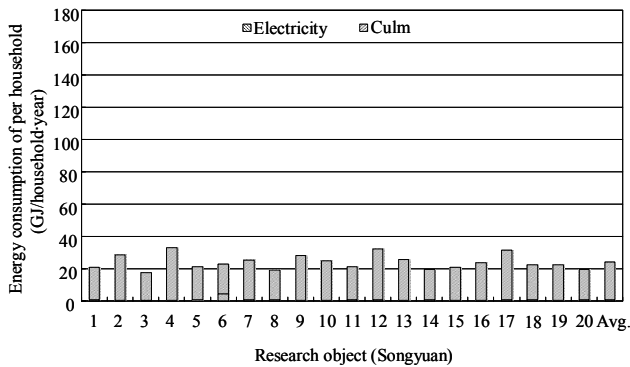


Fig. 4. Songyuan energy consumption of per household

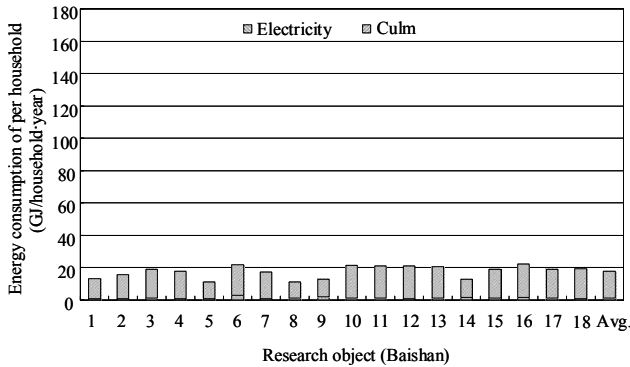


Fig. 5. Baishan energy consumption of per household

The comparison of different energy consumption is shown in table 1. Compared the reckoned result of this research with

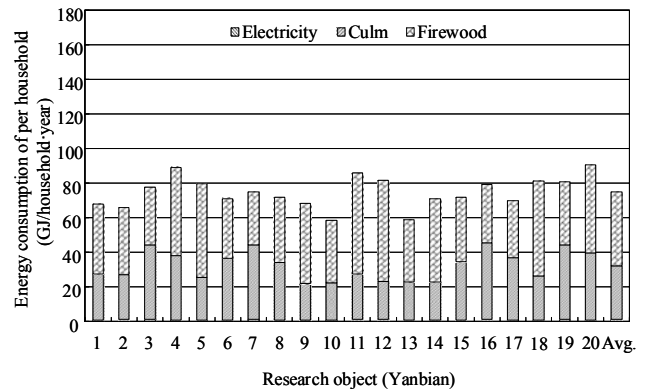


Fig. 6. Yanbian energy consumption of per household

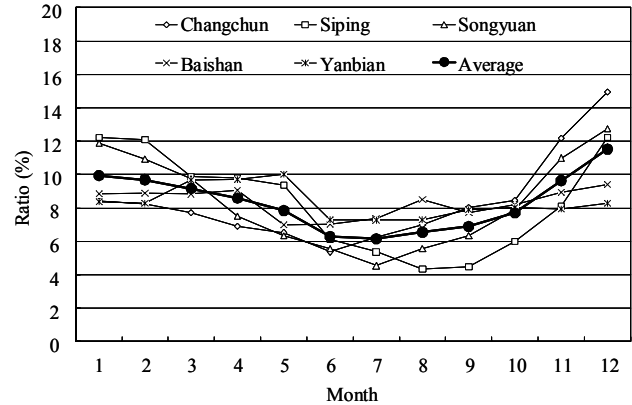


Fig. 7. Variation of average energy consumption of per household in different months of every area

the reckoned result of different provinces in 1999, the usage of clean energy and liquefied gas represent a big percent, whereas electric power, brushwood and firewood are used at small amount. Especially the consumption of coal and petroleum present zero use. Figure 7 is shown the variation of average energy consumption of per household in different months of every area. Based on the Figure 7, there are big differences between in winter and summer in average energy consumption of per household; the value of winter is much bigger than that of summer.

3.2 Energy consumption of per building area and per person

The energy consumption per building area of each area is shown in Figure 8 to Figure12, and the energy consumption per person of each area is shown in Figure13 to Figure17. The same as the energy consumption of per household, there are few differences within every research area, but prodigious differences in different areas in energy consumption per building area and per person.

The average energy consumption of per building area and per person is shown in table 2. The average energy consumption of per building area and per person are respectively 0.682GJ/m²-year and 14.438 GJ/person-year.

Table 1. Comparison of different energy consumption (GJ/household-year)

Energy	Coal	Petroleum	Liquefied gas	Culm	Firewood	Brushwood	Electricity	Total
Reckoned Value (2005)	0.0	0.0	0.5	47.2	0.1	8.5	1.0	57.3
Reckoned Value (1999)	2.5	0.2	0.0	43.6		13.9	1.5	61.8

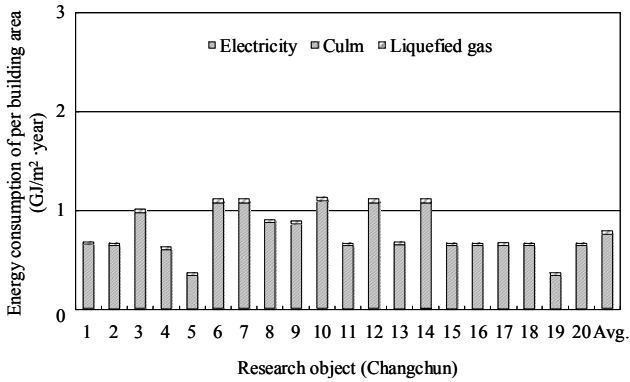


Fig. 8. Changchun energy consumption of per building area

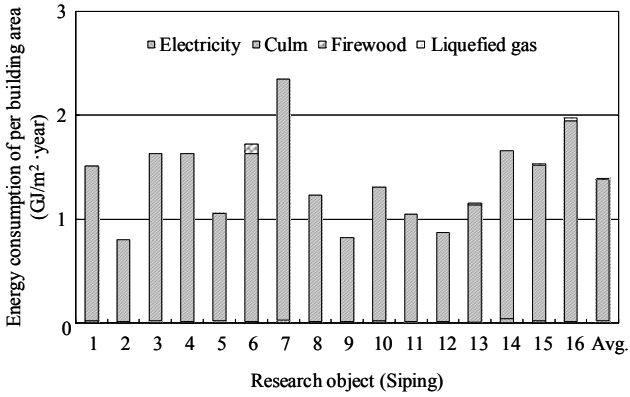


Fig. 9. Siping energy consumption of per building area

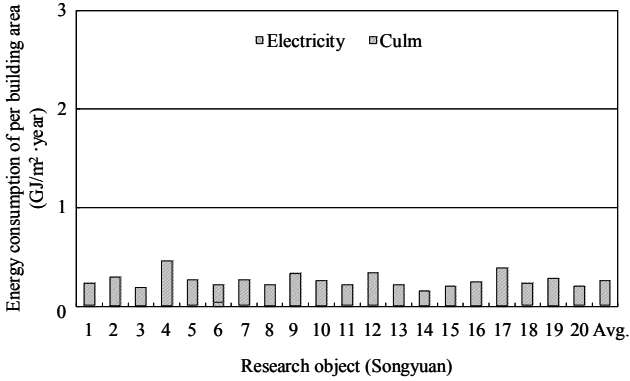


Fig. 10. Songyuan energy consumption of per building area

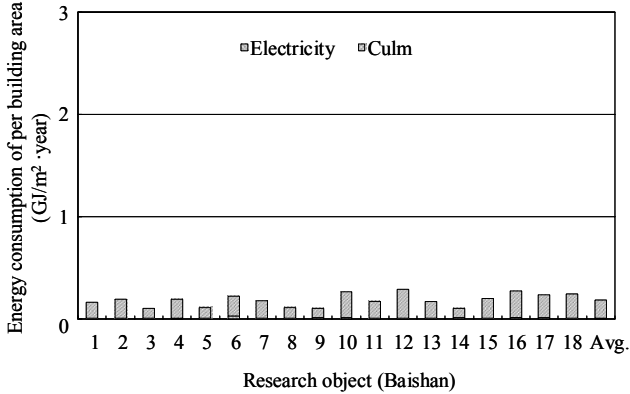


Fig. 11. Baishan energy consumption of per building area

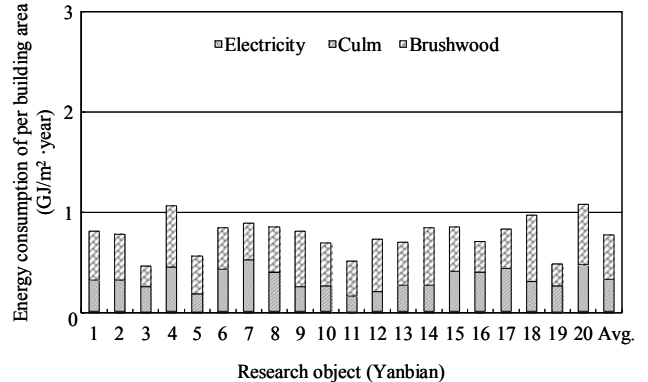


Fig. 12. Yanbian energy consumption of per building area

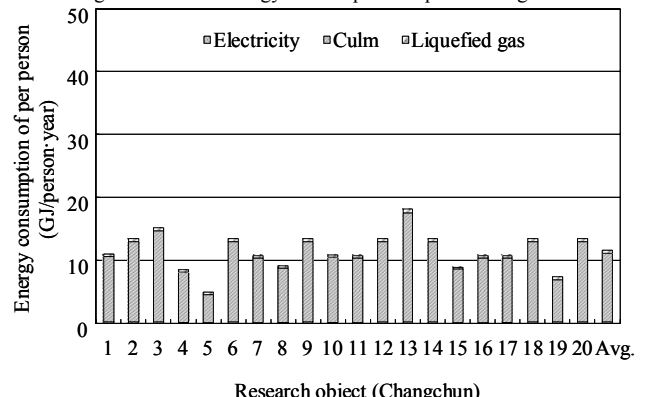


Fig. 13. Changchun energy consumption of per person

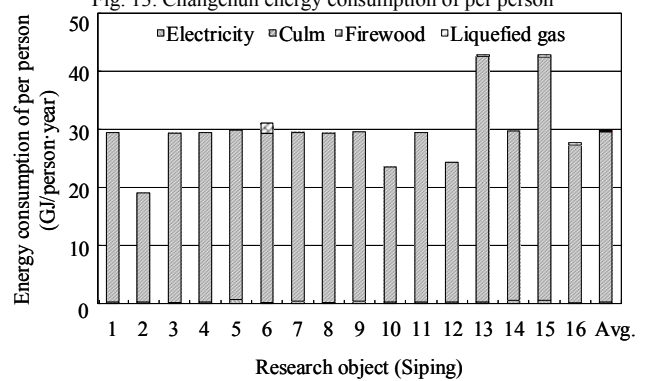


Fig. 14. Siping energy consumption of per person

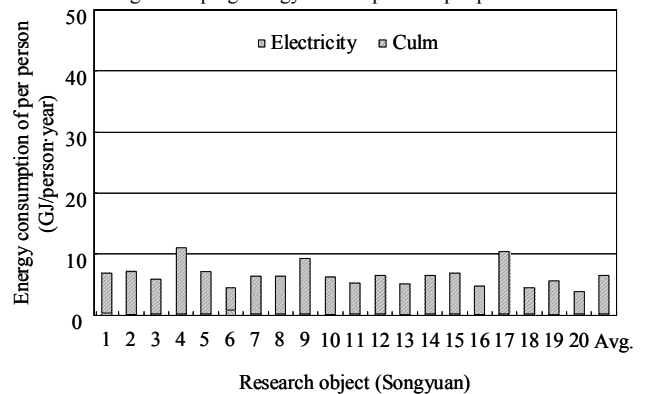


Fig. 15. Songyuan energy consumption of per person

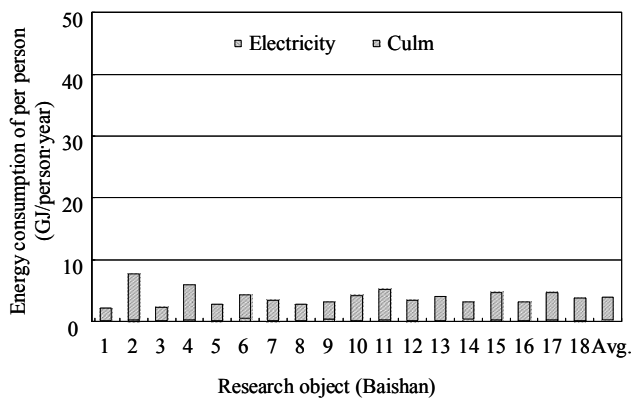


Fig. 16. Baishan energy consumption of per person

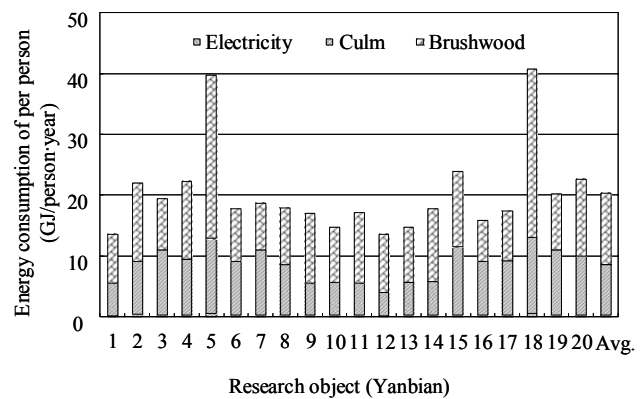


Fig. 17. Yanbian energy consumption of per person

Table 2. Reckoned average energy consumption of per building area and per person

Energy	Electricity	Culm	Firewood	Brushwood	Liquefied gas	Total
Average energy consumption of per building area (GJ/ m ² -year)	0.012	0.574	0.001	0.007	0.088	0.682
Average energy consumption of per person (GJ/person-year)	0.248	11.721	0.021	0.103	2.345	14.438

4. CONCLUSIONS

The paper selects 5 rural areas of Jilin province in China as research objects and carries out practical researches on the energy consumption of 2005. The principal results are generalized as follows:

- 1) As the energy consumption of per household, the energy consumption of per building area and per person are concerned, there are few differences within every research area, but when it comes to averages of different areas, there are prodigious differences between them.
- 2) Whichever area we selects uses about more than 90 percent of clean energy (culm, brushwood and firewood), and it also uses electricity and liquefied gas that only account for less than 10 percent.
- 3) According to "China Energy Statistics Yearbook" in 1999, the reckoned value of the rural residential energy consumption of Jilin province is 61.8GJ /household-year, which is a little larger than the reckoned value (57.3GJ/ household-year) of the research.
- 4) The average energy consumption of per household is very large in winter, whereas it is small in summer in every area.
- 5) The averages energy consumption of per household, per building area and per person are respectively 57.3 GJ/household-year, 0.682 GJ/m²-year and 14.438 GJ/man· year.

Henceforth, the findings of this research could be applied to the supply and demand of rural energy program, and also be used as essential data for the controlling air pollution research.

REFERENCES

- [1] Fujii, T., Shimoda, Y., Morikawa, T. et al. (2005). Development of city scale residential energy end-use model including heat load calculation : Development and application of city scale residential energy end-use model by considering with various household categories Part 1. Journal of Environmental Engineering. Transactions of AIJ, NO.589, pp.51.
- [2] Hiramatsu, Y., Asamori, T., Tarumi, H., (2005). Studies on the estimation of the residential energy system considering the family growth. Journal of Environmental Engineering. Transactions of AIJ, NO.594, pp.45.
- [3] Ning, Y., Tonooka, Y., Liu, J., (2006). A survey on rural residential energy consumption in Dongbei area of china. In: The Fifteenth Conference of Japan Energy Institute, Aug.2006, pp.388.
- [4] Miura, S., (2000). A study on the transition of energy consumption and co2 emissions of housing in prefectural capitals all over Japan. Journal of Architecture, Planning and Environmental Engineering. Transactions of AIJ, NO.528, pp.75.
- [5] Tanaka, A., Nakagami, H., Ishihara, O. et al. (2003). Study on nonlinear multi-variable-analysis method and its capability of generalization for residential energy consumption. Journal of Environmental Engineering. Transactions of AIJ, NO.570, pp.67.
- [6] Tonooka, Y., Fukasawa, O., Murahashi, Y. et al. (2005). A detailed energy demand estimation and co2 emission inventory of residential house by prefecture and housing type in Japan. Journal of Environmental Engineering. Transactions of AIJ, NO.592, pp.89.
- [7] Yoshino, H., Murakami, S., Akabayashi, S. et al. (2006). Survey of the peak electric in residential buildings: Analysis of the data from survey of energy consumption for 80 houses in Japan. Journal of Environmental Engineering. Transactions of AIJ, NO.610, pp.99.