

# ***EMPIRICAL INVESTIGATION OF ENERGY POVERTY IN JAPAN – A CATEGORICAL COMPARISON OF HOUSEHOLDS***

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## **Overview**

The issue of energy (or fuel) poverty has gained increasing attention in developed nations in the past couple of decades. In Japan, energy poverty studies are relatively young and limited in comparison to other developed countries. The 2011 Great East Japan Earthquake triggered major concerns over households' affordability of energy. Energy policy changes in the aftermath of the earthquake, as well as alternative factors such as stagnating economy and rise in taxes, resulted in escalating energy costs. Hence, different types of households' experiences of energy poverty were investigated in a few studies, from 2013 to 2020 [1-5]. The number of studies are far outnumbered by the ones conducted in other developed countries, such as the European nations; though they draw a preliminary understanding of the situation in Japan. [1] and [5] suggest that certain types of households in Japan, such as the elderly or single parents are categorically energy poor, or in higher risk of underlying in this category in comparison to other categories of households. We have conducted surveys in two different cities in Japan, namely Tokyo and Oita in order to further explore the issue of energy poverty. Furthermore, we focused on the comparison of ordinary households and college students, in order to investigate whether students experience a tougher challenge.

## **Methods**

We conducted surveys in two cities in Japan; namely Tokyo city located in Kanto region, and Beppu city in Oita prefecture located in Kyushu region. Aside from conducting surveys among random households inside the city, we put a special focus on college students and collected separate survey samples from this category. The results were then compiled and classified into four groups, namely "Tokyo City", "Tokyo Student", "Beppu City" and "Beppu Student".

In order to measure energy poverty in economic terms, we adopted the widely used "10% indicator", first introduced by Boardman in 1991 [6]. Although there are many controversies regarding the accurate portration capability of this indicator, we adopted this indicator in our study due to its simplicity in use, and pragmatically versatile characteristic. Furthermore, in the absence of a large-scale comprehensive dataset of all the households in a city, the usage of other commonly used indicators such as the "Low Income, High Cost Indicator" or "Double Median or Mean Indicator" may be inaccurate. The 10% indicator has been applied in the majority of the studies conducted in Japan, and it adequately portrays the results of this study.

We drew comparisons among the four observed groups using energy poverty means and variances. In addition, in order to further investigate the degree of variance between ordinary households and students, we conducted the t-test to determine the statistical significance among these two categories.

## **Findings**

Table 1 summarizes the number and date of collected samples by each group. A total of 724 household survey samples were collected; 165 surveys from Tokyo city, 164 surveys from Beppu city, 166 surveys from Tokyo students and 229 surveys from Beppu students. By analyzing simple statistics of the collected data from each category, we observed distinct differences in energy poverty, assuming a 10% threshold for energy poverty (Figure 1). We can see contrasts between Tokyo and Beppu city households as well. In Beppu city, the mean energy expenditure to income ratio ( $\mu_B$ ) is within one standard deviation ( $\sigma_B$ ) of reaching the energy poverty threshold, whereas that of Tokyo ( $\mu_T$ ) is almost twice as far from the standard deviation ( $2\sigma_T$ ). In comparison, the mean energy expenditure to income ratio

for students in both Beppu ( $\mu_{BU}$ ) and Tokyo ( $\mu_{TU}$ ) are less than half of the standard deviation far ( $\sigma_{BU}/2$  and  $\sigma_{TU}/2$  respectively) from reaching the energy poverty threshold.

The results of the independent samples test between ordinary households and college students of Tokyo and Beppu city demonstrated significance of  $p = 0.003$  and  $p = 0.013$ , respectively, which approved the alternative hypothesis, thus suggesting that the energy poverty rates between students and ordinary households in both cities are statistically significant.

**Table 1**

Category	Samples (n)	Period
Tokyo City	165	January 2020
Beppu City	164	January 2020
Tokyo Student	166	December 2019 – January 2020
Beppu Student	229	January 2019 – January 2020

Table 1 - The number and date of collected samples by group

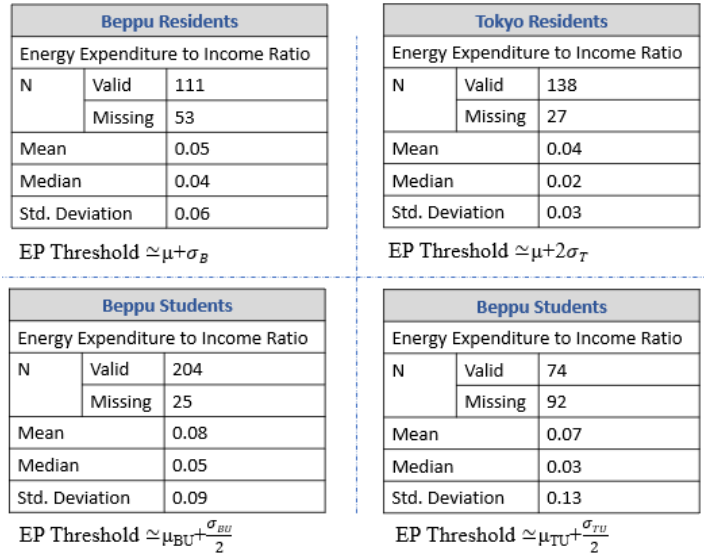


Figure 1 - Simple statistics of collected samples by category

## Conclusions

We investigated energy poverty among different households using the 10% indicator in Japan, with a focus on college students versus ordinary households. The results suggested that energy poverty rates are different between two cities, and energy poverty threshold varies depending on the category of the household. Furthermore, the statistical significance of the difference in energy poverty rates between ordinary households and college students was proved by Students's t-test. Based on our findings, we suggest college students in Japan should be considered as sensitive to energy poverty, in addition to other categories of households suggested by other scholars in this field.

## References

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