

Investigation and Analysis of Electricity Tariffs in Japan, China and Thailand

日本、中国、タイの電気料金を比較・検討する。これにより合理的な料金設定を考えることができ、再生エネルギーの導入にもつながっていく。

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Abstract

The issue of global warming due to rising greenhouse gas (GHG) emissions presents a great challenge to the stability of the world's climate, economy and population. A major source of GHGs is the burning of fossil fuels to provide energy, particularly electricity. Furthermore, in some developing countries with rapid economic development, due to the severe electricity shortage, ration power supplies have been introduced in the peak seasons. With this background, since the 1990s, electricity market regulation, especially tariff regulation, has been paid more and more attention around the world. A rational electricity tariff may promote the introduction of renewable energy and energy efficiency measures. In this study, the current status of electricity tariff in three main Asian countries, namely, Japan, China and Thailand, is investigated and compared. Firstly, by examining the electricity tariff structures in various countries, their difference and characteristics are recognized. Then, the tariff rates in different countries are illustrated and compared from the residential, commercial and industrial aspects. According to the results of analysis, both tariff structures and rates show obvious diversity in the three examined countries. It will be beneficial for a country to develop a rational electricity tariff by executing such an international comparison.

Keywords Electricity tariff structure; Tariff rate; Japan; China; Thailand

1. Introduction

It has been widely recognized that global climate change due to rising greenhouse gas (GHG) emissions presents one of the greatest challenges for human development. A major source of GHGs is the burning of fossil fuels to provide energy, particularly electricity, which is the key end-use energy type. It is reported that the share of electricity in global energy consumption increased from 12% in 1980 to 19% in 2007. Furthermore, about 68% of the world's

electricity was generated by fossil fuel combustion (IEA, 2009a; IEA, 2009b). Therefore, it is expected that the electricity sector may play an important role in future climate change strategy through cleaner power generation and reduced electricity consumption. On the other hand, in the past few years, global electricity consumption has been growing gradually to a value as high as 19,800 billion kWh by the year 2007. Within this, the developed countries (e.g., China, etc.) with rapid economic develop-

ment contribute the most to the increased electricity consumption. However, severe electricity shortage still prevails in these areas especially in some peak seasons. For example, in China, power shortage reached 40 million kilowatts at the beginning of 2008. Power rationing had to be implemented for industry to ensure residential application. Against this background, in order to deal with continuing global warming and increasing power consumption, since the 1990s, electricity market regulation has been paid more and more attention around the world. Within this, tariff regulation is considered the key item because a rational electricity tariff may promote the introduction of clean energy and energy efficiency measures. A lot of research has been reported on this topic. Al-Sanea et al. (2005) investigated the effect of electricity tariff on the optimum insulation thickness in building walls. Luk (2005) reviewed the problems and inefficiencies of the electricity tariff in Hong Kong and promoted some suggestions for overcoming them. However, when examining the electricity tariff in a specific country, a global viewpoint is always necessary to compare it with the situation in other countries. By learning the good aspects which have been introduced in other countries and taking into consideration their own characteristics, a reasonable tariff can be developed.

In this study, focus is placed on three main Asian countries, namely, Japan, China and Thailand. First, the current status of electric power supply and consumption is reviewed. Second, by examining the electricity tariff structures in various countries, their difference and characteristics are recognized. In addition, the tariff rates in different countries are illustrated and compared in terms of residential, commercial and industrial aspects.

2. Current Status of Electric Power Supply and Consumption

Before investigating the electricity tariff, it is of vital importance to understand the current situation of power supply and consumption, which may reflect

the nature of current electricity tariff and affect future tariff regulation. China has the largest power capacity (796 GW), following by Japan and Thailand, with the values of 241 GW and 30 GW, respectively. In addition, in Japan, the main energy source for power generation is LNG, which has a share of about 25.5%, followed by nuclear, hydro, oil and coal. However, in China, the situation is quite different. Coal plays the dominant role in power generation, with a share of about 71.6%. Hydro is another main source for power generation in China with a ratio of about 21.6%. Furthermore, it is interesting to note that due to recent rapid development of wind farms, the capacity of wind turbines has increased over that of nuclear stations. In Thailand, natural gas is the dominant energy source with a share of about 71.2%, followed by coal, hydro and oil.

Fig.1 illustrates annual electricity consumption and electrification rates in the three countries. As expected, Thailand has the lowest electricity consumption due to its small area and population. Power consumption in China has increased gradually, especially in recent years. By the year 2007, annual total power consumption increased to about 3073 billion kWh, which is about five times of that in 1990. On the other hand, the increase of power consumption in Japan is marginal. Furthermore, before 1995, Chinese electricity consumption was less than Japan; after 1995, it showed a rapid increase to a value as high as three times that in Japan by the year 2007. As to the electrification rate, Japan has a relatively large ratio at around 15-18%. Due to the rapid development of Chinese electricity industry, the electrification rate increased from 5.8% in 1990 to about 13.5% in 2007.

In addition, in order to understand the general efficiency of power consumption, Fig. 2 shows per GDP and per capita electricity consumptions in the three examined countries. According to the profiles illustrated in the figure, Japan has the lowest per GDP power consumption, which was about 27% of China. This is partly due to its high energy-utilization efficiency. In the past few years, Chinese

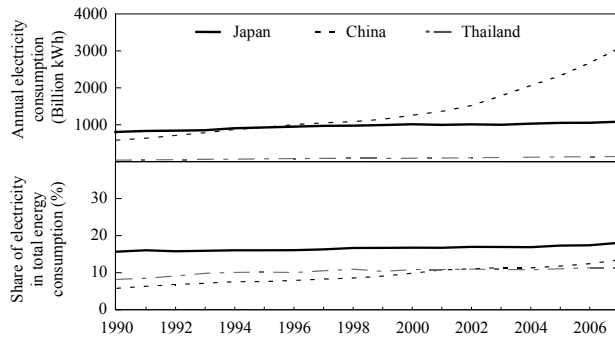


Fig. 1 Comparison of Electricity Consumption and Electrification Rate

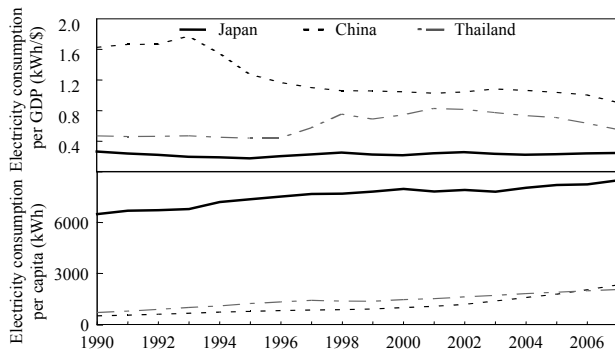


Fig. 2 Comparison of Electricity Consumption Intensity (Per GDP and Capita)

electricity consumption intensity has been decreasing gradually, although was still at a relatively high value, which was even larger than that of Thailand. However, it is interesting to notice that electricity consumption intensity illustrated a rising trend in the past few years compared with that in the 1990s in Thailand. On the other hand, in terms of per capita electricity consumption, Japan has the largest value and is increasing gradually. This is due to its relatively high level of quality of life. China had relatively low per capita electricity consumption but was rising gradually.

3. Review of Current Electricity Tariff Structure

Fig. 3 shows images of electricity supply grids in Japan, China and Thailand. It can be concluded that, in Japan, the electric utility service is provided by ten regional power companies. As to China, the situation is more complex. Generally, national electricity consumption is served by two companies, namely, the Southern China Grid and State Grid, which is further divided into five sub-grids. In addition, each sub-grid is composed of several province level companies. However, the situation is quite

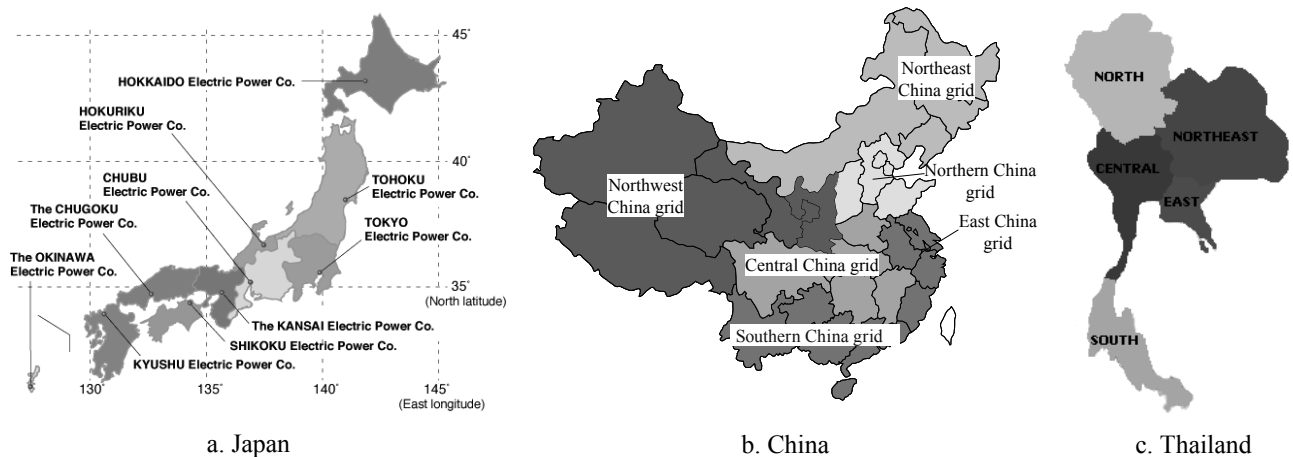


Fig. 3 Image of electricity supply grid in Japan, China and Thailand

simple in Thailand due to its relatively small area. A single electric utility takes the role of the whole power supply for the country.

Although there may be some differences among the tariffs of various companies in a single country, the fluctuation is marginal. Fig. 4 shows the general electricity tariff structure in the three countries. Generally, residence, commerce and industry are treated in separate ways. In addition, a normal rate and a time of use (TOU) (or time of day: TOD) rate are the main tariff types in all three countries. However, according to the figure, some difference in the tariff structures can be concluded as follows.

① Many more alternatives are available for residential power application in Japan than in the other two countries. In China, special industry with relatively high energy consumption is endowed a specific tariff which is not assessed in Japan and Thailand. In addition, a special tariff in Thailand is set for government institutions and non-profit organizations, which are given no attention by China and Japan.

② In China, the TOD tariff is employed for all applications. However, it is only applied to residential use in Japan and large service in Thailand. On the other hand, the TOU tariff is widely employed in Japan's commercial and industrial application and all sectors in Thailand.

③ Although double-item tariffs (composed of demand charge and energy charge) are wide spread in both Japan and Thailand, they are still an alternative one in China.

As to the components of electricity tariff, as shown in Fig. 5, China has the simplest one which is only composed of an energy charge and a demand charge (sometimes is neglected). In Thailand, a service charge is added to some applications. Japan has the most complicated tariff components. Besides the normal energy charge, the fuel cost adjustment amount is included. In addition, in order to promote the adoption of photovoltaic system, a solar surcharge which is proportional to the power consumption is expected to be introduced next year.

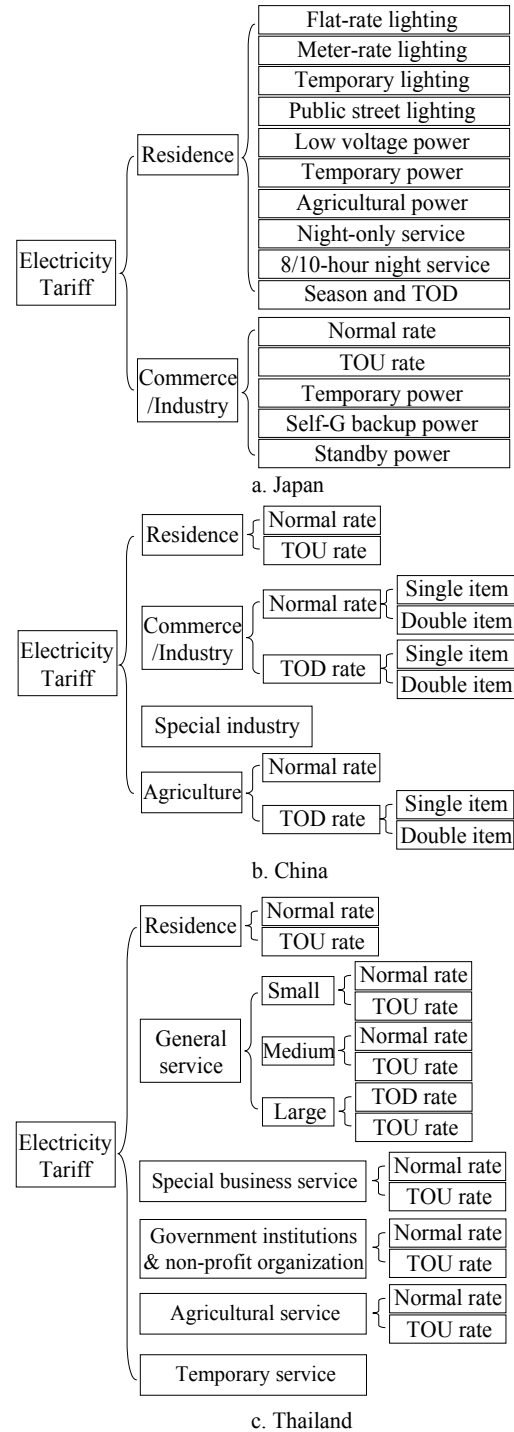


Fig. 4 General Electricity Tariff Structure in Japan, China and Thailand

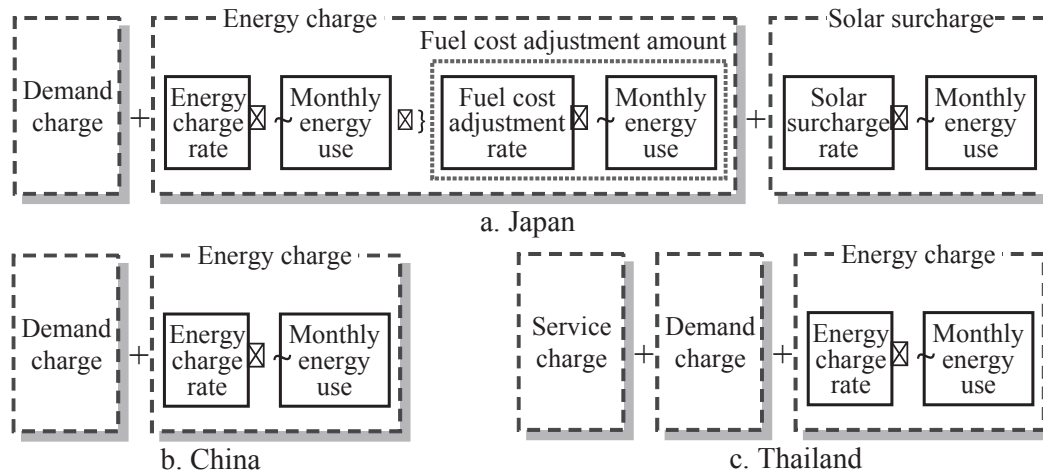


Fig. 5 Electricity tariff components

4. Comparative Analysis of Electricity Tariff Rates

It is difficult to compare electricity tariff rates due to the following reasons. On the one hand, different tariff structures may be introduced in various countries as discussed above. On the other hand, currency exchange rates are always fluctuating. In the following, the average unit rates with different calculation methods are compared for the three examined countries.

4.1. Comparison Based on Statistical Data

The average unit rates published in the statistical data are usually calculated by dividing total income from electricity sales by the quantity of electricity sold. It is the easiest and most common method to calculate average unit rate for a company or even a country. Fig. 6 shows the average tariff rates in Japan, China and Thailand in 2007. According to the figures, different from other two countries, the residential tariff rate is lower than the commercial and industrial rates in China. In addition, Japan has a relatively high tariff rate compared with both China and Thailand.

4.2. Comparison Based on a Model Case

In this method, the actual electricity bills paid by users are used to compare the tariff rates. An

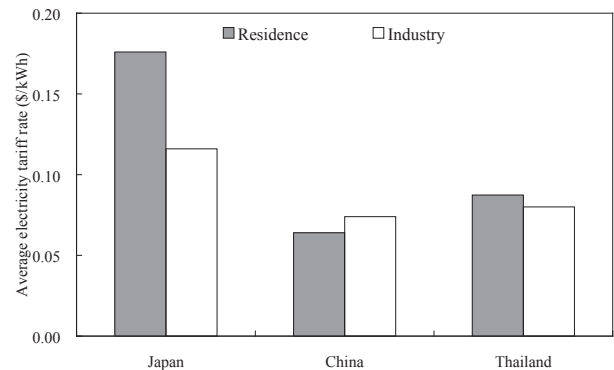


Fig. 6 Comparison of Average Tariff Rates in Japan, China and Thailand

assumed user with unified usage conditions (menu, contract demand, power consumption, etc.) is predetermined, and the average tariff rates are calculated and compared. In the following, actual tariff rates of representative utility companies in Japan, China and Thailand are investigated and applied to the model case. For simplicity, the normal rate is assumed for the power consumption in the summer period.

Fig. 7 shows the average tariff rate for residential application with monthly power consumption between 40-500 kWh. Generally, Japan has a relatively large tariff rate, which is about 3 times greater than that of China and Thailand. In addition, due to the

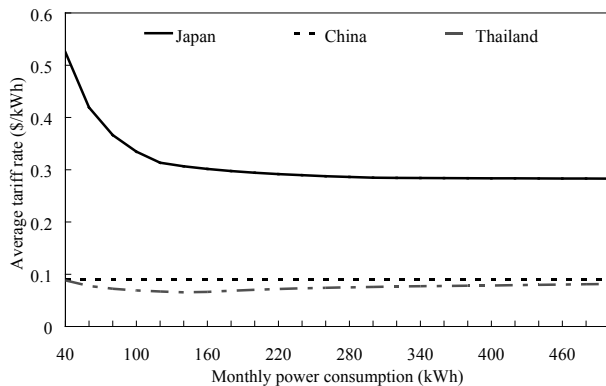


Fig. 7 Comparison of Average Tariff Rates with Varied Power Consumption (Residential Customer)

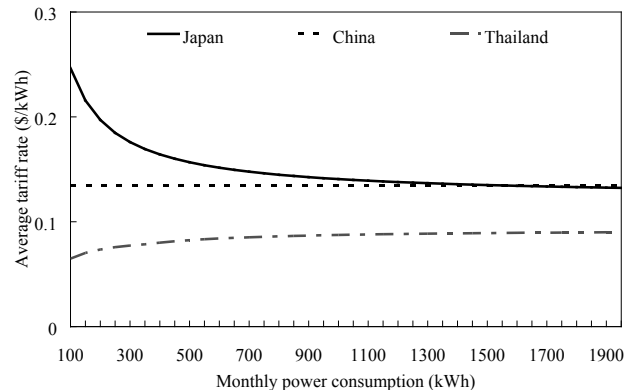


Fig. 8 Comparison of Average Tariff Rates with Varied Power Consumption (Commercial Customer)

introduction of demand charge, the average tariff rate decreases as the power consumption increases. China has a flat tariff rate which is larger than that of Thailand.

On the other hand, looking into the average tariff rates for commercial application as shown in Fig. 8, Japan has a reduced commercial tariff rate than the residential one, which is quite different from the situation in China. In addition, when monthly power consumption is over 1600 kWh, the average tariff rate in Japan even decreases below than that of China. In Thailand, the commercial tariff rate shows an increased trend with the rise of power consumption.

5. Conclusions

In this study, firstly, the current status of electric power supply and consumption in Japan, China and Thailand are reviewed. By examining the electricity tariff structures in various countries, their difference and characteristics are recognized. In addition, the tariff rates in different countries are illustrated and compared from the residential, commercial and industrial aspects.

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