Historical Trends in Japan's Power Generation Costs and Their Influence on Finance in the Electric Industry

Yuji Matsuo* Yuji Yamaguchi** Tomoko Murakami***

1. Introduction

Following the Fukushima Daiichi nuclear power plant accident in the wake of the Great East Japan Earthquake, Japan's energy policy had to be drastically changed. According to the Basic Energy Plan published in 2010[1)], nine new nuclear power reactors would be built by 2020, and 14 reactors by 2030. However, following the nuclear accident, this policy has begun to be reviewed. Based on discussions at the Fundamental Issues Subcommittee of the Advisory Committee for Natural Resources and Energy and the Energy and Environment Council, an Innovative Strategy for Energy and the Environment was determined at a meeting of the Council held on September 14, 2012. This Innovative Strategy states the goal of ending nuclear power generation by the 2030s. This strategy has not been approved by the Cabinet, however, and the future of the nuclear power generation remains uncertain. At any rate, regardless of the Fukushima accident, nuclear energy—which is deemed to be quasi-domestic energy—remains superior to fossil fuels in terms of a stable supply of energy in Japan, a country which has few natural resources. In addition, the international community continues to ask Japan to reduce its greenhouse gas emissions.

Under these circumstances, the nuclear reactors that were suspended for periodic inspections after the Fukushima accident were not permitted to resume operation, and nuclear power generation in Japan continued to decline. The No. 3 unit at the Tomari nuclear power plant of Hokkaido Electric Power shut down for a periodic inspection on May 5, 2012, which led to the situation that all of the nuclear power plants in Japan stopped operation. The Oi nuclear power plant of Kansai Electric Power resumed operation of the No. 3 unit on July 5, and of the No. 4 unit on July 21. However, no other nuclear reactors have been permitted to resume operation. Since the Nuclear Regulation Authority—which was established in September—has not presented any new regulatory system, the early resumption of the operation of additional nuclear reactors will be difficult.

Electric utilities announced their interim financial results for FY2012 toward the end of October. The results show that many of these fell deep into the red due to increases in the cost of purchasing fossil fuels stemming from the suspension of nuclear power plants. Power generation costs directly affect the profitability of electric utilities and greatly affect their management. In addition, these costs have a large impact on industrial activities and the lives of people in Japan due to rising electric bills. We previously evaluated the actual costs of thermal power generation and nuclear power generation, using the financial reports of ten general electricity utilities and two wholesale electricity utilities up to FY2010[2)]. Based on this evaluation, in this report we quantitatively evaluate the effects on power generation costs of Japan's situation described above, using electricity utilities' financial reports up to FY2011. We also analyzed the profitability of the Japanese electric industry, using the financial statements included in the reports, and quantitatively evaluated the effects of changes in power generation costs.

* Senior Researcher, Nuclear Energy Group, Strategy & Industry Research Unit, IEEJ
** Researcher, Nuclear Energy Group, Strategy & Industry Research Unit, IEEJ
*** Manager, Nuclear Energy Group, Strategy & Industry Research Unit, IEEJ

2. Trends in power generation costs up to FY2011

2-1 Methodology

In this report, we estimate power generation costs using the same method used in the previous paper by the authors[2]. We referred to the financial reports of ten general electricity utilities and two wholesale electricity utilities[3] from FY2006 to FY2011, and estimated power generation costs per kWh (unit cost) for hydroelectric, thermal, nuclear, and "new energies" power generation (including renewables, such as geothermal power) by dividing the cost of power generation by the amount of power. The cost of power generation is the electric utilities' operating expenses plus the interest expenses in their statements of income. Electric utility operating expenses are divided into hydroelectric, thermal, and nuclear power generation expenses, as well as "new energies" (geothermal, etc.) power generation expenses in the statements of income for each utility, and the schedules of expenses for each category are included in the financial report. However, interest expenses are not divided according to power generation methods. In this paper we use the method that is used by Kunitake[4] and estimate the interest expenses for each power generation method by dividing the interest expenses for the entire electric utility business in proportion to the total amount of the fixed assets of the electric utility plant and the allowance for equipment and construction in progress.

We estimate the amount of power, the denominator, as the amount of power at the sending end by subtracting the amount of power for own use in the power plant, which is included in the electric power statistics,[5] from the amount of power at the generating end. Expenses are all adjusted to expenses in FY2010, using the Domestic Corporate Goods Price Index, for consistency with the past paper.[2]

Schedules of electric utility operating expenses show the details of expenses. We categorize expenses as shown in Table 2-1. Interest expenses are included in the capital cost.

Table 2-1 Classification of Power Generation Costs Based on Schedules of Electric Utility Operating Expenses

Classification	Element
Capital cost	Fixed asset tax, depreciation and amortization, loss on disposal of fixed assets, allotted expenses for common use equipment
Fuel cost	Fuel cost
Back-end cost	Expenses for reprocessing spent fuel, preparation expenses for reprocessing spent fuel, waste disposal expenses, specified radioactive waste disposal expenses
Decommissioning cost	Nuclear power generation facilities demolition expense
Operation and maintenance cost	All expenses other than the above

2-2 Estimates

2-2-1 Trends in average power generation unit cost and total power generation cost

Figure 2-1 shows trends in the average power generation unit cost of 12 electricity utilities from FY2006 to FY2011. The average power generation unit cost rose from 8.1 yen/kWh in FY2006 to 10.2 yen in FY2008, reflecting surges in crude oil prices. The unit cost declined to 8.4 yen/kWh in FY2009 and to 8.6 yen/kWh in FY2010 as oil prices fell, and rose to 11.6 yen/kWh in FY2011, far exceeding the FY2008 level. The unit cost

rose as much as 3.1 yen/kWh from FY2010, before the Fukushima accident, to FY2011, after the accident. As described below, the reasons for this increase are considered to include the decrease in electricity production at nuclear power plants, which were not permitted to resume operation, the increase in purchases of fossil fuel, and increases in the import prices of fossil fuels.

If no nuclear power plants resume operation other than the two that have already resumed operation in FY2012, as expected in the literature[6)], we expect the average power generation unit cost for the 12 utilities to rise 1 yen/kWh from FY2011, to around 12.6 yen/kWh (in this paper, unlike document 6), actual fossil fuel prices are used up to September 2012). The increase in the power generation unit cost from FY2011 to FY2012 is smaller than that from FY2010 to FY2011 because the expected fossil fuel prices in FY2012 were lower than the actual fossil fuel prices in FY2011 and therefore increase in the cost of purchasing fossil fuel is partly offset.

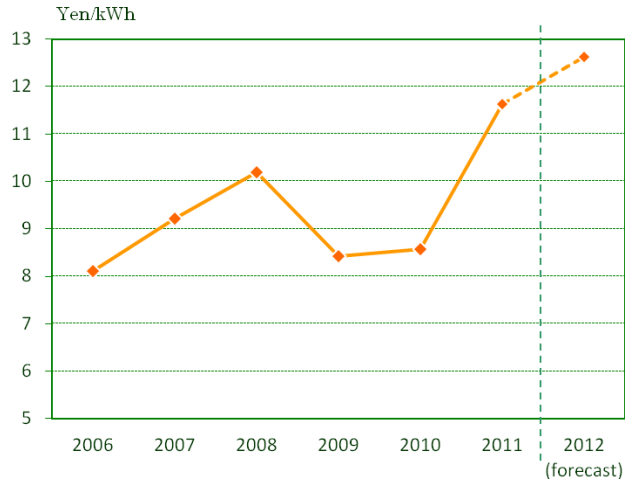

Figure 2-1 Power Generation Unit Cost (Average of 12 Utilities)

Figure 2-2 shows the total costs (for 12 utilities) of power generation. Total costs rose to 8.6 trillion yen in FY2008, when crude oil prices soared, but declined to 6.9 trillion yen in FY2009 and 7.5 trillion yen in FY2010. However, total costs climbed by 2.0 trillion yen from FY2010 to FY2011, to 9.5 trillion yen. Fuel costs for thermal power generation in particular changed sharply, rising 2.3 trillion yen (1.6-fold), from 3.7 trillion yen in FY2010 to 6.0 trillion yen in FY2011. The ratio of fuel costs to total costs increased from 49% in FY2010 to 64% in FY2011. The costs of coal, oil, and natural gas climbed by 0.1 trillion yen, 0.9 trillion yen, and 1.3 trillion yen, respectively, which shows that the decrease in the electricity generated by nuclear power was offset primarily by power generated from LNG and oil rather than by coal. It also reflects that among primary energy prices, the price of oil and LNG rose more significantly than the price of coal from FY2010 to FY2011.

Meanwhile, the cost of thermal power generation less fuel cost and the cost of hydroelectric and “new energy” power generation remained roughly flat. The cost of nuclear power generation declined by 0.3 trillion yen. In nuclear power generation, expenses including those for reprocessing spent fuel, in addition to the cost of purchasing fuel, change in accordance with the electricity generated. As the electricity generated from nuclear power plants declined once nuclear power plants suspended operation in FY2011, those expenses also decreased. Based on the outlook described in document 6), we forecast that total costs in FY2012 will increase 0.7 trillion yen from FY2011, to 10.2 trillion yen.

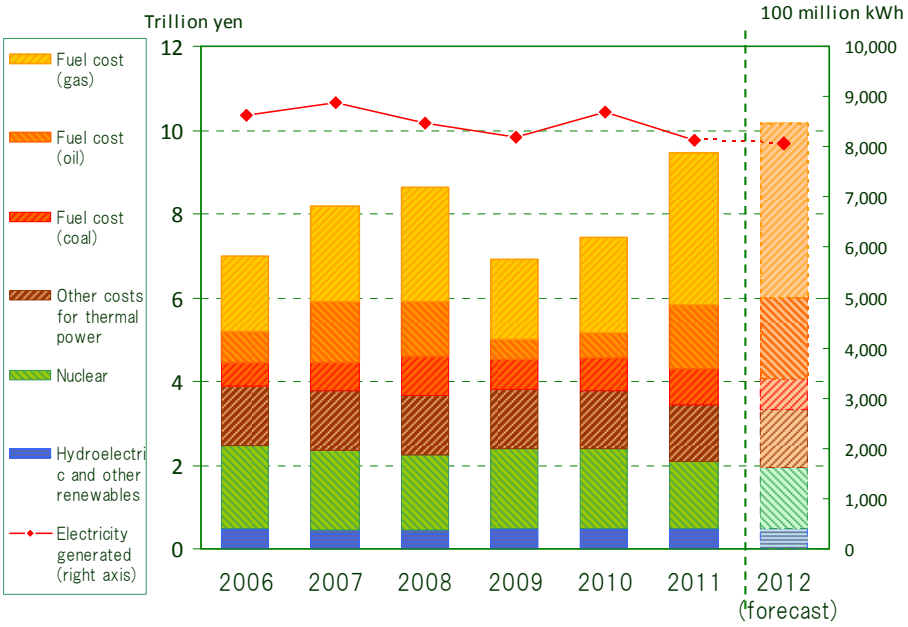

Figure 2-2 Total Costs of Power Generation (Average of 12 Utilities)

In FY2008, when primary energy prices soared, the average CIF price of imported crude oil was 92.72 dollars per barrel.[7)] At that time, the yen was relatively weak, at 100.51 yen against the dollar, and soaring crude oil prices significantly increased the cost of purchasing fossil fuels for power generation in Japan. The CIF price of imported crude oil was 83.84 dollars and 114.10 dollars per barrel, in FY2010 and FY2011, respectively. The price was very high, especially in FY2011. Fortunately, however, since the yen was strong, 86.09 yen against the dollar in FY2010 and 78.98 yen in FY2011, the impact of rising oil prices was not as great as in FY2008.

Figure 2-3 shows major factors for the change in power generation costs from FY2010 to FY2011. Power generation costs increased 1.2 trillion yen due to rising primary energy prices, while the strong yen reduced this increase by 0.4 trillion yen. The biggest factor for this increase was a rise in the volume of fuel purchased in association with the expansion of power generated through thermal power, which translated to a 1.4 trillion yen increase in costs. Subtracting the costs by 0.3 trillion yen due to the reduction in electricity generated from nuclear power, costs increased a little over 1 trillion yen. This rise in power generation costs caused by the increase in thermal power generation, which stemmed from the decrease in nuclear power generation as a result of the suspension of the nuclear power plants that were shut down for regular inspections and were not permitted to resume operation in FY2011. Dividing this rise by the net output in FY2011, we estimate that power generation costs rose around 1.4 yen/kWh.

We need to pay particular attention to the fact that changes in primary energy prices and exchange rates have a big impact on power generation costs. If the import price of fossil fuels effectively rises 1.5-fold in FY2012 as in Figure 2-1 due to the combination of changes in exchange rates and primary energy prices, the power generation unit cost will climb sharply to 16.9 yen/kWh from 12.6 yen/kWh. Dependence on thermal power generation makes the risk of changes in power generation costs extremely high.

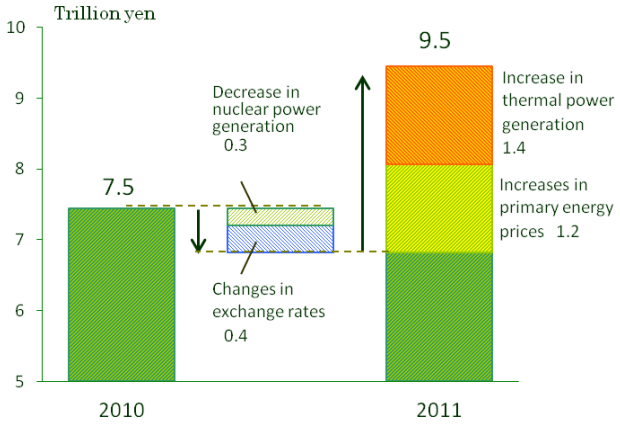

Figure 2-3 Factors for Changes in Total Power Generation Costs (Total of 12 Utilities)

2-2-2 Trends in power generation unit cost by power source

Figure 2-4 shows trends in the thermal power generation unit cost. The thermal power generation unit cost rose from 9.8 yen/kWh in FY2010 to 11.5 yen/kWh in FY2011. Of this cost, fuel costs stood at 9.4 yen/kWh, accounting for 82% of the total unit cost. The main reasons for this rise in the unit costs are the increasing prices for primary energy, including oil and LNG, and the expanding share of oil and LNG in fuel for thermal power generation. As shown in Figure 2-2, in response to the increase in thermal power generation, output from expensive oil and LNG increased instead of relatively low-priced coal.

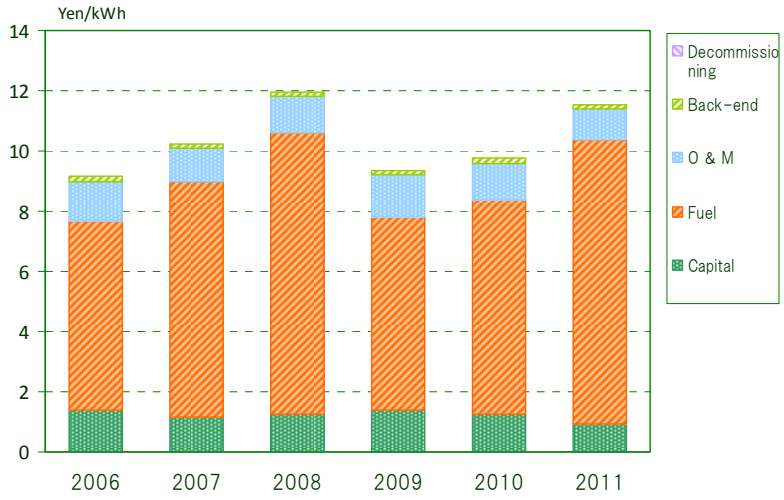

Figure 2-4 Thermal Power Generation Unit Cost

Figure 2-5 shows trends in the nuclear power generation unit cost. The unit cost remained around 7 yen/kWh in the past. However, in FY2011 the capacity factor fell to 22.7%, and output plummeted to 108 TWh, around a third of the FY2010 level. As a result, the power generation cost per kWh rose sharply to 16.8 yen/kWh. This change shows that the capacity factor is the biggest factor in nuclear power generation costs, and that improving the capacity factor significantly reduces nuclear power generation costs.

As shown in Figure 2-6, total expenses for nuclear power generation were relatively stable until FY2010.

However, in FY2011 nuclear power generation output declined, and expenses associated with the output in the current system, including fuel costs, back-end costs, and decommissioning costs, fell sharply. It is apparent that the reason for the sharp increase in the unit cost despite the drop in total costs is the change in the capacity factor, and that this change exceeded the level that could be offset by reducing variable costs.

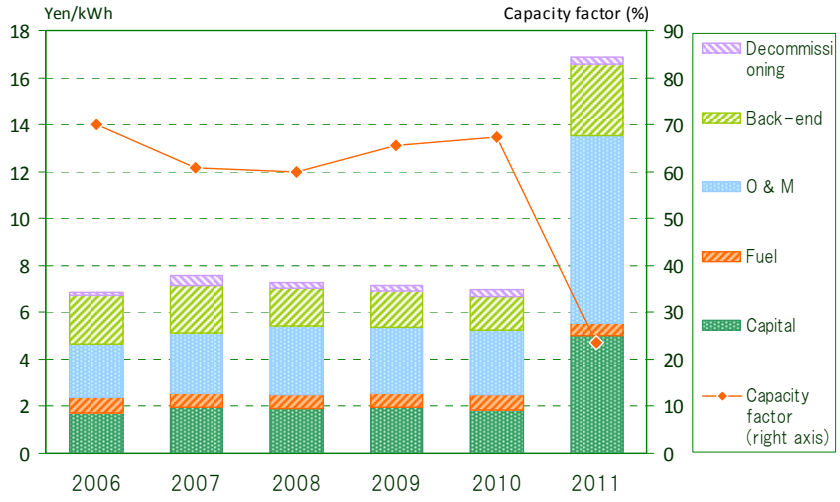

Figure 2-5 Nuclear Power Generation Unit Cost

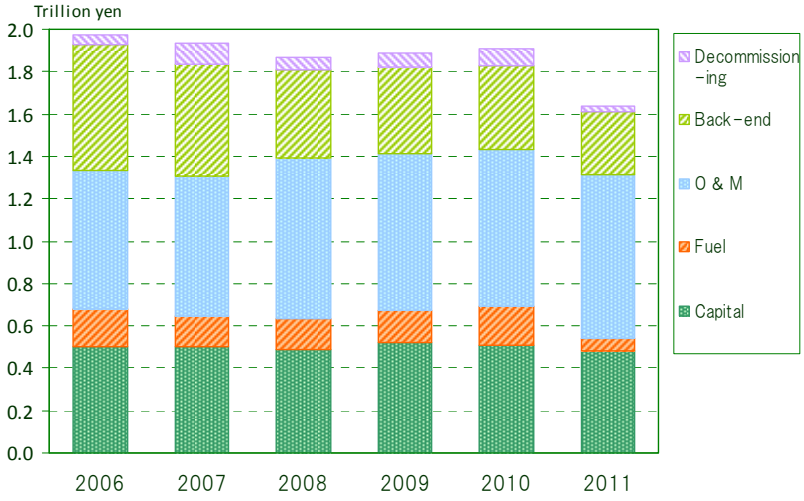

Figure 2-6 Total Costs of Nuclear Power Generation

Figure 2-7 shows trends in the power generation unit cost of “New energy” including geothermal. This item came to be included in the financial report of electric utilities in FY2009, and there are no estimates for preceding years. The graph shows that capital costs in particular rose from FY2009 to FY2011.

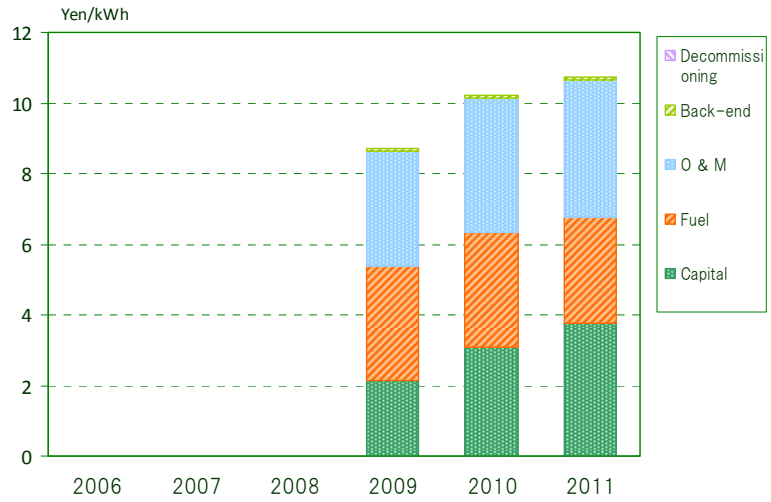

Figure 2-7 Geothermal, and other such power sources. Power Generation Unit Cost

3. Analysis of earnings and financial condition of each electric utility

In this chapter, we quantitatively analyze the effects of the increases in power generation costs described in Chapter 2 on the results of each electric utility in FY2011, using each company's financial statements. We also estimate the effects in FY2012.

3-1 Methodology

We calculated net income and retained earnings for electric utilities from FY2006 to FY2011 based on their financial reports. We calculated their interest-bearing debt based on their Fact Books[8].

We did not include two wholesale electric utilities or, of the general electric utilities, Okinawa Electric Power and Tokyo Electric Power (TEPCO), in our calculations. We calculated the data for eight general electric utilities since the effect on results of increases in power generation costs was small at wholesale electric utilities, which do not engage in electricity retailing, as well as at Okinawa Electric Power, which does not have any nuclear power plants. We excluded TEPCO as it is not appropriate to treat the utility, which has received an injection of public funds, in the same way as other general electric utilities.

We estimated the earnings of the eight general electric utilities in FY2012 based on their ordinary income in FY2011 and on the assumption that their earnings in FY2012 will be the same as those in FY2011, except for changes in nuclear power generation and extraordinary income and loss, and that their earnings will decline only due to increases in the costs associated with decreased nuclear power generation.

We assumed the nuclear power generation of the eight general electric utilities and the increase in thermal power generation associated with the decline in nuclear power generation in FY2012 based on the literature,[6] and used the actual power generation unit cost (only the variable cost) in FY2011. We calculated the increase in costs by subtracting the decline in expenses associated with the decrease in nuclear power generation from the increase in thermal power generation multiplied by the power generation unit cost. We calculated the net loss in FY2012 by adding the increase in costs to the ordinary profit or loss in FY2011. Retained earnings in FY2012 were calculated by subtracting the net loss in FY2012 from retained earnings at the end of FY2011.[1]

[1] In actuality, a net loss should reflect corporate taxes and income taxes-deferred in addition to the net loss we calculated with the method for this time. It is difficult to estimate corporate taxes and income taxes-deferred, however, so these are not reflected.

3-2 Trends in net income and retained earnings

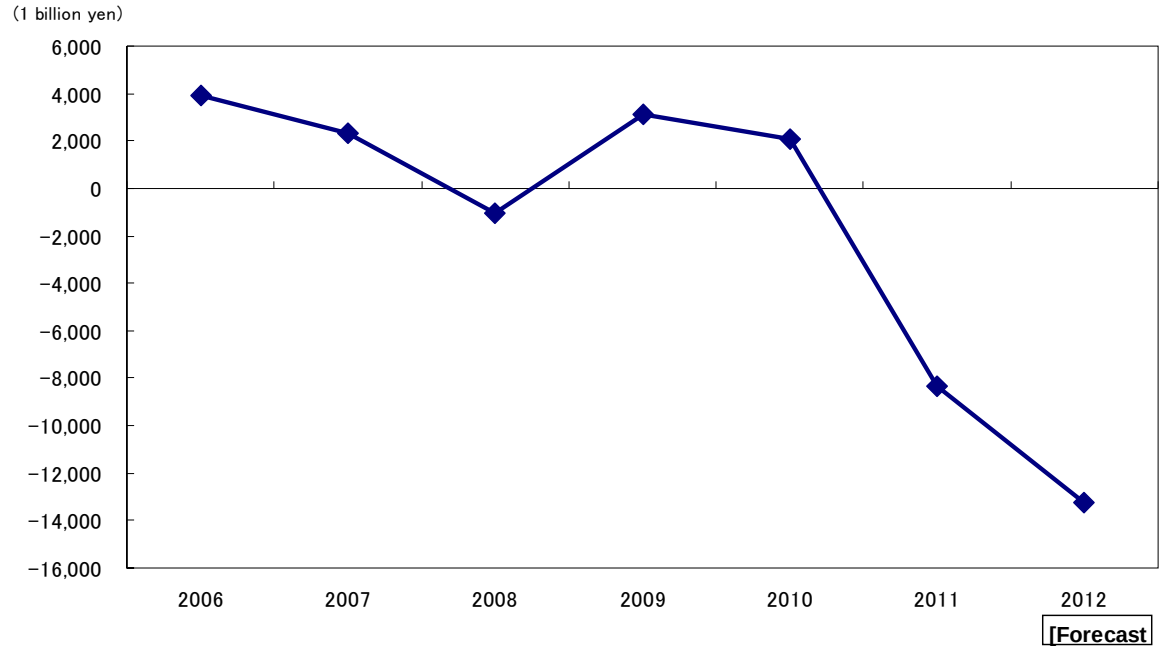

Figure 3-1 Net Income of Eight General Electric Utilities

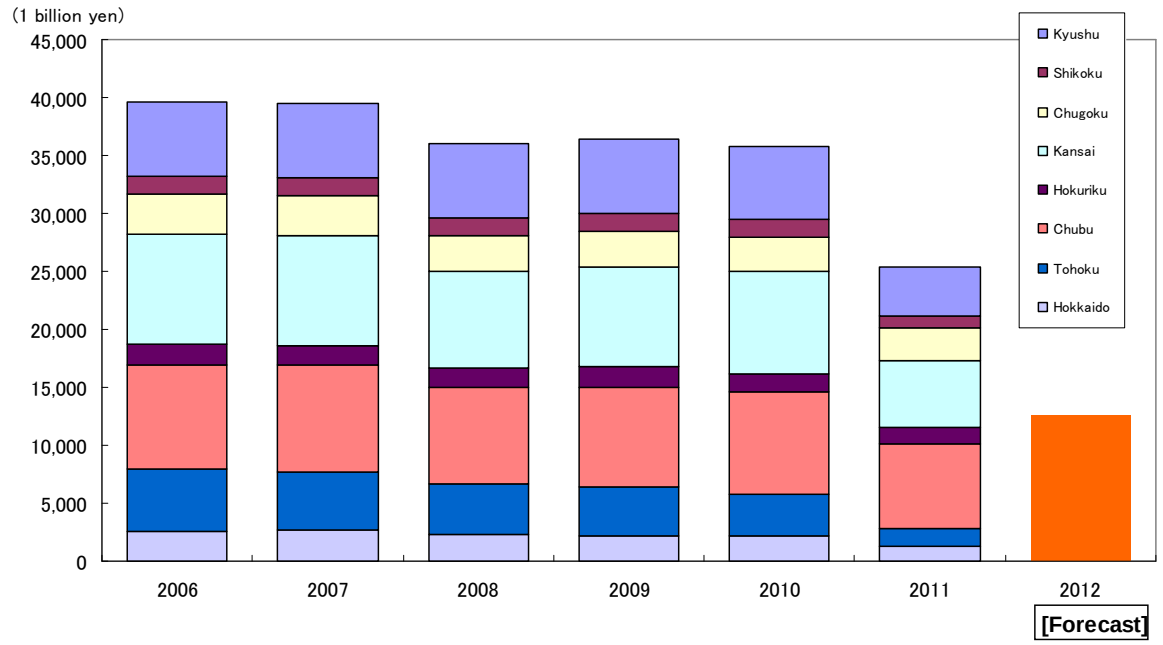

Figure 3-2 Retained Earnings of Eight General Electric Utilities

Figure 3-1 and Figure 3-2 show the trends in net income and retained earnings, respectively, of eight general electric utilities excluding Okinawa Electric Power and TEPCO.

Net income was 200–400 billion yen from FY2006 to FY2010, except in FY2008, when net income for each utility fell due to rising fossil fuel prices. As described above, however, earnings declined sharply at each utility in FY2011, and a net loss of 800 billion yen was recorded, reflecting the effects of the earthquake and the replacement of nuclear power generation (which was suspended) with thermal power generation. Compared with the level in typical years, the net income dropped 1 trillion yen.

Earnings declined sharply because the electric utilities did not raise electric rates, despite the increase in the cost of thermal power generation described above. To compensate for huge losses, the utilities reduced their retained earnings. We assume that they did not raise electric rates because they considered the adverse effects of increases in electric rates on regional economies and households and believed that increases in electric rates would not be accepted when they had a huge amount of retained earnings. Their retained earnings decreased over 1 trillion yen—2.5 trillion yen in FY2011 from 3.6 trillion yen in FY2010. One trillion yen is three to five years' worth of net income. The financial standing of the utilities has rapidly worsened.

In FY2012, nuclear power generation declined further and was replaced by thermal power generation, which has a high unit cost. Considering this situation, we expect the net loss of general electric utilities—which was 800 billion yen in FY2011—to grow to 1.3 trillion yen in FY2012. With this loss expansion, retained earnings will plunge to 1.2 trillion yen.

This will be the first time retained earnings will have decreased more than 1 trillion yen in one year since the time when the electric power industry came to be operated by ten general electric utilities. This situation occurred because the long-term suspension of nuclear power generation, a key source of electricity, was not anticipated. It is very unlikely that any effective steps may be taken in a few months, and it remains unclear whether any nuclear power plants will resume operation during this fiscal year. In these circumstances, as described above, the loss in general electric utilities will likely expand to over 1 trillion yen, and retained earnings will likely decline to a record low.

3-3 Trends in interest-bearing debt and capital adequacy ratio

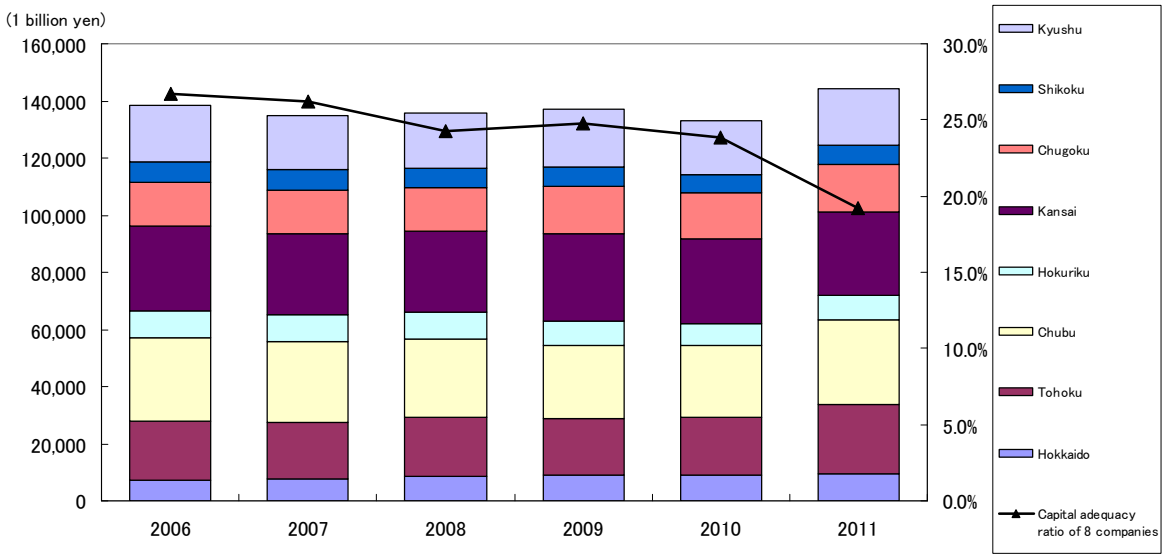

Figure 3-3 Interest-Bearing Debt and Capital Adequacy Ratio for Eight General Electric Utilities

Figure 3-3 shows trends in the interest-bearing debt and capital adequacy ratio of the eight general electric utilities for the past five years. Since FY2006, each company has improved its financial standing, and as a result, the interest-bearing debt of the eight utilities gradually decreased, from 13.8 trillion yen in FY2006 to 13.3 trillion yen in FY2010. In FY2011 the general electric utilities borrowed substantial amounts from financial institutions, however, due to the large investments needed to restore facilities affected by the earthquake and improve the safety of nuclear power plants, and the worsening of cash flows from operating activities. As a result, interest-bearing debt rose over 1 trillion yen, to 14.4 trillion yen.

In addition to the increases in interest-bearing debt, the equity capital of the eight utilities declined due to the decreases in retained earnings as mentioned above. Consequently, the capital adequacy ratio of the eight utilities declined sharply, from 23.9% in FY2010 to 19.2%, in FY2011.

Electric utilities have a number of accounts to prevent their financial situation from rapidly worsening, including reserves for the huge long-term expenses associated with the decommissioning of nuclear power facilities and spent fuel, such as a reserve for decommissioning and a reserve for reprocessing spent fuel; and reserves for unexpected, short-term expenses, such as a reserve for water-level fluctuations. However, these accounts did not apply to the Fukushima accident or the long-term suspension of the nuclear power plants of electric utilities. As a result, the financial situation of the electric utilities has worsened drastically. A stable supply of electricity is a key element in people's lives and the nation's economic activities, and electric utilities need to at least be able to continue stable operations to maintain a steady supply. There are ongoing discussions open to the public regarding the reform of electric utilities and systems. No matter what systems are planned, more detailed consideration regarding measures to continue business in case of an emergency is recommended for a steady supply of electricity and for the prevention of adverse effects on financial markets.

4. Conclusion

As of November 2012, the operation of nuclear power plants in Japan has been suspended except for the No. 3 and No. 4 reactors at the Oi nuclear power plant of Kansai Electric Power. These are unlikely to resume operation this fiscal year. Chairman Shunichi Tanaka of the Nuclear Regulation Authority (NRA), which was established on September 19, said that the NRA will make technical decisions individually regarding whether to resume operating a nuclear power plant under new safety standards to be established based on lessons learnt from the Fukushima accident. He also said that the new safety standards will include neighboring local government disaster-prevention measures regarding the nuclear power plants, including evacuation plans, and that the framework for new safety standards will be determined in FY2012[9)]. Judging from his comments, it would be very difficult to restart any nuclear power plants in FY2012. Chances are that, as in summer this year, most of the electric utilities cannot depend on nuclear power generation from the summer through the winter of FY2013. As we described in Chapter 2, in FY2011 nuclear power generation declined to around a third of its level a year ago, and the cost of fossil fuels rose almost 1.6-fold, which weighed on the management of electric utilities. Results in FY2012 will likely show a more challenging situation, and significant improvements are not expected so far.

We also need to note the fact that with increased thermal power generation, the risk of rising costs associated with changes in primary energy prices and exchange rates is increasing drastically. Rising primary energy prices are now partially offset by the strong yen. If the yen depreciates, however, and if primary energy prices rise, the average power generation cost for the 12 electric utilities might easily climb by a few yen/kWh or more, as described in Chapter 2. We should not forget this risk when considering Japan's future energy supply.

As we described in Chapter 3, we had not expected nuclear power plants—a key power source—to be suspended for more than a year in an existing framework of our electric power system or that nuclear power generation would be replaced by thermal power generation (primarily oil and natural gas-fueled thermal power generation). Due to this unexpected situation, the retained earnings of electric utilities were reduced, equivalent to a few years' worth of net income, and their financial position worsened. This problem cannot be dealt with by the electric utilities alone.

To address the important issue of choosing electricity sources, we need to carefully consider not only a stable supply, but also a wide range of areas, including the energy security and economic development of the country, and to develop clear plans. Japan's electric industry is controlled by the government and is greatly affected by government policies. Under these circumstances, it is necessary for the government to provide clear policies for the stable management of electric utilities, which is very important for a steady supply of electricity.

The future direction of our power source portfolio is uncertain, and the inadequate system for addressing this uncertainty is definitely the biggest risk for electric utilities. For the stability of the electricity industry and the development of the Japanese economy, the government should clearly formulate a basic policy regarding the composition of power sources, including the percentage of nuclear power, and an effective plan both at home and abroad, and should develop a system that will be able to handle sudden changes in the composition of power sources.

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Contact: report@tky.ieej.or.jp