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Renewable Energy Act and Effect on Electricity Prices

Increase in electricity prices depends on renewable energy installed capacity and FIT

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Summary

- The Renewable Energy Special Measures Act enacted 26 August 2011 provides for a feed-in tariff (FIT) system where all renewable electricity will be purchased at a fixed price (surplus electricity in the case of households) and FIT added to electricity prices as a surcharge. FIT will be determined every fiscal year by power source by referring to the views of a third-party expert committee. For the first three years after the law takes effect, FIT will be set at levels that will encourage the expanded generation of renewable electricity.

- Key issues are how FIT will be determined and the degree to which electricity prices will rise. Bearing in mind the experiences of other nations, it will be necessary to develop announcement procedures that allow FIT to be anticipated several years forward so as to promote the adoption of renewable energy, to establish rules for lowering FIT at an early stage when renewable energy investments overheat, and to establish a framework for determining FIT that takes into account energy strategy and the tax payer burden.

- In the case where 20% of power will be generated from renewable energy sources and FIT will fall by half 10 years after start of the FIT system, the electricity charges of a standard household and a large factory are estimated to increase Y431 and Y3.45 million, respectively, per month. Estimation figures will yield different results depending on assumptions used. Frequent reference has been made to date of the government estimation that electricity charges would rise about Y150 per month. Rather than simply using this figure in assumptions about renewable energy, it will be necessary to develop forecasts of electricity charges based on the desired installed generating capacity target for renewable energy and also FIT to be determined through future discussions.

- Electricity prices are often said to be high in Japan. However, when industrial-use electricity prices are compared on a purchasing power parity basis, those in Japan are similar to those in European nations but around 40% higher than those in Korea. The cost of electricity to Japanese manufacturers is less than the major nation average as they possess production technology that makes efficient use of electricity. When only the higher electricity cost and the

hollowing out of industry are considered, Japanese industries should be able to maintain and further increase international competitiveness by expanding energy-saving investments and by further developing electrically efficient manufacturing systems.

1. Introduction

Renewable Energy Act finally passed

On 26 August 2011, the Renewable Energy Special Measures Act (the full name is Act on Special Measures Concerning the Procurement of Renewable Energy Sourced Electricity by Electric Utilities; hereafter, Renewable Energy Act), one of the conditions raised by former Prime Minister Naoto Kan for stepping down from office, was enacted and is scheduled to take effect from 1 July 2012. The renewable energy bill presented to the Diet by the government saw many revisions during legislative deliberations. In its final form, the new law mandates that electric power companies must purchase the entire amount of electricity generated from solar and other renewable energy sources at a price determined by the government.

Expanded use of renewable energy a pending issue for Japan

The current Basic Energy Plan covering the period to 2030 (approved by the cabinet in June 2010), which former Prime Minister Kan said needed to be completely redone, has established the goal of doubling Japan's energy self-sufficiency rate from its current 18%.[1] It also has the goal of increasing the percentage of zero-emission electricity generation (electricity generated by nuclear power plants and by renewable energy sources) from 34% to about 70%. Raising the proportion of energy generated from domestic sources is important from the perspective of energy security, given the expectation that fossil fuel prices will rise sharply reflecting the growing presence of emerging-market economies. Moreover, reducing CO2 and other emissions and increasing zero-emission power generation are not only demanded by the international community from the need to address global environmental problems but they also offer a growth strategy that will directly contribute to new developments for the energy industry.

Outlook uncertain

The nuclear power plant incident occasioned by the Great East Japan Earthquake has created a serious, structural power supply problem for Japan. Since Japan will be forced to withdraw from its nuclear power policy for the time being, there is increasing discussion of the need for demand-side initiatives regarding electric power and of the need to expand the use of renewable energy. Despite hopes that the Renewable Energy Act will serve as a trigger for such action, it is still unclear whether the adoption of renewable energy will grow smoothly to meet the ambitious goals that have been set. There is also the question of how well renewable energy will meet the demand for electricity in terms of quantity and quality.

Purchase price the key for renewable energy

As the new law is put into effect, the purchase price for renewable electricity and what will happen to general electricity prices remain uncertain at the present moment. Economic activity related to renewable energy will need to be positioned as a strategic growth industry that will generate future income and jobs. Should the price of electricity become too high, living standards will be undercut, and domestic production and jobs will flow overseas. In this report, we have summarized the main points of the Renewable Energy Act and analyzed the new law from a macroeconomic perspective by focusing on price, one of the most important factors in considering renewable energy.

1. The energy self-sufficiency rate consists of the percentage share of domestic energy (renewable energy, etc.) and quasi-domestic energy (nuclear power) in the domestic supply of primary energy. The energy self-sufficiency rate of OECD member nations averages around 70%.

2. What Kind of Law is the Renewable Energy Act?

a) Overview of the Renewable Energy Act, a law passed through a process of revision

Feed-in tariff system adopted to promote investments in independent power generation

An overview of the Renewable Energy Act is provided in Chart 1, whose distinguishing feature is the adoption of a feed-in tariff (FIT) system, where all electricity generated from renewable energy sources is purchased at a fixed price. Electric power companies are mandated, in principle, to purchase at a fixed price, and over the long term, all the electricity generated from renewable energy sources by non-power companies and independent power providers (subject to contracts and electrical connections). To date, the electricity generated by independent power providers has for the most part been sold to major electric power companies through negotiated agreements at low prices. However, should independent power providers now be recognized as generating a stable supply of electricity from the efficient use of renewable energy sources, purchase of such electricity at a fixed price will be guaranteed. Since generating electricity from renewable energy sources will promise a certain level of profits, there are reports of companies already planning to build mega solar farms in anticipation of the new law. The electricity purchase system that has been in place only covered surplus electricity from solar power generation.

Surplus electricity purchase system to be maintained for households

Regarding electricity generated by households, the FIT system will not apply. Instead, the current surplus electricity purchase system will be maintained as it will promote energy conservation incentives and hold the national cost of electricity somewhat below the FIT system.[2]

FIT cost of electric power companies to be transferred to electricity bills as surcharge

Under the FIT system, the cost of purchasing electricity by electric power companies will be transferred to electricity bills as a surcharge, which is similar to the current system. In other words, the new system will be one where all electricity users share costs in proportion to their electricity consumption. For this reason, the more electricity is generated from renewable energy sources, the more electricity prices will rise.

Measures to waive or reduce surcharge for electricity charges

The new law includes a provision to reduce the surcharge for some electricity users. Specifically, for business establishments using large amounts of electricity, more than 80% of the surcharge will be waived when electricity use exceeds a certain level (this provision is discussed further in 3, b)). Also, the surcharge will be waived until end-March 2013 for companies and households that were seriously affected by the Great East Japan Earthquake. It appears that the possibility is being investigated of using tax revenues (such as oil and coal tax or the electric power development promotion tax, held in the energy measures special account) to supplement the surcharge that is waived through reduction measures.

FIT will be determined by Minister of Economy, Trade, and Industry after ensuring transparency

The purchase price of electricity, which will greatly influence renewable energy investments, will be determined by the Minister of Economy, Trade, and Industry after giving careful consideration to the views of a third-party expert committee (the "purchase price calculation committee"). Appointments to the committee will require the approval of both houses of the Diet. Once the committee determines the purchase price, it must promptly report the basis and calculation method to the Diet. In this manner, the transparency of the price determination process will be ensured.

2. Advisory Committee on Energy and Natural Resources, New and Renewable Energy Subcommittee and Electricity Industry Subcommittee, Electricity Purchase System Subgroup, "Saisei kano enerugi no zenryo kaitori seido ni okeru shosai seido sekkei ni tsuite kaitori seido shoiinkai hokokusho," (Report of the electricity purchase system subgroup on designing system details regarding the feed-in tariff system for renewable energy), 18 February 2011.

Overview of the Renewable Energy Act	Chart 1
Power sources	Solar power, wind power, small and micro hydropower, geothermal power, and biomass power
Purchase system	A feed-in tariff (FIT) system will be used. However, a surplus electricity purchase system will be applied for solar power generated by households. Throughout the purchase period, electric power companies will purchase electricity at a fixed price.
Purchase period	A standard period from the installation of the renewable power generating equipment until it needs to be replaced
Purchase price	Purchase prices will be determined by the Minister of Economy, Trade, and Industry after coordinating with the pertinent minister with jurisdiction over the power source concerned and after taking into consideration the views of the "purchase price calculation committee" whose members are appointed with the approval of both houses of the Diet. Purchase prices will be determined every fiscal year by power source. When necessary, such as by reason of changes in equipment costs, purchase prices can be determined each half year. For the first three years after the law takes effect, purchase prices will be set at levels that will encourage the expansion of renewable-energy power generation.
Surcharge	The cost of purchasing electricity will be added to electricity bill as a surcharge. Reduction measures will be made available, such as 1) discounting more than 80% of the surcharge for companies that are large users of electricity when certain criteria are met and 2) waiving the surcharge until end-March 2013 for companies and households that were seriously affected by the Great East Japan Earthquake.
Exception to the connection obligation of electric power companies	Electric power companies may refuse to purchase renewable electricity when they believe that doing so will risk impeding the stable supply of electricity

Source: Compiled by DIR.

FIT to be determined each year/half year and to be set high for the first three years

Purchase prices will be determined each fiscal year according to the category, form, and size of power generation facilities. When purchase prices have to be adjusted due to changes in the power generation environment, such as the situation surrounding the supply of electricity from renewable energy sources or major changes in equipment costs, purchase prices can be changed every half year. Also, purchase prices are expected to be set high for the first three years after the law takes effect to intensively promote the expanded use of renewable electricity.[3] The higher the purchase price is set, the greater will be the rate of return offered by renewable energy investments. Thus, there is every reason for believing that power generation based on renewable energy sources will increase.

FIT periods expected to be around 15 to 20 years (10 years for solar power generation by households)

Regarding purchase periods, the Renewable Energy Act only specifies that they are to be determined by considering a standard period from the start of the supply of renewable electricity to the time when power generation facilities have to be replaced. In the subcommittee report referenced in footnote 2, a purchase period of 15 to 20 years is suggested. With respect to solar power generation by households, it is widely assumed that the purchase period will be for 10 years as is currently the case.

Stakeholders take interest in how the exception clause regarding the obligation to purchase electricity will be implemented

Under the FIT system, electric power companies cannot, in principle, refuse to buy electricity from independent power companies, non-power companies, and households. However, in cases where there is risk that the stable supply of electricity will be impeded, electric power companies are permitted to refuse to establish electrical connections with electricity suppliers. There is no denying that unstable supply is a characteristic of solar power, wind power, and other forms of

3. In establishing the purchase price, Article 7 of the Supplementary Provisions to the Renewable Energy Act stipulates that the Minister of Economy, Trade, and Industry shall, in order to intensively promote the expanded use of electricity from renewable energy sources, take into account the profit to be received by specified suppliers for a period of three years from the date the law takes effect.

natural energy. Specialists are therefore keenly interested in whether the exception clause of the law will offer electric power companies a reason to be less than eager about purchasing electricity. To preclude such a situation from arising without good reason, it will be essential to build a smart grid (next-generation transmission network) while enhancing the sophistication of renewable energy technology at the same time.

b) How will FIT be determined?

Focusing on the issue of prices

From a macroeconomic perspective, two issues that deserve the most attention regarding the Renewable Energy Act are 1) how will the purchase price of electricity be determined and 2) how far will electricity prices rise. This is because the behavior of people or the efficiency of resource allocation hinges on price or its future outlook. In the paragraphs to follow, we will examine these issues in light of the experience of nations that have already adopted FIT regimes.

Determining FIT difficult

Since purchase price and purchase period are fixed under a FIT system, renewable energy investments are guaranteed to yield profits as long as total electricity revenues (quantity of electricity sold x purchase price x purchase period) exceed total costs. While the Renewable Energy Act stipulates that the purchase price be determined in a manner that avoids excessive surcharges, the purchase price will basically be set by taking into account the cost of power generation and the profit to be realized by electricity suppliers. If the purchase price is set far above investment costs, renewable energy investments will increase beyond expectations. The possibility cannot be ruled out that such a development would ultimately increase the national burden of electricity by way of significantly higher electricity prices. On the other hand, if the purchase price is set low and the required level of investment returns cannot be expected or if there is no guarantee that electricity will be purchased for a certain period or for a more or less set price (if there is considerable political risk that a new administration would change the FIT system), renewable energy investments will not be made, and the intended objectives of the FIT system will not be achieved. Also, should the purchase price be rapidly reduced to dampen investments while the FIT system is in operation, the resulting decrease in investments may lead to bankruptcies or unemployment on a scale that cannot be ignored.

Spain experienced expansion and collapse of a solar power bubble

This possibility became reality in Spain. Spain implemented a policy to expand solar power generation in 2007 and instituted a FIT program guaranteeing the purchase of electricity at a high, fixed rate over the long term. Solar power investments exploded as a result, and new installed capacity reached 2,760 MW in 2008, about five times the level of 2007 (and about 28 times the level of 2006).[4] When the government sharply reduced the purchase price to curb investments, new installed capacity fell to 60 MW in 2009, and this change in policy gave rise to many bankruptcies and the loss of jobs.

German program determines FIT by giving consideration to future transparency and system prices

In contrast to the situation in Spain, Germany succeeded in expanding renewable energy investments at a sustainable pace, and such investments appear to be contributing to economic vitality. Germany's Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) reports that renewable energy investments totaled €26.6 billion in 2010 (€19.5 billion in solar power investments), corresponding to about 6.5% of nominal private fixed capital formation. Such investments are reported to have created about 370,000 jobs.[5] The main features of Germany's FIT program are 1) the purchase price is reduced in line with system prices (equipment costs) and 2) the annual percentage reduction in

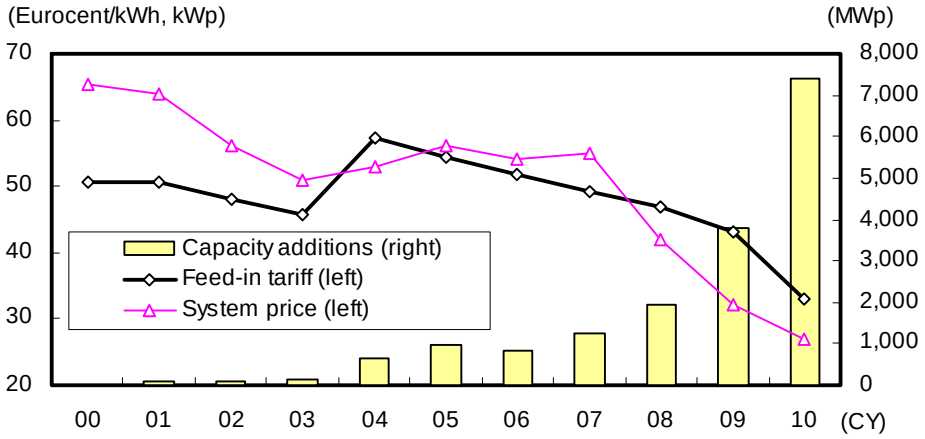
4. International Energy Agency (IEA), "Trends in photovoltaic applications survey report of selected IEA countries between 1992 and 2009," 2010.
5. Investment amount and number of job created from "Renewable energy sources 2010," BMU, 2011.

purchase price is indicated for several years forward so electricity suppliers can plan for the future.

FIT and system prices have generally fallen together in Germany

In Germany, the Renewable Energy Law (Erneuerbare Energien Gesetz; EEG; which took effect in 2000) specified the feed-in tariff and its annual percentage reduction (by generating capacity and energy source) at 2004 and 2008 revisions. For example, the annual reduction was 5% for solar power (fixed installations) and 2% for wind power between 2005 and 2008. Because system prices for solar power are high relative to other renewables and they decline at a faster pace, the feed-in tariff and annual percentage reduction for solar power was set with this in mind. An examination of the trend of purchase prices and system prices for solar power (Chart 2) reveals that purchase prices have fallen with the exception of 2004 and that system prices have generally declined in line with the purchase price (since purchase price and system price are for different generating capacities in the chart, their difference should not be taken as indicating the level of profit).

Germany: Solar Power Feed-in Tariff, System Price, Installed Capacity **Chart 2**



Source: International Energy Agency (IEA), Germany's Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU); compiled by DIR.
Notes: 1) Feed-in tariff is that for solar generators of less than 100 kWp capacity, installed in homes and buildings; 2010 based on tariff cut implemented 1 October 2010.
2) System price: average price of solar roof systems with less than 100 kWp capacity.

Prior announcement of FIT invites investment and achieves reductions in system prices and increased industry competitiveness

The prior announcement of future feed-in tariffs encourages fixed investments since it facilitates the development of profit plans by electricity suppliers. Also, early applications being rewarded with a higher purchase price is likely serving as an incentive to bring investments forward. The need to realize profits and to sell products in an environment where the purchase price continues to fall encourages manufacturers of power generation systems to work on reducing system prices. Such efforts contribute to the elevation of the technological level and strict cost control, thereby helping to foster the renewable energy industry and strengthen international competitiveness.

Changes in FIT or system prices change investment behavior

Focusing on the trend of installed capacity in Chart 2, we can see that it increased sharply above the prior-year level in 2004 and between 2009 and 2010. In the first instance, with the revision of EEG in 2004, purchase prices were increased to promote the expansion of solar power investments, for which generating capacity had been small. In the latter instance, system prices decreasing by about 25% annually in 2008 and 2009 widened the differential between the purchase price and the system price representing investment cost (the rate of return rose), and this change promoted fixed investments. The German government then widened the annual reduction from 9% to 13% on 1 July 2010 and further widened it by another

3% in 1 October.[6] Despite these changes, generating capacity climbed 7,400 MWp in 2010, or about twice the figure for the previous year.

FIT that suitably corresponds to system prices indispensable for increasing fixed investments on a sustained basis

As the above discussion should make clear, even if purchase prices are reduced, depending on their level relative to system prices, renewable energy investments may still grow more than anticipated. Takehama (2010)[7] notes that Germany's solar power market overheats when the rate of return (ratio of annual revenues from electricity sales to system prices) exceeds 10%, making it difficult to control the pace of installation. Takehama estimates that the rate of return was 11.7% in Oct-Dec 2009 when new generating capacity surged upward and around 12% from end-2009 through January 2010. Given the difference in the trend growth rate and the level of interest rates between Germany and Japan, a rate of return of 10% cannot be expected to have the same effect in Japan (since Japan suffers from low growth, investments may still increase at a lower rate of return). Even so, the case of Germany is highly suggestive in considering the process for determining an optimum purchase price.

A scheme to make future prices easy to forecast

In light of the examples of Spain and Germany, how should Japan go about setting purchase prices for electricity? There is the possibility that Japan will announce purchase prices no more than one year forward, contrasting with Germany where purchase prices and annual percentage reduction are indicated for several years forward. Since the basis and calculation method for determining purchase prices will be disclosed in Japan, it may be possible to develop some idea of future prices. However, electricity suppliers will have a harder time forecasting future prices in Japan than in Germany, and the FIT system and its implementation in Japan may turn into one that frustrates the development of profit plans. Also, if system prices do not decline, it will be difficult to reduce purchase prices, and the incentive for technological innovation and cost reductions will be weaker for system manufacturers than is the case in Germany. To improve the lack of transparency regarding future prices, it may be effective for the announcement of purchase prices to be accompanied by expected prices for several fiscal years forward, even if only approximate and provisional.

One possibility is to establish a target level for installed generating capacity

Learning from Spain's experience, it will be desirable to establish a definite rule beforehand for reducing purchase prices at an early stage when renewable energy investments begin to overheat and risk a loss of control. In particular, since the purchase price will be set high for the first three years after the Renewable Energy Act takes effect, the implementation of the law will need to fully reflect this intent while ensuring that there is never the need to sharply reduce purchase prices. To begin with, whether the rapid growth of a new category of investment is desirable or problematic is exceedingly difficult to determine. If the purchase price proves inadequate to the task of speeding up or slowing down such investments as desired, one idea is to establish and publicize a target level for installed generating capacity beforehand (maximum level or cap). If installed capacity increases rapidly and there is a growing chance that it will exceed its target, the purchase price can be flexibly reduced. On the other hand, if investments grow slowly, the purchase price

6. "National Survey Report of PV Power Applications in Germany 2010" (IEA) indicates the feed-in tariff for solar power (building installations, up to 30 kW) to be steadily reduced at a rapid pace from 2011 onward—to 28.74 euro cents/kWh on 1 January 2011 (annual percentage reduction [APR] of 13% from the figure before revision), to 24.43 euro cents/kWh on 1 July 2011 (APR of 15%), to 22.23 euro cents/kWh in 2012 (APR of 9%), and to 20.23 euro cents/kWh in 2013 (APR of 9%).

7. Asami Takehama, professor in the College of Social Sciences, Ritsumeikan University, "Doitsu ni okeru taiyoko hatsuden ni taisuru 'feed-in-tariff' no seido sekkei, hiyo to koka" (The design, cost, and effectiveness of the feed-in tariff system for solar power in Germany), Ritsumeikan sangyoshakai ronshu, December 2010.

can be either maintained at its current level or be increased.[8] Here as well, what will be important is increasing predictability for the private sector.

FIT determination has to balance needs of stable supply and national burden rate

The price determination process will also need to give full consideration to energy policies and the national burden rate. Given current conditions in Japan, restarting nuclear power plants will be politically difficult, and the possibility of power shortages is creating uncertainties. Since solar power and wind power have low operating rates and supply is thus intermittent, rapidly increasing such generation will not necessarily be desirable in terms of energy policy. Given the high purchase price for solar power, the expansion of renewable energy being greatly tilted toward it would readily result in higher electricity prices (an estimation of electricity prices is provided in 3. a) below).

From perspective of energy strategy, FIT should be set so as to increase geothermal power

Geothermal power is a source of renewable energy with the greatest potential of substituting for nuclear power in supplying base load power. Japan is a land of volcanoes, and its world-class geothermal potential (31.8 million kW) is comparable to that of Indonesia or the US.[9] Geothermal power has a stable operating rate of around 70% and is unaffected by the time of day. Thus, it is reasonable to think that it can supply a certain portion of base load power. Current geothermal generating capacity, however, is only 530,000 kW (0.2% of total generating capacity). Such factors as the Natural Park Act preventing development and high initial costs have been impediments. The benefits of expanding the use of geothermal power by setting a high purchase price and easing regulations under the Natural Park Act would likely be considerable.

3. What Will Become of Electricity Prices under the Renewable Energy Act?

a) How far will electricity charges rise?

Surcharge estimated to total between Y460 and Y630 billion; monthly electricity charges of households estimated to increase between Y150 and Y200

Since the cost of purchasing renewable electricity will be transferred to electricity prices, how far electricity prices will rise through the expanded generation of renewable electricity is a pressing issue for all households and companies. Before the renewable energy bill was revised by the Diet, the Ministry of Economy, Trade, and Industry (METI) had estimated that the surcharge would total between Y460 and Y630 billion in the tenth year after the start of the FIT system and that the monthly electricity bill of households would increase between Y150 and Y200 (= Y0.5 to 0.68/kWh x 300 kWh).[10] Since the total surcharge was €4.7 billion in Germany in 2009 (about Y520 billion assuming an exchange rate of Y110/euro),[11] the surcharge estimated by METI is about the same level as in Germany.

Estimate that monthly household electricity bill would rise Y150 takes on life of its own

The design of the FIT system, however, was revised in the process of enacting the Renewable Energy Act, and what the purchase price will be is currently unknown. Also, forecasts of electricity prices will vary greatly depending on the assumptions used. Despite the enormity of undecided factors, the figure of the monthly electricity charges rising Y150 has taken on a spirited life of its own.

8. Should this be expressed in the form of monetary policy, it is similar to the effect of stabilizing the expected rate of inflation and of increasing the flexibility of monetary policy by having economic agents come to share a desirable rate of inflation.
9. The sum of hot water resources of 150 degrees centigrade or more (23.47 million kW) and hot spring power sources of 53 to 120 degrees centigrade (8.33 million kW).
10. Agency for Natural Resources and Energy, “The Framework of Japan’s Feed-in Tariff Scheme for Renewable Energy,” 4 August 2010.
11. BMU, “Renewable Energy Sources in Figures,” 2010.

Our approach to estimating electricity charges

Given the above, we sought to develop our own estimates of electricity prices. The approach and assumptions used in our estimation are as follows (to prevent calculations from becoming overly complex, we did not consider surcharge reduction measures).

(1) Electricity demand, the amount of electricity generated by thermal power, and prices of petrochemical fuels are assumed to remain flat. These assumptions are made to isolate the increase in cost attributable to the expanded generation of renewable electricity.

(2) The share of electricity generated by renewable energy sources is assumed to increase to around 20% in the tenth year after the start of the FIT system, and the share of electricity generated by nuclear power to decrease by the same percentage.[12] In other words, since the share of renewable energy sources was 9% in FY09, the share of renewables will increase 11 percentage points, and the share of nuclear power will fall from 29% to 18%. However, given the difficulty of restarting nuclear power plants, the share of nuclear power may fall further. Should this additional decline be supplemented by thermal power, fuel costs will increase, and electricity prices will rise above our estimation results.

(3) Solar power is assumed to account for 82% of new installed capacity for renewable electricity (cumulative generating capacity will be 50 million kW).[13] This percentage is based on that for installed capacity indicated in "The Framework of Japan's Feed-in Tariff Scheme for Renewable Energy" published by the Agency for Natural Resources and Energy on 4 August 2010. Since the share of solar power, which has a high generating cost, will have a large impact on overall electricity prices, we also estimated the case of solar power generating capacity growing by half of our main assumption (25 million kW; 56% share of installed capacity for renewables).

(4) We assumed that the purchase price will be Y45/kWh for solar power and Y20/kWh for other renewables. What purchase prices will be is unknown at the present moment. The purchase price for solar power is expected to be decided based on the current system (Y42/kWh for household generation and Y40/kWh for non-household generation). In the case of other renewables, their purchase prices will likely be determined by referring to the Y15 to Y20/kWh listed in "Report of the Electricity Purchase System Subgroup on designing system details regarding the feed-in tariff system for renewable energy" [source in Japanese] (Advisory Committee on Energy and Natural Resources, New and Renewable Energy Subcommittee and Electricity Industry Subcommittee, Electricity Purchase System Subgroup, 18 February 2011). If we allow for purchase prices being set high for the first three years after the new law takes effect as noted above, purchase prices of Y45/kWh for solar power and Y20/kWh for other renewables are realistic assumptions.

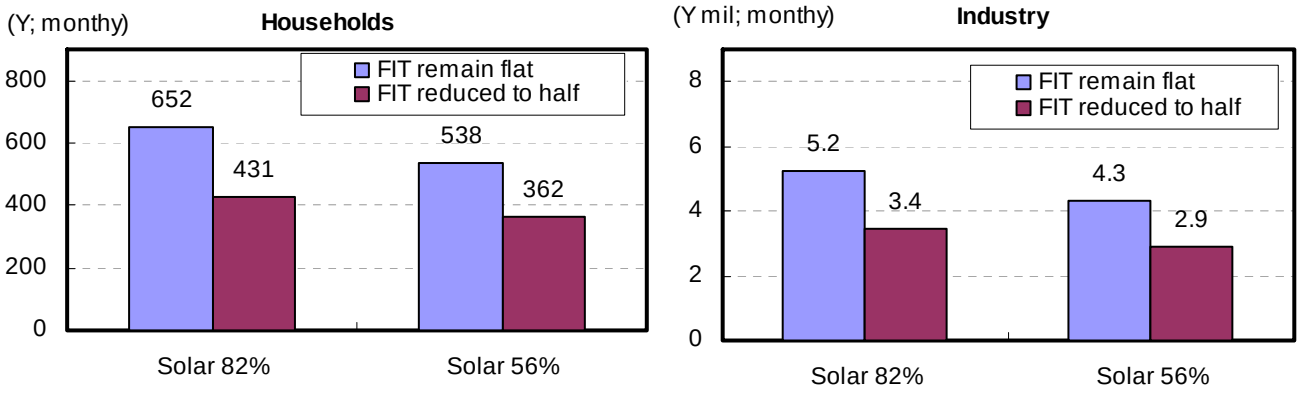
Estimating cases with FIT being unchanged and being gradually reduced

Chart 3 illustrates estimation results for the tenth year after the start of the FIT system. The chart portrays the increase in monthly electricity charges from their levels in FY09. The left graph shows estimation results for a standard household (electricity consumption of 300 kWh/month) and the right graph for a large factory (electricity consumption of 2.4 million kWh/month). These graphs illustrate the cases of the purchase price remaining flat even 10 years after the start of the FIT system (bar graph on the left) and of the purchase price being gradually reduced to

12. We assumed the generating cost of nuclear power to be Y5.5/kWh, based on the estimation results of the Federation of Electric Power Companies of Japan, "Moderu shisan ni yoru kaku dengen no hatsuden kosuto hikaku" (Comparison of the generating costs of power sources according to model calculations), January 2004.
13. This figure assumes that 60% of household solar power generation will result in surplus electricity.

one half its initial level 10 years later (bar graph on the right).[14] We provided for these two cases since it is realistic to assume that purchase prices will gradually decrease as system prices fall. The case where purchase prices remain flat can be viewed as the pessimistic case where electricity prices rise by the maximum amount.[15]

Increase in Electricity Charges in the 10th Year from Introduction of Renewable Energy Act, Assuming Renewable Energy Power Accounts for 20% of Electricity **Chart 3**



Source: Compiled by DIR.
Notes: 1) "Solar 82%" ("Solar 56%") is where electricity from solar power accounts for 82% (56%) of that from renewable energy and the capacity of solar power generation is 50 MW (25 MW).
2) Increase in electricity charges = increase in electricity price per 1kWh x monthly power consumption (standard case: 300 kWh for households and 2.4 mWh for industry).
3) FIT: Feed-in tariffs.

Electricity charges will rise sharply if FIT remains flat

In the case where purchase prices are unchanged and the share of solar power is 82%, the price of electricity will increase Y2.2/kWh. If a standard household is assumed to pay monthly electricity charges of Y6,600 (= Y22/kWh x 300 kWh) and a company (a large factory) Y24.5 million (= Y10.19/kWh x 2.4 million kWh), the household electricity bill will rise 10% compared to FY09 (increase of Y652) and the company bill 21% (increase of Y5.22 million). However, in the case where purchase prices decrease by half, which we believe is a more realistic assumption, the price of electricity will increase Y1.4 /kWh, with the household electricity bill rising 7% (increase of Y431) and that of companies 14% (increase of Y3.45 million).

A higher share for solar power means a higher electricity charges

Next, taking the case where the purchase price remains flat and solar power's share of installed capacity is 56%, electricity prices will increase by a smaller margin than in the case of an 82% share. This is the outcome of solar power's reduced share, whose purchase price is higher than that for other renewables. In addition to technological limitations, solar power is associated with a natural limitation in the form of an average operating rate of 12%. In contrast, average operating rates are 25%[16] and 70%, respectively, for wind power and geothermal power. A low operating rate means that more generating capacity will be needed to achieve the same level of output as solar power, and the per unit generating cost will be higher. While Germany's installed capacity for solar power is large, electricity generated by solar power accounted for only 6.2% of the total for renewable energy in 2008.

14. We assumed that installed generation capacity would increase at a fixed rate in line with declines in FIT (accompanied by declines in system prices).
15. We assumed electricity demand remains flat, which implies that even if the economy (real GDP) grows, greater energy conservation would avoid any increase in electricity demand. For this reason, should energy conservation not improve and electricity demand rise, the electricity bill might exceed our pessimistic case.
16. The arithmetic average of land-based wind power (operating rate of 20%) and offshore wind power (30%).

Even so, solar power's share of the aggregate feed-in tariff was 24.6%.[17] Bearing in mind that promoting fixed investments in a manner that is overly tilted toward solar power would increase the national burden rate, it will be important to consider what the best mix will be for the structure of power generation.

Reasons why our estimation of electricity charges is higher than that of METI's

Compared to METI estimates, electricity prices will rise by a higher margin according to our estimation. Our assumptions for the adoption of renewable energy and for power generation costs were most similar to those of METI in the case where purchase prices fall by half and the percentage share of solar power is 82%. In this scenario, we calculated that the price of electricity would increase Y1.4/kWh, a figure that is 2.1 to 2.8 times higher than METI's estimate (Y0.5 to Y0.68/kWh). This divergence stems from differing assumptions about the pace of installing power generation facilities and also future purchase prices. One major factor in particular is METI's assumption that installed capacity would be about half of what we have assumed.

Discussions premised on monthly electricity bill rising Y150 not appropriate

In the process of enacting the Renewable Energy Act, there was a growing tendency to develop separate purchase prices according to renewable energy sources and the form and size of power generation facilities. Also, to greatly expand the generation of renewable electricity in response to nuclear power plant problems and environmental issues, it will be necessary to install large-scale generating facilities for solar power and wind power beyond the assumptions made in the METI estimation. In other words, how electricity prices will be affected will differ greatly depending on the target established for the installed capacity for renewable energy and on the structure of purchase prices. Takehama (2011) notes that, for a three-person German household using 3,500 kW per year, the additional charge added to their annual electricity bill was Y7,893 in 2010 (Y658 per month).[18] He also notes that this figure will rise further in FY11. To this day, we see the media referring to the government's estimate that the monthly electricity charge will rise by about Y150. It is no longer appropriate, however, to premise the discussion of electricity charges on this figure.

b) Industries that benefit from surcharge reduction measures

Surcharge to be reduced by Y7 billion in first fiscal year

The estimation above does not factor in surcharge reduction measures for disaster areas or for companies that are large consumers of electricity. As explained in 2. a), the possibility of using funds in the energy measures special account is being examined for the purpose of covering the unpaid portion of the surcharge arising from reduction measures. Should this come to pass, electricity prices would not increase to the extent that special account funds can be tapped.[19] According to media reports, METI has estimated the surcharge reduction amount to be about Y7 billion in the first fiscal year (July 2012 to March 2013). This is an extremely small figure compared to the surplus carryover from the previous fiscal year recorded in the special account (Y117.2 billion in the initial FY11 budget).

Cases where surcharge to be waived/reduced

There is still much uncertainty about how much of the surcharge will be affected by reduction measures. According to the Renewable Energy Act, more than 80% of the surcharge can be discounted when annual electricity purchases exceed a certain amount when either 1) the unit power consumption (consumption of electricity supplied by electric power companies / industry product sales) of the businesses of

17. Frondel, Ritter, Vance, "Economic Impacts from the Promotion of Renewable Energy Technologies—The German Experience", 2009.
18. Asami Takehama, "Saiene fukyu no kagi wa kaitori kakaku, sanko ni naru Doitsu no senshinsei" (The purchase price is the key to the spread of renewable energy: Germany's case offers a point of reference), Shukan ekonomisuto, Mainichi Newspaper, 6 September 2011.
19. The energy measures special account is funded by such taxes as the petroleum and coal tax and the electric power development promotion tax that are borne by citizens.

a company affiliated with the manufacturing sector exceeds eight times the manufacturing sector average or 2) the unit power consumption of the business facilities of a company affiliated with the non-manufacturing sector exceeds a certain multiple of the non-manufacturing sector average.

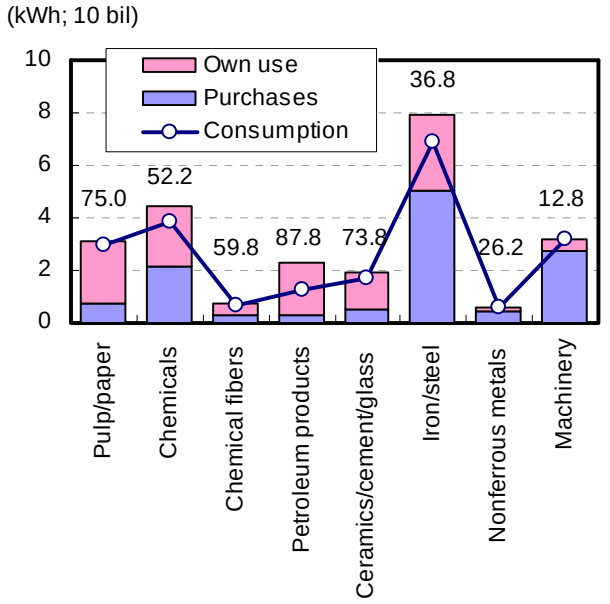
Reduction amounts currently uncertain

Since the calculation of reduction amounts will be based on the amount of electricity purchased from electric power companies and not on total electricity consumed, companies that are large consumers of electricity may still not qualify for reduction measures if they generate large amounts of electricity on their own. Also, the "certain multiple" that will apply to the non-manufacturing sector and the minimum threshold for the amount of electricity purchased by the manufacturing and non-manufacturing sectors will be determined by cabinet order, and what the cabinet will decide is currently unknown. Another category to benefit from reduction measures are companies and households that were severely damaged by the Great East Japan Earthquake. There is currently no way of knowing what the qualifying criteria will be or the size of surcharge reduction measures.

Iron/steel and nonferrous metals mainly benefit from reduction measures

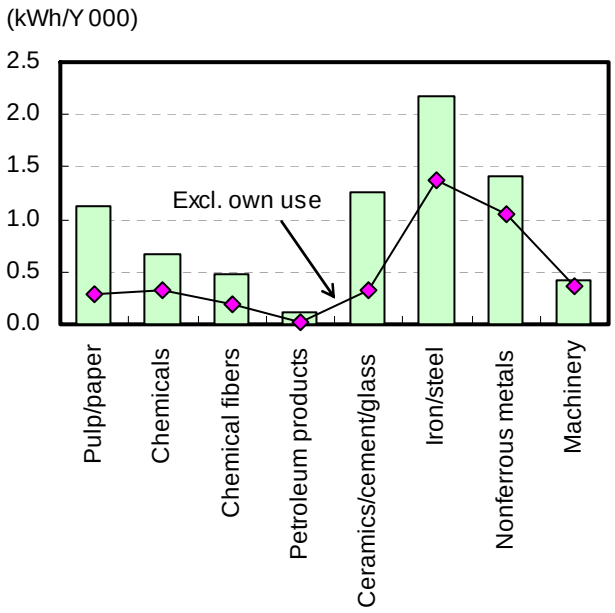
Limiting ourselves to the manufacturing sector, we used macroeconomic statistics to develop a general understanding of which industries would benefit from the reduction and waving of the surcharge. Chart 4 portrays electricity consumption and in-house power generation by industry. Figures in the chart indicate the percentage share of in-house power generation. It is evident that these figures are high for such materials industries as petroleum products, pulp/paper/paperboard, and ceramic/cement/glass products. Based on this industry data, Chart 5 offers a broken line graph of electricity purchased (electricity consumed minus in-house power generation) divided by sales. While the bar graphs including in-house power generation are high for the pulp/paper/paperboard industries, the proportion of in-house power generation is also high for these industries. Thus, when compared on an electricity purchased basis, they are positioned at a similar level to the machinery industry. As a result, the elevated positions of the iron/steel and nonferrous metal industries stand out, and reduction measures are expected to mostly benefit these two industries. It should be borne in mind, however, that this analysis was undertaken on an industry basis. It was not performed on a business facility basis, restrictions in available data meant that figures for electricity consumption were limited to large-lot consumption (contracted electricity of 500 kW or more), and only industries where the percentage shares of in-house power generation are known were examined. Hence, it goes without saying that calculation results should be viewed with some latitude.

Power Purchases and Sales by Industry (2010) Chart 4



Source: Ministry of Economy, Trade, and Industry; compiled by DIR.
Notes: 1) Survey of 1,600 business facilities for each respective industry.
2) Figures in charts: % of power generation for own use.
3) Difference between bar graph and line graph: power sales.

Unit Power Consumption by Industry (2010) Chart 5



Source: Ministry of Finance, Ministry of Economy, Trade, and Industry; compiled by DIR.
Note: Unit power consumption = power consumption / industry product sales; power consumption: electricity sales to large-lot industrial users; industrial sales: all companies; petroleum products incl. coal products.

4. Are Japan's Electricity Prices High in International Terms?

a) International comparison of industrial-use electricity prices

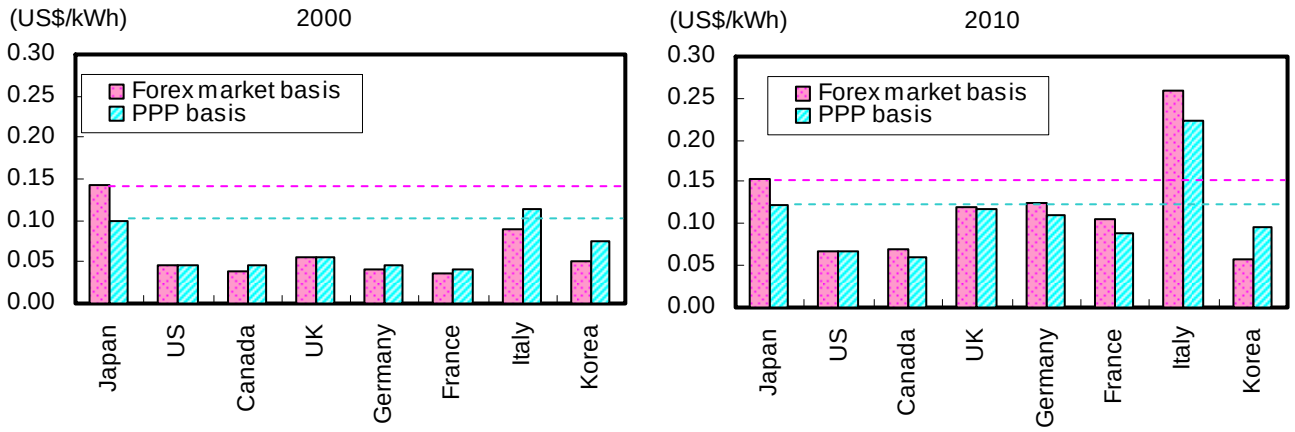
Electricity prices and international competitiveness

Once the Renewable Energy Act takes effect, electricity prices are expected to rise along with the amount of electricity purchased under the FIT system. This draws our attention to the level of electricity prices in Japan and how they compare in international terms. Electricity prices are generally said to be high in Japan compared to other nations. They are two to three times higher than those in Korea, an export competitor with Japan. The observation is sometimes made that electricity prices climbing any higher in Japan would pose severe challenges. How different are electricity prices in Japan compared to other nations? If electricity prices are high in relative terms, does this necessarily mean that the manufacturing sector's electricity cost represents a large burden? In the paragraphs to follow, we provide an international comparison of industrial-use electricity prices.

Chart 6 offers a comparison of the electricity prices of major developed nations (G-7 + Korea) for 2000 and 2010 (2009 for Korea) based on IEA and other data. Electricity prices shown are average unit values for one year.[20] The chart also provides comparisons measured by market exchange rates (converted into US dollars) and measured by purchasing power parity (IMF figures). The following characteristics can be identified in Chart 6.

20. IEA explains that, given the existence of a diversity of contracts and price structures, it used average unit value to examine the representative electricity prices of the broad sectors of the economy, such as the industrial and household sectors.

Electricity Price for Industrial Users by Country **Chart 6**



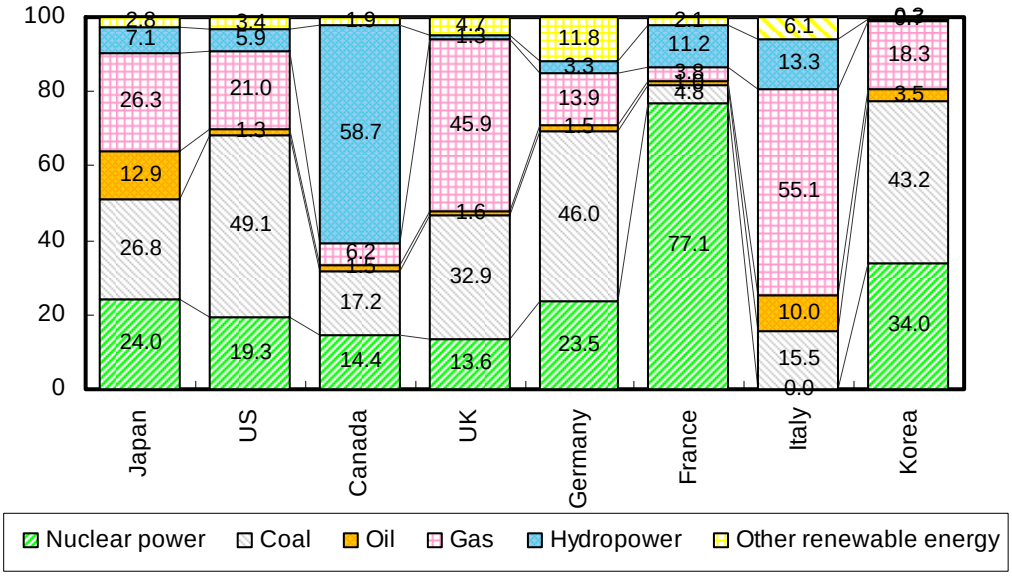
Source: IMF, IEA/OECD, US Energy Information Administration (EIA), Eurostat; compiled by DIR.
Notes: 1) Purchasing power parity (PPP): IMF basis.
2) Electricity price: IEA/OECD data, excl Germany and US; Germany: IEA/OECD data through 2007 and Eurostat data thereafter; US: EIA data; Korea: 2009 IEA/OECD data.

Difference in electricity prices with other nations narrowed from 10 years ago

Japan's electricity prices were higher than those of other nations in 2000 and 2010, but this difference has narrowed during this period. This is not because of changes in exchange rates. The main contributing factor has been the decline of Japan's electricity prices in absolute and relative terms on a national currency basis. In other words, working backwards from IEA data, an electricity rate that was Y15.4/kWh in 2000 in Japan fell by more than 10% to Y13.5/kWh in 2010. During the same period, electricity prices rose nearly 30% in Canada and Korea and climbed nearly 50% in the US. In the case of European nations, electricity prices have more than doubled. The ascent of electricity prices in foreign nations is mainly explained by the increased cost of generating electricity attributable to higher fuel costs for thermal power, such as for oil, coal and natural gas, and to the introduction of FIT regimes. Electricity prices rose by the largest amount in Italy since it does not have nuclear power plants and depends greatly on thermal power (Chart 7) and since it imports a considerable amount of electricity (net imports accounted for 12.9% of final electricity consumption in 2008). Naturally, rising fuel costs contributed to higher electricity prices in Japan as well. However, since growth of electricity demand slowed during the same period and since the deregulation of the electric power industry also had some effect,[21] electricity prices decreased.[22] Compared to European nations, the deregulation of the electric power industry is lagging in Japan. An examination of the trend of world electricity prices over the last decade suggests that the relationship between deregulation and electricity prices is not such a simple one.

21. Satoshi Yamaguchi, "Denryoku jiyuka no seika to kadai" (The outcomes and pending issues of deregulating the electric power industry), Chosa to joho, 25 September 2007.
22. Since the trend of general prices in Japan continues to be deflationary, it might naturally be thought that electricity prices are falling as well. While this is true, an examination of the relationship between electricity prices and average prices in the Corporate Goods Price Index for this period reveals that electricity prices have even declined in relative terms.

Energy Source for Power Generation by Country (%) **Chart 7**



Source: IEA/OECD; compiled by DIR.
Note: Incl. own use power.

Purchasing power parity offers better way to make international comparisons than market exchange rates

We can see in Chart 6 that the difference in electricity prices with foreign nations is smaller when measured by purchasing power parity (PPP) than by market exchange rates. A critical issue in making international comparisons, whether for electricity prices or for other data, is what exchange rate to use to align units of comparison. Comparisons will not be made along the same ruler unless the conversion rate used brings price levels into alignment. The exchange rate that satisfies this condition is PPP. International comparisons of electricity prices are frequently seen using data measured by market exchange rates. While such comparisons do standardize the currency unit, they do not provide an adequate comparison since data is not adjusted for domestic price levels. Another reason why market exchange rates are not suitable for making international comparisons is the way they reflect momentary differences in interest rates or in international capital flows. For example, should the yen appreciate against the dollar due to some momentary shock in foreign exchange markets, it will appear that electricity prices in Japan have risen in dollar terms.

Electricity prices in Japan similar to those in Europe but about 40% higher than those in Korea

Japan's electricity prices measured by PPP diverge less from that of other nations than when measured by market exchange rates, and it is about the same level as electricity prices in European nations. There is no question that electricity prices are higher in Japan than in Korea, an export competitor with Japan. In a market exchange rate comparison, Japan's electricity prices were about 2.7 times higher than those of Korea in 2009. On a PPP basis, however, they were about 1.4 times higher in Japan. Thus, while the difference in electricity prices between Japan and Korea is not as large as is generally reported, prices in Japan are still about 40% higher.

b) Manufacturing electricity cost not relatively high

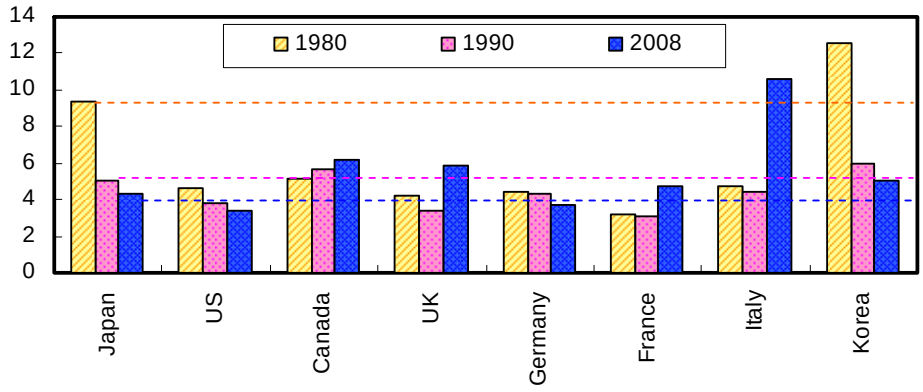
When looking at electricity cost, unit power consumption should be considered

Although industrial-use electricity prices are about 40% higher in Japan than in Korea, this does not necessarily mean that the electricity cost is 40% larger for Japanese companies than for Korean companies. Should the value added generated by Japanese companies per unit of electricity be greater than the comparable figure for Korea, Japanese companies will use less electricity to create the same amount of value added. Thus, it is necessary to compare electricity cost by allowing for unit power consumption.

Electricity cost relatively low in Japan

Chart 8 compares the electricity charges paid by the manufacturing sector as a percentage of the sector's nominal GDP (subsequently, electricity cost) for G-7 nations and Korea. The chart depicts how much is paid for electricity in generating value added, and it provides an international comparison of electricity cost for the manufacturing sector (the most recent data is for 2008). Japan's electricity cost was exceeded only by that for Korea in 1980. By 1990, however, unit power consumption had improved greatly, and Japan's electricity cost fell to the level of other developed nations. As of 2008, Japan's electricity cost was on the low side among the nations that we compared. Moreover, since electricity prices grew more slowly in Japan than in other nations between 2008 and 2010, it is reasonable to think that Japan's electricity cost has declined in relative terms. Should we assume that Japan's electricity cost in 2010 has changed only in relation to the increase of electricity prices, Japan's cost would be 4.1%. This is the lowest figure after that for the US (3.4%) and is about 40% lower than the corresponding figure for Korea (5.7% as of 2009).

Electricity Cost for Manufacturers
(manufacturing industry electricity costs as % of nominal GDP)* **Chart 8**



Source: IEA/OECD, United Nations, US Energy Information Administration, Eurostat; compiled by DIR.
* Electricity price (local currency basis) x manufacturing electricity consumption / nominal GDP.

Ongoing appreciation of the yen aggravating industry hollowing

Electricity prices have the potential of increasing hereafter due to such factors as higher fuel costs arising from the operation of thermal power plants made necessary by the halt of nuclear power generation.[23] However, considering electricity costs relative to corporate earnings have not been excessively high in Japan, higher electricity prices will not immediately place Japanese firms at a competitive disadvantage with Korea. Japanese manufacturers possess production technology that makes efficient use of electricity. Also, the cost of electricity to Japan's manufacturing sector is less than the average for developed nations. When only higher electricity costs and the hollowing out of industry are considered, Japanese industries should be able to maintain and further increase their international competitiveness by expanding energy-saving investments and further developing electrically efficient manufacturing systems. Naturally, higher electricity prices, which are a production cost, must be avoided as much as possible. It would be overly pessimistic, however, to assume that higher electricity prices would bring the manufacturing sector to a standstill. What is aggravating the hollowing out of industry is the ongoing appreciation of the yen. Thus, the pressing issue for Japan is overcoming the excessively strong yen.

23. DIR, "Power Shortage and Japan's Economy", 25 July 2011, Mikio Mizobata, Keiji Kanda, and Hitoshi Suzuki.