

Ideal Industrial Structure of Japan's Energy Industry

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Electricity Supply Post-Disaster

After the Great East Japan Earthquake and the Fukushima Dai-ichi nuclear power plant accident, the direction of Japan's energy policy has become unclear. This summer, the government imposed an obligation on large-scale electricity users in the areas under the jurisdiction of Tokyo Electric Power Company and Tohoku Electric Power Company of a 15% maximum electricity-saving compared to last year, while also asking for electricity-saving of 10% or more in the Kansai Electric Power Company area. In the case where the nuclear power stations that are currently halted or will soon be halted for regular periodic inspections do not start operation again, it can be expected that in the summer of next year (2012), there will be extremely severe electricity shortages.

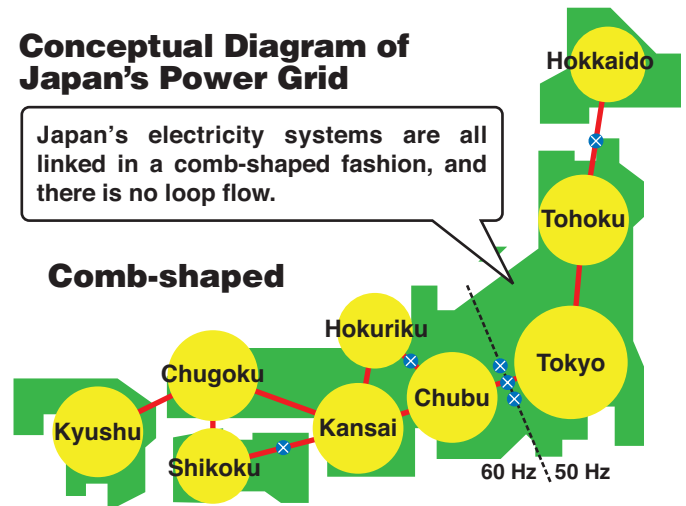
From the viewpoints of global warming and self-sufficiency in energy supply, promising candidates as substitutes for nuclear power are electricity-saving and the promotion of renewable forms of energy such as wind power. However, in order to expand and promote these two candidate substitutes, it would be impossible to avoid a greater burden being imposed on the Japanese people. In addition, for the promotion of renewable energy, a decade-long timeline is required. Putting aside for the time being the goal of reduction of carbon dioxide, while implementing full operation of thermal power centering on natural gas, there is no choice but to make more serious efforts to save electricity, so as to minimize any negative influence on economic activities. It is also essential to seek greater efficiency in electricity operations. In this paper, I will examine the ideal state of Japan's electricity operations in the post-disaster world.

Origins of Japan's Electricity Industry

The first electricity company in Japan was established in 1882. The history of the Japanese electricity industry thereafter can be broadly divided into three periods. During the first, up until 1939, many private companies entered the electricity business. However, from 1939, through the National General Mobilization Act, the electricity industry came under state supervision. Electricity facilities were jointly supervised in the half-public, half-private Japan Electric Transmission & Generation Company, while electricity distribution operations were implemented through nine private companies. Then, in 1951, under the Allied Forces GHQ, the electricity system was completed, revolving around nine power distribution companies, and has continued until today. (Since 1988, when Okinawa Electric Power Company was privatized, there have actually been 10 companies; below, however, I will describe them as nine companies.) This year marks the 60th anniversary of the establishment of the system based on these nine electricity companies.

Conceptual Diagram of Japan's Power Grid

Japan's electricity systems are all linked in a comb-shaped fashion, and there is no loop flow.



Source: METI HP

Features of Japan's Electricity Industry

I would like to mention two features peculiar to Japan's current electric power system. First, a public service operation is run by the private sector. For the development of nuclear power, the so-called "three power-supply laws" framework is often employed, while the problem of disposing of used nuclear fuel (namely, the "back-end problem") makes national assistance essential. In other words, a major feature of Japan's electricity industry is that nuclear power is operated by private companies with the presumption of state intervention.

The second feature is the regional monopolies in electricity generation and transmission. During the war, power generation and transmission were supervised by the state, while distribution was carried out independently by each of the nine companies, under its own jurisdiction. After the war, Japan Power Generation and Supply was broken up and divided into the current nine electric power companies. At the beginning of 1951, each electric power company became vertically integrated across generation, transmission and distribution in their respective geographical area. The areas for power provision of each company were joined by interconnecting lines in such a way that electricity is made available throughout the country. However, in the Meiji era, Japan's two major power companies, located respectively in the east and west of the country, independently imported thermal power generators from different foreign manufacturers, so that even now in east Japan 50 hertz, the frequency of the European continent, is mostly used, while west Japan is dominated by the 60-hertz frequency, the same as that of the US. As a result, when transmitting electricity between east and west Japan, it is necessary to alter the frequency of electricity between 50 and 60 hertz, resulting in a substantial amount of power loss in transmission. This is, of course, a major obstacle to managing an effective nationwide power supply network.

In the 1990s, it was noted that Japan's electricity fees were higher than those in other countries, and since 1995 an electricity system reform has taken place four times, every five years. Of these reforms, liberalization of the power generation divisions and partial liberalization of the retail divisions, as well as establishment of the Japan Electric Power Exchange, were implemented. In particular, the government established new organization, which monitors the use of electricity transmission lines; it also separates the operation of electricity transmission from that of generation for each company. Through these institutional reforms, Japan's electricity prices have steadily declined by more than 20%. It is fair to evaluate that the liberalization of Japan's electricity has been successful.

Electricity Market in Post-Disaster Japan

At the present moment, considerable efforts in myriad aspects continue to be made in order to stabilize TEPCO's Fukushima Dai-ichi nuclear power plant, and we now have a legal framework on pecuniary compensation for the people suffering from the nuclear power plant incident, as the Law on Compensation for Nuclear Damage was passed in the Diet in August. However, since the order to halt operation of the Hamaoka nuclear power plant was made by then Prime Minister Naoto Kan in May, there have been many cases where local governments were unwilling to agree on the restart of nuclear power plants that had been halted for safety inspections. Against this background, we have been facing a severer shortage of electricity supply. In order to alleviate this supply shortage, there is no other option but to promote saving electricity and energy and to develop new sources of electricity to expand the electric power supply. In particular, it would be worthwhile to put greater effort into studying ways to curb demand or save energy by using an economic incentive as a means to ease the electricity supply shortage.

A uniform restriction on the use of electricity by large-scale users within the supply areas of Tohoku Electric Power Company and TEPCO cannot be considered an efficient way to control electricity demand. We should think about a new framework in which an individual user could volunteer to reduce his or her demand for electricity and thus the overall electricity demand would be contained at a certain target level. It is often assumed that price can work as a means to control demand; however, it is also to be noted that the electricity price could have an enormous impact upon people's daily lives. Thus, it would be dangerous to rely excessively on the use of the price mechanism in electricity, which is largely in the nature of a public service.

It might be useful in the long run to provide each household with information on the amount of electricity consumed by the use of smart meters; However, it should be noted that some households, including those in which both the husband and wife work or those with elderly residents, would not necessarily feel a need for such meters. It is worth reconsidering whether smart meters should be introduced for all households in Japan.

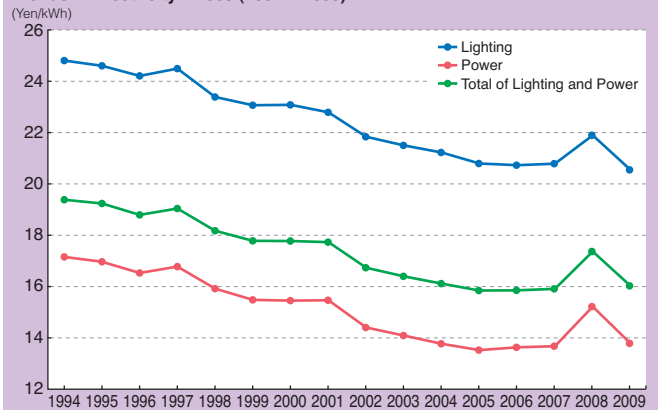
How Much Can We Rely on Renewable Energy Sources?

We expect an important contribution from renewable energy sources including wind and solar power generation as new sources of electricity to compensate for the reduction in nuclear power generation. In particular, since the Great East Japan Earthquake has made clear the need to construct anew an energy supply system that can withstand the risks of disaster, dispersion-

Price of Electricity: Price Trends

Since the start of the reforms of the electricity operations system, electricity prices have been continuously dropping, but have been fluctuating since the year before last, reflecting the prices of fuel.

Trends in Electricity Prices (1994 – 2009)



Note: 1. Lighting is the average unit of electricity prices mainly in the domestic sector, while Power is the average unit of electricity prices mainly in offices, factories, etc., including the area of demand subject to liberalization.
2. Computation of the average unit is calculated as follows: revenue from Lighting and revenue from Power, each divided by the respective amount of electricity sold (kWh) (including the area of demand subject to liberalization).

Source: Actual Power Demand (Final Report), Federation of Electric Power Companies; statements of accounts materials from various power companies

type power sources have attracted much attention as a means to achieve a stable supply of electricity. "Dispersion-type power sources" refers to small-scale power generating facilities to be set up for electricity users nearby.

Now, it is solar power generation that is at the center of our interest as a promising candidate as a dispersion type. Regional governments have been providing subsidies for installing solar power generation facilities for residential use, along with a feed-in tariff that the national government has implemented since 2009. By allowing for selling power generated beyond the amount needed for one's own personal consumption to power companies at a higher price, this feed-in system aims at promoting the spread of residential solar power generation. The amount (kW) introduced in the first year after the system was started has increased almost threefold; in terms of diffusion, this system has been fairly successful.

However, since solar power generation can produce electricity only during the daytime on sunny days, its rate of capacity utilization is low. Also, compared to existing power sources, its generation efficiency is much weaker.

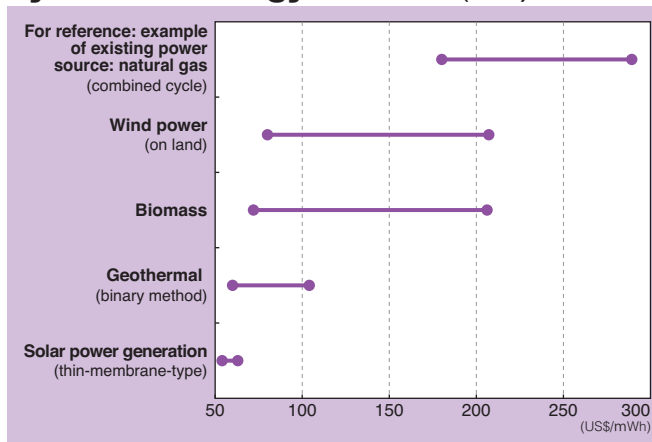
As we observe an increase in imports of cheap solar panels, in particular from China, it has been pointed out that an expansion of the market of solar power generation by the feed-in tariff system could hinder the development of Japanese national producers and/or the creation of jobs in industries engaged in solar power generation.

Though the spread of renewable energy sources is desirable in terms of protecting the global environment and ensuring a stable supply of electricity, we need to seek a well-balanced approach in light of the cost and benefit of promoting renewable energy. While promoting renewable energy generation will contribute to a more secure electricity supply, renewables lags far behind existing sources in terms of power generation efficiency. In order to minimize the costs borne by the Japanese people, it is necessary to strike a balance between efficiency and safety in supplying electricity.

Ideal Electricity Supply Structure of Japan's Electric Industry

What is the desirable industrial organizational structure for Japan's electric power industry in the post-disaster era?

Cost of generation of electric power by natural energy sources (2010)



Note: Cost of generation of electric power is the amount that can cover the operation and investment cost within the serviceable period of a facility

Source: Compiled by the author based on the World Economic Forum (April 2011)

The ideal picture is likely to differ depending on whether we take a short-term or a long-term perspective.

In the short term, in order to secure the supply of electricity, it is imperative to coordinate the operation of electricity generation and transmission. For that purpose, we can find an economic rationale in maintaining the current structure of our electric power industry where generation and transmission are vertically integrated. Otherwise, the lack of coordination between generation and transmission may well further exacerbate the shortage of electricity supply.

However, in the mid- or long-term perspective, it is essential to re-evaluate the current structure of the electricity supply system in order to make the electricity supply more efficient. There are at least two points to consider in thinking about the ideal business structure of Japan's electricity industry hereafter. The first point is that we should invigorate competition in the generation or retail and wholesale sectors. If new entrants provide a wide range of services by using transmission lines, that would lead to the exploration of new needs of electricity consumers and eventually spark innovation. Taking advantage of the market mechanism would be useful to improve the efficiency of the electricity supply.

In Japan, aiming at revitalization of the electricity market, institutional reforms of the electricity supply business have been implemented four times so far. The main consequences of these reforms is the creation of opportunities for entry by independent power producers and power producers and suppliers through liberalization of the generation sector and expansion of the scope of liberalization of the retail sector. Also, the Electric Power System Council of Japan was founded as a surveillance institute for these new entrants in order to maintain their free and fair access to transmission networks. Thus, the government achieved a separation of generation and transmission of electric power by function and accounting, while maintaining the integration of generation and transmission of electric power companies.

Is the Market Mechanism Almighty?

How much has this separation of the generation and transmission of electric power by function and accounting contributed to the promotion of competition in the electricity market since 10 years ago, when the

reform was put into practice? If it has not resulted in a significant increase in new entrants which the government originally assumed, it is necessary to urgently explore the reasons therefor. Market liberalization is not always a key solution for promoting market competition. Depending on the market structure of an industry, strengthening regulation could be desirable for the industry.

For example, in California in the US, where the generation sector and the transmission sector for electric power are vertically separated, in 2000 when a large-scale blackout occurred, it is well-known that the price of electricity in the wholesale electricity market rose to a maximum of nearly five times the normal price. Though the aging of power-generating facilities and the soaring prices of natural resources and so forth were considered the main factors to have caused such a wholesale price rise, academic research has made it clear that a significant portion of the price hike was also due to the impact of the market power exercised by a group of power generators that took advantage of the rapid decline in the electric power supply. This lesson shows us that sometimes it is necessary to introduce regulation instead of further liberalization in dealing with market distortion caused by anticompetitive behavior.

In the end, by identifying the downside of the institutional reforms achieved so far in Japan, it is important for us to keep a perspective for activating the electricity market with a well-balanced approach of market liberalization and regulation, which are mutually complementary, in responding to the issues identified in the policy review.

Pursuing Industrial Reorganization to Realizing Scale Economy

Another policy direction to be pursued in achieving an efficient electric power business is expansion of the scale of business. Looking overseas, in Western countries, mergers and acquisitions across industries such as electricity and gas took place one after another to seek bargaining power to respond to the emerging "natural resources nationalism," and this led to the birth of general-energy big business corporations.

In Japan as well, against the background of a significant increase in management risk in the electric power business, it should be considered an important management agenda item to pursue scale economies in order to bear business risks and keep a stable and less expensive electricity supply. In Japan, where the transmission lines of electricity are closed within the island nation, we have virtually no pressure at all for competition coming from overseas in the electricity business. Nine electric power companies operating appear to be too many in relation to the market size. In the steel and chemical industries, painstaking efforts have been undertaken to raise their competitiveness, and there must be many lessons to be learned from their experience for the electric power industry as well. I believe that an increase in cross-industry or cross-region mergers and acquisitions in the energy sector revolving around electricity would be most desirable for the future of our energy industries.

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