

Issues of Power System Reform

- From “Rationing” to Market Mechanisms -

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Why is it Necessary to Reform Japan's Power System?

The accident at the Fukushima Daiichi Nuclear Power Station made manifest the problems inherent in Japan's power system. Now we are able to clearly see the latent problems in a system in which the majority of power is supplied by ten General Power Utilities¹ ('GPU') which hold what amount to monopolies over their specific regions of the country, and in which power is supplied in each of those regions in a form which suggests a system of rationing, with vertical integration from upstream generation through transmission to downstream retail.

Let us consider some of these problems here.

(1) Japan has to date relied for the majority of its power on large-scale centralized generation facilities, in particular nuclear facilities. The loss of the ability to make use of these nuclear facilities has had a significant impact on society as a whole. The cultivation of a broader range of supply channels, including the expansion of the use of distributed power sources close to the site of consumption, can be seen to be necessary.

(2) Given the existence of a developing national consensus regarding the undesirability of an excessive reliance on nuclear energy, it will be essential to create a business environment promoting the active involvement of a variety of power producers in order to ensure a more diverse range of power sources, including renewable energies. The present situation, in which businesses with power transmission networks are virtually monopolized by GPUs, impedes the realization of such a business environment.

(3) Japan's power system has not been predicated upon the use of the power transmission network across different areas. The intensification of regional monopolies means that there has been almost no competition across regional boundaries. Even if we were to attempt to generate wind power in Hokkaido and transmit it to Honshu, the capacity of the interconnection lines between Hokkaido and Honshu² would be too low to enable this. In addition, East and west Japan use different cycles, significantly restricting competition and power exchange across the boundary between the two regions.

(4) Up to the present, the expansion of supply to satisfy demand has been a given in Japan's power system, based on the principle of ensuring a stable supply of power. The aggressive construction of nuclear power stations in order to respond to the high levels of power demand in regions such as the Tokyo metropolitan area and the Kansai area also proceeded from the need to ensure a stable supply of power. A stable supply of power is of course important, but if we consider global trends, we see that flexibility on the

demand side in response to the status of supply capacity is also recognized as being necessary. It will be essential for Japan to actively introduce demand response (DR) mechanisms, which adjust demand in response to trends in supply, in addition to power saving measures to cut back on electricity use.

(5) Related to the above points, it will be necessary to build mechanisms giving users greater freedom of choice in terms of power. We must realize the introduction of a range of fee structures at the retail level, in addition to the participation of diverse power retailers in the market. In addition, it will also be necessary to diversify the entities supplying power in order to enable users to choose from among a range of power retailers.

From “Rationing” to a Market-based Power Supply System

The electricity industry tends to be thought of as a special field, but in fact what lies at the root of the power system reforms discussed here is the incorporation of changes which have already been made in many other business fields. What this refers to is a move away from a system of “rationing” towards a full utilization of market mechanisms.

I will attempt to outline the characteristics of the “rationing-based” power system. It is convenient in this to draw analogies with the rice market. Let us assume that residents of Tokyo purchase rice from the retailer TEPCO; this rice, having been produced by the producer TEPCO, is transported to market by the transport company TEPCO. The range of alternative choices is extremely limited. Based on a general cost method, the cost of the rice to the consumer is the cost of its production plus a fixed amount of profit.

These are the characteristics of the system of rationing. However, this type of rationing system is undesirable; the residents of Tokyo should be able to purchase rice produced by a variety of producers, and fees and services should be flexible rather than regulated. Further, a company which owns power transmission facilities should transmit power produced by a variety of generating companies in addition to its own power without discrimination. Under these conditions, we could expect a diverse range of generating companies to enter the market. For users also, the range of choice would widen. There would also be competition between companies in the market; we could expect competition in the areas of both power generation and power retail.

For the electricity industry, the transmission and distribution of power are areas in which economies of scale are extremely high, and they are therefore areas in which we could not expect competition between multiple companies. In the case of power transmission and distribution, it would be necessary to realize operations on the basis of rules ensuring a high level of fairness and transparency, and to build a system enabling all generating companies and power retailers to use the services under the same conditions. This will be made possible by the separation of power generation from power transmission and distribution (Figure 1).

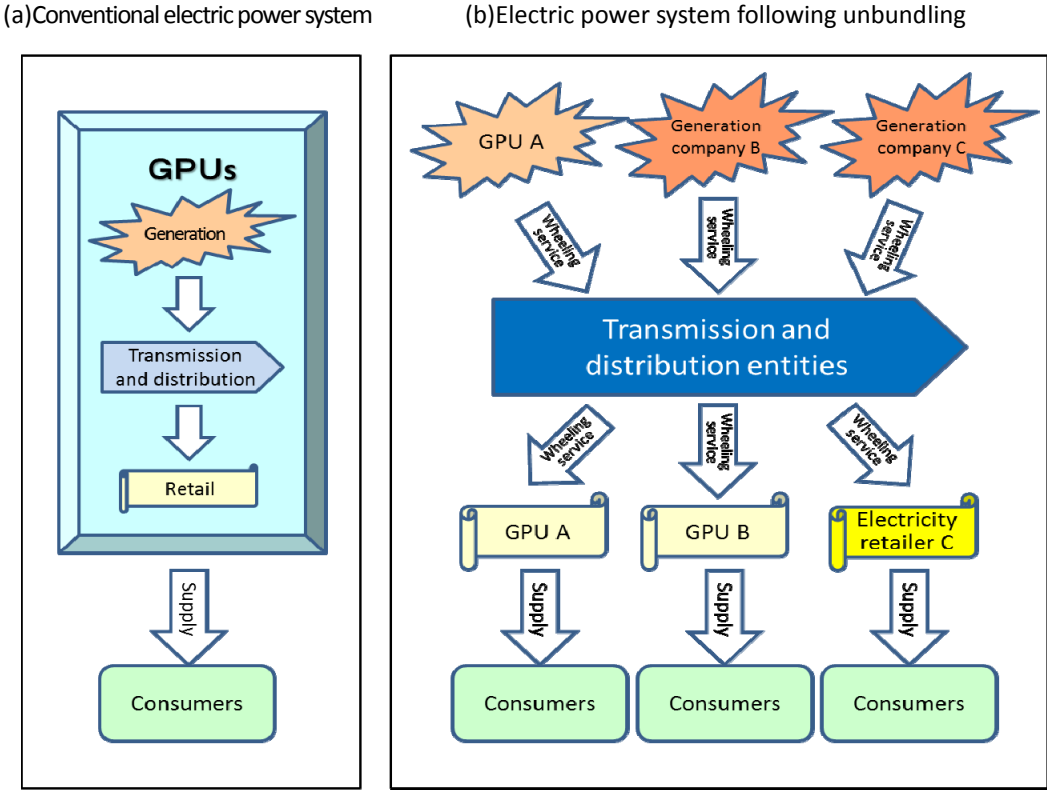
I used the analogy of rice in order to discuss the system of “rationing,” but in the field of rice production,

in addition to numerous other fields, we have already seen the transition from a system of “rationing” to a system based on market competition. The periods involved and the methods used may differ, but efforts to more actively incorporate market mechanisms in fields including rail transport, communications, and finance by methods including privatization and deregulation are ongoing.

Unbundling in the field of communications has opened communications networks to a greater number of businesses, and the broadband network has advanced in leaps and bounds. Separation of power generation from transmission and distribution is also called unbundling, and its aim is similar to that of unbundling in the communications industry.

Naturally, even as the market is liberalized, the necessary regulation will be enhanced. What is required is not the elimination of regulation, but the reform of regulation. In the case of power, even if the liberalization of generation and retail were to proceed, appropriate regulation would be necessary in the transmission and distribution sectors produced by the separation of power generation from transmission and distribution in order to ensure their functioning as public goods. Economies of scale are at work in the case of power transmission and distribution networks. It would be difficult to realize efficient use of these networks relying exclusively on market mechanisms. What will be necessary is the careful implementation of regulations while opening the networks to generating companies and power retailers.

Figure 1 The conventional electric power system and the system following unbundling



(Note) For the sake of simplicity, processes such as transformation have been omitted.
 (Source) Formulated by NIRA

Why do we need to separate Generation from Transmission and Distribution?

The Expert Committee on the Electricity Power Systems Reform of The Agency for Natural Resources and Energy (ANRE) has produced a report which proposes more far-reaching initiatives for the separation of power generation from transmission and distribution than has previously been the case. Whether to employ legal unbundling, in which generation companies and transmission companies are separated and placed under holding companies established by GPUs, or to employ functional unbundling, in which independent entities are responsible for transmission and distribution functions, will be a matter for future discussion. Looking at examples in Europe and elsewhere, one finds many cases in which countries have progressed from legal unbundling to ownership unbundling, in which ownership is also separated³ (Figure 2).

Figure 2 Status of unbundling of electricity generation and transmission functions in major European nations

Country	Main transmission companies (Nationality)	Status of unbundling
UK	National Grid (UK)	Ownership unbundling
Germany	Tennet (Netherlands) Elia (Belgium) Amprion (Germany)	Ownership unbundling
	TransnetBW GmbH (Germany) EnBW Regional AG (Germany)	Legal unbundling (Subsidiaries of German power giant EnBW)
France	Réseau de transport d' électricité (RTE) (France)	Legal unbundling (Subsidiary of Électricité de France (EDF))

(References) Yamada, H., *Hassoden bunri wa kirifuda ka – Denryoku shisutemu no kozo kaikaku (Is Unbundling the Answer?– Structural Reform in Japan’s Power System)*, Nippon Hyoron Sha Co., Ltd.
Igirisu no denki jigyo (The Electricity Industry in the UK), Japan Electric Power Information Center, Inc.
Doitsu no denki jigyo (The Electricity Industry in Germany), Japan Electric Power Information Center, Inc.
Furansu no denki jigyo (The Electricity Industry in France), Japan Electric Power Information Center, Inc.

Whichever path is chosen, it is to be hoped that there will be a more robust separation of power generation from transmission and distribution than the accounting unbundling which has previously been the case. The separation of power generation functions from power transmission and distribution functions has two major aims. One of these is to ensure neutral and transparent power transmission and distribution functions in order to realize the free participation of generating companies in the market and to promote competition, in addition to encouraging the participation of diverse businesses at the retail level.

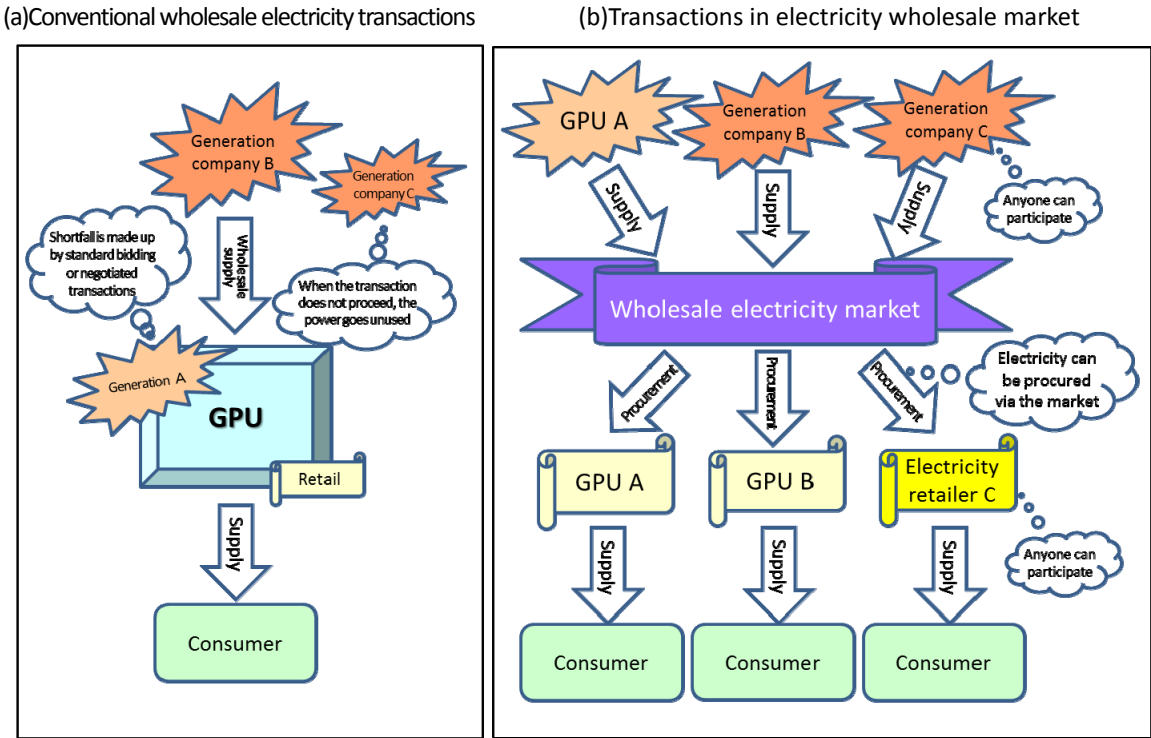
The other is to move away from the present situation in which transmission functions are divided by region, and to realize transmission functions across a broader area. It is hoped that this will promote competition which transcends regional boundaries. The operation of transmission networks across a

broader area should also open up the path towards the effective use of renewable energies, the characteristics of which vary from region to region.

Looking at major advanced nations around the world, in addition to Europe, most of the U.S., with the exception of certain southern states, has separated power generation and transmission functions. It cannot be considered desirable for Japan alone to cling to an outmoded system. The separation of power generation from transmission and distribution is a path which cannot be avoided if we are to utilize market mechanisms in the power industry.

However, the influence of the existing power companies, which have held regional monopolies for many years, is so strong that simply creating the appropriate business environment by means of this separation will not promote competition in the power market. It will be necessary to invigorate trading in the wholesale power market at the same time as separating generation from transmission and distribution (Figure 3).

Figure 3 Flow of transactions in electricity wholesale market



(Source) Formulated by NIRA

Ultimately, it will be essential for a diverse range of generation companies to be able to actively supply power to the wholesale market, and for any retailer to flexibly procure power from the wholesale market. In the power wholesale market also, it will be necessary to strengthen market functions, for example by creating hour-ahead and day-ahead markets and futures markets.

It will probably not be the case that simply separating power generation from transmission and

distribution and creating a more diverse market will activate trading in power via the wholesale market. Efforts to activate the market will be essential. A variety of methods can be considered, such as actively introducing power produced by independent entities (for example, J-POWER and municipalities with generating facilities) into the wholesale market, requiring GPUs to simultaneously supply power to the wholesale market and bid to procure power from the wholesale market (i.e. the establishment of a market making function), or requesting GPUs to introduce their excess power to the market. These methods should be the subject of a more intense focus in future policy discussions.

Promoting Liberalization at the Retail Level

Liberalization at the retail level is another important aspect of the present power system reforms. It is hoped that these initiatives will promote the entry of diverse businesses into the power retail market, creating a broad range of choices for users. Another expectation is that by promoting liberalization at the retail level, a business environment will be created in which the demand response system mentioned above can be actively pushed ahead. Liberalization of the retail market is also important from the perspective of expanding the utilization of distributed power sources, for example small and medium-sized cogeneration systems.

The question of who user information from meters belongs to is key to considering retail-level liberalization. Up to the present, user meters have been most readily viewed as a means by which GPUs are able to charge fees.

However, if smart meters enable a more detailed understanding of the status of power use among consumers, this information should make it possible to provide a variety of retail services. At present, the introduction of smart meters is proceeding at a brisk pace. How they will be used is the question. Meter information should be regarded as common information rather than as the property of a specific business.

In many cases overseas, more efficient and flexible power use is realized by means of the comprehensive centralized analysis of the power consumption data of large numbers of users by companies known as aggregators⁴. It is to be hoped that GPUs, as retailers, will introduce more flexible fee systems, and at the same time it will be desirable for a variety of businesses to participate in the retail market.

It will also be desirable that these businesses at the retail level not be limited to electricity-related businesses, but also encompass gas, oil and other companies in order to promote competition and cooperation between a variety of energy industries. The discussion in this paper is limited to the reform of the electric power system, but it is surely the case that systems related to gas and other energy sources – in fact, all energy systems – must be reexamined. Just as the separation of generation from transmission and distribution functions is being discussed in the electric power industry, similar reforms are presumably necessary in other energy industries such as the gas industry.

At present there are limitations on the pace of expansion of the use of renewable energies. The active use

of thermal generation, cogeneration, and other sources is required. Reconsideration of the gas transmission and distribution systems will be important in achieving this. One measure which may be considered is the creation of a national network of the gas transmission pipeline systems presently restricted to individual cities.

Expectations for Technological Innovation and Business Innovation

The significance of enhancing the use of market mechanisms in the power industry is enormous. The main immediate benefits will be the promotion of competition in the power industry and the realization of a wider range of choice for consumers. From the long-term perspective, however, the effects of expanding market functions can be expected to be greater.

It is true of all business areas, not merely electric power, that strengthening market functions promotes innovation. In the case of the electricity industry, innovation can be expected in a variety of fields, including power generation, electricity retail, and energy-saving technologies.

What is demanded in the field of power generation is the use of more efficient thermal generation, increased use of distributed power sources, as in cogeneration, and, above all, increased use of renewable energies. However, the most effective allocation of these diverse energy sources from the perspective of society as a whole cannot be decided at present.

The government introduced a system of fixed-price purchasing (the Feed-in Tariff Scheme; FIT) from July this year. This system will no doubt be significant in the short term as a means of stimulating the introduction of renewable energies, but cannot be a long-term measure. Expansion of the use of renewable energy by means of government guarantee of the purchase price is nothing more or less than a form of controlled economy.

There may be significant changes in the allocation of energy use in the future as a result of factors such as trends in the future price of natural gas and other energy sources and advances in technologies related to solar and wind power, etc. It is difficult to predict at present which fields technologies will advance in.

The important thing will be to create the conditions for rapid and flexible response to trends in the economic environment and in technological progress. To the extent that the separation of power generation from transmission and distribution functions enables the market entry of a diverse range of power generation companies, participation in fields in which technological development is vigorous will be promoted, and this should drive the realization of further innovation.

Competition at the retail level will be highly significant in shifting energy use in a desirable direction throughout society as a whole. If expansion of the use of renewable energies is the key to responding to global environmental issues on the supply side, the promotion of energy conservation and the institution of DR in order to achieve a flexible coordination of demand with supply are the keys on the demand side. The participation of diverse businesses at the retail level is also required from the perspective of increasing incentives for this energy conservation and DR on the demand side.

It will be important to create mechanisms which make the promotion of energy conservation and DR a benefit to both electricity users and retailers. This will in itself have the effect of driving innovation, and new business models will also be produced.

The control of emissions of greenhouse gases⁵ cannot be discussed in terms of the power industry alone. The issue involves the curbing of greenhouse gases from all social activities. However, it is obvious that the use of market mechanisms will also be an important factor in curbing greenhouse gas emissions. In the future we can perhaps expect the enhancement of mechanisms to enable the public to act on the basis of a more direct awareness of the social costs of greenhouse gas emissions, such as carbon taxes and emissions trading.

It goes without saying, however, that the adequate functioning of market mechanisms in the electric power system is a prerequisite for the effective use of market mechanisms in responding to environmental issues.

Notes

1. From north to south, Hokkaido Electric Power Co., Inc., Tohoku Electric Power Co., Inc., Tokyo Electric Power Co., Inc., Hokuriku Electric Power Co., Inc., Chubu Electric Power Co., Inc., Kansai Electric Power Co., Inc., Chugoku Electric Power Co., Inc., Shikoku Electric Power Co., Inc., Kyushu Electric Power Co., Inc., and Okinawa Electric Power Co., Inc. are the 10 utilities which have been allocated their respective regions.
2. The present interconnection facilities between Hokkaido and Honshu are owned and operated by J-POWER, and are able to supply 250kV/600MW of direct current power.
3. In the EU, EU Directive 2003/54/EC, the Second Energy Package, requires that the transmission sector in each member state is unbundled. For example, unbundling by ownership has been completed in the UK, while in Germany, of four major companies, three are ownership unbundled, and one is legally unbundled.
4. A type of electricity retailer which receives a high-voltage, high-volume power supply from a generation company and supplies power to multiple small and medium-sized consumers. For example, the management company of a large-scale commercial facility or an apartment block could function as an aggregator in centrally managing the supply of power to a group of consumers. In such cases, it is the aggregator which reads the consumer's meters and charges fees for the power used.
5. The Kyoto Protocol adopted by the 3rd Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3, held in Kyoto in 1997) specifies that Japan must reduce greenhouse gas emissions by 6% against 1990 levels in the five-year period from 2008 to 2012. Targets for the second commitment period, from 2013, are currently the subject of international negotiations.

Profile of Motoshige Itoh:

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