Electricity Market Reform in Japan

Bumpy Road Ahead

By Glenn R. George, Hans-Martin Ihle, and Miura Wataru

This is the first in a series of three articles related to power market reform in Japan and its implications both for Japan and globally.
he tragic earthquake and tsunami in March 2011 were followed by the nuclear accidents at the Fukushima Daiichi plant. This led to a major re-evaluation of electric power market arrangements and infrastructure in Japan.

During that period, some areas of Japan experienced rolling blackouts. All nuclear power plants, which together provided around 25 percent of Japan’s electricity, had been taken offline.

The Japanese electricity market was long dominated by 10 vertically integrated local electric power companies, EPCOs. There has been insufficient interconnection capacity between the different local markets to support a robust competitive wholesale power market,¹ which is shown in Figure 1. The figure provides an overview of the 10 local markets, as well as the interconnection capacity between them.

Natural gas-fired generation, fueled by imported liquefied natural gas, LNG, replaced nuclear in the energy mix. This led to significant increases in the price of electricity for consumers.

According to the Institute of Energy Economics, Japanese industrial customers were charged 20.4 cents per kilowatt-hour in 2012 on average. Residential customers paid 29.0 cents.

The LNG price has since decreased. By 2014, industrial and residential prices in Japan had come down to 18.8 cents and 25.3 cents respectively.

By comparison, in the U.S., industrial and residential customers were charged an average of 7.1 cents and 12.5 cents respectively per kilowatt-hour in 2014.

The first attempts to open up the electricity market in Japan were undertaken in 1995. The market was first opened to independent power producers.

In the following years, the government opened the retail market for large consumers in stages: for consumers over 2,000 kilowatts in 2000; those over 500 kilowatts in 2004; and those over 50 kilowatts in 2005.

The government then started regulating third-party access to the transmission system. And then it established a wholesale power exchange, JEPX.

These measures, however, did not lead to significant improvements in the challenging power market situation that was created by the Fukushima Daiichi accident. In 2013, the government issued its Policy on Electricity Market Reform, with the following three objectives. Secure a stable supply of electricity. Reduce electricity prices for consumers to the largest extent possible. And create choice for consumers as well as new opportunities for businesses.²

The Japanese government committed itself to liberalizing the local energy market in a series of three steps. Each was incorporated into a bill introduced into the Imperial Diet.

The first bill passed in 2013. It called for the establishment of the Tokyo office. Mr. Ihle has nearly ten years’ experience in the design and implementation of auctions and competitive market mechanisms. He advises NERA clients on auctions and regulatory issues in energy, telecommunications, and other sectors worldwide, with a focus on the Asia-Pacific Region. Mr. Ihle holds a Masters in Economics from the University of Cambridge, where he specialized in industrial organization, game theory, and applied econometrics.

Miura Wataru is an associate analyst in NERA’s Antitrust Practice in Tokyo. Using his knowledge and expertise in accounting, economics, and corporate finance, Mr. Wataru advises clients on high-profile antitrust cases and litigation procedures. He recently undertook a major evaluation of the damages caused by the Fukushima Daiichi incident. Mr. Wataru holds a Bachelors in Economics from the University of Waseda.
New contracts, however, need not follow these pricing principles. A number of new retail providers have targeted high demand customers, offering significant discounts. This has led to the bizarre situation in which households that use much more electricity may actually pay less for it than others, per kilowatt-hour consumed.

Given Japan’s severe resource constraints, an incentive structure which does not strongly encourage energy efficiency is perverse.

Other providers have focused on offering bundles such as gas of the Organization for Cross-Regional Coordination of Transmission Operators, OCCTO, in 2015. Its main function is to improve interconnection between the local markets. OCCTO also seeks to ensure that demand can be met in all markets even in extreme situations.

The second bill passed in 2014. It expanded retail competition to the residential sector, under 50 kilowatts, in April 2016.

The third bill passed in 2015. It established unbundling and separation of transmission and generation by 2020.

Retail Liberalization went live in April this year. There are concerns, however, that the more fundamental changes to the wholesale market may fall short of expectations. This would be to the detriment not only of consumers, but of the electricity sector as a whole.

**Retail Liberalization in 2016**

More than 300 companies have registered as retail electricity providers since the second bill, on retail liberalization, passed in 2014. These include companies from the energy sector, such as gas companies and oil wholesalers, as well as from other sectors, including telecommunications companies (Softbank), cable TV providers, and non-life insurance providers.

The electricity prices that the local electric power companies have historically been allowed to charge were regulated and calculated based on the fully distributed cost method, allowing for a rate of return. They were also structured in a way that provided incentives for heavy consumers of electricity to reduce their consumption.

New contracts, however, need not follow these pricing principles. A number of new retail providers have targeted high demand customers, offering significant discounts. This has led to the bizarre situation in which households that use much more electricity may actually pay less for it than others, per kilowatt-hour consumed.

Given Japan’s severe resource constraints, an incentive structure which does not strongly encourage energy efficiency is perverse.

Other providers have focused on offering bundles such as gas...
and electricity. Incumbent electric power companies have been quick to react to this trend by teaming up with strong partners such as Tokyo Electric Power Company and Softbank.

Another trend seems to be to offer reward points rather than large price discounts, as is the case with Rakuten, a popular online market place in Japan. Points can be redeemed with any purchase on its marketplace platform.

As noted above, the competitive retail market began operating on April 1. After only one week, more than 600,000 customers had already switched their electricity plan. Sixty percent of those left Tokyo Electric Power.

Customers are voting with their feet. Many blame Tokyo Electric Power for the Fukushima accident. At this rate, it could lose three percent or more of market share by next year.³

When a customer changes suppliers, its electricity meter will be replaced at no extra cost with a smart meter. These will allow providers to customize their plans to customers' needs. Smart meters also make it easier for customers to switch providers in the future. All households across Japan are scheduled to receive a smart meter by 2024 at the latest.⁴

Wholesale Liberalization

The next big step for the Japanese government is to liberalize the wholesale market. This will require the separation of retail, transmission, and distribution businesses of the local electric power companies.

In particular, separation of the transmission business from the local distribution business is key to preventing the local electric power companies from discriminating against new entrants with respect to access to transmission lines. The government has set itself a deadline to achieve unbundling by 2020.

Rather than pursue what is sometimes called functional unbundling of generation from the wires business, where both corporate ownership and billing functions are separated, the government has agreed to follow Tokyo Electric Power’s proposed model of legal unbundling. See Figure 2. The local electric power companies have two options to achieve legal unbundling.

Under one option, the electric power company creates a holding company that holds separate generation, transmission, and retail companies. Under the other, the electric power company splits its transmission assets and operations from its generation and retail operations. The transmission company could then be held as a wholly-owned subsidiary.

It is worth noting that, under either approach to legal unbundling, a significant set of functions remains regulated much as they were in the past.

Under either option, the transmission company would effectively turn into the local grid operator, and would need to remain regulated. This means that Japan will have 10 different grid operators, each looking after its own local market.

Of potential concern is the fact that legal unbundling will leave intact a financial relationship between the unbundled transmission company and its parent. The transmission company would, therefore, not be as independent as many grid operators in other liberalized markets.

For example, in the United Kingdom and in many parts of...
also have promoted cross-regional interconnection.

The newly formed Electricity and Gas Market Surveillance Commission, EGC, will act as an independent regulator in charge of monitoring and regulating the transmission market. EGC will examine whether transmission companies are kept neutral and, if necessary, suggest remedies to address any concerns.

EGC is composed of five part-time commissioners. As an Article 8 body under the National Government Organization Act, it is similar to an advisory council reporting to the Ministry of Economy, Trade and Industry (METI).

It can make proposals to METI and recommend a course of action for power utilities; however, the proposals are not legally binding. There appear to be legitimate concerns over the effectiveness of the surveillance commission as an independent regulator.

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**Fig. 3**

<table>
<thead>
<tr>
<th>Notifying EPCO</th>
<th>Name of Line</th>
<th>Voltage</th>
<th>Length</th>
<th>Use Start Date</th>
<th>Construction Start Date</th>
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<tbody>
<tr>
<td>Hokkaido</td>
<td>Hokuto-Imabetu main line</td>
<td>250kv</td>
<td>122km</td>
<td>March 2019</td>
<td>April 2014</td>
</tr>
<tr>
<td></td>
<td>Minamikyuyo line</td>
<td>187kv</td>
<td>4km</td>
<td>October 2015</td>
<td>March 2014</td>
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<tr>
<td></td>
<td>Ishikari main line used for thermal power</td>
<td>275kv</td>
<td>21km</td>
<td>February 2018</td>
<td>April 2015</td>
</tr>
<tr>
<td></td>
<td>Dounan main line</td>
<td>275kv</td>
<td>0.3km</td>
<td>October 2017</td>
<td>May 2016</td>
</tr>
<tr>
<td>Tohoku</td>
<td>East Hanamachi line</td>
<td>275kv</td>
<td>3.3km</td>
<td>October 2017</td>
<td>February 2016</td>
</tr>
<tr>
<td></td>
<td>South Yamaigata line</td>
<td>275kv</td>
<td>22.5km</td>
<td>June 2018</td>
<td>April 2015</td>
</tr>
<tr>
<td>Tokyo</td>
<td>New-furukawa line and New-sakado line</td>
<td>500kv</td>
<td>0.4km</td>
<td>May 2015</td>
<td>April 2014</td>
</tr>
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<td></td>
<td>Kawasaki-Toyosu line</td>
<td>275kv</td>
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<td>August 2009</td>
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<td>Oohuto line</td>
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<td>November 2014</td>
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<td>Chubu</td>
<td>Tokyo-Chubu main line (DC)</td>
<td>DC±200kv</td>
<td>89km</td>
<td>2020</td>
<td>2017</td>
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<td></td>
<td>Tokyo-Chubu inter converter station branch line</td>
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<td>2019</td>
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<td></td>
<td>Ena branch line</td>
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<td>September 2021</td>
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<td></td>
<td>Shimo in branch line</td>
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<td>September 2021</td>
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<td>March 2014</td>
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<td></td>
<td>Mihama line (improved)</td>
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<td></td>
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<td>After 2020</td>
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<td>19km</td>
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<td>July 2013</td>
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<td>December 2017</td>
<td>May 2015</td>
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<td>Kyushu</td>
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<td>November 2014</td>
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<tr>
<td></td>
<td>New-kagoshima line</td>
<td>220kv</td>
<td>5km</td>
<td>March 2020</td>
<td>May 2017</td>
</tr>
<tr>
<td>Okinawa</td>
<td>Nishinahomoyose line</td>
<td>132kv</td>
<td>10km</td>
<td>October 2017</td>
<td>May 2015</td>
</tr>
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</table>

the U.S., utility affiliates were allowed to retain ownership of the transmission assets. But operation of the grid was handed to an independent third party, which is known in the U.S. as an independent system operator or regional transmission organization. This helps ensure open and equal access to the transmission system by all generators.

Japan has, in effect, established 10 local grid operators. Their actions are coordinated at a high level by OCCTO (the coordination organization), which is in charge of balancing demand and supply at the national level.

In so doing, Japan forewent the opportunity to create a single independent system operator in charge of the entire national grid. This might have improved network efficiency, as all local markets would be managed in an integrated manner. It might also have promoted cross-regional interconnection.

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EGC is composed of five part-time commissioners. As an Article 8 body under the National Government Organization Act, it is similar to an advisory council reporting to the Ministry of Economy, Trade and Industry (METI).

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**Fig. 4**

### Wholesale Market Vision

![Diagram of wholesale market vision]

1. **OCCTO, the coordination organization**

   Inaugurated in April 2015, OCCTO’s mandate is to manage electricity demand and supply more efficiently at a national level and to promote cross-regional interconnection. All electric power companies, wholesale electric companies, power producers, and suppliers are required to be a member of the coordination organization.

   In particular, OCCTO’s role is to review supply and demand plans from all electricity retailers and generators. OCCTO will also identify any long-term imbalances. All generators and retailers need to submit their supply and demand plans to OCCTO.

   OCCTO will aggregate these plans and stress-test them to identify any long-term imbalances, both at a regional and a national level. OCCTO should ensure that the benefits of transmission system investments outweigh the costs.

   OCCTO’s role is also to mandate that electric power companies increase electricity generation or improve interconnection. There is a proposal for OCCTO to run a capacity auction to increase generation. The benefits of auctions may be particularly great in local markets where OCCTO has identified a capacity shortage.

   With regard to interconnection, OCCTO could, via a recommendation to the Ministry/METI, require local electric power companies to build additional interconnection capacity where justified on a cost-benefit basis. How this would be paid for remains unclear. So far, OCCTO has relied on voluntary action by the local electric power companies to build additional interconnection infrastructure.

   OCCTO will in the future require all retailers to secure adequate capacity to cover their demand. In the future, retailers will have to secure adequate capacity to cover their demand.

   Improving interconnection is critical to improving the efficiency of the Japanese electricity market.

   For example, renewable generation would be most efficient in more remote areas, such as wind turbines in Hokkaido or solar power in Shikoku. But it is now impossible to consume this electricity in the demand centres of Tokyo and Osaka. At the same time, improving interconnection would introduce...
cross-regional competition.

OCCTO has yet to commit itself to improving interconnection. It lists in its latest annual report the planned transmission investments within the next 10 years. The information contained in Figure 3 was extracted from that annual report.

All but one of the planned lines are within the territory of one local electric power company. The only cross-regional line planned so far is the Chubu-Tokyo line highlighted in bold. It will cost around 165 million dollars to build, including the necessary frequency converter, and will take around 10 years to complete.7

The Chubu-Tokyo line will have a total capacity of 3,000 megawatts. The only other cross-regional interconnector currently under discussion is a line connecting Tokyo and Tohoku, which would cost around 150 million dollars to build and would have a total capacity of 11,200 megawatts.

All of these planned lines are voluntary commitments by electric power companies to invest in transmission infrastructure. OCCTO could potentially recommend that the Ministry require development of cross-regional transmission infrastructure; however, this seems unlikely. And it is unclear how such improvements would be financed.

OCR mentions that financing would be based on the benefits to the local electric power companies being interconnected. But it is unclear what is meant by this.8

A better way to provide incentives and financing to build transmission infrastructure might be to sell capacity on the interconnector in an auction. The auction proceeds could then finance the infrastructure investment. For example, the interconnector built in the Channel tunnel between the U.K. and France, ElecLink, will be able to forward-sell long-term contracts for up to 80 percent (800 megawatts) of its interconnector capacity.

Of course, any new transmission capacity must be justified on the basis of net benefit. But where new capacity is needed, a competitive procurement process might be the best path forward.

Transmission capacity in Japan is also not being allocated efficiently under current arrangements. Significant amounts of transmission capacity are tied to long-term plans (scheduled interchange). These are allocated on a first-come, first-served basis to long-term power sources, such as nuclear, coal, or hydro.

Unused scheduled interchange capacity must be released at least seven days in advance. This, however, does not give alternate users of the capacity sufficient certainty to plan ahead.

Reducing the length of scheduled-interchange contracts and allocating this long-term capacity in an auction would create a level playing field for all parties interested in using transmission capacity. It would also allocate this scarce resource efficiently.

2. Current state of wholesale market

The Japanese generation sector had already been deregulated as part of earlier reforms. A small number of independent generators already operate in the market, making up around 10 percent of total generation.

Their main route to market at the moment is either through JEPX, the wholesale power exchange, which handles around two percent of all electricity produced in Japan. Or, an independent generator can sell to the local electric power company under a bilateral contract.

JEPX has a well-established spot trading market with a total of 48 products that are traded in thirty-minute intervals, twenty-four hours a day. Parties bid a quantity and price at which they want to buy or sell.

A clearing price is established at which the supply of a product equals demand. This price applies to all winning buyers and sellers. JEPX also has a small forward market and a small intraday trading system.

The government’s vision for a liberalized wholesale market is depicted in Figure 4. It is not unlike the current market arrangements and relies heavily on bilateral agreements. JEPX has the potential to turn into a major common power pool if the local electric power companies are required to bid a certain percentage of their capacity into this market.

Without such a requirement, it is unlikely that the liberalization of the wholesale market would make the exchange JEPX any more relevant than it is at the moment.

Conclusion

The reforms being undertaken in Japan will undoubtedly transform the electricity market in the coming years. There
are encouraging signs that the liberalization of the retail market is already introducing some much-needed competition, with large numbers of customers switching to new providers in the first months.

Combining the customer switching behavior with the rollout of smart meters has huge potential to induce consumers to account for the actual cost of electricity at the time of consumption. The new meters will also make it easier for customers to change providers in the future.

As a result, retail pricing plans may become much more closely tailored to the needs of individual customers. This will not only allow customers to save money, but also to reduce consumption of electricity at peak times, increasing overall system efficiency.

In short, Japan’s electricity sector could be poised to enter a golden era of customer choice, lower prices, and innovative products and services. But for this outcome to emerge, three things must happen.

First, Japan must rethink certain elements of its wholesale market design. Given the strength of vested interests and the complexity of the wholesale market, wholesale market liberalization is understandably more challenging than liberalization of the retail market.

Significant changes in the wholesale market, however, may be necessary, such as an enhanced transmission capacity allocation process, some mechanism (such as a capacity auction) to increase certain types of generation capacity, and improvements to JEPX. Without these changes, the reforms may fall short of delivering true choice for consumers, lowering their bills, and achieving an affordable and reliable energy mix.

Only the government of Japan is in a position to implement such changes.

The other two essential success factors are, by contrast, within the control of Japanese electricity market participants themselves. Incumbent and potential future players in the Japanese electric power sector must gain experience and insight into the functioning of robust liberalized wholesale and retail power markets. They can do this by participating in such markets overseas.

Only global experience will allow them to deliver the innovative products and services at attractive prices that consumers expect and demand.

Market participants must then deploy this experience in creative ways back in the home market, tailoring global prototypes (new corporate structures, flexible business models, innovative generation technologies, and customer-focused products and services) to local conditions and preferences.

Each of these two elements will be the subject of an article in an upcoming issue of Public Utilities Fortnightly.

Endnotes:
1. This is further complicated by the fact that Japan has essentially two separate electricity grids. One is for East Japan, which runs on 50 hertz and includes Tokyo, as well as the disaster-struck Tohoku. And one is for West Japan, which runs on 60 hertz and includes Nagoya, Osaka, and the rest of the southwest. The two grids are linked via three low-capacity frequency converters. This makes it difficult to share electricity if one grid suffers a supply problem.
7. Estimated cost is Yen 17.5 billion. OCCTO, “OCCTO’s Activities to Improve the Nation-wide Grid,” 2015.