

European Electricity Market Challenges under Renewable Energy Expansion

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Solar, wind and other renewable energies can be domestically produced and are free from carbon dioxide emission. Renewables are expected to widen the energy business base to produce positive economic effects. In a bid to exploit these advantages, numerous countries in the world provide and enhance policy support for the expansion of renewable energy use.

Since the feed-in-tariff system for electric utilities' purchases of electricity generated with renewable energies at fixed prices was introduced in Japan in July 2012, renewable energy, in particular solar photovoltaics power generation capacity has expanded rapidly. Japan's approved FIT power generation capacity has increased more rapidly than expected, reaching 87 gigawatts at the end of March 2016. The Institute of Energy Economics, Japan, projects FIT generation capacity in operation to reach 65 GW at the end of FY2017. As a result, renewables other than hydro are expected to account for 7% of electricity generated and received by Japanese electric utilities in FY2017, a sharp rise from 4% in 2015.

The expansion of solar photovoltaics, wind and other renewable power generation will increase renewables' importance for Japan's power mix. We will have to sufficiently consider how the expansion of renewable energies will influence the three "E" challenges for the energy mix -- energy security, economic efficiency and environmental protection. It may be needless to say that the renewable energy expansion will contribute to improving Japan's energy self-sufficiency ratio and reducing CO₂ emissions. As for economic efficiency, however, it is estimated that if all 87 GW in approved FIT power generation capacity is in operation, cumulative surcharges over the 20-year FIT period would total 56 trillion yen to boost electricity costs by 3.2 yen per kilowatt-hour. How to expand renewable energy while holding down such burden on consumers is a key future challenge. Institutional reform and other initiatives to address the challenge have already been launched in Japan and the world.

In fact, however, the expansion of renewable power generation will have another important impact. That is the impact on supply and demand, and prices in the liberalized wholesale electricity market. If the impact triggers a decline in electricity prices, it may variously affect the maintenance of other existing power generation capacity and new capacity investment to cause various influences on stable electricity supply. At the same time, the electricity price fall may bring about various uncertainties and challenges regarding the achievement of the desirable energy mix.

In this respect, it is significant to pay attention to what happened in European countries that have strongly promoted the use of renewable energies and advanced electricity market liberalization. In Germany, however, massive renewable electricity, including wind-generated electricity that has expanded rapidly under policy support, flew into the wholesale market to help trigger a sharp drop in electricity prices. Under the German system, peculiar uncertainties regarding renewable energy power generation projection (an auction is conducted in a day-before market without information on power generation projection), a limit on supply and demand adjustments through the grid linked to France and other countries, and other factors have all in all caused a massive renewable electricity inflow and wild fluctuations in such inflow that have plunged prices into the negative territory, resulting in negative prices.

In the circumstances, as a matter of fact, the economic efficiency of other existing power generation capacity has been seriously affected. Particularly, natural gas power plants, which are inferior to coal power plants in the merit order, have been pushed out from the market. As a result, natural gas power plants have been suspended or decommissioned. Given the difficult situation for natural gas power plants that have been expected to play a key role as a supply-demand buffer, a system for ordering the maintenance of natural gas power generation capacity planned to be decommissioned has been introduced as a form of the so-called capacity mechanism. This result has not been limited to Germany. As wholesale electricity prices have declined substantially, various systems have been considered or implemented in Western countries to introduce some forms of the capacity mechanism commensurate with their respective conditions to secure stable electricity supply in terms of operating and reserve capacity.

As symbolized by the decommissioning of existing power generation capacity, the remarkable slump in wholesale electricity prices has brought about a severe business environment for the German electricity industry. Eon, RWE and other German electricity and energy companies that represent Europe booked heavy losses in 2015, indicating that their investment capacity and program were affected. In considering the German case, we must take into account the presence of international grid lines linking Germany to neighboring countries. In fact, even if volatile renewable power generation expands, most of the fluctuations in electricity supply can be absorbed by supply and demand adjustments through the international grid lines. If massive renewable power generation causes electricity supply to exceed Germany's domestic demand, surplus supply can be exported for adjustment. If demand exceeds supply, electricity is imported into Germany for adjustment. We must take note of the fact that the presence of the supply-demand adjustment function through the international connectivity is a key precondition for the German system to address the stable electricity supply challenge.

In terms of electricity market liberalization and renewable energy expansion, the British case is also interesting. In the United Kingdom, renewable electricity is not provided directly to the wholesale market but is subjected to retail purchases. If renewable energy expansion triggers an increase in retail purchases, however, demand in the wholesale market may decline to bring about price falls. Over recent years, gas price drops have also led wholesale electricity prices to decline. As renewable power generation is forecast in a fine-tuned manner, however, any supply-demand

imbalance has fallen short of causing negative prices. As for nuclear power generation positioned as a key part of the desirable energy mix, however, it has been recognized that it would be difficult to promote nuclear energy if it is completely left to market forces. As a result, nuclear energy, as well as renewables, has been subjected to the FIT system based on the contract for difference method. The combination of renewable electricity expansion and a liberalized electricity market brings about various challenges regarding the policy-based realization of a desirable energy mix. How to learn lessons from the success and failure regarding these existing cases and take advantage will become important for Japan's future consideration of relevant policy challenges.

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