

# ***FUTURE OF ELECTRIC POWER MIX IN JAPAN***

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## **Overview**

This paper shows that Japan's electricity power policy which was set by the former Japanese Administration led by Democratic Party of Japan (DPJ) is not sustainable and may cause serious problems, by explaining our research result for the APERC's "APEC Energy Demand and Supply Outlook 5<sup>th</sup> Edition".

After the accident at the Fukushima Daiichi Nuclear Power Station in March 2011, the Japanese government led by DPJ decided an overall revision of "The Strategic Energy Plan of Japan", which was stipulated in June 2010. The Japanese government considered three options for how much nuclear energy would contribute to the power generation mix in 2030, namely 0%, 15% or 20-25%, but the government did not decide until their step down, leaving future power generation mix quite unclear. The government only regulated the rules regarding the 40-year limitation of the operation period of nuclear power plants would be strictly applied.

## **Methods**

We projected future of electric power mix toward year 2035 for "APEC Energy Demand and Supply Outlook 5<sup>th</sup> Edition", considering the above-mentioned situation as we set Business-As-Usual (BAU) case.

As for electricity demand, we assumed that Japan's per capita GDP is expected to increase at an annual rate of 1.1% from 2010 to 2035. We conclude that Japan's electricity generation is expected to decrease from 1,071 TWh to 1,010 TWh in 2035; the average annual rate of this decrease is 0.2%.

As for electricity supply, we set the main preconditions as follows, while considering some uncertainty on restart of nuclear power plants and levels of introduced renewable energy by Feed-In Tariff system.

- (1) Capacity factor of restarted existing nuclear power plants will remain 70%, based upon the track record of 69% for the past two decades.
- (2) All of the existing 50 units of nuclear power plants will stop after 40 years from the start of operation. New nuclear power plants, including those under construction, will not be allowed into operation.
- (3) The increase in power generation capacity by renewable energy from 2012 to 2035 is as follows; Solar: 6.9 times, wind; 3.4 times, geothermal: 1.6 times and biomass: 1.5 times. This precondition is based upon two assumptions: firstly the government's forecasts for 2020 with the effect of Feed-In Tariff system will be achieved, and secondly the growth rate of renewable power generation will be halved after 2020 toward 2035.
- (4) Power generation by oil will be minimized, since Japan depends upon almost all oil supply from abroad. In other words, Japan cannot continue to be the world largest oil power generation country.
- (5) Power generation capacity by combined cycle gas turbine and new coal steam turbine will substitute the loss of nuclear power generation on 50:50 basis.

## **Results**

Under the above-mentioned preconditions, we conclude that Japan's power generation shares in 2035 by sources as follows; coal: 30.8%, oil: 1.0%, gas: 38.4%, hydro: 11.1%, renewable energy: 13.0% and nuclear: 5.7%. For reference, the following are share of energy in power generation mix in 2010; coal: 26.3%, oil: 7.3%, gas: 28.2%, hydro: 8.1%, renewable energy: 3.1% and nuclear: 27.0%. The large drop in the share of nuclear is expected to be compensated mainly by the increase in gas and renewables.

APERC's BAU case projects increase in natural gas import volumes by 32.5% during the period from 2009 to 2035, which means increase in the same degree of increase in natural gas import values, if there is no increase in natural gas price in the future. Japan may also face higher cost of electricity by introducing renewables which would partly substitute the loss of nuclear power.

The Table 1 compares the results of projection of share of power generation mix in 2035 by APERC with World Energy Outlook (WEO) 2012 (Current Policy Scenario) of International Energy Agency (IEA) and Asia/World Energy Outlook 2012 of the Institute of Energy Economics, Japan (IEEJ).

**Table 1 Share of power generation mix in 2035**

|            | APERC | WEO 2012(CP) | IEEJ 2012 |
|------------|-------|--------------|-----------|
| Nuclear    | 5.7   | 19.4         | 7.2       |
| Gas        | 38.4  | 34.0         | 38.8      |
| Hydro      | 11.1  | 7.3          | 6.9       |
| Coal       | 30.8  | 24.8         | 30.1      |
| Oil        | 1.0   | 2.6          | 7.0       |
| Renewables | 13.0  | 12.0         | 10.1      |

The large difference of nuclear share between APERC's Outlook and IEA's WEO 2012 can be explained as follows: while IEA anticipates changes in Japan's Nuclear policy in future, APERC does not have such anticipation.

The relatively small differential of nuclear share between APERC's Outlook and IEEJ's is due to the difference in how to deal with nuclear power plants under construction (Shimane No.3 and Ohma) and the differentials in capacity factor. IEEJ expected the two nuclear power plants under construction will be completed and put into operation. Assumed capacity factor is 70% by APERC, but 80% by IEEJ, which is based upon the relatively good track record of late 1990s and early 2000s.

In terms of CO<sub>2</sub> emission, it is better to compare the projections not at 2035 but at 2030 which is the target year of "The Strategic Energy Plan of Japan" of 2010. The 2010 Plan expected to reduce the dependency on fossil fuels by 40 percent points from 66% in 2007 to 26% in 2030. That implies the reduction of CO<sub>2</sub> emission in power generation sector in a similar scale.

However, APERC's projection shows the power mix in which 64% will be supplied by thermal power generation by fossil fuel (gas: 34%, coal: 29%, and oil: 1%). CO<sub>2</sub> emission in power generation sector is expected to remain at almost the same level in 2035 compared to 2010 (Table 2).

This means that the dependency on fossil fuels in power sector will not change, and therefore the expected CO<sub>2</sub> reduction in power sector is totally impossible.

**Table 2 BAU CO<sub>2</sub> Emission by Sector in APERC's Outlook**

|                         | Unit: Million Tonnes CO <sub>2</sub> |       |       |       |       |       |       |       |       |       |  |
|-------------------------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
|                         | 1990                                 | 1995  | 2000  | 2005  | 2010  | 2015  | 2020  | 2025  | 2030  | 2035  |  |
| Electricity Generation  | 334.3                                | 363.6 | 384.3 | 433.1 | 400.7 | 403.1 | 397.9 | 406.7 | 399.8 | 423.2 |  |
| Other Transformation    | 112.0                                | 112.6 | 117.1 | 114.8 | 105.7 | 103.0 | 100.2 | 98.9  | 96.9  | 99.2  |  |
| Industry                | 241.7                                | 228.3 | 220.6 | 219.2 | 186.5 | 174.5 | 164.1 | 154.2 | 145.3 | 140.3 |  |
| Other                   | 163.9                                | 182.9 | 191.4 | 196.5 | 170.5 | 173.6 | 172.3 | 169.1 | 165.9 | 162.5 |  |
| Domestic Transport      | 217.3                                | 258.6 | 266.8 | 255.8 | 231.1 | 209.0 | 189.7 | 172.4 | 156.8 | 141.9 |  |
| International Transport | 31.0                                 | 34.7  | 36.8  | 41.4  | 31.2  | 32.5  | 31.7  | 29.9  | 28.1  | 26.4  |  |

## Conclusions

Our conclusions are as follows.

- (1) Assuming policy which was set by DPJ, we conclude that share of nuclear energy in the future power generation mix in Japan will decrease from 27.0% in 2010 to 5.7% in 2035.
- (2) Decrease in share of nuclear in power generation mix should be covered by use of natural gas and renewable energy. Japan may face outflow of national wealth by importing larger amount of natural gas and higher cost of electricity by introducing renewable energy.
- (3) Japan may not achieve the CO<sub>2</sub> emission reduction target in power sector due to decreasing nuclear's share in power generation mix.