DISCUSSIONS ABOUT THE ROLE OF NUCLEAR POWER FOR ACHIEVING THE PARIS AGREEMENT IN JAPAN

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Summary

Japanese government determined its INDC to GHG emission reduction for the COP21 in 2015. Not only decreasing CO_2 emission, but also improving self-sufficiency rate of energy and lowering electricity costs for preserving international competitiveness of industry were placed as important issues for setting it. We discussed current status and the importance of nuclear power in that plan and evaluated the economic impacts by using our econometric models, if some portion of nuclear power will be substituted by other sources. The result shows that nuclear power is important for achieving the three issues at the same time, and non-negligible economic loss may happen if the use of nuclear power in the INDC target will not be achieved.

The Japanese INDC and situation of nuclear

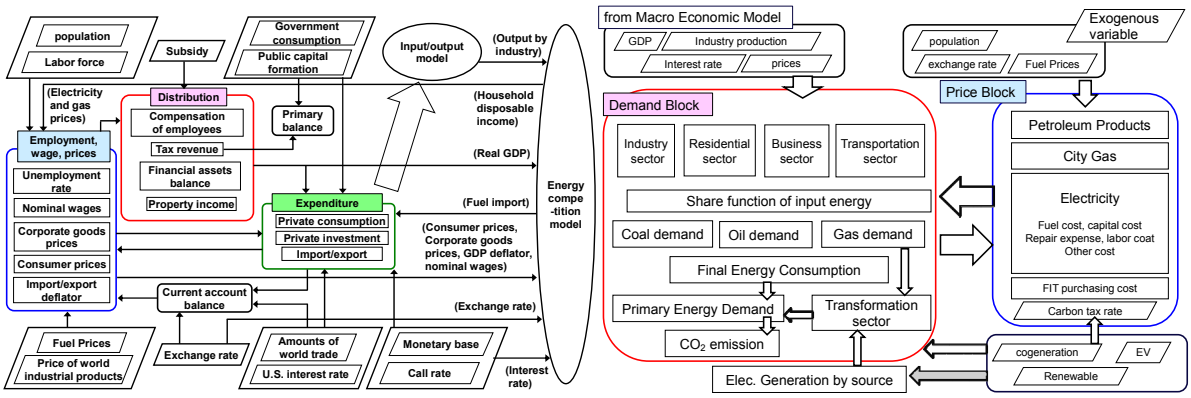
According to the Japanese INDC (Intended Nationally Determined Contribution) to GHG emission reduction for the COP21 in 2015, energy-originated CO_2, which occupied 87.7% of total GHG emission weighted by the global warming factor in 2013, should be controlled to 75% level of the year 2013 in 2030 (Government of Japan (2015)). Decarbonization in power generation mix and promoting electrification in final energy use are quite important for CO_2 emission reduction, because electric technologies such as heat pump water heater and electric vehicles are energy efficient and can reduce it considerably by replacing fossil fuel based technologies. The target of average CO_2 emissions factor of power generation in 2030 in the INDC is set to be 0.37kg-CO_2/kWh. Japanese government aims to increase the share of carbon-free electricity to 44% (nuclear 20-22%, renewables 22-24%) in 2030 to achieve this target (Government of Japan (2015), METI (2015)).

A new safety standard for nuclear power was set after the Fukushima accident in 2011, and electric utilities repaired some of existing power plants and applied their investigation to the Nuclear Regulation Authority (NRA), Japan to restart them. On the other hand, 9 units whose cost for the repair is not economical will be decomissioned. It is expected that the capacity of 30GW will be required to satisfy 20-22% supply target in 2030 at a relatively high capacity factor (75-82%, actual average records before the Fukushima accident (1970-2010): 71.8%). It is achievable if all of existing 35 units (total capacity 34.17GW) will be operated in 2030, however, 10 units (total capacity 9.33GW) have not been applied for the investigation yet. And more, it requires the use of aged units. NRA sets 40 years operation in principle, and requests another investigation for additional 20 years operation. So, if the units operated after 1990, operated before 1990 and 60 years operation is approved at present (3 units, 2.48GW), and 3 units under construction (total capacity 4.14GW) are summed up, its total is 27.85GW and not sufficient. It means that increasing the units of 60 years operation or constructing new power plants is indispensable.

Results of quantitative analysis

We evaluated the economic impacts if the operation of nuclear power plants will be limited in 2030 by using our econometric models. Fig.1 shows the structure of the Macro Economic Model and the Energy Competition Model respectively. Both of those are annual base models and the parameters were calculated by the past 20-30 year records. By using these models and the Input/output Model, the impact of changes in energy policy to the macro economy can be evaluated.

Case setting is shown in Table 1. The growth rate of real GDP in the Base Case was set to be 1.7% p.a., which is same as the governmental assumption in the INDC target, by adjusting the external conditions such as the growth rate of world economy and exchange rate. The share of nuclear power in 2030 will be 22% in the Base Case (same as the INDC target). In the other cases, it will be only 15% and the deficit will be supplemented by LNG power (the LNG Case) or solar power (the Renewable Case). The share of 15% almost corresponds to the amounts that all of existing power plants operated after 1990 and two units under construction will be operated at 70% capacity factor.



(a) Macro Economi Model (b) Energy Competition Model

Fig.1 Structure of the Macro Economic Model and the Energy Competition Model

Table 1 Case setting

Case Name	Growth Rate of Real GDP	Share of Power Generation		
		Nuclear	LNG	Renewable
Base	1.7% p.a.	22%	27%	22%
LNG	-	15%	34%	22%
Renewable	-	15%	27%	29%

Fig.2 shows the changes in the cost of electricity supply. Supplementing the deficit by LNG will bring 0.5 trillion yen cost up more than the Base Case in 2030. In the Renewable case, it will be tripled to 1.5 trillion yen. It will bring the rise in electricity price, and consecutively, decrease in real income of household and capital investment by industry. Cumulative reduced amounts of capital investment until 2030 compared with the Base Case will be 2.3 trillion yen in the LNG Case and 2.5 trillion yen in the Renewable Case. As a result, real GDP in 2030 will be decrease by 2.5 trillion yen in the LNG Case and 2.7 trillion yen in the Renewable Case (Fig.3). Energy-originated CO_2 in 2030 will increase by 1.9% in the LNG Case compared with the Base Case. On the other hand, it will decrease by 0.5% in the Renewable Case on account of the shrink of the economy.

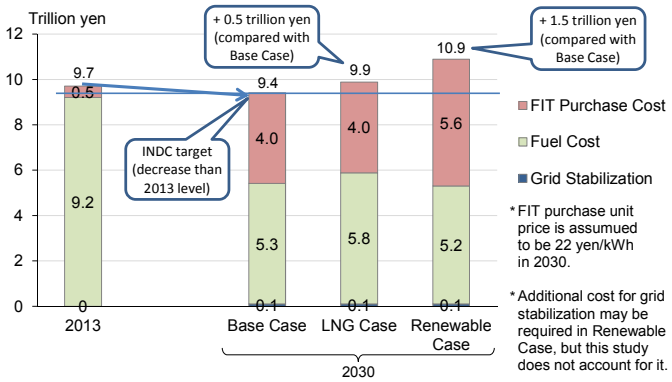


Fig.2 Estimated cost of electricity supply

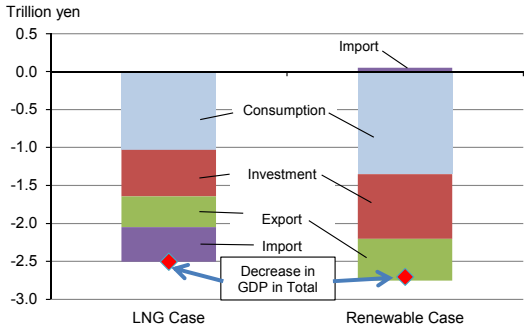


Fig.3 Changes in real GDP in 2030 (compared with the Base Case)

Conclusions

We discussed the Japanese INDC target in 2030 and current situation of nuclear power. Increasing the units which are approved for 60 years operation or constructing new power plants is indispensable for it, however, its pathway is still steep. We evaluated the economic impacts by using our econometric models if some portion of nuclear power will be substituted by other sources. The result shows that nuclear power is important for achieving the INDC target, and non-negligible economic loss may happen if the use of nuclear power will be limited.

References

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